B.E. (Civil Engineering)
Revised 2018 Regulations, Curriculum & Syllabi
(Candidates admitted during Academic Year 2021-2022)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

VISION OF THE DEPARTMENT

To educate the students to face the challenges pertaining to Civil Engineering by maintaining continuous sprit on creativity, innovation, safety and ethics.

MISSION OF THE DEPARTMENT

i. To prepare students to learn beyond the syllabi and textbooks.

ii. To train students through periodical in-plant training and industrial visits.

iii. To motivate students to pursue higher education through competitive examinations.

iv. To create Centre of Excellence in the emerging areas of Civil Engineering.

v. To give a broad education to the students on recent areas of development through interactions and camps.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Achieve successful career in Civil Engineering and related fields such as entrepreneurship, consultancy, government service and academia and engage in lifelong learning for professional growth.

II. Exhibit high level of technical expertise with good communication skills and team work to pursue higher study or research career in institutes of repute.

III. Demonstrate core competency in using modern tools and techniques with a good understanding of social, environmental and ethical issues for solving real-time problems in Civil Engineering.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

a) **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b) **Problem Analysis**: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

c) **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.

d) **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.

e) **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

f) **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.

g) **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.

h) **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) **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.

k) **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.

l) **Life-long Learning**: Recognize the need for, and have the preparation andability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OBJECTIVES (PSOs)

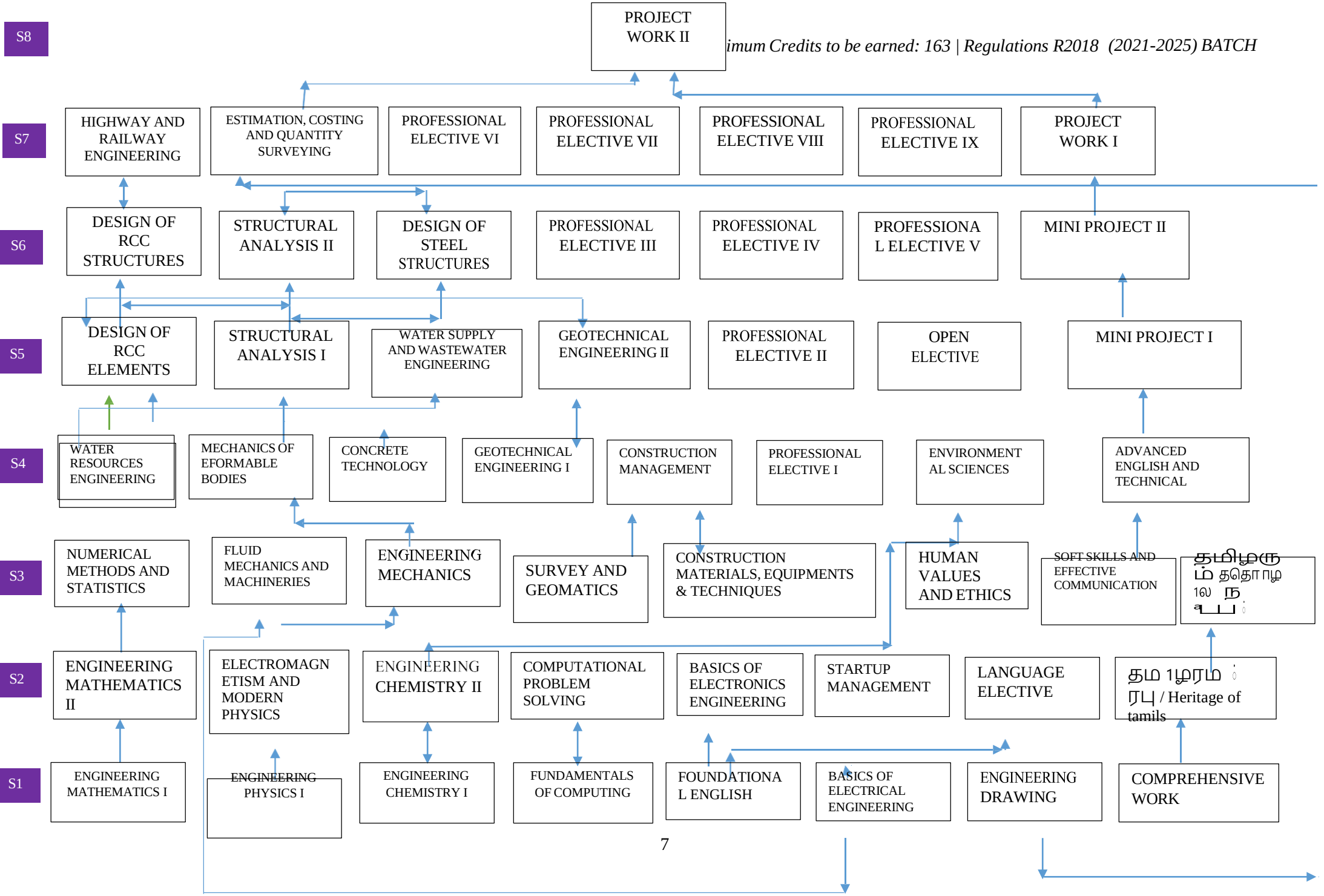
m) Apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n) Design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO1	X	X	X	X	X	X	X	X	X	X	X	X
PEO2	X	X	X	X	X				X	X	X	X
PEO3	X	X	X	X	X	X	X				X	X

imum Credits to be earned: 163 | Regulations R2018 (2021-2025) BATCH



DEPARTMENT OF CIVIL ENGINEERING
R2018 (Revised) for the batch 2021- 2025
Minimum Credits to be earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18CE101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18CE102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18CE103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18CE104	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18CE105	ENGINEERING DRAWING	1	0	4	3	5	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**24**				**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
18CE201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18CE202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
18CE203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18CE204	ENGINEERING MECHANICS	3	0	0	3	3	50	50	100	ES
18CE205	FUNDAMENTALS OF CIVIL ENGINEERING	2	0	2	3	4	50	50	100	BS
	LANGUAGE ELECTIVES	1	0	2	2	3	100	0	100	HSS
18CE206	ENGINEERING PRACTICES LABORATORY	0	0	4	2	4	100	0	100	ES
Total		**13**	**1**	**12**	**20**	**26**				**-**

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18CE301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18CE302	MECHANICS OF DEFORMABLE BODIES	3	1	0	4	4	40	60	100	ES
18CE303	APPLIED GEOLOGY	3	0	0	3	3	40	60	100	ES
18CE304	SURVEY AND GEOMATICS	3	0	0	3	3	40	60	100	PC
18CE305	FLUID MECHANICS AND MACHINERIES	3	0	2	4	5	50	50	100	PC
18CE306	COMPUTER PROGRAMMING	2	0	2	3	4	50	50	100	ES
18CE307	COMPUTER AIDED BUILDING DRAWING LABORATORY	0	0	4	2	4	100	0	100	PC
18CE308	SURVEY LABORATORY	0	0	4	2	4	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**17**	**2**	**14**	**25**	**33**				-

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18CE401	CONCRETE TECHNOLOGY	3	0	0	3	3	40	60	100	ES
18CE402	DESIGN OF RCC ELEMENTS	3	0	0	3	3	40	60	100	PC
18CE403	STRUCTURAL ANALYSIS I	3	1	0	4	4	40	60	100	PC
18CE404	SOIL MECHANICS	3	0	0	3	3	40	60	100	PC
18CE405	WATER RESOURCES ENGINEERING	3	0	0	3	3	40	60	100	ES
18CE406	CONSTRUCTION TECHNIQUES AND EQUIPMENTS	3	0	0	3	3	40	60	100	PC
18CE407	STRENGTH OF MATERIALS LABORATORY	0	0	4	2	4	100	0	100	PC
18CE408	GEOTECHNICAL ENGINEERING LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**20**	**1**	**10**	**23**	**31**				**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21CE501	STRUCTURAL ANALYSIS II	3	1	0	4	4	40	60	100	PC
21CE502	DESIGN OF RCC STRUCTURES	3	0	0	3	3	40	60	100	PC
21CE503	FOUNDATION ENGINEERING	3	0	0	3	3	40	60	100	PC
21CE504	IRRIGATION ENGINEERING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
21CE507	CONCRETE AND STRUCTURAL ANALYSIS LABORATORY	0	0	4	2	4	100	0	100	PC
21CE508	COMPUTER AIDED DESIGN AND DRAWING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**1**	**12**	**24**	**31**				**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
21CE602	DESIGN OF STEEL STRUCTURES	3	0	0	3	3	40	60	100	PC
21CE603	WATER SUPPLY AND WASTEWATER ENGINEERING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
21CE607	COMPUTER AIDED PLANNING AND MANAGEMENT LABORATORY	0	0	4	2	4	100	0	100	PC
21CE608	ENVIRONMENTAL ENGINEERING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**0**	**10**	**21**	**27**	**600**	**300**	**900**	

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21CE701	ESTIMATION, COSTING AND QUANTITY SURVEYING	3	0	0	3	3	40	60	100	PC
21CE702	HIGHWAY AND RAILWAY ENGINEERING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
21CE707	TRANSPORTATION ENGINEERINGLABORATORY	0	0	4	2	4	100	0	100	PC
21CE708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
Total		**18**	**0**	**10**	**23**	**28**				**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21CE801	PROJECT WORK II	0	0	18	9	18	50	50	100	EEC
Total		**0**	**0**	**18**	**9**	**18**				**-**

ELECTIVES

LANGUAGE ELECTIVES

Code No.	Course	L	T	P	C	Hours/Week	Maximum Marks			Category
							CA	ES	Total	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANO MATERIALS SCIENCE	3	0	0	3	3	50	50	100	BS
18GE0P2	SEMI CONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	50	50	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	50	50	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	50	50	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	50	50	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	50	50	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPHTHEORY AND COMBINATORICS	3	0	0	3	3	50	50	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	50	50	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	50	50	100	BS
ENTREPRENEURSHIP ELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	50	50	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	50	50	100	PE

ELECTIVES										
VERTICAL I- MODERN STRUCTURES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21CE001	REPAIR AND REHABILITATION OF STRUCTURES	3	0	0	3	3	40	60	100	PE
21CE002	PRESTRESSED CONCRETE STRUCTURES	3	0	0	3	3	40	60	100	PE
21CE003	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE004	BRIDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE005	TALL STRUCTURES	3	0	0	3	3	40	60	100	PE
21CE006	STRUCTURAL HEALTH MONITORING	3	0	0	3	3	40	60	100	PE
VERTICAL II- ADVANCED DESIGN										
21CE007	DESIGN OF TIMBER AND MASONRY ELEMENTS	3	0	0	3	3	40	60	100	PE
21CE008	ADVANCED RC DESIGN	3	0	0	3	3	40	60	100	PE
21CE009	ADVANCED STEEL DESIGN	3	0	0	3	3	40	60	100	PE
21CE010	INDUSTRIAL STRUCTURES	3	0	0	3	3	40	60	100	PE
21CE011	FINITE ELEMENT ANALYSIS	3	0	0	3	3	40	60	100	PE
21CE012	STEEL CONCRETE COMPOSITE STRUCTURES	3	0	0	3	3	40	60	100	PE
VERTICAL III- CONSTRUCTION TECHNIQUES AND PRACTICES										
21CE013	BUILDING SERVICES	3	0	0	3	3	40	60	100	PE
21CE014	CONCEPTUAL PLANNING AND BYE LAWS	3	0	0	3	3	40	60	100	PE
21CE015	COST EFFECTIVE CONSTRUCTION AND GREEN BUILDING	3	0	0	3	3	40	60	100	PE
21CE016	PREFABRICATED STRUCTURES AND PRE-ENGINEERED BUILDING	3	0	0	3	3	40	60	100	PE
21CE017	ENERGY EFFICIENT BUILDINGS	3	0	0	3	3	40	60	100	PE
21CE018	CONSTRUCTION MANAGEMENT AND SAFETY	3	0	0	3	3	40	60	100	PE
VERTICAL IV- GEOTECHNICAL APPLICATIONS										
21CE019	GROUND IMPROVEMENT TECHNIQUES	3	0	0	3	3	40	60	100	PE
21CE020	GEOENVIRONMENTAL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE021	INTRODUCTION TO GEOTECHNICAL EARTHQUAKE	3	0	0	3	3	40	60	100	PE

	ENGINEERING									
21CE022	REINFORCED SOIL STRUCTURES	3	0	0	3	3	40	60	100	PE
21CE023	ROCK MECHANICS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
21CE024	EARTH RETAINING STRUCTURES	3	0	0	3	3	40	60	100	PE
VERTICAL V- TRANSPORTATION AND GEO-INFORMATICS										
21CE025	URBAN TRANSPORTATION PLANNING AND SYSTEMS	3	0	0	3	3	40	60	100	PE
21CE026	MASS TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
21CE027	TRAFFIC ENGINEERING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
21CE028	TRANSPORTATION PLANNING AND SYSTEMS	3	0	0	3	3	40	60	100	PE
21CE029	TOTAL STATION AND GPS SURVEYING	3	0	0	3	3	40	60	100	PE
21CE030	REMOTE SENSING AND GIS	3	0	0	3	3	40	60	100	PE
VERTICAL VI- ENVIRONMENTAL ASPECTS										
21CE031	AIR POLLUTION CONTROL AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
21CE032	SOLID WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
21CE033	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	3	40	60	100	PE
21CE034	ENERGY SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE035	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
21CE036	HAZARDOUS WASTE MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VII- COMPUTER APPLICATION										
21CE037	APPLICATIONS OF NUMERICAL METHODS IN CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE038	APPLICATION OF PYTHON FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE039	INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE040	APPLICATION OF MATLAB FOR CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE041	APPLICATION OF R PROGRAMMING IN CIVIL ENGINEERING	3	0	0	3	3	40	60	100	PE
21CE042	RISK ASSESSMENT AND SAFETY MANAGEMENT	3	0	0	3	3	40	60	100	PE

MINOR DEGREE										
VERTICAL VI- ENVIRONMENTAL ASPECTS										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
21CEM01	AIR POLLUTION CONTROL AND MANAGEMENT	3	0	0	3	3	40	60	100	
21CEM02	SOLID WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
21CEM03	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	3	40	60	100	
21CEM04	ENERGY SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	
21CEM05	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
21CEM06	HAZARDOUS WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
Honours Degree										
VERTICAL VI- ENVIRONMENTAL ASPECTS										
21CEH01	AIR POLLUTION CONTROL AND MANAGEMENT	3	0	0	3	3	40	60	100	
21CEHO2	SOLID WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
21CEH03	ENVIRONMENTAL IMPACT ASSESSMENT	3	0	0	3	3	40	60	100	
21CEH04	ENERGY SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	
21CEH05	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
21CEH06	HAZARDOUS WASTE MANAGEMENT	3	0	0	3	3	40	60	100	
OPEN ELECTIVES										
21OCE01	ENERGY CONSERVATION AND MANAGEMENT									
21OCE02	GREEN BUILDINGS	3	0	0	3	3	50	50	100	PE
21OCE03	DISASTER PREPAREDNESS AND PLANNING	3	0	0	3	3	50	50	100	PE
21OCE04	ENVIRONMENTAL IMPACT ASSESMENT	3	0	0	3	3	50	50	100	PE
21OCE05	BUILDING SERVICES	3	0	0	3	3	50	50	100	PE
21OCE06	INDUSTRIAL WASTE MANAGEMENT	3	0	0	3	3	50	50	100	PE

21OCE07	WEALTH FROM WASTE	3	0	0	3	3	50	50	100	PE
21OCE08	RISK AND SAFETY MANAGEMENT	3	0	0	3	3	50	50	100	PE
21OCE09	CONCEPTS OF REMOTE SENSING	3	0	0	3	3	50	50	100	PE

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDITS	CREDITS in %	Range of total credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1.	BS	10	13	4						27	17	15%	20%
2.	ES	6	5	10	6					27	17	15%	20%
3.	HSS	2	2				2			6	4	5%	10%
4.	PC			11	17	18	10	8		64	39	35%	45%
5.	PE					6	9	12		27	17	15%	20%
6.	EEC							3	9	12	7	5%	10%
TOTAL		18	20	25	23	24	21	23	9	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18CE101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and for different matrices to describe the stability of the linear systems in engineering fields
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigen values and Eigenvectors
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Analyze the reliability, safety analysis of engineering systems and design of engineering structures using higher order linear differential equations.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces
5. Apply the concept of analytic function to estimate the integral in complex plane

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	1	2												
3	1	2												
4	1	2												
5	1	2												

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices : Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann

Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolle s Theorem, Mean Value Theorem, optimization, indeterminate forms, L'Hopital's Rule.

Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchy"s Integral Formula - Classification of Singularities - Cauchy"s Residue Theorem

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016.
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999

18CE102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Illustrate the Newtons three laws of motion and apply the same to solve the real world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements.
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2								2					
3	2	1												
4	2	1							2					
5	2	1							2					

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial frames - definition of mass - Newtons second law-gravitational force and weight - Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion - energy of simple harmonic oscillator - spring mass system - time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations.

Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor.

Concept and source of magnetic fields - Amperes theorem - determination of magnetic field due to different current distributions - Faradays law - self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light - laws of reflection and refraction - refractive index and Snells law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses - compound microscope - human eye.

Conditions of interference - Youngs double slit experiment - intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution - diffraction grating - applications.

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - twin paradox - length contraction - relativistic mass variation - space time graph.

Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of wavelength of mercury spectral lines-spectrometer

4 **4 Hours**

EXPERIMENT 4

Determination of refractive index of solid and liquid-travelling microscope

5 **3 Hours**

EXPERIMENT 5

Determination of wavelength of laser-diffraction grating

6 **4 Hours**

EXPERIMENT 6

Determination of frequency of a tuning fork-MeldeÃ¢??s apparatus

7 **4 Hours**

EXPERIMENT 7

Thickness of a thin wire using interference of light-Air wedge method

Total: 60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012

18CE103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the fundamentals of atomic and molecular chemistry for engineering applications
- Identify the quality parameters, estimation and discharge of impurities in water for domestic and industrial applications
- Interpret the principle involved during curing mechanism of cement

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Explain basic concepts of chemistry relating to chemical reactions and equilibrium conditions
2. Interpret the structural parameters and molecular properties of ceramic materials
3. Outline the important water quality parameters, their analysis and fundamentals of physico-chemical treatments
4. Analyze the various types of process involved in curing of construction materials
5. Compare the principles and procedures of various analytical instruments used for material characterization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	2	1												
3	1	2											1	1
4	2	2												
5	2	1												

UNIT I **5 Hours**

CHEMICAL BONDING AND STRUCTURE OF MOLECULES

Atomic and molecular structures - Intermolecular forces: Ionic, dipolar and Van der Waals interactions. Classification of ionic structure: Zinc sulfide and sodium chloride system - VSEPR - Molecular orbital theory - Hybridization.

UNIT II **8 Hours**

STRUCTURE AND COMPOSITION OF MINERALS

Different ionic structures: AX, AX2, A2X, AmEnXp. Types of minerals: Rock salt - Rutile - Zinc blende - Antifluorite - Wurtzite - Nickelarsenide - Cadmiumiodide - Corundum - CsCl - Perovskite - Spinel (normal-inverse) - Illmenite - Olivine. Structure of Silicates.

UNIT III **6 Hours**

WATER TECHNOLOGY

Water quality parameters: pH, acidity, alkalinity, chlorides, hardness and dissolved gases - Water quality requirements for drinking, irrigation, concrete and industrial uses: WHO, BIS, EPA, ISO Standards - Concepts of titration and buffering. Types of hardness - Estimation of hardness by EDTA method. Types of alkalinity - Water softening methods: Ion exchange, reverse osmosis and electrodialysis. Chemistry of chlorination.

UNIT IV **6 Hours**

CURING MECHANISM OF CONSTRUCTION MATERIALS

Drying, firing cycles of following refractory materials: Silica bricks - Magnesite bricks - Dolomite - Forsterite - Chromite bricks - Carbon/graphite refractory - Insulating bricks. Classification of fireclays and fireclay bricks.

UNIT V **5 Hours**

INSTRUMENTAL METHODS

Principle and application of UV-Visible spectrophotometer (Estimation of iron, chromium, zinc copper and lead) - Colorimeter (Estimation of iron and copper) - Flame photometer (Estimation of sodium) - Atomic absorption spectrophotometer (Estimation procedure for any two elements) - Surface characterization techniques.

FURTHER READING

Application of nanotechnology in civil engineering. A review on degradation of quality of water in India over a decade. Construction of green buildings and its advances.

1 **6 Hours**

EXPERIMENT 1

Identification of ionic and covalent bonds by melting temperature variation

2 **4 Hours**

EXPERIMENT 2

Determination of conductivity of cesium chloride, zinc blende, glucose and sucrose

3 **6 Hours**

EXPERIMENT 3

Water quality of BIT campus (both river and bore well) with respect the hardness, alkalinity, TDS and pH

4 **6 Hours**

EXPERIMENT 4

Estimation of Magnesium in dolomites and limestones by volumetric method

5 **4 Hours**

EXPERIMENT 5

Estimation of iron (thiocyanate method) in the given solution by spectrophotometric method

6 **4 Hours**

EXPERIMENT 6

Estimation of chloride by argentometric method

Total: 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford University press, 2014.
2. B.R. Puri, L.R. Sharma, M.S. Pathania, Principles of Physical Chemistry, Vishal publishing company, 2017.
3. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
4. Carter, C. Barry, Norton, M. Gran, Ceramic materials: Science and Engineering, Springer, 2013.
5. Douglas A. Skoog, Donald M. West, F. James, Fundamentals of analytical chemistry, Brooks/cole, 2014.
6. W. D. Kingery, Harvey Kent Bowen, Donald Robert Uhlmann, Introduction to ceramics, Wiley Interscience Publication, John Wiley & Sons, 2010

18CE104 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electric circuits and wiring
- To illustrate the construction and operation of various electrical machines and renewable energy sources.
- To learn the fundamentals of electrical safety measures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.

Course Outcomes (COs)

1. Apply the fundamental laws to electric circuits and measure the electrical quantities
2. Apply the laws of magnetism for the operation of Diesel generator and Induction motor
3. Illustrate the concept of electrical wiring for household and industrial purposes
4. Analyze the different energy strategies for green building
5. Analyze the performance characteristics of electrical safety equipments

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		1										
2	1	2		1										
3	1	1												
4	1	2												
5	1	2		1										

UNIT I **6 Hours**

INTRODUCTION TO ELECTRICITY

Concept of basic Electricity- Single phase & three phase circuits-Measurement of electrical quantities like Voltage, Current, Resistance, Impedance, power factor and energy.

UNIT II **6 Hours**

ELECTRICAL MACHINES

Generator- operation &different parts of Diesel Generator (DG) set, applications-Motor-construction, operation of single phase & three phase Induction Motor, applications.

UNIT III **6 Hours**

ELECTRICAL WIRING

Types of wires,switches-Wiring layout for house with light, fan & power socket, Staircase wiring-Types of Lamps-applications-Single Line Diagram of Distribution system

UNIT IV **6 Hours**

GREEN BUILDING CONCEPTS

Renewable Energy Basics-Solar Photovoltaic generation-Building Energy analysis-Energy Conservation & Management

UNIT V **6 Hours**

ELECTRICAL SAFETY AND MAINTENANCE

IE Standards for electrical safety-Fuses-types, ratings-MCB-working, ELCB-Lightning Arrester-Earthing-Concepts & types

1 **4 Hours**

EXPERIMENT 1

Connect a 60W Lamp with switch across the supply of 230V and measure the actual current, voltage and power for the circuit.

2 **4 Hours**

EXPERIMENT 2

Demonstrate an electrical circuit for dim bright application using a lamp.

3 **4 Hours**

EXPERIMENT 3

Develop the wiring circuit for single phase pump motor with necessary protection circuits.

4 **4 Hours**

EXPERIMENT 4

Develop a circuit to control two lamps using Staircase wiring.

5 **6 Hours**

EXPERIMENT 5

Demonstrate the fluorescent lamp wiring.

6 **4 Hours**

EXPERIMENT 6

Calculate the energy consumption of electrical appliances such as LED, CFL and Ceiling fan using energy meter.

7 **4 Hours**

EXPERIMENT 7

Calculate the fuse ratings of iron box and heater.

Total: 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010.

4. Muthusubramanian & Salivahanan, Basic Electrical and Electronics Engineering and Communication Engineering, Seventh Edition, Tata MCGraw Hill Education Private Limited, 2011.
5. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008

18CE105 ENGINEERING DRAWING 1 0 4 3

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on developing projections of points and lines.
- To familiarize about projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of orthographic to isometric projections and vice versa.

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.
n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.
Course Outcomes (COs)

1. Create an engineering drawing as per industrial standard
2. Construct orthographic projections of points and lines.
3. Create projection of planes and simple solids
4. Develop section of solids and surfaces.
5. Demonstrate the conversion of orthographic to isometric and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3								1	3				2
2	2								1	3				1
3	2								1	3				2
4	3								1	3				2
5	3								1	3			1	

UNIT I **3 Hours**

FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimensioningof drawings. Construction of conic sections-ellipse, parabola and hyperbola using eccentricity method.

UNIT II **3 Hours**

PROJECTION OF POINTS AND STRAIGHT LINES

Principles of projection, Projection of points in four quadrants, first angle projection of straight lines - perpendicularto one plane, parallel and inclined to both planes.

UNIT III **3 Hours**

PROJECTION OF PLANES AND SOLIDS

Projection of simple planes and projection of simple solids parallel, perpendicular and inclined to one plane using change of position method

UNIT IV **3 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids-Simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids.

UNIT V **3 Hours**

ORTHOGRAPHIC AND ISOMETRIC PROJECTION

Orthographic and isometric projection of components used in engineering applications

1 **4 Hours**

EXPERIMENT 1

Lettering and Dimensioning

2 **6 Hours**

EXPERIMENT 2

Conic sections ellipse, parabola, hyperbola

3 **4 Hours**

EXPERIMENT 3

Projections of Points

4 **6 Hours**

EXPERIMENT 4

Projections of Lines

5 **6 Hours**

EXPERIMENT 5

Projections of Planes

6 **6 Hours**

EXPERIMENT 6

Projections of Solids

7 **5 Hours**

EXPERIMENT 7

Projections of Sections

8 **5 Hours**

EXPERIMENT 8

Development of surfaces

9 **6 Hours**

EXPERIMENT 9

Orthographic projections

10 **6 Hours**

EXPERIMENT 10

Isometric Projections

11 **6 Hours**

EXPERIMENT 11

Creating solids model

Total: 75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International,2005.
2. BasantAgrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008.
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46,2008.
4. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt.Limited, 2008.
5. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.

18CE201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems
3. Analyse the properties of analytic functions.
4. Construct first order differential equations from real time phenomena and solve it by suitable method
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	2												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoullis equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012
5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18CE202 ENGINEERING PHYSICS II **2 0 2 3**

Course Objectives

- To understand the laws of kinematics to infer the objects moving in rectilinear and circular motion
- To apply the properties of matter to represent the strength of the materials and interpret the heat transfer mechanisms in various materials
- To analyze the concepts of ultrasonics and non destructive testing methods to detect the flaws in engineering materials

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Infer the laws of kinematics to interpret the rectilinear and circular motion of objects moving in one and two dimensions.
2. Identify the properties of materials to represent their strength in structure and design of engineering materials.
3. Use thermodynamic laws to infer the thermal expansion of solids and explain the thermodynamic processes.
4. Outline the properties and types of sound waves to rectify the factors affecting the acoustics of buildings
5. Compare the three types of non destructive testing methods to detect the flaws in engineering materials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	2	2							2					
3	2	2							2					
4	2	2							2					
5	2	2												

UNIT I **6 Hours**

DYNAMICS

Kinematics: motion in one dimension - instantaneous speed, velocity and acceleration - freely falling objects. Motion in two dimensions: constant acceleration - projectile motion. Circular motion: particle in uniform and non-uniform circular motion - motion in the accelerated frames - motion in the presence of resistive forces.

UNIT II **6 Hours**

PROPERTIES OF MATTER

Elasticity: elastic and plastic materials - Hookes law - elastic behavior of a material - stress-strain diagram - factors affecting elasticity - modulii of elasticity - Poisson""s ratio and its significance. Viscosity: coefficient of viscosity - Reynolds number - streamline and turbulent flow of a liquid. Poiseuilles Method: viscosity of a liquid.

UNIT III **6 Hours**

HEAT AND THERMODYNAMICS

Temperature and the zeroth law of thermodynamics - thermometer and temperature scale -thermal expansion of solids - anomalous properties of water - first law of thermodynamics - heat and internal energy - specific heat and calorimetry - latent heat - applications of first law of thermodynamics: isothermal and adiabatic processes - second law of thermodynamics - entropy.

UNIT IV **6 Hours**

ACOUSTICS AND ULTRASONICS

Classification of sound waves - absorption coefficient - sound absorbing materials - reverberation - Sabines formula (qualitative) - factors affecting acoustics of buildings and their remedies. Properties of ultrasonic waves - generation of ultrasonic waves: magnetostriction oscillator - piezo electric oscillator. Determination of velocity of ultrasonic waves by acoustic grating method - applications.

UNIT V **6 Hours**

NON-DESTRUCTIVE TESTING

Introduction - steps involved in NDT process - X-ray radiography: displacement method - merits and demerits - applications. Liquid penetrant method: mechanism - advantages - disadvantages - applications. Ultrasonic flaw detector: block diagram - construction - working. Applications of NDT.

1 **5 Hours**

EXPERIMENT 1

Determination of thermal conductivity of a bad conductor Lees disc method

2 **5 Hours**

EXPERIMENT 2

Band gap determination of a given semiconductor

3 **5 Hours**

EXPERIMENT 3

Determination of coefficient of viscosity of the given liquid Poiseuilles method.

4 **5 Hours**

EXPERIMENT 4

Ultrasonic interferometer: wavelength and velocity determination of ultrasonic waves.

5 **5 Hours**

EXPERIMENT 5

Determination of frequency of vibrating rod using Meldes apparatus.

6 **5 Hours**

EXPERIMENT 6

Determination of youngs modulus of a given beam Non-uniform bending method.

Total: 60 Hours

Reference(s)

1. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
2. Raymond A. Serway John W. Jewett, Jr. Physics for Scientists and Engineers with Modern Physics, Seventh Edition, Thomson Learning, Inc. 2008.
3. Brij Lal, N Subrahmanyam and P S Hemne, Heat Thermodynamics and Statistical Physics, S. Chand Publisher, 2008.
4. V Rajendran and A Marikani, Applied Physics for Engineers, Tata McGraw-Hill Publishing Company, New Delhi, 2002
5. H C Verma, Concepts of Physics (Vol I), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017.
6. P K Palanisamy, Engineering Physics, SCI Tech Publications, PVT Ltd, New Delhi, 2017

18CE203 ENGINEERING CHEMISTRY II **2 0 2 3**

Course Objectives

- Classify composite materials based on its properties
- Interpret the properties steel and carbon nanomaterials
- Analyze the various types of organic and inorganic coating
- Interpret qualitatively the mechanism of corrosion and explain the methods of corrosion control
- Analyze the various types of organic and inorganic coating

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Differentiate plastic and non-plastic materials based on its forms and properties
2. Identify properties while changing composition of steels and carbon nanomaterials
3. Classify of various types of electrode to measure the physico-chemical parameters
4. Outline the forms of deterioration of construction materials
5. Illustrate the characteristics of protective coatings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	2	1												
3	1	2												
4	2	2											1	1
5	2	1												

UNIT I **6 Hours**

NON PLASTIC AND PLASTIC MATERIALS

Polymorphic forms and transformations of SiO_2. Different natural forms of SiO_2 of industrial importance - Properties and uses.

Clay: Classification of clay - Composition, Particle shape, Size, Plasticity, CEC, Occurrences, Important properties and uses of China Clay, Fire Clay, Bentonites.

UNIT II **6 Hours**

STEEL AND CARBON NANO MATERIALS

Alloys: Purpose of alloying - Function and effects of alloying elements - Properties of alloys - Classification of alloys. Ferrous alloys: Nichrome and stainless steel. Non-ferrous alloys: Brass and bronze.

Nano Materials - Carbon nanotubes: Single and multiwall - Fullerenes, graphene C60 buckyball - Synthesis, properties and applications.

UNIT III **6 Hours**

ELECTROCHEMICAL INSTRUMENTATION

Electrochemical and electrolytic cells. Metal-metal insoluble salt electrode and redox electrode. Reference electrodes: Calomel electrode silver chloride electrode, Glass electrode - measurement of pH using glass electrode - Redox potentiometry - Potentiometric titration.

UNIT IV **7 Hours**

DETERIORATION OF CONSTRUCTION MATERIAL

Chemical corrosion - Types of oxide layers- Electrochemical corrosion - Mechanism. Galvanic corrosion and differential aeration corrosion - Factors influencing corrosion rate: Nature of metal and environment. Corrosion control methods: Sacrificial anode and impressed current cathodic protection.

UNIT V **5 Hours**

PROTECTIVE COATINGS

Classification - Metallic coating - Hot dipping. Electroplating diffusion coating.

Paint: Characteristics of paints - Constituents - Drying process. Varnishes - characteristics of good varnishes - Constituents. Enamels and lacquers.

FURTHER READING

Fire proof paint, Natural Corrosion inhibitors, Electrochemistry of batteries

1 **6 Hours**

EXPERIMENT 1

Estimation of iron and calcium in fired clay by volumetric method

2 **4 Hours**

EXPERIMENT 2

Estimation of copper content in brass by volumetric method

3 **4 Hours**

EXPERIMENT 3

Estimation of amount of acids (HCl and CH3COOH) in the given solution by conductometric titration

4 **6 Hours**

EXPERIMENT 4

Measurement of rate of corrosion on mild steel in aerated / neutral / acidic / alkaline medium by weight loss method

5 **4 Hours**

EXPERIMENT 5

Estimation of dye obtained from paint by spectrophotometric method

6 **2 Hours**

EXPERIMENT 6

Determination of strength of acidity in the given solution by pH measurement

7 **4 Hours**

EXPERIMENT 7

Estimation of iron in the given sample by potentiometric method using calomel electrode

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, DhanpatRai Publishing Company, New Delhi, 2013.
2. S. Vairam, Engineering Chemistry, John Wiley & sons, 2014.
3. Clive H. Hare, Protective Coatings: Fundamentals of Chemistry and Composition, Technology Publishing Company, 1994.
4. Abel Banov, Paints and Coatings Handbook, Structures Publishing Company, 1973.
5. Anthony E. Hughes, Johannes M.C. Mol, Mikhail L. Zheludkevich, Rudolph G. Buchheit, Active Protective Coatings: New-Generation Coatings for Metals, springer, 2015.
6. Fritz Aldinger, Volker A. Weberruss, Advanced Ceramics and Future Materials, Wiley VCH verlag, 2010

18CE204 ENGINEERING MECHANICS 3 0 0 3

Course Objectives

- To introduce coplanar and space forces and the conditions for the equilibrium of particles and rigid bodies.
- To develop capacity to predict the effect of force
- To understand the different primitive and user defined data types.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

Course Outcomes (COs)

1. Compute the resultant force for various force systems using laws of mechanics.
2. Apply the equations of statics to determine the unknown reactions in plane and space
3. Compute the unknown frictional forces using free body diagram of particles and rigid bodies
4. Evaluate the sectional properties of surfaces and solids
5. Apply the equations of dynamics to determine the unknown quantities in kinetics and kinematics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1	2												
3	1	3												
4	1		1											
5	3	1												

UNIT I **9 Hours**

BASICS AND STATICS OF PARTICLES

Introduction - Units and dimensions - Laws of mechanics - Parallelogram law of forces - Vectors - Vectorial representation of forces -Coplanar forces - Resolution and composition of forces - Equilibrium of a particle under coplanar forces - Forces in space - Equilibrium of a particle in space.

UNIT II **9 Hours**

EQUILIBRIUM OF RIGID BODIES

Free body diagram - Types of supports and their reactions - Moments and couples- Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Resolution of a given force into a force acting at a given point and a couple - Reduction of a system of coplanar forces acting on a rigid body into a single force and a single couple - Equilibrium of rigid bodies in two dimensions - Equilibrium of rigid bodies in three dimensions

UNIT III **9 Hours**

FRICTION

Frictional force - Laws of Coulomb friction - Angle of friction - Cone of friction - Simple contact friction - Ladder friction - Belt friction -Transmission of power through belts - Wedge friction - Problems involving the equilibrium of rigid bodies with frictional forces

UNIT IV **9 Hours**

CENTRE OF GRAVITY AND MOMENT OF INERTIA

Determination of areas and volumes - First moment of area and the determination of centroid of any cross section - Moment of inertia of plane areas - Parallel axis theorem - Polar moment of inertia- Product of inertia-Principal moments of inertia of plane areas

UNIT V **9 Hours**

DYNAMICS OF PARTICLES

Kinematics of particles in rectilinear motion - Relationships between displacement - velocity and acceleration - Uniform rectilinear motion and uniformly accelerated rectilinear motion - Curvilinear motion-projectile motion. Newtons second law of motion - Work done by a force-kinetic energy and potential energy - Principle of work and energy

FOR FURTHER READING

Equilibrium of Multiply Connected Rigid Bodies - Friction Offered by Thrust Bearing - Screw jack - Rolling resistance - Mass centre of a body - Moment of inertia of mass of a body - Principal Mass Moment of Inertia - Principle of impulse and momentum - Impact of elastic bodies

Total: 45 Hours

Reference(s)

1. M. S. Palanisamy and S. Nagan, Engineering Mechanics - Statics & Dynamics, TMH Publishing Company, 2005
2. F. P. Beer and E. R. Johnston, Vector Mechanics for Engineers - Statics and Dynamics,Tata McGraw Hill Publishing Company, New Delhi, 2005
3. R.C. Hibbeller, Engineering Mechanics- Statics (vol. I), Dynamics (vol. II), Pearson Education Asia Pvt. Ltd., 2000
4. Andrew Pytel and Jaan Kiusalaas, Engineering Mechanics - Statics (vol.I), Dynamics (vol. II), Brooks / Cole Publishing Company, 1999
5. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, Pearson Education Asia Pvt. Ltd., 2004
6. Kottiswaran.N, Engineering Mechanics - Statics and Dynamics, Sri Balaji Publications, 2005

18CE205 FUNDAMENTALS OF CIVIL ENGINEERING 2 0 2 3

Course Objectives

- Gain knowledge about the properties and uses of various materials for constructions
- Recognize the necessity for composite materials like concrete, RCC
- Understand the building components

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Understand the scope and importance of civil engineering.
2. Understand the composition, properties and classification of building materials.
3. Analyze the properties of timber, and other building materials used in construction.
4. Explain the various building components and their functions.
5. Differentiate the types of masonry and also enumerate the functions of super-structure.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		1		2									1
2	1		3		2									
3	1			2	3								1	
4	2		3		1									
5	2		1		3								2	

UNIT I **9 Hours**

SCOPE OF CIVIL ENGINEERING

Scope of Civil Engineering- Functions of a Civil Engineer - Types of Building: Residential- Commercial- Industrial & Institutional buildings- Site selection- Units & Unit conversions- Room dimensions as per NBC.

UNIT II **9 Hours**

PRIMARY BUILDING MATERIALS

Bricks: Manufacturing of bricks-Types- Characteristics of Bricks. Stone: Characteristics of Stones- Coarse aggregate- Characteristics of good building stone. Concrete: Definition-Cement-Types- Manufacturing of cement. Fine aggregate- M-sand- Manufacturing of M-Sand. Water- Water standards for construction purpose. Steel: Properties- Grade- Cold formed steel- Hot rolled steel- Sections.

UNIT III **9 Hours**

OTHER BUILDING MATERIALS

Timber: Types of Timber - Seasoning of Timber- Applications. PVC, UPVC, Aluminium, Glass & Stainless steel types- Applications in construction. Paints: Composition of oil paints- Purpose of paints- Applications. Enamels- Varnishes- Plaster of Paris- Purpose- Applications.

UNIT IV **9 Hours**

BUILDING COMPONENTS (SUB-STRUCTURE)

Components of Building- Sub structures- Foundation and its Types- Construction sequence in Building- Design sequence in Building- Ground level- Basement- Plinth level- Sill level- Lintel level- Roof level- Parapet level.

UNIT V **9 Hours**

BUILDING COMPONENTS (SUPER-STRUCTURE)

Super-structure - Walls: Types of Stone masonry and Brick masonry walls- Brick bonds- Slab- Beam- Column- Roof- Floor- Door- Windows- Lintel- Parapet.

1 **2 Hours**

EXPERIMENT 1

Fineness test on Cement as per BIS

2 **2 Hours**

EXPERIMENT 2

Consistency test on cement

3 **4 Hours**

EXPERIMENT 3

Initial and final setting time test on cement

4 **3 Hours**

EXPERIMENT 4

Soundness test on cement

5 **4 Hours**

EXPERIMENT 5

Compressive strength test on cement mortar

Total: 60 Hours

Reference(s)

1. S. K. Duggal, Building Materials, New Age International (P) Ltd., 2003
2. P. C. Varghese, Building Materials, PHI Learning Private Limited, New Delhi, 2010
3. S. P. Arora and S. P. Bindra, Textbook of Building Construction, DhanpatRai Publications (P) Ltd., 2003

4. Punmia B. C., Jain A. J. and Jain A. J. Building construction, Laxmi Publications, 2005
5. Shetty .M.S., " Concrete Technology, Theory and Practice", Revised Edition, S. Chand & company Ltd., New Delhi,2006
6. E. Keith Blankenbaker, "Construction and Building Technology", 1st Edition, 2009

18CE206 ENGINEERING PRACTICES 0 0 4 2

LABORATORY

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and household pipe line connections using suitable tools.
- To develop the skills for preparing the green sand mould and to make simple household electrical connection
- To provide hands on training for dismantling and assembling of petrol engines, gear box and pumps.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)
a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
Course Outcomes (COs)

1. Fabricate simple components using carpentry, sheet metal and welding equipment/tools
2. Make fitting joints and household pipe line connections using suitable tools.
3. Prepare green sand mould and make simple household electrical connections using suitable tools
4. Dismantle and assemble petrol engines, gear box and pumps.
5. Make simple models using wood and sheet metal.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	1													
3	2													
4	1													
5	2													

1 **2 Hours**

EXPERIMENT 1

Forming of simple object in sheet metal using suitable tools (Example: Brick mould / Cube mould)

2 **4 Hours**

EXPERIMENT 2

Fabrication of a simple component using thin and thick plates. (Example: wadrobe)

3 **2 Hours**

EXPERIMENT 3

Making a simple component using carpentry power tools. (Example: Door ,window frames].

4 **2 Hours**

EXPERIMENT 4

Prepare a "V" (or) Half round (or) Square joint from the given mild Steel flat.

5 **4 Hours**

EXPERIMENT 5

Construct a household pipe line connections using pipes, Tee joint, Four way joint, elbow, union, bend, Gate way and Taps (or) Construct a pipe connections of house application centrifugal pump using pipes, bend, gate valve, flanges and foot valve.

6 **3 Hours**

EXPERIMENT 6

Prepare a green sand mould using solid pattern/split pattern

7 **3 Hours**

EXPERIMENT 7

Construct a domestic electrical wire connections using indicator, one way switch with calling bell, two way switch with lamp, one way switch with fan regulator and one way switch with socket.

8 **3 Hours**

EXPERIMENT 8

Dismantling and assembly of Centrifugal Monoblock / Gear Pump / Gear box.

9 **3 Hours**

EXPERIMENT 9

Dismantling and assembly of two stroke and four stroke petrol engine.

10 **4 Hours**

EXPERIMENT 10

Mini Project (Fabrication of Small Components).

Total: 30 Hours

18CE301 ENGINEERING MATHEMATICS III **3 1 0 4**

Course Objectives

- Develop the knowledge of periodic and non periodic functions and their representations using Fourier analysis
- Understand the Laplace Transform to solve real world problems
- Predict the changes in the manufacturing process using the concepts of statistics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Use the properties of periodic and non-periodic vibrations with the help of Fourier analysis in civil engineering.
2. Formulate a function in frequency domain for which the function defined in time domain through the techniques of Laplace transforms
3. Compute the position of a particle that depends on more than one parameter, using partial differential equations
4. Predict the outcome of civil engineering problem using the concepts of probability and its distributions
5. Justify and validate the mathematical model for a civil engineering problems with the help of hypothesis testing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	1													
3	1													
4		2												
5		2												

UNIT I **10 Hours**

FOURIER ANALYSIS

Review of Fourier series for periodic functions. Orthogonal functions. The Euler coefficients. Fourier transforms. Properties of Fourier transform. Applications of Fourier series and transform analysis.

UNIT II **9 Hours**

LAPLACE TRANSFORM

Properties and theorems of Laplace transform. Shifting theorems.Convolution.Applications to ordinary differential equations.Applications to linear system analysis.

UNIT III **11 Hours**

PARTIAL DIFFERENTIAL EQUATION

Introduction to partial differential equations.One-dimensional wave equation.Method of separation of variables.D'Alemberts solution of the wave equation.Heat equation.Laplace equation. Telegraph equations. Laplace transform method of solution.

UNIT IV **8 Hours**

PROBABILITY THEORY

Probability.Random variables, probability densities and distributions, mean and variance of a distribution.Conditional probability.Bayes theorem.Binomial, Poisson and normal distributions.

UNIT V **7 Hours**

MATHEMATICAL STATISTICS

Sample mean and variance.Sampling distributions.Statistical estimation of parameters, confidence intervals. Testing of hypotheses, one-sample and two-sample inferences. Applications to statistical quality control and reliability analysis.

Total: 60 Hours

Reference(s)

1. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016.
2. Johnson Richard A. and BhaltacharyyaGouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
3. O'Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993.
5. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995.

18CE302 MECHANICS OF DEFORMABLE BODIES 3 1 0 4

Course Objectives

- Develop the understanding on the state of stresses and strains in engineering components as a result of different loading conditions
- Provide the principles and equations, and necessary tools to analyze structural members under axial loads, bending, shear, and torsion.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Compute the simple stress and strain for one and two dimensional elements
2. Evaluate Principal stress,strain and analyze thin cylinders
3. Determine and plot shear force and bending moment diagram for statically determinate beams
4. Evaluate the slope and deflection of statically determinate beams using different methods.
5. Identify the buckling and stability of columns subjected to axial load, and compute the uniaxial and biaxial bending moments

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	1	2												
3	1	2												
4	1	3												
5	1	3												

UNIT I **9 Hours**

STRESSES AND STRAINS

Stress at a point - Types of stress - Strain at a point - Types of strain - Elastic limit - Hooke's law - Modulus of elasticity - Stress-Strain diagram - Stresses in composite bars - Thermal stresses - Poisson''s ratio Rigidity modulus - Bulk modulus - Relation between elastic constants

UNIT II **8 Hours**

TWO DIMENSIONAL STATE OF STRESS

Two dimensional state of stress at a point -Normal and shear stresses on any plane -Principal planes and principal stresses -Maximum shear stress -Analytical methods and Mohr's circle method -Two dimensional state of strains at a point-Principal strains and their directions. Thin Cylinder: Stresses and deformations in thin walled cylinders and spherical shells due to internal pressure

UNIT III **11 Hours**

BENDING AND STRESSES IN BEAMS

Shear force and bending moment for cantilever, simply supported and over hanging beams for any type of loading - Relationship between rate of loading, shear force and bending moment- Theory of

simple bending -Assumptions -Analysis for bending stresses -Load carrying capacity of beams - Flitched beams - Stresses in solid and hollow circular shafts

UNIT IV **9 Hours**

DEFLECTION OF STATICALLY DETERMINATE BEAMS

Governing differential equation - Macaulay's method - Moment area method - Conjugate beam method - Strain energy method.

UNIT V **8 Hours**

COLUMNS AND STRUTS

Columns - Slenderness ratio - Calculation of stresses in short columns due to axial load and uni-axial and biaxial bending moments - Core of the section - Buckling load of long columns - Euler's theory - Different end conditions - Rankine's formula - Straight line formula

FOR FURTHER READING

Determination of principal stresses at any point in a beam - Strain rosettes

Total: 60 Hours

Reference(s)

1. S. Rajput, Strength of Materials, S. Chand & Co., 2014
2. R. K. Bansal, A Textbook ofStrength of Materials, Laxmi Publications,6th Edition 2015
3. S. M. A. Kazimi, Solid Mechanics, Tata McGraw Hill Book Co Ltd., 2001
4. P. Boresi, Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition, 2002.
5. B. S. Basavarajaiah and P. Mahadevappa, Strength of Materials, CBS Publishers & Distributors Pvt. Ltd., 2014

18CE303 APPLIED GEOLOGY 3 0 0 3

Course Objectives

- To provide basic knowledge on earth sciences and their applications in civil engineering
- To provide essential knowledge on classification of rocks and their uses in civil engineering constructions
- Apply the knowledge of application of geological investigation in projects such as dams,tunnels,bridges, and roads

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Describe the interior and exterior structure of earth.
2. Discuss the crystal structure, mineral types and properties
3. Understand the formation of rocks and its properties
4. Identify subsurface information and groundwater potential sites through geophysical investigations
5. Apply geological principles for mitigation of natural hazards and select sites for dams and tunnels

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1											
2	2	2	2											
3	1		2	3										
4	1			2	3									
5	1	1	1											

UNIT I **8 Hours**

GENERAL GEOLOGY

Geological time scale- Branches and scope of geology- Importance of geology from Civil Engineering point of view- Earth-surface features and internal structure- Weathering of Rocks-types

UNIT II **9 Hours**

MINERALOGY

Role of study of physical properties of minerals in the identification of minerals-Significance of physical properties of following common rock forming minerals: Feldsper, Quartz, Olivine, Augite, Hornblende, Muscovite, Biotite, Garnet, Talc and Calcite- Study of other common economics minerals such as Pyrite, Hematite , Magnetite, Chrorite , Galena , Graphite, Magnesite, and Bauxite

UNIT III **9 Hours**

PETROLOGY

Formation and classification of rocks - Igneous, Sedimentary and metamorphic rocks, their texture and structures, properties of granite, pegmatite, dolerite, gabbro, charnockite, basalt, sandstone, conglomerate, breccia, limestone, shale, laterite, schist, gneiss, quartzite, marble, khondalite and slate- Drilling Techniques, Core Recovery, RQD, Engineering Properties of Rocks

UNIT IV **9 Hours**

STRUCTURAL GEOLOGY

Outcrop, Strike and dip, types and classifications of folds, faults, joints, unconformities- Subsurface Investigations: Geophysical methods - Electrical Resistivity and Seismic refraction methods

UNIT V **10 Hours**

DAMS AND TUNNELS

Types of dams- Requirements of dam sites- preliminary and detailed geological investigations for a dam site- Purpose of tunneling, geological considerations for tunneling -Case histories of dam failures and their causes- Geology of the major dam sites of India- Factors affecting the seepage and leakage of reservoir and the remedial measures

Total: 45 Hours

Reference(s)

1. Engineering Geology by N. Chennakesavulu, McMillan, India Ltd. 2005 ISBN13:978.0230-63870-9
2. Parbin Singh. A Text book of Engineering and General Geology, Katson publishing house, Ludhiana 2009.
3. Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India Learning Private Limited, New Delhi, 2012.
4. Principles of Engineering Geology by K.V.G.K. Gokhale, B.S publications ISBN-13: 978-8178002187

18CE304 SURVEY AND GEOMATICS 3 0 0 3

Course Objectives

- To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers.
- To learn the various methods of plane and geodetic surveying to solve the real world Civil Engineering problems.
- To introduce the concepts of Control Surveying and Astronomical surveying.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.
n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. The use of various surveying instruments and mapping
2. Measuring Horizontal angle and vertical angle using different instruments
3. Methods of Leveling and setting Levels with different instruments
4. Concepts of astronomical surveying and methods to determine time, longitude, latitude and azimuth
5. Concept and principle of modern surveying.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2								2	1
2	2	3		2	1									
3	2	2			2									
4	2				2									
5	2													

UNIT I **9 Hours**

FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELING

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Basic Principles- Bearing - Types - True Bearing - Magnetic Bearing - Levelling - Principles and theory of Levelling - Datum - Bench Marks - Temporary and Permanent Adjustments- Methods of Levelling- Booking - Reduction - Sources of errors in Levelling - Curvature and refraction.

UNIT II **9 Hours**

THEODOLITE AND TACHEOMETRIC SURVEYING

Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometry surveying - Contour - Contouring - Characteristics of contours - Methods of contouring - Tacheometric contouring - Contour gradient - Uses of contour plan and map

UNIT III **9 Hours**

CONTROL SURVEYING AND ADJUSTMENT

Horizontal and vertical control - Methods - specifications - triangulation- baseline - satellite stations - reduction to centre- trigonometrical levelling - single and reciprocal observations - traversing - Gales table. - Errors Sources - precautions and corrections - classification of errors - true and most probable values - weighed observations - principle of least squares - normal equation

UNIT IV **9 Hours**

ADVANCED TOPICS IN SURVEYING

Hydrographic Surveying - Tides - MSL - Sounding methods - - Engineering project surveys- requirements and specifications, various stages of survey work Setting out of works- simple circular curves.

UNIT V **9 Hours**

GEOMATICS

Total Station : Advantages - Fundamental quantities measured - Parts and accessories - working principle - On board calculations - Field procedure - Errors and Good practices in using Total Station GPS Surveying : Different segments - space, control and user segments - satellite configuration - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - Hand Held and Geodetic receivers - data processing.

Total: 45 Hours

Reference(s)

1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2014
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. James M. Anderson and Edward M. Mikhail, Surveying, Theory and Practice, 7th Edition,McGraw Hill, 2001.
4. Bannister and S. Raymond, Surveying, 7th Edition, Longman 2004.
5. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014

18CE305 FLUID MECHANICS AND MACHINERIES 3 0 2 4

Course Objectives

- To introduce the basic concepts of fluid statics, kinematics and dynamics
- To enable students to solve practical problems involving fluid statics, fluid flow, turbines and pumps

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain the fundamental properties of fluids and methods of pressure measurement in fluid statics
2. Infer fundamentals of fluid kinematics and dynamics and their applications in hydraulic experiments
3. Identify factors affecting flow through pipes to estimate head loss and conditions for choosing boundary conditions
4. Assess the performance of a model by dimensional analysis and similitude
5. Compute the efficiency and performance of pumps and turbines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	3	2	1		3									
3	3	2	1		3									
4	2	3	1											
5	2	3	1		3									

UNIT I **9 Hours**

FLUID PROPERTIES AND FLUID STATICS

Fluid properties - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension.
Fluid statics- Hydrostatic law - Pascal's law - Pressure measurement - Buoyancy and meta-centre

UNIT II **9 Hours**

FLUID KINEMATICS AND FLUID DYNAMICS

Classification of fluid flow - Reynolds Transport Theorem - Velocity and acceleration - Continuity equation - Stream line, Streak line, Path line, Velocity Potential and Stream function.

Dynamics: Euler's equations of motion - Bernoulli's theorem and proof - Application of Bernoulli's equation - Pitot tube, Orifice meter, Venturi meter

UNIT III **9 Hours**

FLOW THROUGH PIPES AND BOUNDARY LAYER

Development of laminar and turbulent flows in circular pipes - Hagen-Poiseuille equation - Darcy-Weisbach equation - Major and minor losses - Empirical formulae for friction loss - Equivalent pipe - Water hammer and cavitation - Pipe network analysis - Hardy cross method - Boundary layer concept - Displacement and momentum thickness

UNIT IV **9 Hours**

DIMENSIONAL ANALYSIS, SIMILITUDE AND MODEL ANALYSIS

Dimensional homogeneity - Dimensionless numbers - Methods of dimensional analysis - Rayleigh's method - Buckingham's pi theorem - Method of selecting repeating variables - Types of similarities - Hydraulic similitude - Model analysis - Types of models - Similarity laws.

UNIT V **9 Hours**

PUMPS AND TURBINES

Impulse-momentum principle - Impact of jet - Velocity triangle - Types of pumps - Properties of centrifugal pump - Pump characteristics - Specific speed, NPSH, slip - Reciprocating pump - Indicator diagram - Classification of turbines - Efficiency of turbines.

1 **4 Hours**

EXPERIMENT 1

Determination of Co-efficient of discharge of Orifice meter, Venturi meter.

2 **3 Hours**

EXPERIMENT 2

Determination of Co-efficient of Impact Jet.

3 **3 Hours**

EXPERIMENT 3

Determination of friction factor in a piping system.

4 **3 Hours**

EXPERIMENT 4

Study on Performance Characteristics of Centrifugal pump and Reciprocating pump

5 **3 Hours**

EXPERIMENT 5

Study on performance characteristics of Pelton Wheel Turbine.

6 **3 Hours**

EXPERIMENT 6

Study on performance characteristics of Francis Turbine.

7 **2 Hours**

EXPERIMENT 7

Study on performance characteristics of Kaplan Turbine.

8 **2 Hours**

EXPERIMENT 8

Demonstrate the Bernoulli equation concept learnt in theory and their limitations

9 **3 Hours**

EXPERIMENT 9

Experimental study on stability of floating bodies.

10 **4 Hours**

EXPERIMENT 10

INNOVATIVE PRACTICE

Total: 75 Hours

Reference(s)

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010 ISBN-10: 9780195699630
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House ISBN-10: 8190089374 ISBN-13: 9788190089371
3. R. K. Bansal, Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2005. (Revised Ninth Edition) ISBN-10: 8131808157 ISBN-13: 9788131808153
4. Yunus A. Cengal and John M. Cimbala, Fluid Mechanics - Fundamentals and Applications (In SI Units), McGraw Hill International Book Co., 2004. ISBN-10: 0073380326, ISBN-13: 978-0073380322
5. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill. ISBN-10: 9780070154414, ISBN- 13: 0070154414
6. Fluid Mechanics, Frank M. White, McGraw Hill Education, 8th Edition, 2015, ISBN-10: 0073398276, ISBN-13: 978-0073398273

18CE306 COMPUTER PROGRAMMING 2 0 2 3

Course Objectives

- Study the basic components and operations of a computer
- Use office automation tools
- Write and develop programs using C language constructs

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

l. 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.

Course Outcomes (COs)

1. Identify the basic hardware components and Install and configure Windows and Linux operating systems
2. Install and work with office automation software
3. Implement C programs using operators, type conversion and input-output functions.
4. Apply decision making and looping statements in writing C programs.
5. Develop C programs using the concepts of Arrays and strings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				3							2		
2	1				3				2					
3	1				3				2					
4	1				2							3		
5	1				3				2					

UNIT I **6 Hours**

INTRODUCTION TO COMPUTER

Components of a computer - Input - Output devices - Installation - Number systems - Operating systems - types of operating Systems - RAM-ROM - Internet and E-mail

UNIT II **5 Hours**

OFFICE AUTOMATION

Word Processing - Features - Understanding spread sheet - applications - Making presentations - Use of stand alone and open source software for creating word, excel and powerpoint presentations

UNIT III **5 Hours**

C INTRODUCTION

Problem Solving Techniques - C Primitives: Introduction to C- Planning and writing a C program- - Compiling and executing the C program - Operators and Expressions - Type Conversion Formatted I/O functions.

UNIT IV **7 Hours**

CONTROL STATEMENTS

Decision Making and Branching - Statement - Decision Making and Looping Jump Statements

UNIT V **7 Hours**

ARRAYS AND STRINGS

Arrays- one dimensional array - two-dimensional arrays - multi dimensional arrays. Strings - String handling functions.

FOR FURTHER READING

File handling using C

1 **2 Hours**

EXPERIMENT 1

a) Study of desktop computer, motherboard and its interfacing components.
b) Install and configure computer drivers and system components.

2 **2 Hours**

EXPERIMENT 2

Disk formatting, partitioning and Disk operating system commands

3 **2 Hours**

EXPERIMENT 3

a) Install, upgrade and configure Windows/Linux operating systems.
b) Installation of Dual OS using Virtual Machine

4 **2 Hours**

EXPERIMENT 4

a)Installation Antivirus and configure the antivirus.
b)Installation of printer and scanner software.

5 **2 Hours**

EXPERIMENT 5

a) Create an advertisement page in Word
b) Create a Mail Merge Letter and a macro for inserting a picture and formatting the text in Word
c) Create an Excel sheet and include all basic formatting options
d) Create a PPT incorporating the major formatting options and animations

6 **4 Hours**

EXPERIMENT 6

Write and execute basic programs in C illustrating operators and expressions

7 **4 Hours**

EXPERIMENT 7

Write and Execute programs in C to illustrate the concept of control structures

8 **3 Hours**

EXPERIMENT 8

Write and Execute programs in C to illustrate the concept of arrays

9 **3 Hours**

EXPERIMENT 9

Write and Execute programs in C to illustrate the concept of strings

10 **6 Hours**

EXPERIMENT 10

Develop a small application of your choice using C

Total: 60 Hours

Reference(s)

1. ITL Educational Solutions Limited, Introduction to Information Technology, Pearson Education, India, 2006.
2. Behrouz A.Forouzan and Richard F. Gilberg, Computer Science: A Structure program approach using C, Cengage learning-2009.
3. Herbert Schildt, C- The complete Reference, McGraw Hill, 2010.

0 0 4 2

18CE307 COMPUTER AIDED BUILDING DRAWING LABORATORY

Course Objectives

- To make the students learn the various elements of Residential / Institutional / Workshop buildings
- To impart fundamental knowledge on AutoCAD & Revit and to make the students draw the structures, the plan, elevation and sectional view of a building.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

l. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Understand the various basic commands used for drafting and know the types of coordinate systems.
2. Draw the brick bond models using basic drawing and modify commands
3. Prepare the site plan by manual and computer aided drawing; arrange the components of building to satisfy the functional and orientation aspect.
4. Sketch the detailed drawings of plan,elevation and section of a single storey residential building and list the schedule of joineries.
5. Create a model of a building with rendering effects using Revit.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1				1							1		
2	2				2			1	1					
3	3				3			1	1					
4	1				2							1	1	
5	1				1			1	1					

1 **10 Hours**

EXPERIMENT 1

Simple drawing using basic draw commands and coordinate system

2 **10 Hours**

EXPERIMENT 2

Develop a model of a Brick wall using basic draw and modify commands

3 **10 Hours**

EXPERIMENT 3

Plan of a single storeyed residential building

4 **10 Hours**

EXPERIMENT 4

Elevation and cross section of a single storeyed residential building

5 **10 Hours**

EXPERIMENT 5

Plan, elevation and cross section of an industrial building

6 **10 Hours**

EXPERIMENT 6

Draw the Plan and elevation of residential building with rendering effects using Revit

Total: 60 Hours

Reference(s)

1. Donnie Gladfelter, Autocadd 2013 and Autocadd LT 2013, autodesk official training guides, 2013
2. Ellen Finkelstein, Autocadd 2012 and Autocadd LT 2012 Bible, 2012
3. Shah. M.G, Kale. C.M and Patki. S.Y, "Building Drawing", Tata McGraw Hill Book Co., 2004
4. CloisE.Kicklighter., "Architecture, Residential Drawing and Design", The Good Heart - Willcox Company Inc., 2000
5. Donald E. Hepler and Paul I. Wallach., "Architecture, Drafting and Design", Tata McGraw Hill Book Co., New Delhi, 1998.

18CE308 SURVEY LABORATORY 0 0 4 2

Course Objectives

- To determine the relative position of any objects or points of the earth.
- To develop methods through the knowledge of modern science and the technology and use them in the field.
- To prepare a map or plan to represent an area on a horizontal plan.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. use conventional surveying tools such as chain/tape, compass, plane table, level in the field of civil engineering applications such as structural plotting and highway profiling
2. apply the procedures involved in field work and to work as a surveying team
3. take accurate measurements, field booking, plotting and adjustment of errors can be understood
4. To prepare a topographical map which shows the hills, valleys, rivers, villages, towns, forests, etc. of a country.
5. To prepare a geological map showing areas including underground resources.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1			1									
2		2			1									
3		2	1	1	1									
4		2	1	2	2									
5		1	1	1	1									

1 **6 Hours**

EXPERIMENT 1

Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset

2 **6 Hours**

EXPERIMENT 2

Setting out works - Foundation marking using tapes single Room and Double Room Compass Survey

3 **6 Hours**

EXPERIMENT 3

Levelling - Longitudinal and cross-section and plotting

4 **6 Hours**

EXPERIMENT 4

Fly levelling using Dumpy level and tilting level

5 **6 Hours**

EXPERIMENT 5

Measurements of horizontal angles by reiteration and repetition and vertical angles using theodolite

6 **6 Hours**

EXPERIMENT 6

Fixing gradient for a pipe line

7 **8 Hours**

EXPERIMENT 7

Contouring - Block Contouring for non uniform terrain

8 **8 Hours**

EXPERIMENT 8

Total Station - Study of Total Station, Measuring Horizontal and vertical angles

9 **8 Hours**

EXPERIMENT 9

Determination of distance and difference in elevation between two inaccessible points using Total station

Total: 60 Hours

Reference(s)

1. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
2. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014

18CE401 CONCRETE TECHNOLOGY 3 0 0 3

Course Objectives

- To impart a sound technical knowledge on the ingredients of conventional and special concrete.
- To impart basic knowledge on the properties of fresh and hardened concrete.
- To provide basic understanding on the usage of different admixture in enhancing the specific requirements of the concrete.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Analyze the properties of concrete ingredients as per IS code
2. Apply mix proportion principles to design a concrete mix by using IS code
3. Evaluate the hardened concrete properties
4. Examine the concrete properties based on the addition of admixtures
5. Identify the suitable special concrete based on the field requirement.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											2
2	1	2	3											2
3	1	3			2								2	
4	1	2	3										2	
5	1	2	3											2

UNIT I **9 Hours**

INGREDIENTS OF CONCRETE

Cement: Composition and properties of cement- different types of cements - Hydration of cement - Structure of hydrated cement -Tests on physical properties of cement Consistency-Setting Time - Soundness-Strength. Aggregates: Classification; Size shape -Tests on aggregates - standard specifications and requirements - Bulking of sand - Sieve Analysis-Fineness modulus-interpretation of gradation charts - Quality of water for mixing and curing.

UNIT II **9 Hours**

FRESH CONCRETE

Mix Proportioning of Concrete: General Principles - Mix Design of Concrete: IS Method - Particle Packing Density, Rheology - Production process - Batching and Mixing - RMC - Transporting - pumping - Workability - Slump - Vee bee - Compaction factor - Factors affecting workability- Segregation and bleeding - Methods of compaction and curing.

UNIT III **9 Hours**

HARDENED CONCRETE

Compressive strength - fracture mechanism - role of paste aggregate bond - effect of aggregate properties - effect of air entrainment, degree of compaction - effect of curing - factors affecting test compressive strength results - tensile strength - modulus of rupture - split tensile strength - Elastic Modulus, Poison's Ratio, Fatigue, Impact and abrasion- Creep - mechanism - factors influencing- effects - shrinkage mechanism - types- factors affecting - effect - thermal expansion -Introduction to durability - relation between durability and permeability - common degradation processes

UNIT IV **9 Hours**

MINERAL AND CHEMICAL ADMIXTURES

Mineral admixtures - Fly ash, blast furnace slag, silica fume, and metakaolin - their production, properties, and effects on concrete properties; other reactive and inert mineral additives - chemical admixtures - role of chemical admixtures - water reducing agents - plasticizers, super plasticizers, hyper plasticizers - retarders - accelerators - Air entraining agents - Viscosity modifying agents - corrosion inhibitors - water proofing admixtures - anti-shrinkage admixtures

UNIT V **9 Hours**

SPECIAL CONCRETE

Special concrete properties & applications of high strength concrete - Self compaction concrete - fiber reinforced concrete - heavy and light weight concrete - High volume fly ash concrete - Geopolymer concrete - recycled aggregate concrete - Slurry Infiltrated Fiber Concrete - Sulfur concrete - Pervious concrete - Refractory Concrete - Air entrained concrete - polymer concrete - coloured concrete - Shotcrete - Ferrocement concrete

SELF STUDY

Prestressed concrete - Precast concrete - Vacuum concrete - Mass concrete, Cellular concrete, Bendable concrete, light transmitting concrete.

Total: 45 Hours

Reference(s)

1. Neville, A.M. and Brooks, J.J.," CONCRETE TECHNOLOGY", ELBS .1990.
2. P.Kumar Mehta and Paulo J.M. Monteiro, Concrete - Micro structure, Properties and Materials, Indian Concrete Institute, Chennai,1997
3. M.S.Shetty, Concrete Technology, S.Chand and Co., Ltd., NewDelhi, 2003

4. A.R.Santhakumar, Concrete Technology, Oxford University Press, New Delhi, 2007
5. M.L.Gambhir, Concrete Technology, Tata Mc Graw Hill Publishing Co., Ltd., New Delhi, 2007

18CE402 DESIGN OF RCC ELEMENTS 3 0 0 3

Course Objectives

- To introduce the basic concepts and steps for reinforced concrete sectional design mainly in accordance with Indian Standard codes of practice
- To underline and discuss basic principles of mechanics regarding the design of reinforced concrete systems and elements

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Illustrate the design principles of working stress method for beam
2. Design a types slab based on based on the limiting condition and the staircase
3. Design of beam for various sections subjected to flexure as per the limit state method.
4. Design of beam for shear and Evaluate the beam section for deflection and crack
5. Design of column subjected to axial, uniaxial and biaxial moment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											1
2	2	3	1											1
3	2	3	1											1
4	2	3	1											1
5	2	3	1											1

UNIT I **9 Hours**

WORKING STRESS METHOD

Aims of design - Method of design - Working stress method - Assumptions - Stress strain behavior of steel and concrete - Stress block parameters - Design of singly and doubly reinforced rectangular sections by working stress method.

UNIT II **9 Hours**

LIMIT STATE DESIGN OF SLAB AND STAIRCASE

Limit state method - Principles - Partial safety factor - Design of RC rectangular one and two way slabs subjected to uniformly distributed load by limit state method -Introduction to flat slab - Types of stairs - Design of stairs spanning horizontally - Design of doglegged stair.

UNIT III **9 Hours**

LIMIT STATE DESIGN OF BEAMS FOR FLEXURE

Stress block parameters - Neutral axis-Balanced-Under Reinforced-Over Reinforced Sections - Design of singly reinforced rectangular section - Design of doubly reinforced rectangular section - Design of flanged (T & L) beams.

UNIT IV **9 Hours**

LIMIT STATE DESIGN OF BEAMS FOR SHEAR

Shear forces in beam - Types of shear resistance - Design of vertical stirrups - Design of Bent-up bars - Development length - Design of beams for flexure, shear and torsion (Combined effect) Parameters considered in limit state of serviceability - Check for deflection and crack width.

UNIT V **9 Hours**

LIMIT STATE DESIGN OF COLUMNS

Types of columns - Provisions of IS-456 code for the design of columns - Design of short columns subjected to axial load, uniaxial and biaxial bending moment. Design of long column subjected to axial load

Total: 45 Hours

Reference(s)

1. B. C. Punmia, A. K. Jain, Limit State Design of Reinforced Concrete, Laxmi Publications,Revised edition (2016)
2. S. Unnikrishna Pillai and DevedasMenon, Reinforced Concrete Design, McGraw Hill Education; 3 edition 2017
3. S. N. Sinha, Reinforced Concrete Design, McGraw Hill Education (India) Private Limited; 3 edition (New Delhi), April 9, 2014.
4. N. Krishna Raju, Advanced Reinforced Concrete Design (IS : 456-2000), CBS; 3rd edition (2016) 2016
5. P. C. Varghese, Limit State Design of Reinforced Concrete, PHI Learning Pvt. Ltd., New Delhi, 2008
6. IS 456:2000 Plain and reinforced concrete-Code of Practice

18CE403 STRUCTURAL ANALYSIS I **3 1 0 4**

Course Objectives

- To impart knowledge on the different methods of analysis of statically indeterminate structures
- To impart knowledge on moving loads and influence line diagrams
- To provide a thorough understanding on arches and influence line diagram
- At the end of the course students will be conversant with classical method of analysis.

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Compute the member forces and deflection of determinate and indeterminate structures
2. Analyse the bending moment and shear force for beam, sway and non-sway frame by slope deflection method.
3. Analyse the bending moment and shear force for beam, sway and non-sway frame by moment distribution method.
4. Identify the vertical reaction, horizontal thrust and bending moment for two and three hinged arches.
5. Represent the ILD for Simply supported and over hanging beams subjected to moving load.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1											2	
2		2											2	
3		2											1	
4		2											1	
5		3											1	

UNIT I **9 Hours**

DEFLECTION OF DETERMINATE STRUCTURES

Determination of Static and Kinematic Indeterminacy in Beams, plane and space Trusses and Frames - Degree of Freedom - Analysis of plane trusses by method of joint,method of section and tension coefficient method - Castigliano's First and Second Theorems - Deflection of statically determinate beams, pin jointed trusses and rigid jointed frames by energy method and unit load method. - Analysis of pin connected indeterminate trusses by consistent deformation method - Betti's reciprocal theorem.

UNIT II **9 Hours**

SLOPE DEFLECTION METHOD

Derivation of slope deflection equations - Application to Continuous beams and rigid frames (with and without sway) - Effect of Support displacements.

UNIT III **9 Hours**

MOMENT DISTRIBUTION METHOD

Absolute and relative stiffness and carry over factors - Analysis of continuous beams - Plane rigid jointed frames with and without sway - Effect of settlement of supports - Nayler's simplification.

UNIT IV **9 Hours**

ARCHES

Arches as structural forms - Examples of arch structures - Types of arches - Analysis of three hinged, two hinged and fixed arches having parabolic and circular shapes - Settlement and temperature effects

UNIT V **9 Hours**

MOVING LOADS AND INFLUENCE LINES

Influence Lines: Introduction - Construction of ILD for shear force and bending moment at a sections- determination of load positions for maximum shear force and bending moments for simply supported and overhanging beams with several point loads and UDL and determination of their values - Sketching of absolute maximum BMD.

FRAMED ANALYSIS

Analysis of multi-storeyed building frame for horizontal loads by portal method and cantilever method. Analysis of multi-storeyed building frame for vertical loads by two cycle moment distribution method- using substitute frames

Total: 60 Hours

Reference(s)

1. C.S. Reddy, Basic structural analysis, Second edition, Tata McGraw Hill publishing company limited,1996
2. SS Bhavikatti ,Structural Analysis , ,Third edition, Volume I Second Edition Volume II , Vikas Publishing House (p) ltd ,2009

18CE404 SOIL MECHANICS **3 0 0 3**

Course Objectives

- To make the students gain adequate knowledge on soil formation and characteristics
- To make them know the significance of the soil properties

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

1. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering assify the soil based on index properties and understand the compaction process
2. Determine the stress distribution and the permeability of soils
3. Evaluate the vertical stress due to external loads and consolidation settlement of clayey soils
4. Compute the shear strength parameters of soils under different drainage conditions
5. Analyze the stability of slopes and provide slope protection methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2		3										1
2	3	3												1
3	3	3												1
4	3	3		3										1
5	3	2	1	2									1	1

UNIT I **10 Hours**

SOIL CLASSIFICATION

Soil formation and nature of soils - Phase diagrams - Basic definitions and inter-relationships - Index Properties of soils - Classification based on BIS. Compaction - Factors affecting compaction - Laboratory & Field Compaction methods.

UNIT II **10 Hours**

EFFECTIVE STRESS

Soil water - Various forms - Static pressure in water - Total - Neutral and effective stress distribution in soils - Liquefaction & quicksand conditions. Flow of water through soils - Darcy"s law;

Assumptions and validity - Permeability - Coefficient of permeability - Factors affecting permeability - Permeability of stratified deposits of soils - Laboratory tests - Seepage analysis.

UNIT III **10 Hours**

STRESS DISTRIBUTION

Boussinesqs and Wester Guard"s theories of stresses due to concentrated loads - Circular, Rectangular load - Strip load -New Mark"s chart. Consolidation - Fundamental definitions - Spring analogy - Terzaghi"s one-dimensional consolidation theory - Assumptions, limitations and applications - Pre-consolidation pressure and its determination - Normally, under and over consolidated soils

UNIT IV **8 Hours**

SHEAR STRENGTH OF SOILS

Shear strength - Factors affecting shear strength of soils- Mohr - Coulomb theory - Measurement of shear strength parameters - Direct shear - Unconfined compression - Triaxial - Drained and un- drained conditions - Vane shear tests.

UNIT V **7 Hours**

STABILITY OF SLOPES

Types of slopes - Failure mechanism of slopes - Total and effective stress analysis - Finite slopes - Stability analysis for purely cohesive and c-phi soils - Method of slices - Friction circle method - Taylor""s Stability number - Slope protection methods

Total: 45 Hours

Text Book(s)

1. B. N. D. Narasinga Rao, Soil Mechanics and Foundation Engineering, Wiley India Pvt. Ltd., New Delhi, 2015.
2. B. C. Punmia, Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005.

Reference(s)

1. Alam Singh, Soil Engineering in Theory and Practice, Asia Publishing House, Bombay, 2ndEdition, 2009.
2. Braja M. Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole, Australia, 8th Edition, 2015.
3. Karl Terzaghi, Soil Mechanics in Engineering Practice, 3rd edition, John Wiley & Sons, Inc, 1995.
4. IS Codes: IS 1498: 1970, IS 2810: 1979, IS 2809: 1972, IS 2720 : Part 1 to Part 41

18CE405 WATER RESOURCES ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on spatial and temporal distribution of water available in any region
- To disseminate the knowledge on hydrologic estimates for river and reservoir management
- To emphasize the need for water resources planning and management

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Infer the fundamentals of hydrological parameters and need for water conservation
2. Assess the variations in distribution of rainfall, runoff, infiltration and evapo transpiration
3. Demonstrate development and applications of hydrographs and frequency analysis from stream flow data
4. Attribute strategies for sustainable reservoir operation and flood control using reliability, economic analysis and flood routing techniques
5. Identify methods of groundwater assessment and extraction including factors affecting groundwater yield

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2	1											
3	1	3	2											
4	2	3											1	2
5	3	2											2	

UNIT I **9 Hours**

INTRODUCTION

Climate and weather- meteorological and hydrological parameters - hydrologic cycle - water-budget equation - water resources survey - consumptive and non-consumptive water use - water scarcity and its impacts - water resources planning - watershed management - national water policy.

UNIT II **9 Hours**

FUNDAMENTALS OF HYDROLOGY

Types of precipitation - measurement of rainfall - rain-gauge density - estimates of missing data and adjustment of records - optimum rain-gauge network design - intensity-duration and depth-area- duration relations - frequency analysis of rainfall data - losses from precipitation - interception and depression storage - estimation of evaporation and transpiration - measurement of infiltration - infiltrationindices - effective rainfall - estimation of runoff.

UNIT III **9 Hours**

STREAM FLOW ANALYSIS

Components of stream flow - stream gauging - stage-discharge rating curve - selection of site for stream gauging station - hydrograph analysis - hydrograph separation - unit hydrograph-S-curve hydrograph - unithydrograph of different deviations - synthetic unit hydrograph - methods for peak discharge estimation - frequency analysis of stream flow data- Role of rivers.

UNIT IV **9 Hours**

RESERVOIR PLANNING AND MANAGEMENT

Single purpose and multipurpose reservoir - determination of storage capacity and yield - strategies for reservoir operation - reservoir reliability - reservoir sedimentation and desilting - reservoir flood routing -Muskingum channel routing - methods of flood control - flood forecasting and warning - economic analysis of water resources projects.

UNIT V **9 Hours**

GROUNDWATER HYDROLOGY

Types of geologic formations and aquifers - aquifer properties - Darcy's law - transmissibility - well hydraulics - steady state flow equations for confined and unconfined aquifers - Dupuit's assumptions - specific capacity - cavity wells - yield of a well - pumping test and recuperation test - construction of open wells and bore wells - well shrouding and well development.

Total: 45 Hours

Reference(s)

1. Berndtsson, P. N. Chadramouli,C.S.P.Ojha, R. Fluid Mechanics and Machinery,Oxford University Press,ISBN-10: 9780195699630,2010.
2. K Subramanya, Engineering Hydrology,4th Edition, Tata McGraw Hill, New Delhi, ISBN: 1259029972, 2017.
3. VenTeChow, D.R. Maidment and L.W. Mays, Applied Hydrology, 1st Edition, McGraw Hill, New York,ISBN: 0071001743,1998.
4. K.N. Duggal, J.P. Soni, Elements of Water Resources Engineering, New Age International Pvt Ltd Publishers, New Delhi, ISBN: 8122408079, 2008.
5. P. Jaya Rami Reddy, A Textbook of Hydrology,3rd Edition, Tata McGraw Hill, New Delhi, 2016, ISBN:9380856040, 2016.
6. H. M. Ragunath, Hydrology: Principles, analysis, and design, Wiley Eastern Limited, New Delhi,ISBN: 0470200367,1985

18CE406 CONSTRUCTION TECHNIQUES AND EQUIPMENTS **3 0 0 3**

Course Objectives

- To impart knowledge on concrete mix design and the importance of chemical/mineral admixtures
- Make the student familiar with various construction techniques and practices and their equipment needed for different types of construction activities

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

f. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Generalize the aspects involved in concrete technology
2. Identify the suitable site and techniques involved in good construction practices
3. Apply appropriate techniques used for sub structure construction
4. Identify and apply different techniques for super structure construction
5. Identify the different construction equipments for various applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2									3		2	3
2	2	1									3		1	2
3	3	2									1		2	1
4	1	3									2		1	2
5	1	2	1			1					3		2	

UNIT I **9 Hours**

CONCRETE TECHNOLOGY

Cements - Grade of cements - concrete chemicals and Applications - Grade of concrete - manufacturing of concrete -Batching- mixing - transporting - placing -compaction of concrete - curing

and finishing - Testing of fresh and hardened concrete - quality of concrete - Extreme Weather Concreting - Ready mix Concrete - Non-destructive testing

UNIT II **9 Hours**

CONSTRUCTION PRACTICES

Site Clearance - Marking -Earthwork - Building foundation-Basements-Temporary shed-Shuttering sheet piles-Slip and moving forms-scaffolding-Deshuttering forms-types of floors and roofs - Ventilators-Building component and their function: Brick masonry- Bond- Jointing-Stone masonry.

UNIT III **9 Hours**

SUB STRUCTURE CONSTRUCTION

Techniques of box jacking- pipe jacking- under water construction of diaphragm walls and basement Tunnellingtechniques- piling techniques -well and caisson -sinking cofferdam -cable anchoring and grouting, sheet pile-Shoring for deep cutting-well point- Dewatering and stand by plant equipment for underground open excavation

UNIT IV **9 Hours**

SUPER STRUCTURE CONSTRUCTION

Launching girders, bridge decks, off shore platforms - special forms for shells - techniques for heavy decks - in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors -Erection of articulated structures, braced domes and space decks

UNIT V **9 Hours**

CONSTRUCTION EQUIPMENT

Selection of equipment for earth work - earth moving operations - types of earthwork equipment - tractors, motor graders, scrapers, front end waders, earth movers - Equipment for foundation and pile driving. Equipment for compaction, batching and mixing and concreting - Equipment for material handling and erection of structures - Equipment for dredging, trenching, tunnelling.

FURTHER READING

Colouring agents - workability agents. Shoring - shoring methodology. Mixer - vibration - batching plant-Grouting - weather and water proof -construction practice according to NBC 2005 code mix design as per IS code,1062 Sieve analysis as per IS code.

Total: 45 Hours

Reference(s)

1. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 1999.
2. Sharma S.C.Construction Equipment and Management,Khanna Publishers New Delhi, 2002
3. Deodhar, S.V.Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 2012
4. Dr. Mahesh Varma, Construction Equipment and its Planning and Application, Metropolitan Book Company, NewDelhi, 1983
5. Gambhir, M.L, "Concrete Technology", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2004

18CE407 STRENGTH OF MATERIALS LABORATORY

0 0 4 2

Course Objectives

- To make the students understand the behaviour of materials under various loading conditions, viz., tension, compression, torsion and bending
- To know the impact strength and the hardness number of the given material

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

Course Outcomes (COs)

1. Evaluate Young Modulus, torsional strength, impact strength, hardness numbers and tensile strength of given specimens
2. Find the compressive strength of wood and brick
3. Find stiffness of open coiled and close coiled springs

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			1		2									
2		1			2	1								
3			1	2										

1 **4 Hours**

EXPERIMENT 1

Tension test on mild steel rod

2 **4 Hours**

EXPERIMENT 2

Torsion test on mild steel rod

3 **6 Hours**

EXPERIMENT 3

Compression test on brick and wood

4 **6 Hours**

EXPERIMENT 4

Tests on open coil helical springs

5 **6 Hours**

EXPERIMENT 5

Tests on closed coil helical springs

6 **8 Hours**

EXPERIMENT 6

Izod and Charpy impact tests

7 **6 Hours**

EXPERIMENT 7

Determination of Rockwell Hardness Number

8 **6 Hours**

EXPERIMENT 8

Determination of Brinell Hardness Number

9 **6 Hours**

EXPERIMENT 9

Shear test on mild steel rod

10 **8 Hours**

EXPERIMENT 10

Static bending test on metal beam

Total: 60 Hours

18CE408 GEOTECHNICAL ENGINEERING LABORATORY **0 0 4 2**

Course Objectives

- To make the students determine experimentally the fundamental properties of soils that are needed for the classification of soils, determining the strength and seepage characteristics
- To determine the safe bearing capacity of soil at a given site using the knowledge of the fundamental properties of soils

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Classify the given soil sample
2. Determine the index properties of the given soil sample
3. Determine the shear strength characteristics of given soil sample
4. Determine the permeability and swelling characteristics of given soil sample
5. Determine the CBR value of given soil sample

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			1											
2		1	2	1										
3			1	2									2	2
4	-	1												1
5	1	-												1

1 **2 Hours**

GRAIN SIZE DISTRIBUTION

Sieve analysis and Hydrometer analysis

2 **4 Hours**

SPECIFIC GRAVITY

Specific gravity of soil grains

3 **6 Hours**

ATTERBERG LIMITS TEST

a) Liquid limit
b) Plastic limit
c) Shrinkage limit

4 **8 Hours**

STANDARD PROCTOR TEST

Determination of moisture - Density relationship using Standard Proctor test

5 **8 Hours**

PERMEABILITY DETERMINATION

Constant head and falling head methods

6 **8 Hours**

DETERMINATION OF SHEAR STRENGTH PARAMETERS

a) Direct shear test on cohesionless soil
b) Unconfined compression test on cohesive soil
c) Triaxial compression test
d) Vane shear test

7 **6 Hours**

ONE DIMENSIONAL CONSOLIDATION TEST

Determination of co-efficient of consolidation only

8 **6 Hours**

SWELL TEST

Differential free swell and swell pressure tests

9 **6 Hours**

FIELD DENSITY TEST

Core cutter and sand replacement methods

10 **6 Hours**

CBR TEST

Estimation of CBR value for pavement design at a given site

Total: 60 Hours

Reference(s)

1. IS 2720-PART V- 1970 Determination of Liquid limit and Plastic limit
2. IS 2720-PART IV- 1975-Grain size analysis
3. IS 1498- 1970 Classification of soil
4. IS 2720-PART III- 1980 Specific gravity of soil
5. IS 2720-PART X- 1973 Determination of unconfined compressive strength
6. IS 2720-PART XIII- 1972 Direct shear test

21CE501 STRUCTURAL ANALYSIS II **3 1 0 4**

Course Objectives

- To impart a thorough knowledge about the matrix methods of structural analysis
- To impart knowledge on moving loads and influence line diagrams
- To impart knowledge on finite element analysis and tension co-efficient method
- To introduce plastic analysis of structures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Analyze and construct influence line for the trusses and symmetrical arches
2. Analyze the internal forces in the Cables and Suspension bridges.
3. Compute the forces for continuous beams, frames and trusses using flexibility method.
4. Determine the displacement for continuous beams, frames and trusses using stiffness method.
5. Analyze beams, frames and trusses by Kani's method and mechanism method.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											2	
2		1	2										2	
3	1	2											2	
4	1	2											1	
5	2	3											1	

UNIT I **9 Hours**

INFLUENCE LINES FOR FORCES IN PLANE TRUSSES AND ARCHES

N type truss - Pratt truss with parallel chords - Pratt truss with inclined chords - Warren truss with inclined chords. Symmetrical arches: Influence lines for horizontal thrust - Influence lines for B.M - Influence lines for S.F, B.M and normal thrust for moving concentrated loads and UDL- Muller Breslau principle

UNIT II **9 Hours**

CABLES AND SUSPENSION BRIDGES

Components and their Functions - Analysis of cable under concentrated loads and UDL - Shape of cable under self weight - Anchorage of suspension cables - Bending Moment and Shear Force in suspension bridges with three hinged stiffened girders - Max Bending Moment due to moving single

concentrated load and UDL - Influence lines for Bending Moment and Shear Force - Analysis of suspension bridges with two hinged stiffening girders.

UNIT III **9 Hours**

MATRIX FLEXIBILITY METHOD

Introduction - Computation of flexibility matrices - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy.

UNIT IV **9 Hours**

MATRIX STIFFNESS METHOD

Introduction - equilibrium and compatibility - Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of kinematic indeterminacy.

UNIT V **9 Hours**

MISCELLANEOUS TOPICS

Analysis of continuous beams, indeterminate frames and trusses with maximum two degrees of static indeterminacy by Kani's method. Plastic analysis of structures - Assumptions - Moment redistribution - Analysis of fixed and continuous beams and portal frames by mechanism method.

Total: 60 Hours

Reference(s)

1. William weaver Jr.James M . Gare, Matrix Analysis Framed Structures, Third edition Tata McGraw Hill publishing company limited, 2007
2. SS Bhavikatti, Structural Analysis,Third edition, Volume I Second Edition Volume II, Vikas Publishing House (p) ltd ,2009
3. Vaidyanathan.R, Perumal.P, Comprehensive Structural Analysis, Vol I & II Laxmi Publications, 2008
4. C.K. Wang, Intermediate structural analysis Tata McGraw Hill publishing company limited, 1986.
5. Rajasekaran S and Sankarasubramaniyan R Computional structural mechanics, Prentice Hall of India , New Delhi ,2008

21CE502 DESIGN OF RCC STRUCTURES 3 0 0 3

Course Objectives

- To impart knowledge on the basic design philosophy of R.C.C structures
- To make students be familiar about the codal provisions for the design of R.C.C structures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Design various types of foundation.
2. Identify the suitable retaining wall and design cantilever, counter fort retaining wall.
3. Design various types of liquid storage structures as per Indian standard codal provision.
4. Design deck slab and T beam bridges by evaluating the critical load
5. Illustrate the need of prefabricated structures and its behaviour

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		3											
2	1	2	3											1
3	1	2	3											1
4	1		3											1
5	1	2	3										1	

UNIT I **9 Hours**

FOUNDATIONS

Design of Isolated footings: square and rectangular footing Design of isolated footing subjected to uniaxial and biaxial moments. Design of Combined footings: rectangular and trapezoidal shape - Principles of design of mat foundation.

UNIT II **9 Hours**

EARTH RETAINING STRUCTURES

Design of cantilever and counterfort retaining walls for any type of back fill - Stability requirements of retaining walls Effect of surcharge loading in the design of retaining wall.Introduction to Gabion wall

UNIT III **9 Hours**

DESIGN OF WATER TANK

Design of underground and on ground rectangular water tanks- Use of Parts I, II and IV of I.S.3370 Codes - Overhead tanks of rectangular shape and circular shape with domical roof - Design of all components including staging and foundation. Design of underground and on ground circular water tanks

UNIT IV **9 Hours**

BRIDGES

Types of bridges - IRC loadings - Design of single span slab bridge deck for class A loading - Design of the deck of T - beam and slab bridge for class AA loading Design of single span slab bridge deck for class AA loading

UNIT V **9 Hours**

PREFABRICATED STRUCTURES

Need for prefabrication - Principles - Materials - Modular coordination -Standarization - Systems - Production -Transportation -Erection. Behaviour of structural components -Construction of roof and floor slabs - Wall panels -Columns-Connection detail

Total: 45 Hours

Reference(s)

1. N.Krishnaraju, Advanced Reinforced Concrete Design (IS: 456-2000), (Second Edition), CBS Publishers & Distributors, New Delhi, 2013
2. B.C.Punmia, Ashok Kumar Jain and Arun kumar Jain, Limit State Design of Reinforced Concrete, Laxmi Publications (P) Ltd., New Delhi, 2015.
3. Unnikrishna Pillai and Devedas Menon, Reinforced Concrete Design, Tata Mc Graw Hill Publishing Co.Ltd., New Delhi, 2003.
4. M.L.Gambhir, Design of reinforced concrete structures, PHI learning Pvt. Ltd., New Delhi, 2011.
5. P.C.Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
6. IS 456:2000 Plain and reinforced concrete Code of Practice

21CE503 FOUNDATION ENGINEERING 3 0 0 3

Course Objectives

- To impart fundamental knowledge on investigation of the site and selection of suitable foundation
- To impart knowledge on the design concepts of different types of foundations & earth retaining structures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

f. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Conduct site investigation and prepare the report for selection of foundation
2. Compute the bearing capacity and settlement of soil
3. Evaluate the size of shallow foundations
4. Estimate the load carrying capacity of piles and settlement of pile groups
5. Analyse the lateral earth pressure on retaining wall

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1			1							1	
2	3	3	1	2									1	
3	3	3	1										1	
4	3	3	1			1							1	
5	3	3	1										1	

UNIT I **9 Hours**

SITE INVESTIGATION AND SELECTION OF FOUNDATION

Scope & Objectives-Methods of exploration- Depth and spacing of bore holes - Sampling of soil - Methods of sampling -Penetration tests (SPT,SCPT and DCPT)-Interpretation -Bore log report - Requirements of good foundation - Factors governing location and depth of foundation-Types & Selection of foundation

UNIT II **10 Hours**

SHALLOW FOUNDATION

Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi"s formula and BIS formula - Bearing Capacity from insitu tests (SPT, SCPT and Plate load) - Settlement - Components of settlement - Determination of settlement of foundations on granular and clay deposits - Allowable settlements (As per IS Codal provisions) - Methods of minimising total and differential settlement.

UNIT III **9 Hours**

FOOTINGS AND RAFT

Contact pressure distribution below footings - Types and uses of shallow footings - Proportioning of Isolated and Combined footings - Strap footings - Principles of design of mat foundation.

UNIT IV **9 Hours**

PILE FOUNDATION

Types of piles and their function - Factors influencing the selection of pile - Carrying capacity of single pile in granular and cohesive soil - Static formula - dynamic formulae (Engineering news and Hiley"s) - Interpretation with in situ tests (SPT, SCPT and Pile load test) - Negative skin friction - Group capacity by different methods (Feld"s rule and block failure criterion) - Settlement of pile groups

UNIT V **8 Hours**

EARTH PRESSURE

Active and passive earth pressure - Rankine"s theory - Coloumb"s wedge theory - Earth pressure on retaining walls including the effect of surcharge for c and c-phi soil under dry and saturated conditions

Total: 45 Hours

Reference(s)

1. B. N. D. Narasinga Rao, Soil Mechanics and Foundation Engineering, Wiley India Pvt. Ltd., New Delhi, 2015.
2. B. C. Punmia, Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2005.
3. Donald P. Coduto, Foundation Design Principles & Practices, 2nd Edition, Prentice-Hall of India, 2001
4. Braja M. Das, Principles of Geotechnical Engineering, Thomson Brooks/Cole, Australia, 8th Edition, 2015.
5. B.M. Das, Principles of Foundation Engineering, 8th Edition, Cengage Learning, 2015
6. P.C.Varghese, Foundation Engineering, Prentice-Hall of India Private Ltd, New Delhi, 2006

21CE504 IRRIGATION ENGINEERING 3 0 2 4

Course Objectives

- To impart basic knowledge on the types and methods of irrigation
- To outline the design aspects of hydraulic structures in canal regulation
- To illustrate the need of irrigation scheduling and water management

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Estimate the water requirement to prepare the irrigation schedule for crops
2. Identify the suitability of surface and subsurface irrigation methods
3. Design irrigation canals and head regulatory structures
4. Select suitability of impounding structures and suitable spillways
5. Analyse the causes of water logging and identify the suitable drain layout

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2											1	1
2	1	2					1						2	2
3	2	1	3										1	2
4	1	3	2										3	3
5	1	2	2										2	2

UNIT I **9 Hours**

IMPORTANCE OF IRRIGATION

Purpose and benefits of irrigation - historical background - national water policy - standards of irrigation water - consumptive use of water - duty, delta, base period - factors affecting duty - water requirement by crops - irrigation efficiency - irrigation scheduling

UNIT II **9 Hours**

METHODS OF IRRIGATION

Classification of irrigation methods - types of surface irrigation - furrow irrigation - border strip irrigation - basin irrigation - tank irrigation - merit and demerits of subsurface irrigation - lift irrigation - design aspects of micro-irrigation - sprinkler irrigation -drip irrigation - fertigation

UNIT III **9 Hours**

IRRIGATION CANALS AND HEAD WORKS

Classification of canals - principles of design - silt theories - design of lined canal - lining, alignment and maintenance of canals - design of surplus weir - design of tank sluice with tower head - design of canal drops and regulators - types of cross - drainage works

UNIT IV **9 Hours**

IMPOUNDING STRUCTURES

Types of impounding structures - forces acting on gravity dams - analysis of gravity dams - types of earth dams - causes of failure - seepage analysis and control - types and functions of spillways and energy dissipaters

UNIT V **9 Hours**

WATER LOGGING AND DRAINAGE

Causes, ill effects and control of water logging - drainage behind canal lines - objectives of drainage - classification of drains - drainage materials and pipes - design considerations for surface drains - advantages and maintenance of tile drains - layout and installation of drains

FOR FURTHER READING

Water losses during irrigation - water quality problems - irrigation management, climate change and adaptation - modern tools and techniques of soil management

1 **5 Hours**

EXPERIMENT 1

Design and Drawing of Surplus weir

2 **5 Hours**

EXPERIMENT 2

Design and drawing of Tank sluice with Tower Head

3 **4 Hours**

EXPERIMENT 3

Design and drawing of Canal Drop

4 **4 Hours**

EXPERIMENT 4

Design and drawing of Canal Regulator

5 **4 Hours**

EXPERIMENT 5

Design and drawing of Primary Clarifier

6 **4 Hours**

EXPERIMENT 6

Design and drawing of Aeration Tank

7 **4 Hours**

EXPERIMENT 7

Design and drawing of Rapid Sand Filter

Total: 75 Hours

Reference(s)

1. H. M. Raghunath, Irrigation Engieering, Wiley India (P) Ltd, 2011
2. S. K. Garg, Irrigation Engineering and Hydraulic Structure, 19th Edition, Khanna Publishers, 2005
3. B. C. Punmia, Pande B. B. Lal, Ashok Kumar Jain, Irrigation and Water Power Engineering, 16th Edition, Laxmi Publications (P) Ltd, 2009
4. S. K. Sharma, Principles and Practices of Irrigation Engineering, S Chand & company Ltd, 1987
5. S. R. Sahasrabudhe, A Textbook of Irrigation Engineering, S. K. Kataria & Sons, 2013
6. G. S. Birdie, Ram Chandra Das, Irrigation Engineering, Dhanpat Rai Publishing Company (P) Ltd, 2001

21CE507 CONCRETE AND STRUCTURAL ANALYSIS LABORATORY

0 0 4 2

Course Objectives

- To impart basic knowledge on the preliminary tests of the concrete ingredients.
- To provide knowledge on the tests to be conducted on fresh and hardened concrete
- To impart knowledge on the analysis of the different type of structures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Determine the prescribed limits of ingredients as per IS standards for concrete making.
2. Demonstrate the workability property of freshly made concrete.
3. Compute the strength property of concrete by conducting destructive and non-destructive tests.
4. Determine the deflection and behavior of structures under various end conditions
5. Evaluate the modulus of elasticity of the concrete.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			3	2								2	
2	1			2		3							2	
3				1	3	2							1	
4				2	1	3								
5	1			3	2									

1 **8 Hours**

EXPERIMENT 1

Physical tests on cement - Fineness, Standard consistency, Initial and final setting time and soundness test

2 **8 Hours**

EXPERIMENT 2

Tests on aggregate - Sieve analysis on fine and coarse aggregate, Specific gravity, Bulk density of fine and coarse aggregate and bulking of fine aggregate, Elongation index and Flakiness index,

Aggregate Impact value, Crushing
value, abrasion value

3 **8 Hours**

EXPERIMENT 3

Tests on fresh concrete - Slump test, Compaction factor, Vee bee test

4 **8 Hours**

EXPERIMENT 4

Tests on hardened concrete - Cube Compressive strength, Split tensile strength of cylinder and modulus of rupture

5 **8 Hours**

EXPERIMENT 5

To experimentally determine the deflection of pin connected truss

6 **8 Hours**

EXPERIMENT 6

To study the behaviour of struts and columns with various end conditions

7 **8 Hours**

EXPERIMENT 7

To experimentally determine the horizontal thrust in a three hinged arch for a given system of loads

8 **4 Hours**

EXPERIMENT 8

To plot the stress strain curve for concrete.

Total: 60 Hours

Reference(s)

1. P.D.Kulkarni, Text book of Concrete Technology, New Age International (P) Ltd. 2007
2. M.S.Shetty, Concrete Technology, S.Chand and Co., Ltd., NewDelhi, 2003
3. IS: 10262:2009 Concrete Mix Proportioning - Guidelines
4. IS: 2386 PART I & IV AGGREGATE SHAPE TEST
5. Madan Mohan Das, Structural Analysis, PHI Learning (P) Ltd.2011
6. Dr.R.Vaidyanathan and Dr.P.Perumal, Structural Analysis Volume II, Laxmi Publications (P) Ltd. 2016

21CE508 COMPUTER AIDED DESIGN AND DRAWING LABORATORY

0 0 4 2

Course Objectives

- To impart fundamental knowledge on Design and Detailing of structural components
- To impart a thorough knowledge on the computer aided analysis and design of structural components.
- To enhance the capability of the students to draw the plan, elevation and sectional view of various structural elements using softwares

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

Course Outcomes (COs)

1. Analyse, Design and Detailing of RCC building components (slabs, beams and columns).
2. Design and Detailing of Isolated footings using IS456:2000.
3. Design and Detailing of elevated circular water tanks, retaining walls.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3											
2	1	2	3											
3	2	1	3											

1 **10 Hours**

EXPERIMENT 1

Analyse,design and detailing of Framed RCC building components (Slab, Beam and column) using software.

2 **10 Hours**

EXPERIMENT 2

Design and detailing of Isolated footings

3 **10 Hours**

EXPERIMENT 3

Design and detailing of Rectangular water tank

4 **10 Hours**

EXPERIMENT 4

Design and detailing of Elevated circular water tank

5 **10 Hours**

EXPERIMENT 5

Design and detailing of Cantilever retaining wall

6 **10 Hours**

EXPERIMENT 6

Design and detailing of Counterfort retaining wall

Total: 60 Hours

Reference(s)

1. krishnaraju, structural design and drawing, universities press, 2016
2. S.N.Sinha, reinforced concrete design, Tata Mcgraw hill education, 2018

21HS002 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. 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.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3	2	2				
2								3	2	2				
3								3	2	2				
4								3	2	2				
5								3	2	2				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

1.Importance of Human Values & Ethics in 21st Century
2.Understanding the theory of basic human values and ethics
Openness to change
Self-enhancement
Conservation
Self-transcendence
3. Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism – Integrity -Freedom -Justice -Honesty -Truthfulness -Responsibility -Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness -Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence.
Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. (2011). The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin.
2. Gupta, N. L. (2002). Human Values For The 21St Century. India: Anmol Publications Pvt. Limited.
3. Mishra, A. (2017). Happiness Is All We Want. India: Bloomsbury Publishing.
4. Universal Human Values. (2023). (n.p.): Booksclinic Publishing.
5. A Textbook On Professional Ethics And Human Values. (2007). India: New Age International (P) Limited

21CE602 DESIGN OF STEEL STRUCTURES 3 0 0 3

Course Objectives

- To impart knowledge on Limit State Design Methods for steel Structures
- To impart knowledge on the codal provisions for the design of steel structures
- To impart knowledge on the design of connections, tension members, compression members, beams and roof trusses

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Calculate the strength of connections and design the bolted and welded connections.
2. Determine the strength of tension member and Design tension members, Splices & Lug angles.
3. Compute the strength of compression member and Design Struts, Latticed column and Column base.
4. Calculate the strength of beams and Design laterally supported and unsupported Beams, Built-up Beams, Plate Girders, Roof trusses & Gantry girders
5. Execute Steel structure erection and also analyse the failures of structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											
2	3	2	1											
3	3	2	1											
4	3	2	1											2
5	1	1	1										2	

UNIT I **9 Hours**

INTRODUCTION

Steel structures - Properties of steel - Working stress and Limit state design philosophy - Analysis and Design Methods - Structural steel sections - Types of connections - Design of bolted and welded connections - simple connections - Eccentric connections - Frame connections - Design of gusset plate connections - combined stresses - Prying action.

UNIT II **9 Hours**

TENSION MEMBERS

Introduction to Tension Members - behaviour of tension members - Plates under tension - Angles under tension - Design of tension members - Design of tension splices - Design of Lug Angles.

UNIT III **9 Hours**

COMPRESSION MEMBERS

Introduction to types of compression members - Theory of column - Design of Compression Members - Axially loaded columns - Design of lacings and battens - Design of column base: Slab Base - Gusseted Base.

UNIT IV **9 Hours**

FLEXURAL MEMEBERS

Introduction to Flexural Members, Beams, Beams with web openings, Plate Girders, Gantry Girders - Design of laterally supported and unsupported beams - Roof Trusses - Wind load on pitched roof trusses.

UNIT V **9 Hours**

CONSTRUCTION AND CASE STUDIES

Introduction - fabrication procedure - Sequence of Operation - Welded connections - Methods of welding - Defects in welds - Quality control in fabrication and erection - learning from failures: case studies - need for forensic studies - Tacoma Narrows Bridge - Millennium Bridge at London - Cleddau Bridge, Milford Haven, (UK) - Hyatt Regency Walkway Collapses

Total: 45 Hours

Reference(s)

1. N. Subramanian, Design of Steel Structures, Oxford University Press 2015.
2. S. K. Duggal, Limit State Design of Steel Structures, Tata , Mc Graw Hill Education Pvt Ltd, New Delhi, 2014.
3. S.S.Bhavakatti, Design of Steel Structures, IK publications, New Delhi, Third Edition 2017.
4. IS 800 - 2007, General Construction in Steel - Code of Practice, BIS, New Delhi
5. IS 875 (part 3) - 2015, Wind loads on Buildings and Structures, BIS, New Delhi
6. http://www.steel-insdag.org/TM_Contents.asp

21CE603 WATER SUPPLY AND WASTE WATER ENGINEERING **3 0 0 3**

Course Objectives

- To impart knowledge on the quality and quantity of water.
- To select suitable method of water treatment and to find the capacity of water treatment plant.
- To deliver the knowledge on various systems of collection and treatment of municipal wastewater.
- To emphasize the need for sewage treatment and to impart training to design the various treatment units

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Estimate the quantity of water and analyse its quality parameters.
2. Design the coagulation, flocculation and sedimentation tanks including intake structures.
3. Design the filtration and disinfection units and select the typical distribution layout.
4. Estimate the quantity of sewage and analyse its characteristics to design sewers including storm water flow.
5. Design the various sewage treatment units including sludge disposal.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1										1	2
2	2	2	2										1	2
3	2	3	2										1	2
4	2	2	2										1	2
5	2	2	3										1	2

UNIT I **10 Hours**

QUANTITY AND QUALITY OF WATER

Introduction: Scope for Environmental Engineering - Need for protected water supply - Quantity of Water -Population Forecasts - Types of water demands - Domestic demand - Institutional and Commercial demands - Public uses - Fire demand - Per capita consumption - Examination of water - Physical - chemical and microbiological examinations - Water borne diseases - BIS & WHO water standards

UNIT II **8 Hours**

SOURCE, CONVEYANCE AND TREATMENT OF WATER

Intake structures - Different types of intakes - Factors for selection and location of intakes - pipes - Design for the economical diameter of the rising main - Nomograms - Pipe appurtenances - Objectives of water treatment - Typical flow chart of a water treatment plant - Aeration - Objectives - Principles of aeration - Types of aerators - Sedimentation - Theory - Settling tanks -Types - Coagulation and Flocculation- Dosages - Chemical feeding - Flash mixing -Flocculators - Design of sedimentation tanks.

UNIT III **8 Hours**

FILTRATION, DISINFECTION AND DISTRIBUTION

Filtration - Mechanism - Theory of filtration - Design of sand filters - Rapid sand and slow sand filters including construction and operation - Disinfection - Methods of disinfection - Chlorination - Chlorine demand - Residual chlorine. Requirements of good distribution system - Layouts of distribution system - Distribution reservoirs - Storage capacity of distribution reservoirs.

UNIT IV **9 Hours**

QUANTITY OF SEWAGE

Types of sewerage systems suitability - Dry weather flow - Factors effecting dry weather flow - Computation of design flow - Estimation of storm flow: Rational method and empirical formulae - Time of concentration - Design of storm water drain - Physical, chemical and biological characteristics- Design of Sewers - Sewer Materials - Non Silting and Non Scouring Velocities - Gradient- Empirical formulae. Manholes - Water seal system. Sewage farming, sewage sickness.

UNIT V **10 Hours**

TREATMENT OF SEWAGE

Types of Treatment - Flow diagram of a typical municipal sewage treatment plant - Primary Treatment - Screening - Grit chambers - Skimming tanks - Primary sedimentation tanks - Sludge deposit - Secondary treatment - Concepts of Aerobic and Anaerobic activity - Trickling filter - Theory and operation - Types and designs - Activated sludge process - Principle and flow diagram - Methods of aeration -Modifications - F/M ratio - Designs of ASP - Secondary sedimentation tanks - Tertiary treatment - Sludge digestion and filter beds - Methods of sludge disposal.

Total: 45 Hours

Reference(s)

1. Garg, S.K., Environmental Engineering Vol.I, Water Supply Engineering, Khanna Publishers, New Delhi, 2014.
2. Garg, S.K.,Environmental Engineering Vol.II, Sewage Disposal and Air Pollution Engineering, Khanna Publishers, New Delhi, 2014.
3. Birdie, G.S. and Birdie, J.S., Water Supply and Sanitary Engineering, Dhanpat Rai and Sons, New Delhi, 1992.
4. Metcalf and Eddy., 1991.Waste water Engineering, Treatment, Disposal and Reuse, 3rd Edition, Tata McGraw Hill, New Delhi.
5. CPHEEO, 1980. Manual for water supply and treatment, Central Public Health and Environment Engineering Organization, Government of India, New Delhi.

21CE607 COMPUTER AIDED PLANNING AND MANAGEMENT LABORATORY

0 0 4 2

Course Objectives

- To impart knowledge on different concepts of construction planning, scheduling and controlling using primavera software.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. 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.

k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. List the basic tools of project management using software
2. Identify the bar chart of residential building for given task
3. Design the Activity and workers requirement for foundation
4. Explain the network for pumping station and analyse using critical path method
5. Exemplify the optimization resource in multi storied building construction using software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		3									1	2
2	2	3		1							1		2	3
3	1	3		2									2	1
4	1	2		3									1	2
5	2	1		3									2	3

1 **6 Hours**

EXPERIMENT 1

Basics concept of project management tools

2 **6 Hours**

EXPERIMENT 2

Draw the bar chart of residential building for given construction task

3 **6 Hours**

EXPERIMENT 3

Design the housing unit project extract from workers requirement for crash program

4 **6 Hours**

EXPERIMENT 4

Design the Activity and workers requirement for foundation

5 **6 Hours**

EXPERIMENT 5

Draw the commercial buildings for work- breakdown structure

6 **6 Hours**

EXPERIMENT 6

Design the network for pumping station and analyse using critical path method

7 **6 Hours**

EXPERIMENT 7

Determine the activity based on floating method for small scale project

8 **6 Hours**

EXPERIMENT 8

Estimate the expected activity duration in PERT network

9 **6 Hours**

EXPERIMENT 9

Determine the standard deviation in normal distribution for a project

10 **6 Hours**

EXPERIMENT 10

Design of optimization resource in multi storied building construction using software

Total: 60 Hours

Reference(s)

1. CADD Center manual, "Project planning and management by using MS Project" ,CADD Centre Training Services Pvt, 2010
2. Sengupta .B, Guha .H, construction management and planning, Tata Mcgraw Hill,New Delhi,2007
3. Sharma .S.C, "Construction engineering and management" ,Khanna Publishers,Delhi,2008.
4. Kumar Neeraj Jha, construction project management", Dorling Kindersley, New Delhi.2013.

21CE608 ENVIRONMENTAL ENGINEERING LABORATORY

0 0 4 2

Course Objectives

- To provide basic knowledge on the various methods of analysis of water and waste water
- To emphasize the need for water and wastewater treatment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

d. 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.

j. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Determine the important quality parameters of drinking water
2. Analyze wastewater for its various strength characteristics.
3. Conclude the quality of drinking water/strength of wastewater with respect to I.S. limits and specifications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2								2			2	3
2	2	2		3						2			2	3
3	1	2		3						2			2	3

1 **6 Hours**

EXPERIMENT 1

Determination of Acidity and Alkalinity in the given water/wastewater sample.

2 **8 Hours**

EXPERIMENT 2

Estimation of Hardness and Chlorides in the given water and wastewater sample.

3 **8 Hours**

EXPERIMENT 3

Analysis of Sulphates and Nitrates in the given sample.

4

8 Hours

EXPERIMENT 4

Estimation of available chlorine in Bleaching powder and chlorine demand for the given sample.

5

6 Hours

EXPERIMENT 5

Determination of pH, Turbidity and Colour for the given sample.

6

8 Hours

EXPERIMENT 6

Determination of optimum coagulant dosage for the given sample.

7

8 Hours

EXPERIMENT 7

Estimation of Dissolved Oxygen and Bio Chemical Oxygen Demand for the given water/wastewater sample.

8

8 Hours

EXPERIMENT 8

Determination of Chemical Oxygen Demand and Solids(Total and Dissolved - organic and inorganic solids) for the given water/wastewater sample.

Total: 60 Hours

Reference(s)

1. Garg, S.K., Environmental Engineering (Vol.I), Water Supply Engineering, Khanna Publishers, New Delhi, 2014.
2. Garg, S.K., Environmental Engineering (Vol.II),Sewage Disposal and Air Pollution Engineering, Khanna Publishers, New Delhi, 2014.
3. APHA,AWWA, WEF. Standard Methods for the Examination of water and Wastewater, 22nd Edition, Washington: American Public Health Association; 2012

21CE701 ESTIMATION COSTING AND QUANTITY SURVEYING

3 0 0 3

Course Objectives

- To impart fundamental knowledge on investigation of the site and selection of suitable foundation
- To make the students understand the methods of estimating the cost of buildings
- To know about the rate analysis and bill preparations
- To study about the specification writing
- To understand the valuation of land and buildings

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Perform rate analysis of materials of construction
2. Apply different types of estimates in different situations
3. Carry out analysis of rates and bill preparation at different locations
4. Demonstrate the concepts of specification writing
5. Estimate the total cost of construction and plan of building and Carry out valuation of assets

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3											
2	3	3	3	2										
3	3	3		2		1								
4	3			3	1								1	
5		3		3				3						

UNIT I **9 Hours**

BASICS OF ESTIMATION

General items of work in Building - Earthwork - Cement Concrete work - R.C.C. work - Stonework - Brickwork - Wood work - Ironwork - Flooring - Finishing work Standard units- Principles of working out quantities for detailed and abstract estimates - An approximate method of Estimating - Detailed Estimates of Buildings.

UNIT II **9 Hours**

COST ESTIMATION OF QUANTITIES OF MATERIALS

Earthwork excavation - Sand filling - Lime concrete - Cement concrete - R.C.C work - Cement mortar - Brickwork - Reinforced brickwork - Stone masonry - Plastering - Painting - Flooring - White and colour washing - Distempering - Varnishing - Woodwork - Centering - Shuttering and formwork for R.C.C works - AC sheet roofing, etc.

UNIT III **9 Hours**

ESTIMATION OF BUILDINGS

Load bearing and framed structures - Calculation of quantities of brickwork, RCC, PCC, Plastering, white washing, colour washing and painting / varnishing for shops, rooms, residential building with flat and pitched roof - Estimating of a septic tank, soak pit - Sanitary and water supply installations - Water supply pipeline - Sewer line - Tube well - Open well - Estimate of bituminous and cement concrete roads.

UNIT IV **9 Hours**

SPECIFICATION AND TENDERS

Data - Schedule of rates - Analysis of rates - Specifications - sources - Preparation of detailed and general specifications - Tenders -Tamilnadu Tender Transparency Act - e-tender - Preparation of Tender Notice and Document - Contracts - Types of contracts - Drafting of contract documents - Arbitration and legal requirements.

UNIT V **9 Hours**

VALUATION

Valuation: Purpose of valuation, types of property- Depreciation, Sinking fund, Leasehold and freehold property, obsolescence, Gross income, Outgoing and Net income, Capitalized value and year"s purchase - Rental method of valuations - Typical problems - GST Rate for Construction and Building Materials - GST on Building.

FOR FURTHER READING

Special Foundations - Foundation on expansive soils -Reinforced earth

Total: 45 Hours

Reference(s)

1. B.N. Dutta, "Estimating and Costing in Civil Engineering" Theory and Practice Including Specifications and Valuations, Twenty sixth Revised Edition, UBSPD, 2011.
2. Kohli, D.D and Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", S.Chand & Company Ltd., 2004
3. Gurcharan Singh and Jagdish Singh "A Text Book of Estimating, Costing and Valuation", Standard Publishers Distributors, Delhi, 1998
4. K. S. Randwala and K.K. Rangwala "Elements of Estimating and Costing", Chavotar Publishing House, India, 1995

21CE702 HIGHWAY AND RAILWAY ENGINEERING

3 0 0 3

Course Objectives

- To provide a basic knowledge on highway planning and highway materials
- To impart a basic knowledge on geometric design and design of pavements
- To provide a basic knowledge on railway planning, design and construction

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Identify the concepts of highway alignment and the highway proposal
2. Design various cross sectional elements of highway and construction of flexible and rigid pavements as per the standards of Indian Road Congress (IRC)
3. Analyse the construction and maintenance of highways
4. Identify the basic components of railway track.
5. Characterize the techniques used in construction and maintenance of railway track

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1											
2	3	2	1											2
3	1	3	2										1	
4	1	3	1											
5	2	1												2

UNIT I **9 Hours**

HIGHWAY PLANNING AND ALIGNMENT

Introduction to highway - Institutions for highway planning and implementation at different levels - Jayakar committee recommendations - Requirements of ideal alignment - Factors controlling highway alignment -Engineering surveys for alignment - Conventional methods and modern methods (Remote Sensing, GIS and GPS techniques) - Highway cross sectional elements - Right of Way, carriage way, camber, kerbs, shoulders and footpaths [IRC Standards]

UNIT II **9 Hours**

GEOMETRIC DESIGN OF HIGHWAYS

Design of horizontal alignments: Super elevation, Widening of pavements on horizontal curves and transition curves [Problems]. Design of vertical alignments - gradients, summit and valley curves - Sight distances: Factors affecting sight distances, PIEV Theory, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), [Problems in SSD and OSD] - Geometric design of hill roads [IRC Standards Only] - Design principles of flexible and rigid pavements (IRC Recommendations - Problems)

UNIT III **9 Hours**

HIGHWAY CONSTRUCTION AND MAINTENANCE

Construction of WBM, bituminous concrete roads and cement concrete roads - Desirable Properties and Testing of Highway Materials-Soil: California Bearing Ratio Test -Aggregate: Crushing, Abrasion and Impact Tests - Bitumen: Penetration, Ductility, Viscosity, Binder Content and Softening Point Tests - Types of defects in flexible pavements and rigid pavements - Overlays - - Benkelman beam method - Roadside development and Arboriculture.

UNIT IV **9 Hours**

RAILWAY PLANNING AND DESIGN

Introduction - Engineering survey for track alignment- Permanent Way - Components and functions of each component - Gauges in railway tracks - Coning of wheels- Creeps and kinks - Geometric design of railway tracks -Gradient - Super-Elevation - Widening of gauges in curves

UNIT V **9 Hours**

RAILWAY TRACK CONSTRUCTION, MAINTENANCE AND OPERATION

Track construction and maintenance - Track drainage - Lay outs of railway stations and yards - Points and Crossings - Signals - Types of signals - Principles and mechanism of interlocking - Methods of interlocking - Track circuiting - Electric traction - Introduction to modern trends in Indian Railways in the design of high speed tracks - Track Modernization - Automated maintenance and upgrading.

FOR FURTHER READING

Highway Development in India - Classification and cross section of urban and rural roads (IRC)- Introduction to software's used in road design Special repairs - Case studies related to PMS- Build, Operate and Transfer for Highway Projects (Basic Concepts only) Railways for Urban area - LRT & MRTS - Mono Rail - Metro Rail

Total: 45 Hours

Reference(s)

1. S. K. Khanna ,C. E. G. Justo, A.Veeraraghavan, Highway Engineering, Nem Chand and Bros., Roorkee, 2015 (tenth edition) ISBN 978-81-85240-80-0
2. K. P. Subramaniam, Highway, Railway, Airport and Harbour Engineering, Scitech Publications, Chennai, 2011, ISBN-13: 978-8183712712
3. IRC 37 - 2012, Guidelines for the Design of Flexible Pavements
4. S. C. Saxena and S. P. Arora, Railway Engineering, Dhanapat Rai Publications Pvt. Ltd., New Delhi, 2010.
5. S. K. Khanna and C. E. G. Justo, Highway Material Testing Manual, Nem Chand and Bros., Roorkee, 2009
6. L. R. Kadiyali, Principles and Practice of Highway Engineering, Khanna Publishers Ltd., New Delhi, 2017.ISBN No. 978-81-7409-220-X

21CE707 TRANSPORTATION ENGINEERING LABORATORY

0 0 4 2

Course Objectives

- To provide a basic knowledge on highway planning and highway materials
- To impart a basic knowledge on geometric design and design of pavements
- To provide a basic knowledge on economic evaluation of highway projects.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Acquisition of skills in selecting the best highway alignment and the highway proposal
2. Planning of various highway cross sectional elements
3. Design flexible and rigid pavements as per IRC codes
4. Prepare Environmental Impact Assessment for any highway project
5. Better assessment of the proposals because of the cost-benefit analysis knowledge

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	1										
2	1	1	2	3									1	
3	1		3	2										2
4	1		3	1										
5	1	2	1	3										

1 **3 Hours**

EXPERIMENT 1

Shape test on aggregates

2 **3 Hours**

EXPERIMENT 2

Aggregate Impact value

3 **3 Hours**

EXPERIMENT 3

Aggregate abrasion value test

4 **3 Hours**

EXPERIMENT 4

Aggregate Crushing value test

5 **3 Hours**

EXPERIMENT 5

Specific Gravity of Bitumen

6 **3 Hours**

EXPERIMENT 6

Penetration test for bitumen

7 **3 Hours**

EXPERIMENT 7

Ductility test for Bitumen

8 **3 Hours**

EXPERIMENT 8

Flash and fire point test

9 **3 Hours**

EXPERIMENT 9

Softening point test for Bitumen

10 **3 Hours**

EXPERIMENT 10

Viscosity test for Bitumen

Total: 30 Hours

Reference(s)

1. S. K. Khanna and C. E. G. Justo, Highway Material Testing Manual, Nem Chand and Bros. Roorkee, 2002
2. IS: 2386 PART -1 Aggregate Shape test
3. IS: 2386 PART -4 Aggregate Impact value
4. IS: 1203-1978 Penetration test
5. IRC Recommendations for aggregate and bitumen

21CE708 PROJECT WORK I **0 0 6 3**

Course Objectives

- To develop knowledge to formulate a real world problem and project"s goals
- To identify the various tasks of the project to determine standard procedures
- To identify and learn new tools, algorithms and techniques
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions
2. Express the technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present the oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	1			2	1							
2	1	1	2	3		1					1	1		
3			1	1	2			1			1	2		
4		1		1	1	3	1	2	2					
5									1		2	1		

21CE804 PROJECT WORK II **0 0 18 9**

Course Objectives

- To develop knowledge to formulate a real world problem and project goals
- To identify the various tasks of the project to determine standard procedures
- To identify and learn new tools, algorithms and techniques
- To understand the various procedures for validation of the product and analysis the cost effectiveness
- To understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. 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.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions
2. Express the technical ideas, strategies and methodologies

3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present the oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2			1	2							
2	1	2	3	2		2					1	2		
3			1	2	2			2			2	2		
4		1		2	1	2	1	2	2					
5									1		1	2		

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.

Course Outcomes (COs)

1. Use appropriate grammar & vocabulary that is expected at the BEC Preliminary exam level
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature
3. Write straightforward, routine letters of a factual nature, and make notes on routine matters, such as taking/placing orders
4. Follow simple presentations/demonstrations
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual

information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

1. Goodbye party for Miss Pushpa T S - Nissim Ezekiel
2. Our Casuarina Tree - Toru Dutt
3. Palanquin Bearers - Sarojini Naidu
4. The Tyger - William Blake
5. Ode on a Grecian Urn - John Keats

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.
Course Outcomes (COs)

1. Use appropriate grammar & vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

1. A Horse and Two Goats - R K Narayan
2. My Lord the Baby - Rabindranath Tagore
3. Twist in the Tale - Jeffery Archer
4. The Third and Final Continent - Jhumpa Lahiri
5. The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)
j. 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.
Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**
Hello, Initials and Finals of Chinese b,p,m,f,d,,n,l,g,k,h,j,q,x, Tones Four, Chinese Syllables, Tone S

UNIT II **9 Hours**
Thank you - Initials and Finals of Chinese The Neutral Tone Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**
What"s your name - In the school; -In the classroom; -In the school The Interrogative Pronoun, The Sentence, Interrogative Sentences

UNIT IV **9 Hours**
She is my Chinese teacher - In
the library
The Interrogative Pronouns
The Structural Particle
The interrogative Particle

UNIT V **9 Hours**
Her daughter is 20 years old this year - The Interrogative Pronoun Numbers below 100 3.Indicating a Change The Interrogative Phrase **Total: 45 Hours**

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)
j. 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.

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s"appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s"informer sur quelquun, demander de se presenter Lexique - Les alphabets, les nationalites, age, les pays, les couleurs, les jours de la semaine, les mois de l"annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites - Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu - Communication - Chercher un logement, d"ecrire son voisin, s"informer sur un logement - Lexique - L"habitat, les pieces, l"equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie

Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l''imparfait Communication - Propose aÃƒ?Ã‚Â quelqu''''un de faire quelque chose, raconteur une sortie au passe parler un film - Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite

Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcomes (POs)
j. 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.

Course Outcomes (COs)

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

UNIT 1

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

UNIT 2

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

UNIT 3

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

UNIT 4

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

UNIT 5

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day-to-day situations
- To help students acquire the ability to understand a simple technical text in Hindi

Programme Outcomes (POs)
j. 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.
Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day-to-day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Appear for Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				

UNIT I **9 Hours**

UNIT 1

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

UNIT 2

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

UNIT 3

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

UNIT 4

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

UNIT 5

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009
3. Videos, Stories, Rhymes and Songs

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)
j. 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.
Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										-				
2										-				
3										-				
4										-				
5										-				

UNIT I **9 Hours**

UNIT I

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

UNIT II

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

UNIT III

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

UNIT IV

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

UNIT V

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy,

atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

18GE0P2 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	1	1												
4	1	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage

characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	1	2												
3	2	1												
4	1	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein"s prediction - Einstein"s relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting- Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

18GE0C1 CORROSION SCIENCE AND ENGINEERING **3 0 0 3**

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current and applications
4. Compare different methods of storing hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1												
4	2	2					1							
5	3	3												

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge- over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene - butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

21CE001 REPAIR AND REHABILITATION OF STRUCTURES **3 0 0 3**

Course Objectives

- To emphasize the importance of maintenance and in section of structures.
- To impart fundamental knowledge on various repairing strategies.

Programme Outcomes (POs)

c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Diagnosis the damage of distress structures.
2. Investigate the Corrosion factors and control methods
3. Identify the Serviceability and Durability of Concrete Structures.
4. Infer the suitable repair materials and its application
5. Identify the techniques for repair and demolition of distressed structures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1			-		2	3	-					1
2			2		2	3	-					2
3			-		1	2	3					1
4						2	3					3
5			-		1		2					2

UNIT I **9 Hours**

MAINTENANCE AND REPAIR STRATEGIES

Maintenance, repair and rehabilitation - Facets of maintenance - Importance of maintenance - Causes of deterioration - Inspection - Preventive measures - Assessment procedure for evaluating damaged structure.

UNIT II **9 Hours**

CORROSION PROTECTION

Corrosion mechanism - Corrosion damage of reinforced concrete - Causes, Effects and Remedial measures - Methods of corrosion protection - Design and construction errors - Effects of cover thickness - Corrosion inhibitors - Corrosion resistant steels - Coatings - Cathodic protection - Deterioration of concrete, steel, masonry and timber structures - Surface deterioration and efflorescence - Preventive measures.

UNIT III **9 Hours**

SERVICEABILITY AND DURABILITY OF CONCRETE STRUCTURES

Durability of concrete in seawater - Thermal properties of concrete - Fire resistance - Resistance to freezing and thawing - Permeability of concrete - Sulphate attack - Methods of control - Quality assurance - Conceptual bases for quality assurance schemes.

UNIT IV **9 Hours**

MATERIALS AND TECHNIQUES FOR REPAIR

Special concrete and mortar - Concrete chemicals - Special elements for accelerated strength gain - Expansive cement - Polymer concrete - Sulphur infiltrated concrete - Ferro cement - Fiber reinforced concrete.

UNIT V **9 Hours**

TECHNIQUES FOR REPAIR AND DEMOLITION

Rust eliminators and polymers coating for rebars during repair - Foamed concrete - Mortar and dry pack - Vacuum concrete - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - Shoring and underpinning - Engineered demolition techniques for dilapidated structures - Case studies.

Total: 45 Hours

Reference(s)

1. Raiker .R.N,"Learning from Failures, Deficiencies in Design, Construction and Service, - R&D Centre (SDCPL), Raikar Bhavan, Bombay 2017.
2. Repair & Rehabilitation, Compilation from The Indian Concrete Journal,ACC-RCD Publication 2016.
3. Allen .R.T, and Edwards.S.C, Shaw D.N Repair of Concrete Structures, Chapman and Hall,2015.
4. M.S.Shetty, Concrete Technology Theory and Practice, S.Chand & Co., NewDelhi, 2022.
5. Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical Publications, UK, 2016.
6. PeterH.Emmons, Concrete Repair and Maintenance Illustrated Problem Analysis, Repair Strategy, Techniques, Galgotia Publication, 2018.

21CE002 PRESTRESSED CONCRETE STRUCTURES 3 0 0 3

Course Objectives

- Interpret the Basic concept of pre-stress concrete, materials, methods and factors influencing pre-stress.
- Implement the basic assumptions of elastic analysis and design pre-stressed flexural and shear members
- Predict the stresses due to long term and short term deflection and design a pre-stress member accordingly
- Determine the stresses in composite structures and find out how partial pre-stressing is done.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Analyze the stresses in pre-stressed concrete member due to pre-stressing force and its variation due to losses.
2. Design the layout of cables for Type I and Type II beams based on calculation of moment of resistance.
3. Compute the deflections and anchorage zone stresses.
4. Implement the methods for achieving continuity in beams.
5. Evaluate the design of circular pre-stressing and the uses of non-prestressed reinforcement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	3	2									1
2	1	2	3									1
3	1	2	3									1
4	2	1	3									1
5	1	2	3									

UNIT I **9 Hours**

INTRODUCTION

Principles of Prestressing - Classification and types - Advantages over reinforced concrete - Materials - High strength concrete and high tensile steel - Methods of Prestressing - Freyssinet, Magnel Blaton, Lee Mc Call and Killick anchorage systems - Analysis of sections for stresses by stress concept, strength concept and load balancing concept - Losses of prestress.

UNIT II **9 Hours**

DESIGN FOR FLEXURE AND SHEAR

Basic assumptions for calculating flexural stresses - Permissible stresses in steel and concrete as per IS 1343 Code - Design of sections of Type I and Type II post -tensioned and pre -tensioned beams - Check for strength limit state based on IS 1343 Code - Layout of cables in post-tensioned beams - Location of wires in pre-tensioned beams - Design for shear based on IS 1343 Code.

UNIT III **9 Hours**

DEFLECTION AND DESIGN OF ANCHORAGE ZONE

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 Magnel"s method, Guyon"s method and IS 1343 code - Design of anchorage zone reinforcement.

UNIT IV **9 Hours**

COMPOSITE BEAMS AND CONTINUOUS BEAMS

Types of R.C.C - P.S.C composite beams - Analysis and design of composite beams and Continuous Beams - Methods of achieving Continuity in continuous beams - Concordant cable and linear transformation - Calculation of stresses - Principles of design.

UNIT V **9 Hours**

MISCELLANEOUS STRUCTURES

Design of compression members and tension members - Circular prestressing - Water tanks - Pipes - Analysis and design - IS Codal provisions.

Total: 45 Hours

Reference(s)

1. Krishna Raju, N., "Prestressed Concrete", Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Lin, T.Y. and Ned. H. Burns, "Design of Prestressed Concrete Structures", John Wiley & Sons, New York, 2009.
3. Rajagopalan, N., "Prestressed Concrete", Narosa Publishing House, New Delhi,2008.
4. IS 1343 - 2012: Code of practice for Prestressed concrete.
5. IS 784 - 2001: Code of practice for Prestressed concrete pipes.
6. IS 3370 - 1999: Code of practice for concrete structures for the storage of liquids.

21CE003 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING **3 0 0 3**

Course Objectives

- To impart knowledge on the theory of vibration and basics of structural dynamics.
- To impart the design philosophy of earthquake resistant design of structures.
- To create awareness on the use of codal provisions for aseismic design of structures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
l. 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.

Course Outcomes (COs)

1. Infer the concept of equation of motion for a single degree of freedom system.
2. Illustrate the characteristics of earthquakes and its effects.
3. Analysis of the RC building by Equivalent static analysis.
4. Illustrate the various seismic resistant methods and its ductile detailing for RC and masonry structures.
5. Identify the Retrofitting techniques for RC buildings and its structural elements.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	3	2	-	-	-						
2	1	-			2	3						
3		2	3		1							1
4	-	3	2	-	1	-						2
5	-	1		2	3							2

UNIT I **9 Hours**

PRINCIPLES OF DYNAMICS

Vibration studies - Elements of vibratory systems and simple harmonic motion - Vibration with and without damping - D" Alembert"s principle - Degree of freedom: Equation of motion for S.D.O.F. - Damped and undamped free forced vibrations.

UNIT II **9 Hours**

INTRODUCTION TO EARTHQUAKE ENGINEERING

Elements of engineering seismology - Causes of earthquakes - Seismic waves - Magnitude - Intensity and Energy release - Indian seismology - Earthquake history - Catastrophes - Failures - Lessons learnt from past earthquakes - Seismic zone map of India - Estimation of Earthquake Parameters, Microzonation - Strong ground motion characteristics.

UNIT III **9 Hours**

SEISMIC DESIGN OF BUILDINGS

Idealization of building frames - Methods of seismic analysis - Equivalent static analysis - IS 1893 provisions - Design horizontal seismic coefficient - Design base shear distribution - Seismic resistant design of buildings

UNIT IV **9 Hours**

EARTHQUAKE RESISTANT STRUCTURES

Earthquake resistant properties of materials - Lateral force resisting systems - Strong column weak beam - Guidelines for seismic-resistant construction - Building configuration requirements - Ductile detailing of reinforcements in RC buildings - Behavior masonry structures - Behaviour of tall buildings under seismic and wind conditions.

UNIT V **9 Hours**

REPAIRS AND RETROFITTING

Code of practices for repairs and retrofitting - Retrofitting of RC buildings and structural elements - Techniques of retrofitting - Improving structural integrity of masonry buildings - Tuned Mass Dampers - Retrofitting by seismic isolation - Case studies.

Total: 45 Hours

Reference(s)

1. Mario Paz, Structural Dynamics - Theory and Computation, CBS Publications, 2004.
2. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, Prentice Hall of India, 2006.
3. IS 1893 - 2002, Criteria for Earthquake Resistant Design of Structures.
4. IS 4326 - 1993, Earthquake Resistant Design and Construction of Buildings - Code of Practice.
5. IS 13920 - 1993, Ductile Detailing of Reinforced Concrete Structures to Seismic Forces - Code of Practice.
6. IS 13935 - 1993, Repair and Seismic Strengthening of Buildings Guidelines.

21CE004 BRIDGE ENGINEERING **3 0 0 3**

Course Objectives

- To learn the components of bridges, classification of bridges, importance of bridges.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.

Course Outcomes (COs)

1. To be familiar with the components of bridges, classification of bridges, importance of bridges.
2. To identify the specification of road bridges, loads to be considered.
3. To be familiar with various types of bridges such as slab-bridge, T-beam bridge, pre-stressed concrete bridge, continuous bridge, arch bridge, box girder bridge decks.
4. To analysis the various bridges-piers and abutments.
5. To get exposed to evaluation of sub structures, type of foundations, importance of bearings, lessons from bridge failures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2		-	-	3						
2	1			2		3						
3	1	2										
4	1	2		3								
5	1			2	3							

UNIT I **9 Hours**

INTRODUCTION

Components of Bridges - Classification - Importance of Bridges - Investigation for Bridges - Selection of Bridge site - Economical span - Location of piers and abutments - Subsoil exploration - Scour depth - Traffic projection - Choice of bridge type

9 Hours

UNIT II

SPECIFICATION OF BRIDGES

Specification of road bridges - width of carriageway - loads to be considered - dead load - IRC standard live load - Impact effect.

UNIT III **9 Hours**

DESIGN OF BRIDGES

General design considerations - Slab Bridge - Design of T-beam bridge - Prestressed concrete bridge - continuous bridge - Arch Bridge - Box girder bridge decks.

UNIT IV **9 Hours**

ANALYSIS OF BRIDGES

Evaluation of sub structures - Pier and abutments caps - Design of pier - Abutments - Type of foundations.

UNIT V **9 Hours**

BEARING AND JOINTS OF BRIDGES

Importance of Bearings - Bearings for slab bridges - Bearings for girder bridges - Electrometric bearing - Joints - Expansion joints. Construction and Maintenance of bridges - Lessons from bridge failures.

Total: 45 Hours

Reference(s)

1. Ponnuswamy, S., Bridge Engineering, Tata McGraw-Hill, New Delhi, 1997.
2. Victor, D. J., Essentials of Bridge Engineering, Oxford and IBH Publishers Co., New Delhi, 1980.
3. N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.
4. Jagadeesh. T. R. and Jayaram. M. A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd., 2004.
5. Raina. V. K., Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1991

21CE005 TALL STRUCTURES **3 0 0 3**

Course Objectives

- The student should have understood the problems associated with large heights of structures with respect to loads (wind and earthquake and deflections of the structure).
- The Students will be able to understand the rudimentary principles of designing tall buildings as per the existing course.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Course Outcomes (COs)

1. Design the tall building based on different load conditions
2. Analyse the shear wall and load bearing wall panel systems
3. Comparison of Composite Buildings and High Rise Structural Systems
4. Design and analysis of Composite Buildings and High Rise Structural Systems
5. Analyse of High Rise Suspension Systems and Pneumatic High Rise Buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2											
2	1											
3	1											
4	2											
5	2											

UNIT I **9 Hours**

INTRODUCTION

Tall Building in the Urban Context -Tall Building and its Support Structure -Development of High Rise Building Structures - General Planning Considerations.Dead Loads - Live Loads-Construction Loads -Snow, Rain, and Ice Loads - Wind Loads-Seismic Loading, Water and Earth Pressure Loads - Loads - Loads Due to Restrained Volume Changes of Material - Impact and Dynamic Loads - Blast Loads -Combination of Loads.

UNIT II **9 Hours**

THE VERTICAL STRUCTURE PLANE

Dispersion of Vertical Forces- Dispersion of Lateral Forces - Optimum Ground Level Space - Shear Wall Arrangement - Behaviour of Shear Walls under Lateral Loading.Floor Structure or Horizontal Building Plane Floor Framing Systems-Horizontal Bracing- Composite Floor Systems-High - Rise Building as related to assemblage Kits Skeleton Frame Systems - Load Bearing Wall Panel Systems - Panel Frame Systems - Multistory Box Systems.

9 Hours

UNIT III

COMMON HIGH-RISE BUILDING STRUCTURES AND THEIR BEHAVIOUR UNDER LOAD

Bearing Wall Structure-Shear Core Structure - Rigid Frame Systems- The Wall - Beam Structure: Interspatial and Staggered Truss Systems - Frame - Shear Wall Building Systems - Flat Slab Building Structures - Shear Truss - Frame Interaction System with Rigid - Belt Trusses - Tubular Systems-Composite Buildings - Comparison of High - Rise Structural Systems Other Design Approaches Controlling Building Drift Efficient Building Forms - The Counteracting Force or Dynamic Response.

UNIT IV **9 Hours**

APPROXIMATE STRUCTURAL ANALYSIS AND DESIGN OF BUILDINGS

Approximate Analysis of Bearing Wall Buildings -Cross Wall Structure -Long Wall Structure The Rigid Frame Structure Approximate Analysis for Vertical Loading - Approximate Analysis for Lateral Loading - Approximate Design of Rigid Frame Buildings-Lateral Deformation of Rigid Frame Buildings Rigid Frame - Shear Wall Structure - Vierendeel Structure - Hollow Tube Structure.

UNIT V **9 Hours**

ADVANCES IN RAILWAYS

Introduction to modern trends in Indian Railways in the design of high speed tracks - Modern trends in railway track alignment - Railways for Urban area - LRT & MRTS - Mono Rail - Metro Rail - Hyper loop- Recent developments in railway projects.

Total: 45 Hours

Reference(s)

1. WOLFGANG SCHUELLER " High - rise building Structures", John Wiley and Sons Bryan Stafford Smith and Alex Coull, " Tall Building Structures ", Analysis and Design, John Wiley and Sons, Inc.,

21CE006 STRUCTURAL HEALTH MONITORING 3 0 0 3

Course Objectives

- To introduce the concepts involved in the assessment, evaluation and technical diagnosis of different structural systems of strategic importance
- To impart knowledge on both elementary and advanced applications of SHM with case studies

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Recall basic concepts and need for Structural Health monitoring
2. Analyse static and dynamic properties of materials using SHM methods
3. Analyse the damage prediction in different materials using NDT
4. Understand the application of sensors in SHM methods
5. Apply the SHM techniques in different types of structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	-	-									1
2	1	2	-									1
3	-	2	1									1
4	1	2	3									1
5		2	1									1

UNIT I **9 Hours**

INTRODUCTION TO STRUCTURAL HEALTH MONITORING

Introduction -Necessity -Components -Challenges -Advantages - Components of SHM process -SHM issues applied to concrete structures -Level of uncertainties in SHM process

UNIT II **9 Hours**

STRUCTURAL HEALTH MONITORING METHODS

Short term and Long term Monitoring -Local and Global Monitoring -Static and Vibration based SHM - SHM planning and Management - SHM Methods

UNIT III **9 Hours**

DAMAGE IDENTIFICATION METHODS

Damage Identification -Visual Inspection -Comparison of damage identification methods -Non Destructive testing and Evaluation-Vibration based damage detection

UNIT IV **9 Hours**

SENSOR NETWORKING

Sensor Technologies -Fibre optic sensors -Smart Sensing for SHM -Sensing requirements in special structures -Sensor requirements and Data Acquisition -Acquisition system and Networking for SHM - Wireless Sensor Networking -MEMS-Artificial Intelligence in SHM

UNIT V **9 Hours**

APPLICATIONS OF SHM

SHM layout design of offshore structures -SHM Design -Application of SHM in bridges, buildings and offshore structures -Application in structural control strategies -Future of SHM

Total: 45 Hours

Reference(s)

1. Balageas, D., Fritzen, C.P. and Gemes, A. eds., 2010. Structural health monitoring (Vol. 90). John Wiley & Sons.
2. Chandrasekaran, S. 2016. Offshore structural engineering: Reliability and Risk Assessment, CRC Press, Florida, ISBN:978-14-987-6519-0.
3. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures, Springer, 2nd Ed., Singapore. Do, R., 2014.
4. Passive and active sensing technologies for structural health monitoring. University of California, San Diego.
5. Glisic, B. and Inaudi, D., 2008. Fibre optic methods for structural health monitoring. John Wiley & Sons.
6. Nagayama, T. and Spencer Jr, B.F., 2007. Structural health monitoring using smart sensors. Newmark Structural Engineering Laboratory. University of Illinois at Urbana-Champaign.

21CE007 DESIGN OF TIMBER AND MASONRY ELEMENTS **3 0 0 3**

Course Objectives

- To impart basic knowledge on the application and maintenance of timber structures.
- To outline the design aspects of timber and masonry structures.
- To illustrate the need of timber and masonry structures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Identify the suitable structural materials and different load conditions. Identify the suitable structural materials and different load conditions
2. Evaluate the design consideration of various timber elements.
3. Analysis and design of masonry columns for axial and eccentric loading conditions
4. Design of different types of masonry walls.
5. Explain the types and manufacturing process of concrete block walls.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	-				1					1
2	3	2	-				-					1
3	3	1	3	-								2
4	3	3	2				-					2
5	3	2	2									3

UNIT I **9 Hours**

CONCEPTS OF TIMBER STRUCTURES

Factors affecting strength of timber - Permissible stresses - Bearing stress -Types of loads - Dead load - Live load - Wind load - earthquake load - Load Calculation for design as per codal provisions - Choice between different structural materials - Masonry, timber, concrete and steel - Maintenance of Timber Structure.

UNIT II **9 Hours**

DESIGN OF TIMBER STRUCTURES

Design of beams for strength and stiffness as per BIS code - Design of rectangular beams - Design of tension members - Design of compression members of solid and box sections - Types of joints with nails and bolts - Design of bolted and nailed connections - Design of timber joists - Allowable stresses in tension, compression and flexure.

UNIT III **9 Hours**

DESIGN OF BRICK MASONRY COLUMN

Mix proportions - Compressive strength of mortars - Shape factor for masonry units - Stability of piers and walls - Design as per IS Codes - Design of permissible compressive stresses in masonry - Design of masonry column subjected to axial and eccentric loading.

UNIT IV **9 Hours**

DESIGN OF MASONRY WALL

Types of walls - Design of solid load bearing wall for axial loads - Design of solid load bearing wall for eccentric loads - Design of wall with opening - Design of cavity wall - Design of stiffened and unstiffened wall.

UNIT V **9 Hours**

DESIGN OF CONCRETE BLOCK MASONRY

Concrete blocks - Lightweight blocks - AAC Blocks - Hollow Blocks as per IS 2185 - Manufacturing of Hollow Blocks - Tests on Hollow Blocks - Design and Construction of Hollow Block Masonry Walls.

Total: 45 Hours

Reference(s)

1. A.S. Arya, Design of Masonry and Timber Structures, Nemchand and Bros. Publishing, 2007.
2. P. Dayaratnam, Brick and Reinforced Brick Structures, Oxford & IBH Publishing Co. Pvt. Ltd, 1997.
3. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Design of steel structures, Laxmi Publications (P) Ltd, 2007.
4. W. M. C McKenzie, Design of Structural Elements, Macmillan Publishers, 2010.
5. IS: 1905 - 1980, Indian Standard Code of Practice for Structural Safety of Buildings, Masonry Walls, Indian Standards Institution, 1981.
6. IS: 883 - 1994, Code of Practice for Design of Structural Timber in Buildings, BIS New Delhi.

21CE008 ADVANCED RC DESIGN **3 0 0 3**

Course Objectives

- To impart knowledge on the limit state design of RC Structural components
- To enhance the confidence level of students to design the special structural elements as per Indian standard code of practices.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. 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.

Course Outcomes (COs)

1. Design and detailing of special RC elements
2. Analysis of RC slab using yield line theory and design of flat slab and grid floor
3. Design of RC beam for serviceability conditions and design of column as per IS 456
4. Design of RC walls and concepts of ductile detailing
5. Evaluate the RC section with moment redistribution and ultimate load analysis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	1	-	1	-							3
2	2	2		2	1							2
3	1	1	1	1	-							1
4	2	2	1	-	-							1
5	1	1	1	1								

UNIT I **9 Hours**

SPECIAL STRUCTURAL MEMBERS

Design of RC beams: continuous beams, Curved beams and Deep beams - Design of Corbels.

UNIT II **9 Hours**

DESIGN OF SLABS AND YIELD LINE THEORY

Assumptions - Yield line patterns for various types of slabs with different boundary conditions - Yield line theory of slabs - Virtual work method - Equilibrium methods - Hillerborg method of design. Design of flat slabs - Design of grid floors as per I.S.456.

UNIT III **9 Hours**

LIMIT SATATE OF SERVICEABILITY

Parameters considered in limit state of serviceability - Short term deflection - long term deflection - Calculation of deflections in beams under working loads - Calculation of crack width in beams

UNIT IV **9 Hours**

DESIGN OF RC WALL AND DUCTILE DETAILING

Design of RC walls - Shear walls. Concepts of ductility- Factors influencing ductility - Design principles and codal provisions.

UNIT V **9 Hours**

ULTIMATE LOAD ANALYSIS AND INELASTIC BEHAVIOUR

Whitney""s theory - Ultimate load analysis - Moment redistribution and moment rotation characteristics of a R.C. section - Plastic hinges check for rotation capacity of sections. Concept of moment - rotation curves.

Total: 45 Hours

Reference(s)

1. S. Unnikrishna Pillai and DevadosMenon, Reinforced Concrete Design, Tata McGraw Hill Education, 2011
2. P.C. Varghese, Advanced Reinforced Concrete Design, Prentice Hall International Edition, 2006
3. N. Krishnaraju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2000
4. R. Park and T. Paulay, Reinforced Concrete Structures, John Wiley Sons, 2008
5. Gambhir, M.L. Design of Reinforced Concrete Structures, Prentice Hall of India, 2012
6. S.N. Sinha, Handbook of Reinforced Concrete Design, Tata McGraw Hill Education, 2004

21CE009 ADVANCED STEEL DESIGN **3 0 0 3**

Course Objectives

- To impart knowledge on the complex steel structures design
- To introduce the concept of cold formed steel design.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Analyze and design structural components combined bending and axial load
2. Design plate girders and composite beams and its components
3. Compute the suitable section dimension of a gantry girder
4. Analyze and design roof truss and its components
5. Differentiate the cold formed steel and normal steel constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	1	1	1							
2	3	3	1	1	1							
3	3	3	1	1	1							
4	3	3	1	1	1							
5	3	2	1	2	1							

UNIT I **9 Hours**

DESIGN OF BEAM-COLUMNS

Introduction to plate girder - Elements of plate girder - IS 800-2007 codal provisions Preliminary design considerations - concept of Tension field action - design of end panels. Design of plate girder using IS 800-2007- Design of vertical stiffeners - design of longitudinal stiffeners - design of torsional stiffeners - Introduction to steel plate shear wall.

UNIT II **9 Hours**

DESIGN OF PLATE GIRDER

Introduction to plate girder - Elements of plate girder - IS 800-2007 codal provisions Preliminary design considerations - concept of Tension field action - design of end panels. Design of plate girder using IS 800-2007- Design of vertical stiffeners - design of longitudinal stiffeners - design of torsional stiffeners - Introduction to steel plate shear wall.

UNIT III **9 Hours**

DESIGN OF PLATE GIRDER

Introduction - loading consideration - maximum load effect - Selection of Gantry girder - Design of gantry girders for primary loads only

UNIT IV **9 Hours**

DESIGN OF INDUSTRIAL STRUCTURES

Introduction - analysis and design of truss members - Design of gable portal frame - analysis and design of Gantry girder columns - PRE-ENGINEERED BUILDINGS - advantages and design principles

UNIT V **9 Hours**

COLD FORMED STEEL

Introduction - advantages of Cold formed steel sections - Types of Stiffened and Unstiffened Elements - LOCAL BUCKLING - Lateral Buckling - EMPIRICAL METHODS - Z Purlins - Design rules

Total: 45 Hours

Reference(s)

1. J. Rhodes and R.M. Lawson "Design of Structures using Cold Formed Steel Sections, SCI Publication 089, The Steel Construction Institute, U.K. 1992.
2. Limit State Design of Steel Structures S. K. Duggal, McGraw Hill Education Private Ltd. New Delhi.
3. Design of Steel Structures, K. S. Sairam, Pearson Education.
4. Design of Steel Structures, N. Subramanian, Oxford University Press.
5. Indian Standard Code IS 800-2007 General Construction in Steel- Code of Practice, Steel Tables.
6. Design Steel Structures Volume II, Dr. Ramachandra & Vivendra Gehlot, Scientific Publishers Journals Department

21CE010 INDUSTRIAL STRUCTURES **3 0 0 3**

Course Objectives

- To impart knowledge on classification of industries and their functional requirements
- To familiarise the students on the design of silos, bunkers and chimneys
- To impart knowledge on the transmission structures

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. To impart knowledge on the transmission structures
2. Demonstrate the functional requirements for any industry
3. Design of industrial RC and steel structures
4. Design Foundation for industries
5. Analyze the materials in pre-engineered concept

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	2	-	-								1
2	-	2										
3	1	1	3	2								
4	-	1	3	2								
5	1		-	2								

UNIT I **9 Hours**

PLANNING

Classification of Industries and Industrial Structures -Specific requirements for Industries like Engineering, Textiles, Chemicals, steel and cement. Site layout and external facilities required

UNIT II **9 Hours**

FUNCTIONAL REQUIREMENTS

Natural and artificial lighting - Electrical wiring fixtures - Electrical installations - substations - Effluent disposal - Fire expanse and chutes - fire alarm, extinguishers and hydrants - Guidelines from factories act. Heating and Ventilation - Air conditioning

UNIT III **9 Hours**

INDUSTRIAL BUILDINGS

Design and detailing of bunkers, silos, chimneys, Gantry Girders-principles of folded plates and shell roofs

UNIT IV **9 Hours**

FOUNDATION FOR INDUSTRIAL STRUCTURES

Types of Machine Foundations and their design-Foundations for RC and steel chimneys

UNIT V **9 Hours**

PRE ENGINEERED BUILDINGS

Introduction-Advantages and Disadvantages-Primary and secondary structural elements-foundation- wall materials- metal roofing

Total: 45 Hours

Reference(s)

1. N. Krishna Raju, Advanced Reinforced Concrete Design, CBS Publishers and Distributors, 2008
2. P. Dayaratnam, Deign of steel structures, A.H. Wheeler & Co., Ltd., Allahabad, 2008
3. IS :4998 (part 1)"Indian Standard Practice for Design of Reinforced Concrete Chimneys IS: 4995 (part 1 and part 2)criteria for design of reinforced concrete bins for storage of granular and powdery materials IS: 3483 code of practice for noise Reduction in industrial buildings. IS: 6060 code of practice for daylighting of factory buildings SP32-1986, Hand book on Functional requirements of Industrial Buildings. 1995
4. Henn W, Buildings for Industry, Vol I & II, London Hill
5. S. N. Manokar, Tall Chimneys, Design and Construction, Tata McGraw Hill, 1986

21CE011 FINITE ELEMENT ANALYSIS 3 0 0 3

Course Objectives

- To impact basic knowledge on the various steps involved in finite element analysis
- To introduce various types of one - two - three - dimensional elements

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Recall basic concepts of Finite Element Analysis
2. Spot coordinates for various elements
3. Analyse Truss and beam members by Finite element Method
4. Analyse one and two dimensional members
5. Analyse the special parameters of the structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	-	-									1
2	1	2	-									2
3	-	2	1									1
4	1	2	1									1
5	-	2	1									1

UNIT I **9 Hours**

INTRODUCTION

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity - Steps in Finite Element Analysis - Virtual Work and Variational Principle - Galerkin Method- Finite Element Method: Displacement Approach - Stiffness Matrix and Boundary Conditions

UNIT II **9 Hours**

ELEMENT PROPERTIES

Natural Coordinates - Triangular Elements - Rectangular Elements - Lagrange and Serendipity Elements - Solid Elements -Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional

UNIT III **9 Hours**

ANALYSIS OF STRUCTURES BY FEM

Stiffness of Truss Members - Analysis of Truss - Stiffness of Beam Members - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Analysis of Grids.

UNIT IV **9 Hours**

FEM FOR TWO AND THREE DIMENSIONAL STRESS ANALYSIS

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements - Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements

UNIT V **9 Hours**

OTHER APPLICATIONS OF FEM

Fluid flow analysis - vibration analysis - Eigen Values and Eigen Vectors used for fluid analysis in pipes - Elastic Stability analysis - Plate bending problem

Total: 45 Hours

Reference(s)

1. S.Rajasekaran, Finite Element methods in Engineering Design, Wheeler, 1993
2. Chandrupatla, T.R., and Belegundu, A.D., Introduction to Finite Element in Engineering, Third Edition, Prentice Hall, India, 2003
3. Krishnamoorthy C. S,"Finite Element Analysis Theory and Programming", Tata McGraw Hill Education, 1994
4. David V. Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw Hill, 2004
5. Reddy J.N., An Introduction to Finite Element Method, McGraw-Hill, Intl. Student Edition, 1985
6. Rao S.S, The Finite Element Method in Engineering, Pergaman Press, 2014

21CE012 STEEL CONCRETE COMPOSITE STRUCTURES **3 0 0 3**

Course Objectives

- To develop an understanding of the behaviour and design procedure of steel - concrete composite elements and structures.
- To give an exposure on case studies related to steel-concrete composite construction

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.

Course Outcomes (COs)

1. Identify the different types of steel-concrete composite structure and its connections
2. Design the composite beam and column
3. Apply the studs in Roofs and Slabs and predict the cracking pattern
4. Analyse the various bridges and design the economical one
5. Discuss about historical Steel concrete composite construction and seismic behaviour of the structures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-									
2	-	-	-									
3	-											
4	-	-	-									
5	-	-										

UNIT I **9 Hours**

INTRODUCTION

Introduction to steel concrete composite construction advantages Theory of composite structures Introduction to steel Concrete Steel sandwich construction shear connectors Types characteristics and applications.

UNIT II **9 Hours**

DESIGN OF COMPOSITE BEAMS AND SLABS

Elastic Behaviour of composite beams and slabs - Design of composite beams including shear connector - Design of studs - Partial shear - Concrete cracking - Practical considerations - Cost implications

UNIT III **9 Hours**

COMPOSITE COLUMNS AND TRUSSES

Composite columns Types Materials advantages method of design Composite Trusses Analysis Configuration Stud shear connectors Design consideration Cost implications

UNIT IV **9 Hours**

COMPOSITE BRIDGES

Introduction - design of composite bridge deck - Composite box girder bridges - Behaviour of composite box girder bridges - Design concepts

UNIT V **9 Hours**

CASE STUDIES

Case studies on steel - Concrete composite construction -Seismic behaviour of composite structures - Failure of Steel-Concrete composite components/Structure.

Total: 45 Hours

Reference(s)

1. R. P. Johnson, Composite Structures of Steel and Concrete: Beams, slab, columns and frames for buildings, Wiley Blackwell Scientific Publications, UK, 2018.
2. D.J. Oehlers and M.A. Bradford, "Composite Steel and Concrete Structural Members", Fundamental behaviour, pergamon press, Oxford,1995.
3. G. W. Owens and P. Knowels, Steel Designers Manual, Steel Concrete Institute (UK), OxfordBlackwell Scientific Publications, 1992.
4. N. Krishna Raju, "Design of Bridges", Oxford & IBH Publishing Company Pvt. Ltd, NewDelhi. Fourth edition 2015.
5. IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel and Concrete.
6. INSDAG Hand book on Composite Construction - Institute for Steel Development and Growth Publishers, Calcutta

21CE013 BUILDING SERVICES **3 0 0 3**

Course Objectives

- To understand how a building can be made comfortable and safe with the services designed and installed.
- To impart knowledge on basics of electrical wiring system.
- To recognize the importance of fire detection and protection.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Analyze the features of service machineries required for a building.
2. Identify suitable electrical systems and accessories to be installed during the construction of a building.
3. Identify the principles of illumination and artificial light sources.
4. Describe the working principle of refrigerants and air conditioning systems.
5. Analyze the characteristics of fire safety equipment for different types of buildings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	2									2
2	3	2	1									1
3	3	3	2									
4	3	1	2									1
5	1	2	3									2

UNIT I **9 Hours**

ELEVATORS AND CONVEYORS

Elevators - Lifts and Escalators - Special features required for physically handicapped and elderly people - Conveyors - Types of conveyors - Horizontal moving walkways - Design criteria, speed size, capacity, number.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS IN BUILDINGS

Basics of electricity - Single / Three phase supply - Motors and generators - Protective devices in electrical installations - Types of wires - Electrical wiring systems in domestic and commercial buildings - Electrical

wiring layout for building - Earthing - Types of earthing - ISI specifications - Main and distribution boards - Substations - Lightning arrester.

UNIT III **9 Hours**

PRINCIPLES OF ILLUMINATION

Visual tasks - Factors affecting visual tasks - Modern theory of light and colour - Synthesis of light - Additive and subtractive synthesis of colour - Laws of illumination - Classification of lighting - Artificial light sources - Spectral energy distribution - LED lightings - Daylight factor - Design of modern lighting - Lighting for stores, offices, schools, hospitals and house lighting - Special features required for physically handicapped and elderly in building types - Specifications of National Building Code of India.

UNIT IV **9 Hours**

REFRIGERATION PRINCIPLES

Thermodynamics - Refrigerants - Vapour compression cycle - Compressors - Evaporators - Refrigerant Control devices - Cooling towers - Starters - Air handling units - Water piping - Vapour Absorption Machine(VAM) - Window type and packaged air conditioners - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C. systems.

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Fire resistant construction materials - Safety regulations as per NBC - Planning considerations in buildings - Fire escapes systems - Heat and smoke detectors - Automatic sprinklers - Fire Fighting pump and water storage - Fire hydrants - Dry and wet risers.

Total: 45 Hours

Reference(s)

1. Roger Greeno and Fred Hall, Building Services Handbook (8th edition), Routledge Publishers, 2015.
2. G. Steffy, Architectural Lighting Design, John Wiley and Sons, 2008.
3. J. Killinger and L. Killinger, Heating and Cooling Essentials, Goodheart-Wilcox Publishers, 2003.
4. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1988.
5. R. Udhayakumar , A text book of Building services, Eswar Press, 2007.
6. SP 7 (2005) : National Building Code of India 2005.

21CE014 CONCEPTUAL PLANNING AND BYE LAWS 3 0 0 3

Course Objectives

- To provide a broad exposure to the students about the concepts of Planning necessary in Civil Engineering practice
- To make the students familiar with National Building Code of India and other relevant codes for the functional design of residential and industrial buildings

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the requirement of geometrical design as per NBC and learning the importance of projects
2. To provide the basic knowledge on planning approval procedures and their limitations
3. Recall the general guidelines for various buildings as per NBC
4. To impart the knowledge on Master planning of a city and their elements
5. To make the students understand the Tender process,Working and procedure in India

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	1	1		1							
2	1	2	3		1							
3	1	2	3		1							
4	1	2	1		1							
5	1	2	1		3							

UNIT I **9 Hours**

CIVIL ENGINEERING PROJECTS

Introduction- Consideration for a good project -Project Personnel - Contacts- Geometrical design of buildings- National Building Code (NBC) Specifications for various buildings.

UNIT II **9 Hours**

GOVERNMENT APPROVAL PROCEDURES

Requirements for site approval - Application for planning - Permission and building permit - Boundaries setbacks for domestic and high rised buildings -Provision for differently abled,elderly and children - Requirements of a plan - Inspection procedures- Plan sanction - Limitations - Cancellation of permit - Demolition of buildings - Renewal of permit

UNIT III **9 Hours**

FUNCTIONAL DESIGN OF BUILDINGS

Introduction -Functional design of Residential,Commercial and Industrial buildings - Rules and regulations as per National Building Code of India(NBC 2016) - Fire safety of high rised and commercial buildings (NBC 2016) -Evaluation

UNIT IV **9 Hours**

CITY PLANNING

Urban development - Zoning - Regulations - Requirements for City planning - Spaces excluded from FSI and coverage computation - Special character areas - Planning for apartments industrial and institutional sectors - Delegation of powers

UNIT V **9 Hours**

TENDER PROCESS IN INDIA

Bids Tenders and proposals - Government Tender process - Contracts - Types of Tenders - E - Tendering - System of working - Guidelines and procedures - Government and private sectors - Preparation of tender documents - Big Civil Engineering Construction Companies in India

Total: 45 Hours

Reference(s)

1. B S Ramaswamy,Contracts and Their Management,LexisNexis; 4th edition (2013)
2. Anurag.K.Agarwal,Contracts and Arbitration for Managers,Sage Publications Pvt. Ltd; 1 edition (26 January 2016)
3. Rangwala,Town planning,Charotar Publishing House Pvt. Limited, 2009
4. National Building code of India (NBC) 2016
5. National2.http://www.tn.gov.in/tcp/building_plan.html Building Code of India ,SP 7 : 2016
6. Ernst Neufert,Peter Neufert,Architects Data,Wiley Publisher; 4th edition (2 March 2012)

21CE015 COST EFFECTIVE CONSTRUCTION AND GREEN BUILDING

3 0 0 3

Course Objectives

- To impart knowledge on different concepts of sustainable design and cost effective methods to best fit for a specific construction project.
- To expose the concept of green building techniques for the construction project.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Identify the suitable cost effective construction materials.
2. Select the different types of cost effective systems.
3. Summarise the contribution of buildings in global warming and issues in society and environment.
4. Understand the principle of sustainable development in green building design.
5. Apply the process of green energy in buildings and know the rating systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2					3					2
2	1	3					2					2
3	2	1					3					3
4	1	3					2					1
5	3	2					1					2

UNIT I **9 Hours**

INTRODUCTION TO COST EFFECTIVE CONSTRUCTION MATERIALS

Cost effective construction materials - Stone and Laterite blocks - Burned Bricks -Fly ash blocks - Concrete blocks - Geopolymer concrete - Stabilized mud blocks - Lime - Pozzolana cement - Gypsum board - Bamboo - Lightweight construction materials - Natural and synthetic fibres - Recycling of building materials.

UNIT II **9 Hours**

COST EFFECTIVE METHODS

Cost effective building technologies - Wall construction - Rat trap bond - Cavity wall - Ferro cement and Ferro concrete constructions - Alternative beams, columns and roofing Systems - Door and window frames - Filler slab - Composite beam and panel Roof - Pre-engineered building elements.

UNIT III **9 Hours**

GREEN BUILDING DESIGN

Contribution of buildings towards global warming - Environmental benefit - Health and social benefits - Major energy efficient areas for buildings - Embodied energy in materials - Green materials and design - Comparison of initial cost of green building V/s conventional building - Life cycle cost of buildings.

UNIT IV **9 Hours**

GREEN ENERGY AND SUSTAINABLE DEVELOPMENT

Solar energy - Wind energy - Design for sustainability - Sustainable structure and Green Building - Principles of sustainable development in building design - Characteristics of sustainable buildings- Sustainably managed materials - Integrated lifecycle design of materials and structures.

UNIT V **9 Hours**

GREEN PRACTICES AND RATING SYSTEMS

Renewable energy Controlling the water cycle Impact of materials on the environment Optimizing construction Site management Environmental management of buildings - Green building Evaluation Systems LEED Certification and GRIHA Green Globe Certification Case studies.

Total: 45 Hours

Reference(s)

1. Kibert, C. Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, 2005.
2. Edward G Pita, An Energy Approach- Air-conditioning Principles and Systems, Pearson Education, 2003.
3. K S Jagadeesh, B V Venkatta Rama Reddy & K S Nanjunda Rao, Alternative Building Materials and Technologies, New Age International Publishers.
4. Asko Sarja, Integrated Life Cycle Design of Structures, SPON Press 3.
5. D S Chauhan and S K Sreevasthava, Non conventional Energy Resources, New Age International Publishers.
6. Daniel Vallero and Chris Brasier; Sustainable Design- The science of sustainability and Green Engineering; Wiley; 2008.

21CE016 PREFABRICATED STRUCTURES AND PRE-ENGINEERED BUILDING **3 0 0 3**

Course Objectives

- To impart knowledge on prefabricated elements and the technologies used for fabrication and erection
- To impart knowledge on the applications of prefabricated elements in construction

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Understand the general principles of fabrication.
2. Illustrate the prefabricated components and its connections.
3. Demonstrate the suitable techniques for the Production and erection of different types of members.
4. Analysis and design of precast industrial structures.
5. Compare the design principles of conventional steel building and Pre Engineered Buildings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	1	-	2	3							
2	2	3	1	3								
3	-	1	-	2	3							
4	-	3		2	1							
5	2	2	1	3								

UNIT I **9 Hours**

INTRODUCTION

Need for prefabrication - Principles - Materials - Types of Prefabrication - Prefabrication systems and Structural schemes - Modular co-ordination - Prefabrication of load-carrying members - Disuniting of structures

UNIT II **9 Hours**

PREFABRICATED COMPONENTS

Behaviour and types of structural components - Large panel systems - Roof and floor panels -Rribbed floor panels - Wall panels - Footings - Beams and Columns - Shear walls - Joints for different structural connections - Effective sealing of joints for waterproofing - Provisions for non-structural fastenings.

UNIT III **9 Hours**

PRODUCTION AND HOISTING TECHNOLOGY

Production - Planning of production setup - Manufacturing methods - Stationary and mobile production - Organizing of production - Shuttering and mould design - Storage of precast elements - Dimensional tolerances. Equipment for hoisting and erection - Transportation and Erection - Erection of R.C.Structures - Beams, Slabs, Wall panels and Columns.

UNIT IV **9 Hours**

DESIGN PRINCIPLES

Designing and detailing of precast unit for factory structures - Purlins, Principal rafters, roof trusses, lattice girders, gable frames - Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc - Importance of avoidance of progressive collapse.

UNIT V **9 Hours**

PRE - ENGINEERED BUILDINGS

Pre Engineered Buildings Vs Conventional Steel Buildings - Design procedure of Pre Engineered Buildings - Applications.

Total: 45 Hours

Reference(s)

1. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009
2. L. Mokk, Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.
3. T. Koncz, Manual of Precast Concrete Construction, Vol. I, II, III & IV, Berlin, 1988.
4. B. Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam, London, New York, 1998.
5. Prefabricated Systems: Principles of Construction, Sharon Chung-Klatte, Ulrich Knaack, Reinhard Hasselbach, Birkhauser, 2013.

21CE017 ENERGY EFFICIENT BUILDINGS 3 0 0 3

Course Objectives

- To learn the green buildings concepts applicable to alternate design and to incorporate renewable energy systems in buildings
- To acquire knowledge on landscape and Heating, Ventilation and Airconditioning in Buildings
- To impart knowledge on Eco friendly building concepts

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Illustrate the design aspects of energy efficient buildings
2. Gain knowledge on the role and importance of landscape
3. Design HVAC components in buildings
4. Acquire knowledge on the process of heat transmission in buildings
5. Outline the renewable energy systems in buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	3	1		1							
2	1	3	2		2							
3	-	-	1		1							
4	1	-	1		1							
5	-	3	1		1							

UNIT I **9 Hours**

INTRODUCTION

Conventional versus Energy Efficient buildings Historical perspective Water Energy IAQ requirement analysis Future building design aspects Criticality of resources and needs of modern living Codal Provisions.

9 Hours

UNIT II

LANDSCAPE AND BUILDING ENVELOPES

Energy efficient Landscape design Micro climates various methods Shading Water bodies Building envelope Building materials Envelope heat loss and heat gain its evaluation Paints Insulation Design methods and tools

UNIT III **9 Hours**

HEATING, VENTILATION AND AIRCONDITIONING IN BUILDINGS

Natural Ventilation Passive cooling and heating Application of wind, water and earth for cooling evaporative cooling radiant cooling Hybrid methods Energy Conservation measures Thermal Storage integration in buildings

UNIT IV **9 Hours**

HEAT TRANSMISSION IN BUILDINGS

Surface co-efficient air cavity internal and external surfaces Overall thermal transmittance Wall and windows Heat transfer due to ventilation infiltration Internal heat transfer Solar temperature Decrement factor Phase lag Design of day lighting Computer packages for carrying out thermal design of buildings and predicting performance

UNIT V **9 Hours**

PASSIVE COOLING

Passive cooling concepts Evaporative cooling Radioactive cooling Application of wind Water and earth for cooling Shading paints and cavity walls for cooling Roof radiation traps Earth air-tunnel Introduction of renewable sources in buildings Solar water heating Small wind turbines Stand alone PV systems Hybrid system Economics

Total: 45 Hours

Reference(s)

1. Clarke, Joseph. Energy simulation in building 2nd Edition, Routledge,2007.
2. Krishan, Arvind, Climate responsive architecture a design handbook for energy efficient buildings, Tata McGraw-Hill Education, 2001.
3. Krieder, J and Rabi A Heating and Cooling of buildings: Design for Efficiency, McGraw Hill, 1994.
4. 4. Paul tymkow, Savvas tassov, Maria kolokotrani and Hussam jouhara, Building Services and Design for Energy efficient building 2nd Edition, Taylor and Francis, Routledge.
5. Yap Eh Energy Efficient Buildings, Intech publications, 2018.

21CE018 CONSTRUCTION MANAGEMENT AND SAFETY **3 0 0 3**

Course Objectives

- To study and understand the concept of planning, scheduling, cost and quality control, safety during construction.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity.
2. Apply the scheduling techniques for planning construction projects.
3. Analyze the cost control , monitoring methods and quality control.
4. Identify hazards and its remedial measures in the construction industry
5. Identify the safety measures in handling construction equipments

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	1	1	1							
2	3	3	1	1	1							
3	3	3	1	1	1							
4	3	3	1	1	1							
5	3	2	1	2	1							

UNIT I **9 Hours**

FUNDAMENTALS OF CONSTRUCTION PROJECT MANAGEMENT

Introduction of construction Project Management Construction Scope Construction Project Characteristics Project development and Life Cycle Construction Project Management Practice Roles and Functions and Responsibility of Construction Managers and Major causes of Project failure.

UNIT II **9 Hours**

PLANNING AND ORGANIZING CONSTRUCTION PROJECT

Construction Project organization Planning Project work Scope and integration Processes Defining Project Activities Scheduling Project CPM PERT Precedence Network Analysis Planning and organizing project resources such as manpower material equipment Time and cost for construction site.

UNIT III **9 Hours**

COST CONTROL MONITORING AND ACCOUNTING

The Cost Control Problem The Project Budget Forecasting for Activity Cost Control Financial Accounting Systems and Cost Accounts Control of Project Cash Flows Schedule Control Schedule and Budget Updates Relating Cost and Schedule Information Total Quality Control.

UNIT IV **9 Hours**

CONSTRUCTION SAFETY

Quality and Safety Concerns in Construction Organizing for Quality and Safety Work and Material Specifications Importance of Safety during project construction Accidents and their Causes General precaution to hazardous atmosphere and materials Safety facilities at construction sites Training to project staff and operation staff Emergency rescue equipment Costs of Construction Injuries Legal Implications.

UNIT V **9 Hours**

SAFETY MEASURES IN HANDLING CONSTRUCTION EQUIPMENTS

General requirements of safety in concrete construction Handling of Concrete forms and shoring Safety measures for hoisting and erection of prefabricated elements OSHA Occupational Safety and Healthy Administration for Prestressing Operations Risk Assessment for erecting RC & Steel members Electrical safety in construction site.

Total: 45 Hours

Reference(s)

1. Construction Engineering & Management by Dr. S. Seetharaman - Umesh Publications, Delhi.
2. P. S. Gahlot , B. M. Dhir, Engineering Construction Planning And Management, New Age International, New Delhi (2018)
3. Dr.Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 1983.
4. Sharma S.C. Construction Equipment and Management Khanna Publishers, New Delhi, 2019.
5. Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 2014

21CE019 GROUND IMPROVEMENT TECHNIQUES 3 0 0 3

Course Objectives

- To understand the principles, applications, and design procedures for various ground improvement techniques.
- Gain competence in properly evaluating alternative solutions, and the effectiveness before, during and after using ground improvement.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the various ground improvement techniques.
2. Infer the design methods of dewatering systems.
3. Identify the suitable chemical admixture for stabilization.
4. Select the suitable types of grout and injection method for ground improvement.
5. Assess the effectiveness of a ground improvement technique by geo synthetics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	-	-	-			-					
2	-	-	-	-			-					
3	-	-										
4	-											
5			-	-			-					

UNIT I **9 Hours**

NECESSITY OF GROUND IMPROVEMENT AND MECHANICAL STABILIZATION

Different types of problematic soils - Need for Ground Improvement - Emerging trends in ground Improvement - Mechanical stabilization - Principles and methods of shallow and deep soil compaction - Vibro replacement and Vibro compaction - Dynamic compaction - Properties of compacted soil and compaction control.

UNIT II **9 Hours**

DEWATERING TECHNIQUES

Hydraulic modification - Drainage techniques - Well points - Deep well, preloading, vertical drains, vacuum consolidation, Electro kinematic dewatering - Design of dewatering systems.

UNIT III **9 Hours**

STABILIZATION BY ADMIXTURES

Chemical modification - Cement stabilization and cement columns, Lime stabilization and lime columns - Stabilization using industrial wastes - Methods of applications in the field - Stabilization of expansive clays.

UNIT IV **9 Hours**

STABILIZATION BY GROUTING

Types of grouts and grouting techniques - Grouting equipment and machinery - Injection methods - Grout monitoring - Selection of grout - Design aspects.

UNIT V **9 Hours**

GEOSYNTHETICS IN GROUND IMPROVEMENT

Concept of reinforcement - Geo synthetics - Types, functions and applications - Stability analysis of geo grid reinforced earth retaining wall - Internal and External - Application of Geotextiles as filtration, drainage and separation in the pavement works - Soil nailing.

Total: 45 Hours

Reference(s)

1. Van Impe W.E., Text Book on Soil Improvement Technique and their Evolution, Balkema Publishers, Netherlands, 1994.
2. M. R. Hausman, Engineering Principles of Ground Modification, McGraw Hill Book Co., Singapore, 1990.
3. Purushothama Raj, P. Ground Improvement Techniques, Laxmi Publications, New Delhi, 2005.
4. Peter G. Nicholson, Soil Improvement and Ground Modification Methods, Butterworth-Heinemann publications, Elsevier, 2015.
5. Moseley M.P. and Kirsch K., Ground Improvement, 2nd Edition, Spon Press, Tailor & Francis Group, London, 2004.
6. Koerner, R.M., Design with Geosynthetics, 6th Edition, Prentice Hall, New Jersey, 2002.

21CE020 GEOENVIRONMENTAL ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
f. 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.
l. 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.

Course Outcomes (COs)

1. Identify the soil-pollutant interaction and assess the modification of soil properties
2. Categorize the process of contaminant transport and characterize the contaminated sites
3. Classify different techniques for the remediation of contaminated Sites
4. Design the cover system by identifying the suitable components of landfill
5. Analyze the possible utilization of waste based on their characteristics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	-	-			2						1
2	3	-	-			1						1
3		2	-			2						1
4	1	-	2			-						
5	1	2	-			1						1

UNIT I **9 Hours**

SOIL POLLUTANT INTERACTION

Role of Geo-environmental Engineering - sources, generation and classification of wastes- causes and consequences of soil pollution -factors influencing soil-pollutant interaction-modification of index- physical, chemical and engineering properties

UNIT II **9 Hours**

CONTAMINANT TRANSPORT AND SITE CHARACTERISATION

Transport of contaminant in subsurface - advection, diffusion, dispersion - chemical process in subsurface - sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, volatization - biological process in subsurface - characterization of contaminated sites

UNIT III **9 Hours**

WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES

In situ containment - vertical and horizontal barrier - soil remediation - soil vapour extraction, electro kinetic remediation, soil heating, vitrification, bioremediation, phyto remediation - ground water remediation -pump and treat, In situ flushing, permeable reacting barrier

UNIT IV **9 Hours**

LAND FILLS AND SURFACE IMPOUNDMENTS

Site selection for landfills - Components of landfills - liner system - soil, geomembrane, geosynthetic clay, geocomposite liner system - leachate collection-construction and operation of landfill-landfill cover -disposal of slurry waste in ponds and impoundments

UNIT V **9 Hours**

UTILIZATION OF WASTE

Evaluation of waste materials- flyash, municipal sludge, plastics, scrap tire, blast furnace slag - physical, chemical and biological characteristics-geotechnical reuse of waste materials

Total: 45 Hours

Reference(s)

1. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering - John Wiley and Sons, INC, USA, 2004.
2. Sharma H D and Reddy K R, Geoenvironmental Engineering: Site remediation, Waste containment and Emerging Waste Management Technologies, John Wiley & Sons, Inc. Hoboken, New Jersey, 2004.
3. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1995.
4. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 2014.
5. Bagchi A, Design of landfills and integrated solid waste management, John Wiley & Sons, Inc., USA 2004

21CE021 INTRODUCTION TO GEOTECHNICAL EARTHQUAKE ENGINEERING

3 0 0 3

Course Objectives

- To impart knowledge on dynamic properties of the soil and evaluate the liquefaction potential of the soil.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.

Course Outcomes (COs)

1. Identify the source and magnitude of earthquake
2. Illustrate the dynamic behaviour of soil
3. Evaluate the seismic hazard by deterministic approach
4. Compare the types of liquefaction and evaluate its hazards
5. Evaluate the liquefaction potential by different methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	1		-		-						
2	-	1		2	-	-						
3	-	1		2	-	-						
4	1	-		-	2	-						
5		1			-	2						

UNIT I **9 Hours**

SEISMOLOGY

Internal Structure of the Earth - Continental Drift and Plate Tectonics - Faults - Elastic rebound theory - Different sources of Seismic Activity - Geometric Notation - Location of Earthquakes - Size of Earthquakes

UNIT II **9 Hours**

DYNAMIC PROPERTIES OF SOILS

Measurement of Dynamic Properties of soils - Field Tests - Low strain - Seismic Reflection - Seismic Refraction - Horizontal layering - Steady-State Vibration - Spectral analysis of surface wave - Seismic cross hole - Down Hole - Uphole tests - Laboratory tests - Resonance Column Test - Bender Element.

UNIT III **9 Hours**

SEISMIC HAZARD ANALYSIS

Identification and Evaluation of Earthquake Sources - Geologic Evidence - Tectonic Evidence - Historical Seismicity - Instrumental Seismicity - Deterministic Seismic Hazard Analysis

UNIT IV **9 Hours**

LIQUEFACTION

Liquefaction - Flow liquefaction - Cyclic Mobility - Evaluation of liquefaction Hazards - Liquefaction Susceptibility Criteria - Historical, Geological and Compositional State.

UNIT V **9 Hours**

EVALUATION OF LIQUEFACTION POTENTIALMENT

Evaluation of Initiation of Liquefaction - Cyclic stress approach - Characterization of Liquefaction Resistance - SPT Test - Various correction factor - Factor of Safety.

Total: 45 Hours

Reference(s)

1. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education Inc and Donling Kindersley Publishing Inc. 2013
2. Roberto Villaverde, Fundamental Concepts of Earthquake Engineering, CRC Press Taylor & Francis Group, 2009.
3. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing New Delhi, 2000.
4. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi, 1998.
5. McGuire, R.K. Seismic Hazard and Risk Analysis Earthquake Engineering Research Institute, 2004.
6. Mahanti, N.C. Samal, S.K. Datta, P. Nag.N.K., Diaster Management, Narosa Publishing House, New Delhi, India, 2006.

21CE022 REINFORCED SOIL STRUCTURES 3 0 0 3

Course Objectives

- To make the students gain adequate knowledge on reinforced soil structures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. To develop knowledge about the concept of Reinforced Earth, materials and testing.
2. Design the geotextiles, geogrids, geonets, geomembranes used reinforced earth.
3. Design the soil nailing and geocomposite used reinforced earth.
4. Apply the Reinforced earth technique in civil engineering
5. Apply the Geosynthetics in Environmental Geotechnics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	2	1								
2	3	3	3	1								
3	3	3	3	1								
4	-	-	-	1								2
5	-	-	2	1								2

UNIT I **9 Hours**

REINFORCED EARTH

Introduction; Types and functions; Materials and manufacturing processes; Properties and test methods, Standards and Codes of Practice; Soil-geosynthetic interaction

UNIT II **9 Hours**

PRINCIPLES AND DESIGN

Principles of soil reinforcement; Design of Earth Rainforced Structures with the specifications of its properties: geotextiles, geogrids, geonets, geomembranes-Analysis of failure and factor of safety.

UNIT III **9 Hours**

MODERN TRENDS IN REINFORCED EARTH

Soil Nailing Introduction and feasibility Criteria Types Driven and Grouted nails Principles of Design and Construction Methodology Designing with geocomposites Geocomposites in seperation reinforcement reinforced geotextile composites reinforced geomembrane composites reinforced soil composites using discontinuous fibres and meshes continuous fibres and three dimensional cells geocomposites in drainage and filtration

UNIT IV **9 Hours**

APPLICATION

Construction of geosynthetic reinforced soil retaining structures walls and slopes, Codal provisions. Bearing capacity improvement, embankments on soft soils, Geosynthetics in Pavements, Geosynthetics in roads, airports and railways, separations, drainage and filtering in road pavements and railway tracks, overlay design and construction. Seismic aspects of geosynthetic applications Quality control and in-situ monitoring; Cost analysis Case Histories.

UNIT V **9 Hours**

GEOSYHTETICS IN ENVIRONMENTAL GEOTECHNICS AND GUIDELINES

AASHTO and other relevant guidelines, Pipeline and drainage systems, Geosynthetics in Environmental Control, Liners for ponds and canals, covers and liners for landfills material aspects and stability considerations, Landslides occurrences and methods of mitigation Erosion causes and techniques for control Applications in Tunnels Case Histories.

Total: 45 Hours

Reference(s)

1. G. L. Sivakumar Babu, An Introduction to Soil Reinforcement and Geosynthetics, University Press, 2005.
2. R. M. Koerner, Designing with geosynthetics, Pearson Education Inc., 2005.
3. G. V. Rao, Geosynthetics an Introduction, Sai Master Geoenvironmental Services Pvt. Ltd. Hyderabad, 2011.
4. Shukla, Fundamentals of Geosynthetic Engg. Imperial College Press, London, 2006
5. Clayton, C. R. I., Milititsky, J. and Woods, R. I., Earth Pressure and Earth Retaining Structures, Blackie Academic & Professional, 1993.
6. Ingold, T, Reinforced Earth, Thomas Telford Ltd., 1982.

21CE023 ROCK MECHANICS AND APPLICATIONS 3 0 0 3

Course Objectives

- To impart knowledge on fundamentals of rock mechanics and its application in solving simple problems associated with rock slopes and underground openings.
- Student gains the knowledge on the mechanics of rock and its applications in underground structures and rock slope stability analysis.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.

Course Outcomes (COs)

1. Classify the rocks based on their index properties
2. Evaluate the behaviour of rock under different loading condition
3. Suggest various techniques to improve the in-situ strength of rocks
4. Evaluate the bearing Capacity of foundations on rocks
5. Recall installation methods for rock reinforcement

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2		-								
2	-	1		2								
3	1	2		-								
4		1		2								
5	1	-		-								

UNIT I **9 Hours**

CLASSIFICATION OF ROCKS

Types of Rocks - Physicomechanical properties of rocks - Field and Laboratory tests for physical and mechanical properties- Classification of rock masses - the value of RMR and ratings - Field estimations - New Australian Method

UNIT II **9 Hours**

STRENGTH CRITERIA OF ROCKS

Joint characteristics - Planes of weakness - Stress-strain behavior of intact rock and rock mass under hydrostatic compression and deviatoric loading - Modes of rock failure - Mohr-Coulomb failure criterion and tension cut-off - Hoek Brown failure criterion.

UNIT III **9 Hours**

INSITU STRESSES IN ROCKS

Insitu stresses - Strain gauge Rosette and stress measurement techniques - Methods - Hydraulic fracturing, flat jack, over coring and under coring methods - Stress around the underground excavation - Zone of influence

UNIT IV **9 Hours**

SLOPE STABILITY AND BEARING CAPACITY OF ROCKS

Rock slopes and slope failures - Types and role of discontinuities - Slope analysis and factor of safety - remedial measures for critical slopes - Bearing Capacity of foundations on rocks

UNIT V **9 Hours**

ROCK REINFORCEMENT

Reinforcement of fractured and joined rocks - shotcreting, bolting, anchoring, grouting - stress transfer mechanism, types and installation methods.

Total: 45 Hours

Reference(s)

1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1999.
2. Hudson, A. and Harrison, P., Engineering Rock mechanics - An introduction to the principles, Pergamon publications, 1997.
3. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
4. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.
5. T. Ramamurthy, Editor, Engineering in Rocks for Slopes Foundations and Tunnels, PHI Learning Pvt. Ltd., 2014
6. Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springer verlag, Berlin, 1990.

21CE024 EARTH RETAINING STRUCTURES 3 0 0 3

Course Objectives

- To understand lateral earth pressure theories and pressure theories and design of retaining walls.
- To design anchored bulkheads by different methods.
- To understand pressure envelops and design of various components in braced cuts and cofferdams.
- To understand stability of earth dams and its protection and construction.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Students will be able to design retaining walls, anchored bulkheads, braced cuts, coffer dams and earth dams

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2										

UNIT I **9 Hours**

INTRODUCTION

Earth dams types of dams Design details upstream and downstream slope protection central and inclined cores types and design of filters. Seepage analysis and control seepage through dam and foundations control of seepage in earth dam and foundation.

UNIT II **9 Hours**

LATERAL PRESSURE

Basic concepts Rankine and Coulomb earth pressure theories, graphical methods. Determining active and passive pressures Culmanns, Rebhans, logarithmic spiral methods, friction circle method. Consideration of surcharge, seepage, earth quake, wave effect, stratification, type of backfill, wall friction and adhesion. Retaining walls: Uses, types, stability and design principles of retaining walls, backfill drainage, settlement and tilting.

UNIT III **9 Hours**

ANCHORED BULKHEADS

Classification of anchored bulkheads, free and fixed earth support methods. Rowes theory for free earth supports and equivalent beam methods for fixed earth supports. Design of anchored rods and dead man Braced cuts and Cofferdams: Braced excavations and stability of vertical cuts, lateral pressures in sand and clay, Braced and cellular cofferdams uses, types, components, stability, piping and heaving. Stability of cellular cofferdams, cellular cofferdams in rock and in deep soils.

UNIT IV **9 Hours**

EARTH DAMS- STABILITY ANALYSIS

Classification, seepage control in embankments and foundations, seepage analysis, stability analysis upstream and downstream for steady seepage, rapid draw down, end of construction, method of slices and Bishops method.

UNIT V **9 Hours**

EARTH DAMS -PROTECTION

Slope protection, filters, embankment construction materials and construction, quality control, grouting techniques. Instrumentation and performance observations in earth dams.

Total: 45 Hours

Reference(s)

1. Foundation design by W. C. Teng, Prentice Hall,1962
2. Analysis and design of foundations by Bowles. J. W McGraw Hill, 4th edition, 1955.
3. Earth and Rock-Fill Dams: General Design and Construction Considerations by United States Army Corps of Engineers, University Press of the Pacific,2004
4. Soil mechanics in engineering and practice by Karl Terzaghi, Ralph B. Peck, Gholamreza Mesri,3rd Edition. Wiley India Pvt Ltd,2010.

21CE025 URBAN TRANSPORTATION PLANNING AND SYSTEMS **3 0 0 3**

Course Objectives

- To enhance the knowledge of students on urban transportation planning techniques
- To distinguish the successful features of innovative transportation planning schemes
- To impart knowledge on transportation economics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. Identify and analyze the present trip pattern of transportation.
2. Interpret the future trips and assign the trips using trip assignment.
3. Design a transportation network with different models.
4. Identify the acquisition of skills on mass transportation systems.
5. Infer the awareness on the transportation economics based on demands.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	-	-								2
2	2	1	3	-								
3	1	-	3	2								2
4	1	-	2	3								
5	2	1	3									

UNIT I **9 Hours**

INTRODUCTION TO PLANNING PROCESS

Role of Transportation and Changing Concerns of Society in Transportation Planning Transportation Problems and Problem Domain; Objectives and Constraints; Flow Chart for Transportation Planning Process - Concept of Travel Demand - Survey on Data collection - Urban travel characteristics - Land use transport interaction.

UNIT II **9 Hours**

METHODS OF TRAVEL DEMAND ESTIMATION

Assumptions in Demand Estimation - Introduction to Transportation Planning Practices; Four Stages of Planning -Trip generation analysis - Zoning - Trip generation models - Zonal models - Household models - Category analysis - Trip attractions of work centers - Trip distribution analysis - Trip distribution models- Problems in distribution models.

UNIT III **9 Hours**

MODE CHOICE AND ROUTE SPLIT ANALYSIS

Mode Choice - Mode split analysis - Mode split Models - Mode choice behavior, competing modes, mode split curves, probabilistic models - Traffic assignment - Route split analysis: Elements of transportation networks, nodes and links - Minimum path trees.

UNIT IV **9 Hours**

MASS TRANSPORTATION SYSTEM

History and role of Transit - Recent Trends Mass Transportation Characteristics - Mass rapid transit system - Light rail transit - Personal rapid transit, guided way systems, cabin taxi and dual mode bus - Paratransit systems - Demand responsive system - Intermediate public transport.

UNIT V **9 Hours**

TRANSPORT ECONOMICS

Basic principles of economic evaluation - Method of economic evaluation - Transportation costs - Vehicle operating costs - Financing of road projects - Methods - Private Public Partnership - Toll collection - Build-Operate-Transfer (BOT, BOLT) Schemes - Risk Analysis - Value for Money analysis - Case Studies.

Total: 45 Hours

Reference(s)

1. C. Jotin Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 3rd edition, 2013, ISBN-13: 978-0130335609.
2. L. R. Kadiyali, Traffic and Transportation Planning, Khanna Publishers Ltd., New Delhi, 2017, ISBN No. 978-81-7409-220-X.
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. C. S. Papacostas and Prevedouros, Transportation Engineering and Planning, Prentice Hall of India, New Delhi, 2013, ISBN-13: 978-0130814197
5. B. G. Hutchinson, Principles of Urban Transportation System Planning, Tata McGraw Hill, 2007
6. Meyer, Michael D, ITE Transportation Planning Handbook, John Wiley & Sons 2016

21CE026 MASS TRANSPORTATION SYSTEMS 3 0 0 3

Course Objectives

- To enhance the knowledge on function of public transit and the role of government units
- To impart knowledge on mass transportation system

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Analyze the four various modes of mass transportation
2. Understand the Acquisition of skills on mass transportation systems
3. Identify the cost benefit ratios of transport systems by different methods.
4. Better knowledge on planning of transit systems.
5. Knowledge on developments in public transportation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	3									
2	3	2	1									
3	1	3	2									2
4	2	1	3									2
5	2	1	2									

UNIT I **9 Hours**

INTRODUCTION

Urban transportation systems - Mass rapid transit system - Light rail transit - Personal rapid transit, guided way systems, cabin taxi, dual mode bus - Para transit systems - Demand responsive system - Intermediate public transport.

UNIT II **9 Hours**

MASS TRANSPORTATION SYSTEM

History and role of Transit - Recent Trends Mass Transportation Characteristics - Demand Characteristics - Spatial - Temporal and Behavioral - Characteristics of Transportation Demand. - Urban Mass Transportation Planning - Demand Surveys - Transit oriented land use development.

UNIT III **9 Hours**

DESIGN AND EVALUATION OF MASS TRANSPORT

Four Stages of Planning - Performance Evaluation of Mass Transport System - Structure of Decision Ma king,

- Evaluation and Selection Methods - Selection Procedures - Economic Evaluation Methods. Terminalsand their functions - Design, Typical Characteristics. - Scheduling, Service Analysis, Vehicle Dispatch Policy, Vehicle Requirements, Spacing of Bus Tropos, - Route Spacing and Performance - Operational and Management Issues - Reserved Bus Lanes - Signal Preemption, - Dial- a-Bus

UNIT IV **9 Hours**

TRANSIT PLANNING

Introduction - Definition - Shuttle systems - Corridors - Two dimensional system - Realistic cases only - Flexible transit - Individual public transportation system -Collective transportation

UNIT V **9 Hours**

PUBLIC TRANSIT

Introduction to public transit - History - Personal public transit experiences -Public transportation system characteristics - Mass transit definitions and classifications - Route development - stop location and stopping policy - Schedule development.

Total: 45 Hours

Reference(s)

1. C. Jotin Khisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 2003
2. Hutchinson, B.G., Principles of Urban Transport Systems Planning Mc Graw Hill,New York, 1974
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. Vuchic V.R., Urban Public Transportation System and Technology, Prentice Hall, Inc. Englewood Cliffs, New Jersey, 1981.
5. Agarwal M.K., Urban Transportation in India, INAE, Allied Publishers Ltd., 1996,Grey G.E. & Hoel, LA, Public Transportation? Prentice Hall, Englewood

21CE027 TRAFFIC ENGINEERING AND MANAGEMENT **3 0 0 3**

Course Objectives

- To Provide an insight in traffic and its components, factors affecting road traffic and the design of intersection
- To enable the students to get familiarize in conducting various traffic surveys, interpretation and analysis.
- To enhance an insight on different traffic regulations methods and management methods.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. Acquire and apply knowledge of traffic, its components, and factors affecting road traffic in intersection design
2. Identify the sampling data in conducting various surveys and analysis
3. Capable of understanding traffic movements and designing islands, intersections and road lighting.
4. Capable of designing signals, redesigning the existing signals.
5. Able to remember traffic regulations, impact of noise pollution, air pollution and the method of controlling them.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	3	-								
2	2	1	-	-								
3	2	-	1	3								2
4	1	-	2	3								3
5	2	1	3	-								

UNIT I **9 Hours**

INTRODUCTION

Introduction -Characteristics of Vehicles and Road Users - Skid Resistance and Braking Efficiency, Components of Traffic Engineering- Road, Traffic and Land Use Characteristics - Traffic problems in India - Integrated development of cities and towns.

UNIT II **9 Hours**

TRAFFIC SURVEYS AND ANALYSIS

Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Basics of Traffic flow theory.

UNIT III **9 Hours**

GEOMETRIC DESIGN OF INTERSECTIONS

Conflicts at Intersections - Classification of At-Grade Intersections, - Channelized Intersections - Principles of Intersection Design, Elements of Intersection Design, Rotary design, Grade - Separation and interchanges.

UNIT IV **9 Hours**

TRAFFIC CONTROL

Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design.

UNIT V **9 Hours**

TRAFFIC MANAGEMENT

Traffic Management- Transportation System Management (TSM) - Travel Demand Management (TDM), IRC guidelines - Traffic Forecasting techniques, Restrictions on turning movements, One- way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes, Introduction to Intelligent Transportation System (ITS).

Total: 45 Hours

Reference(s)

1. L. R. Kadiyali, Traffic and TransportationPlanningg, Khanna Publishers Ltd., New Delhi, 2017, ISBN No. 978-81-7409-220-X
2. Drew, D.R. `Traffic Flow Theory and Control", McGraw Hill Book Co. ISBN-13: 978- 0070178311.
3. Institute of Transportation Engineers, `Manual of Transportation Engineering Studies", Prentice Hall, 1992, ISBN No. 9780139267918
4. S. K. Khanna ,C. E. G. Justo, A.Veeraraghavan, Highway Engineering, Nem Chand and Bros., Roorkee, 2015 (tenth edition) ISBN 978-81-85240-80-0
5. Papacostas, C.A., Fundamentals of Transportation Engineering", Prentice-Hall of India Private Limited, New Delhi.2000. ISBN-10: 0133448703.
6. Roger P. Roess, Elena S. Prassas, and William R. McShane , Traffic Engineering"", Pearson; 4 edition (July 4, 2010) ISBN-13: 978-0136135739 , ISBN-10: 0136135730

21CE028 TRANSPORTATION PLANNING AND SYSTEMS **3 0 0 3**

Course Objectives

- To enhance the knowledge of students on transportation planning techniques
- To distinguish the successful features of innovative transportation planning schemes
- To impart knowledge on transportation economics

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
l. 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.

Course Outcomes (COs)

1. Identify and analyze the present trip pattern of transportation.
2. Forecast the future trips and assign the trips using trip assignment.
3. Design a transportation network with different models.
4. Analyze the influence of each factor and design a transportation system
5. Awareness on the transportation economics based on demands.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	-	-								2
2	2	1	3	-								
3	1	-	3	2								2
4	1	-	2	3								
5	2	1	3									

UNIT I **9 Hours**

INTRODUCTION

Introduction - Transportation planning process and concepts - Transportation problems - Urban travel characteristics - Concept of travel demand - Demand function - Demand estimation - Sequential, recursive and simultaneous processes - Land use transport interaction

UNIT II **9 Hours**

TRIP GENERATION

Trip generation analysis - Zoning - Types and sources of data - Expansion factors - Accuracy checks - Trip generation models - Zonal models - Household models - Category analysis - Trip attractions of work centers

UNIT III **9 Hours**

TRIP DISTRIBUTION AND MODE CHOICE MODELING

Trip distribution analysis - Trip distribution models - Growth factor models - Gravity models - Opportunity models - Problems in distribution models - Mode split analysis - Mode split Models - Mode choice behavior, competing modes, mode split curves, probabilistic models

UNIT IV **9 Hours**

ROUTE SPLIT ANALYSIS

Traffic assignment - Route split analysis: Elements of transportation networks, nodes and links - Minimum path trees - All-or-nothing assignment - Multipath assignment - Capacity restraint.

UNIT V **9 Hours**

TRANSPORT ECONOMICS

Introductory Concepts in Transportation Decision Making - Transportation costs - Estimating Transportation Demand and Supply - Vehicle operating costs - Financing of road projects - methods - Private Public Partnership (PPP) - Toll collection - Build-Operate-Transfer (BOT, BOLT) Schemes- Risk Analysis -Value for Money analysis - Case Studies.

Total: 45 Hours

Reference(s)

1. C. JotinKhisty and B. Kent Lall, Transportation Engineering, Prentice Hall of India, New Delhi, 3rd edition, 2013, ISBN-13: 978-0130335609.
2. L. R. Kadiyali, Traffic and TransportationPlanningg, Khanna Publishers Ltd., New Delhi, 2017, ISBN No. 978-81-7409-220-X.
3. M. J. Bruton, Introduction to Transportation Planning, Hutchinson, London, 1992
4. C. S. Papacostas and Prevedouros, Transportation Engineering and Planning, Prentice Hall of India, New Delhi, 2013, ISBN-13: 978-0130814197
5. B. G. Hutchinson, Principles of Urban Transportation System Planning, Tata McGraw Hill, 2007

21CE029 TOTAL STATION AND GPS SURVEYING 3 0 0 3

Course Objectives

- To understand the working of Total Station equipment and solve the surveying problems
- To train the students to acquire skill in making precise measurements and obtaining accurate results with Total Station and GPS
- To make students aware with different advance surveying methodologies applied to carry out large scale survey works as modern instruments have largely changed the approach to survey works with the principles being same.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the principles of topographical map preparation and electronic surveying
2. Propagation of EMR through atmosphere and corrections for its effects
3. Identify the working mechanism and applications of active and passive microwave systems Apply the control point networks and reference systems used with GNSS technology
4. Apply the control point networks and reference systems used with GNSS technology
5. Discuss the practical applications of GPS and the implications of its modernization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	1	1	1	1							
2	2	2	2	-	-							
3	3	3	3	-								
4	2	2	3		-							
5	3	3	3	3	-							

UNIT I **9 Hours**

FUNDAMENTALS OF TOTAL STATION AND GPS

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Basic concepts of GPS - Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion - Keplerian motion- Kepler"s Law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept-GNSS

UNIT II **9 Hours**

ELECTROMAGNETIC WAVES

Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI- Computation of group for light and near infrared waves at standard and ambient conditions- Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction -Total atmospheric correction- Use of temperature - pressure transducers

UNIT III **9 Hours**

ELECTRO OPTICAL AND MICRO WAVE SYSTEM

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments- Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments- Comparison between Electro- optical and Microwave system. Care and maintenance of Total Station instruments. Modern positioning systems - Traversing and Trilateration

UNIT IV **9 Hours**

SATELLITE SYSTEM

GPS - Different segments - space, control and user segments - satellite configuration - GPS signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - GPS receivers

UNIT V **9 Hours**

GPS DATA PROCESSING

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation downloading the data -data processing software modules -solutions of cycle slips, ambiguities, RINEX format. Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -basic constellation of satellite geometry & accuracy measures - applications- long baseline processing- use of different softwares available in the market

Total: 45 Hours

Reference(s)

1. Rueger, J.M. "Electronic Distance Measurement", Springer-Verlag, Berlin, 1990
2. Satheesh Gopi, rasathishkumar, madhu N., Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007

21CE030 REMOTE SENSING AND GIS **3 0 0 3**

Course Objectives

- To deliver the fundamental principles of Remote Sensing and its limitations.
- To impart training on the image Interpretation and Analysis.
- To develop the GIS modeling techniques and applications.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
d. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the fundamental concepts in Remote sensing.
2. Interpret the data from Images through acquisition, storage, manipulation, analysis and display of satellite data.
3. Integrate Remote Sensing and GIS to perform raster and vector data analysis.
4. Extrapolate the database concepts of GIS for the development of design specifications for developing and improving the imagery by selecting suitable data models.
5. Apply the principles and concepts of remote sensing and GIS techniques for important applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	1	-		-							
2	2	2	-	2	-							
3	3	3	-	3								
4	3	3	3	3	-							
5	3	3	-	3	-							

UNIT I **9 Hours**

FUNDAMENTALS OF REMOTE SENSING

History of remote sensing - Indian Space Programs - Elements of remote sensing - Electromagnetic spectrum - Wavelength regions important to remote sensing - Particle and Wave theory - Stefan-Boltzman and Wein""s Laws - Atmospheric scattering and absorption - Platforms and Sensors.

UNIT II **9 Hours**

IMAGE INTERPRETATION AND ANALYSIS

Concept and types of image interpretation - Basic elements of image interpretation - Visual interpretation keys - Types of Data Products - Digital Image Processing - Pre-processing - Image compression and enhancement techniques - Multispectral Image classification - Supervised and unsupervised.

UNIT III **9 Hours**

GEOGRAPHICAL INFORMATION SYSTEM AND ITS ANALYSIS

GIS definition - Basic components of GIS - Data types - Spatial and non-spatial data - Raster and Vector Data - Analysis and structure of Raster and Vector data - Maps - Map projections - Types of map projections- Concept of GPS and its advantages.

UNIT IV **9 Hours**

DATA INPUT, EDITING AND ANALYSIS

Input methods - Data stream - Data Retrieval - Query Building - Simple Spatial Analysis - Overlay Technique - Topological analysis - Modeling surfaces - TIN -DEM - DTM - Slope Model - Integration of Remote Sensing and GIS.

UNIT V **9 Hours**

MAJOR APPLICATIONS OF REMOTE SENSING AND GIS

Natural Resources Management - Land Cover and Land Use - Water Resources and Watershed management - Irrigation and Agriculture - Environmental studies - Groundwater exploration - Wasteland Management - Forest Resources - Natural Disaster Management - Landslides, Flood Routing, Forest Fires, Earthquakes.

Total: 45 Hours

Reference(s)

1. M. Anji Reddy, Remote sensing and Geographical Information Systems, Third Edition, BS Publications, India, 2006.
2. Basudeb Bhatta, Remote Sensing and GIS, Second Edition, Oxford University Press, New Delhi, 2017.
3. Kali Charan Sahu, A Text Book of Remote Sensing and Geographical Information Systems, Kindle Edition, Atlantic Publishers and Distributers (P) Ltd, New Delhi, 2008.
4. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image interpretation, John Willey and sons, inc. New York, 2002.

21CE031 AIR POLLUTION CONTROL AND MANAGEMENT **3 0 0 3**

Course Objectives

- To learn the concept of air pollution and its control measures.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Classify and characterize the various air pollutants and identify their sources.
2. Identify suitable equipment for control of particulate matter.
3. Identify suitable equipment for control of gaseous matter.
4. Choose suitable equipment for air pollution control with respect to emerging trends.
5. Assess the impact on the environment due to air pollution.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	-	-									1
2	1	3	-									1
3	1	3										2
4	1	3	2									3
5	1	2	2									1

UNIT I **9 Hours**

INTRODUCTION

Air pollution - Definition and scope - Air quality management - Scales of air pollution - Sources and classification of pollutants and their effect on human health, vegetation and property - Ambient Air Quality and Emission Standards - Meteorology Fundamentals - Dispersion models - Plume behaviour.

UNIT II **9 Hours**

CONTROL OF PARTICULATE MATTERS

Selection of Control equipment - Settling chambers - Filters, gravitational, Centrifugal - multiple type cyclones- prediction of collection efficiency- pressure drop- wet collectors- Fabric Filters- Electrostatic Precipitators - Operational Considerations.

UNIT III **9 Hours**

CONTROL OF GASEOUS MATTERS

Selection of control Equipment -Principles of Absorption - Adsorption - Condensation - Incineration - Biological air pollution control technologies - Bio scrubbers -Bio filters.

UNIT IV **9 Hours**

EMERGING TRENDS

Process modification - Automobile air pollution and its control - Fuel modification - Mechanical particulate collectors - Entrainment separation - Internal combustion engines - Membrane process - Ultraviolet photolysis - High efficiency particulate air filters - Technical and economic feasibility of selected emerging technologies for air pollution control - Control of indoor air quality.

UNIT V **9 Hours**

AIR QUALITY MANAGEMENT

Air quality standards - Air quality monitoring - Preventive measures - Air pollution control efforts - Zoning - Town planning regulation of new industries - Legislation and enforcement - Environmental Impact Assessment and Air quality - Air quality management at Delhi -a case study.

Total: 45 Hours

Reference(s)

1. Anjaneyulu .D, "Air Pollution and Control Technologies", Allied Publishers, Mumbai, 2002.
2. Rao .M.N, and Rao .H. V. N, "Air Pollution Control", Tata-McGraw-Hill, New Delhi, 2006.
3. Rao .C.S, "Environmental Pollution Control Engineering", Wiley Eastern Ltd., New Delhi,2006.
4. Heumann .W.L, "Industrial Air Pollution Control Systems", McGraw-Hill, New Yark, 2007.
5. Mahajan .S.P, "Pollution Control in Process Industries", Tata McGraw-Hill Publishing Company, New Delhi, 2002.
6. Garg .S.K, "Environmental Engineering Vol. II", Khanna Publishers, New Delhi, 2005.

21CE032 SOLID WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To emphasize the need integrated municipal solid waste management.
- To provide basic for knowledge about the sources, quantity and characteristic of solid waste.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Characterize the solid waste based on source, type and composition and also emphasize the effects of its improper disposal.
2. Identify the suitable method for collection, segregation and transportation of solid waste.
3. Learn and analyze the various off site processing techniques for solid waste.
4. Choose the suitable waste disposal methods and apply the waste to energy techniques for solid waste.
5. Categorize biomedical waste and identify a suitable method to collect, treat and dispose it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2					-					1
2	1	2					-					2
3	1	3					-					3
4	2	2										
5	2	2					1					

UNIT I **9 Hours**

FUNDAMENTALS OF SOLID WASTE MANAGEMENT

Solid waste - Scope and importance - Sources and types of solid wastes - Functional elements of solid waste management - Quantity assessment - Generation rate - Factors affecting generation of solid wastes - characteristics - Methods of sampling - Effects of improper disposal of solid wastes - Public awareness; Role of NGOs; Legal framework regulating municipal solid waste management.

UNIT II **9 Hours**

COLLECTION, SEGREGATION AND TRANSPORTATION OF SOLID WASTE

On-site storage methods - Materials used for containers - On-site segregation of solid wastes - Colour codes - Garbage chutes - Methods of public collection - Selection of location - Requirement of human resources - Types of vehicles - Collection routes - Transfer stations - Operation and maintenance - Options under Indian conditions - Route optimization - Case studies.

UNIT III **9 Hours**

OFF-SITE PROCESSING OF SOLID WASTE

Processing techniques and Equipments: Sorting - Manual and Mechanical - Magnetic Separators - Ballistic method - Eddy Current Separators - Screens for size separation. Volume Reduction - Compaction and Baling; Size Reduction - Shredding - Automatic shredders - Case studies.

UNIT IV **9 Hours**

WASTE CONVERSION TECHNIQUES AND DISPOSAL

Waste to Energy Techniques Composting Aerobic and anaerobic processes Bangalore and Indore processes byproducts Factors affecting composting Merits and demerits Types of composting Incineration, Pyrolysis Merits and demerits. Disposal Mechanisms Open area Dumping Sanitary Land filling Site selection, design and operation of sanitary landfills Methods of sanitary landfills Leachate collection and treatment Fertilizer Residential waste Case studies

UNIT V **9 Hours**

BIOMEDICAL WASTE MANAGEMENT (BMW)

Introduction - Need for safe treatment and disposal of BMW - Colour coding - Types of containers - Categories of Biomedical Waste; Treatment and disposal methods of Biomedical Waste - Biomedical waste management regulations.

Total: 45 Hours

Reference(s)

1. George Tchobanoglous and Frank Kreith, HAndbook of Solid Waste Management, 2nd Edition, McGraw-Hill Publishers, 2002
2. K. Sasikumar and Sanoop Gopi Krishna, "Solid Waste Management" PHI Learning Private Limited, New Delhi, 2013
3. B. Bilitewski, G. HardHe, K. Marek, A. Weissbach, and H. Boeddicker, Waste Management, Springer, 2004
4. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2016
5. R.E. Landreth and P.A. Rebers, Municipal Solid Wastes problems and Solutions, Lewis Publishers, 2020.
6. Bhide A.D. and Sundaresan, B.B., Solid Waste Management in Developing Countries, INSDOC, 1993

21CE033 ENVIRONMENTAL IMPACT ASSESSMENT 3 0 0 3

Course Objectives

- To emphasize the need for EIA.
- To provide basic knowledge on the components, methods and quality control measures of EIA.
- To make the students understand the importance of documentation and monitoring of EIA along with case studies.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. 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.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. 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.

Course Outcomes (COs)

1. Infer the key features of EIA with reference to legislator aspects in India.
2. Analyse the cost benefits and its alternatives in EIA.
3. Illustrate the impact of the project on environmental issues and its policies.
4. Exemplify the various documentation and report procedures for EIA.
5. Elucidate the public to participate in EIA.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	-	1		-		-	-	-				
2		2		-		1			-	-		
3	2					2	1	-	-	-		
4	-	-		2		2		1				
5				-		3			2	2		

9 Hours

UNIT I

INTRODUCTION

Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) - Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - Issues in EIA - National, Cross sectoral, Social and cultural Terms of Reference in EIA.

UNIT II **9 Hours**

COMPONENTS AND QUALITY ANALYSIS

Components - Screening - Setting - Analysis - Prediction of impacts - Mitigation - Matrices - Networks - Checklists - Impact Assessment techniques - Cost benefit analysis - Analysis of alternatives; Trends in EIA practice and evaluation criteria - Capacity building for quality assurance - Expert System in EIA - Formats of regulations.

UNIT III **9 Hours**

PREDICTION, ASSESSMENT AND MITIGATION

Methods for Prediction and assessment of impacts on Air, Water, Soil and Noise - Biological, Cultural, Social and Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts - Policies for decision making.

UNIT IV **9 Hours**

DOCUMENTATION AND MONITORING

Document planning - Collection and organization of relevant information - Use of visual display materials - Team writing - Reminder checklists - Environmental monitoring - Guidelines - Policies - Planning of monitoring programmes - Environmental Management Plan -Post project audit.

UNIT V **9 Hours**

PUBLIC PARTICIPATION

Objectives of public participation - Regulatory requirements - Merits and demerits - Conducting public participation - Conflict management - Dispute resolution - Questionnaires for decision making - Public awareness.

Total: 45 Hours

Reference(s)

1. L. W. Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996.
2. Policy Intervention Analysis: environmental Impact Assessment, Ritu Paliwal, Leena Srivastava, The Energy and Resources Institute (TERI), TERI Press, Durbari Seth Block,IHC Complex, Lodhi Road, New Delhi - 110 003, India, 2014
3. Handbook of Environmental Decision Making in India: An EIA Model (Handbooks Series), O.V.Nandimath, Oxford University Press of India, 2008
4. J. Petts, Handbook of Environmental Impact Assessment Vol. I and II, Blackwell Science, London, 1999.
5. The World Bank Group, Environmental Assessment Sourcebook Vol. I, II and III, The World Bank, Washington, 1991.

21CE034 ENERGY SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on the renewable energy resources
- To introduce the concept of energy source and technology.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

f. 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.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the sources of energy system and resources
2. Explain the sources of energy, efficiency and their storage
3. Understand the energy efficiency and the environment
4. Select a suitable sustainable civil engineering project connected with energy sources
5. Illustrate the concept of green building

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1					2	3					
2	1					2	-					
3	1					2						
4	1					2	3					
5	1					-	2					

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment

UNIT II **9 Hours**

ENERGY SOURCES

Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries).

UNIT III **9 Hours**

ENERGY AND ENVIRONMENT

Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

UNIT IV **9 Hours**

CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES

Coal mining technologies, Oil exploration offshore platforms, Underground and under sea oil pipelines, Solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems.

UNIT V **9 Hours**

ENGINEERING FOR ENERGY CONSERVATION

Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems andSustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guideto Renewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set:Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A.(2006) Energy and the Environment, 2nd Edition, John Wiley
6. E H Thorndike (1976), Energy & Environment: A Primer for Scientists andEngineers, Addison-Wesley Publishing Company

21CE035 INDUSTRIAL WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To provide basic knowledge on the management practices of solid and liquid waste.
- To impart knowledge on the collection, transport and disposal of solid waste.
- To emphasize the need for solid and liquid waste management.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
l. 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.

Course Outcomes (COs)

1. Generalize the characteristics of Industrial Waste and their effect on the environment.
2. Identify the suitable wastewater reclamation concepts for reuse, recycle and recovery.
3. Select the suitable treatment technologies for major Industries and their reclamation concept.
4. Compare the treatment and disposal technique based on the characteristics of wastewater.
5. Infer the Hazardous waste and suitable treatment techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	-	-									
2	2	2	-									1
3	2	2	-									
4	2	3	2									
5	2	3	3									1

UNIT I **9 Hours**

INTRODUCTION

Types of industries and industrial pollution - Nature and Characteristics of industrial wastes - Population equivalent - Bioassay studies - Effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health - Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II **9 Hours**

POLLUTION FROM MAJOR INDUSTRIES

Sources, Characteristics, waste treatment flow sheets for industries such as Textiles, Tanneries, pharmaceuticals, electroplating industries, dairy, sugar, paper, distilleries, steel plants, refineries, fertilizers, thermal power plants - Wastewater reclamation concepts.

UNIT III **9 Hours**

TREATMENT TECHNOLOGIES

Equalization - Neutralization - Removal of suspended and dissolved organic solids - Chemical oxidation - Adsorption - Removal of dissolved inorganics - Combined treatment of industrial and municipal wastes - Residue management - Dewatering - Disposal.

UNIT IV **9 Hours**

CLEANER PRODUCTION

Waste management Approach - Waste Audit, emission inventories and waste management hierarchy for process industries - Zero discharge - Volume and strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery - Applications. Opportunities and barriers to cleaner technologies; Pollution prevention economics; Waste audits- Material balance approach.

UNIT V **9 Hours**

HAZARDOUS WASTE MANAGEMENT

Hazardous wastes - Sources & characterization - Collection, Segregation - Physio chemical treatment - Solidification - Incineration - Secured landfills - Bioremediation of contaminated sites - Regulatory aspects.

Total: 45 Hours

Reference(s)

1. M.N.Rao, A.K.Dutta, Wastewater Treatment, Oxford - IBH Publication, 1995.
2. W .W. Eckenfelder Jr., Industrial Water Pollution Control, McGraw-Hill Book Company, New Delhi, 2000.
3. T.T.Shen, Industrial Pollution Prevention, Springer, 1999.
4. R.L.Stephenson and J.B.Blackburn, Jr., Industrial Wastewater Systems Hand book, Lewis Publisher, New Yark, 1998.
5. H.M.Freeman, Industrial Pollution Prevention Hand Book, McGraw-Hill Inc., New Delhi, 1995.
6. Bishop, P.L., Pollution Prevention: Fundamental & Practice, McGraw-Hill, 2000.

21CE036 HAZARDOUS WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To familiarize the laws and regulations governing hazardous waste storage, transport and treatment.
- To identify environmental concerns for hazardous waste on water, land and air.
- To identify containment technologies and land treatment techniques for hazardous waste.
- To impart knowledge on the principles involved in the management of hazardous wastes from source identification up to disposal.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Generalize the characteristics of hazardous waste and their effect on the environment.
2. Characterize the hazardous waste based on source, type and composition and also emphasize the effects of its improper disposal.
3. Identify the suitable method for collection, segregation and transportation of Hazardous solid waste.
4. Analyze the various off site processing techniques for hazardous waste.
5. Exemplify the suitable waste disposal method for hazardous waste.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2					-					1
2	1	2					-					2
3	1	3					-					3
4	2	2										
5	2	2					1					

UNIT I **9 Hours**

SOURCES OF HAZARDOUS WASTE

Types and Sources hazardous wastes - Need for hazardous waste management - Elements of integrated Hazardous waste management and roles of stakeholders and NGOS - Salient features of Indian legislations on management and handling of hazardous wastes, biomedical wastes, lead acid batteries, E-waste - Case studies.

UNIT II **9 Hours**

CHARACTERIZATION OF HAZARDOUS WASTE

Hazardous waste generation rates and variation - Composition, physical, chemical and biological properties of Hazardous wastes - Hazardous Characteristics - TCLP tests - Waste sampling and characterization plan - Source reduction of wastes - Recycling and reuse - Hazardous Waste Management Rules 2016.

UNIT III **9 Hours**

HANDLING OF HAZARDOUS WASTE

Handling and segregation of wastes at source - Storage and collection Hazardous wastes - Need for transfer and transport - Transfer stations Optimizing waste allocation - Compatibility, storage, labelling and handling of hazardous wastes.

UNIT IV **9 Hours**

PROCESSING OF HAZARDOUS WASTE

Objectives of waste processing - Material separation and processing technologies - Biological and chemical conversion technologies - Thermal conversion technologies and energy recovery - Incineration - Solidification and stabilization of hazardous wastes - Treatment of biomedical wastes and E-waste.

UNIT V **9 Hours**

DISPOSAL OF HAZARDOUS WASTE

Waste disposal options - Disposal in landfills - Landfill Classification- Construction and operation of secured landfills - Bioreactors - Ocean dumping - Land disposal - Soil remediation - Case studies.

Total: 45 Hours

Reference(s)

1. Basic Hazardous waste management, William C.Blackman.Jr, Third Edition, 2016, Lewis Publishers
2. Criteria for hazardous waste landfills-CPCB guidelines 2021.
3. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997.
4. Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2016.
5. Hazardous waste management series (HAZWAMS) - CPCB - Ministry of Environment, Forest and Climate Cahnge - 2022.

21CE037 APPLICATIONS OF NUMERICAL METHODS IN CIVIL ENGINEERING **3 0 0 3**

Course Objectives

- Understand the history and basics of numerical methods.
- Gain knowledge about the different numerical techniques available.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Discuss the various methods of solving linear algebraic and transcendental equations.
2. Estimate the intermediate values using interpolation concepts.
3. Interpret the knowledge of numerical differentiations and integration
4. Apply various numerical techniques in solving complex partial differential equations.
5. Apply various numerical techniques in solving complex differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2										1
2	1	2										2
3	1	3										3
4	2	2										
5	2	2					1					

UNIT I **9 Hours**

LINEAR ALGEBRAIC EQUATIONS

Method of false position Newtons method Solution of linear system of equations by Gaussian elimination and Gauss Jordan methods Iterative methods Gauss Jacobi and Gauss Seidel methods.

UNIT II **9 Hours**

INTERPOLATION

Newtons forward and backward difference formulae Bessels formula Lagranges interpolation formula Newtons divided difference formula.

UNIT III **9 Hours**

NUMERICAL DIFFERENTIATION

Differentiation Using Newtons forward, backward and divided difference interpolation formula Single step Methods Taylor Series Euler and Modified Euler methods Fourth order RungeKutta method for solving first order equations Multistep methods Milnes and Adams predictor and corrector methods.

UNIT IV **9 Hours**

NUMERICAL INTEGRATION

Trapezoidal rule Simpsons 1/3 Double integrals using Trapezoidal and Simpsons rules

UNIT V **9 Hours**

BOUNDARY VALUE PROBLEMS IN PDE

Finite difference approximations to partial derivatives Two dimensional Laplace equations Poisson equations One dimensional heat equation by implicit and explicit methods One dimensional wave equation.

Total: 45 Hours

Reference(s)

1. Kandasamy, P., Thilakavathy, K. and Gunavathy, K., Numerical Methods, S.Chand & Co, New Delhi, reprint 2010.
2. Venkatraman, M. K, Numerical Methods, National Publishing Company, Chennai, 2000.
3. Balagurusamy, E., Numerical Methods, Tata McGraw-Hill, New Delhi, 1999.
4. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., Numerical Methods for Scientific and Engineering Computation, Fourth Edition, New Age International (P) Ltd., New Delhi, 2006.
5. Sankara Rao, K., Numerical Methods for Scientists and Engineers, Second Edition, Prentice Hall India, New Delhi, 2004.

21CE038 APPLICATION OF PYTHON FOR CIVIL ENGINEERING **3 0 0 3**

Course Objectives

- Understand the history and basics of python.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Implement simple python programs using input output operations.
2. Develop python programs using expressions and statements.
3. Implement python programs using control flow statements and strings.
4. Apply the concepts of functions and files in python programming.
5. Design applications using list, sets, tuples and dictionaries in python.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2										1
2	1	2										2
3	1	3										3
4	2	2	-									
5	2	2					1					

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language, algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/O"Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python 3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2017

21CE039 INSTRUMENTATION AND SENSOR TECHNOLOGIES FOR CIVIL ENGINEERING **3 0 0 3**

Course Objectives

- To provide students with a comprehensive understanding of instrumentation principles relevant to civil engineering applications.
- To enable students to apply instrumentation and sensor technologies effectively in civil engineering projects.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
l. 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.

Course Outcomes (COs)

1. Summarize various performance characteristics of instruments and the quality of measurement
2. Interpret the type of transducer based on the transduction principles
3. Identify the relevant transducer for measurement of physical quantities
4. Discover the additional attributes in advanced sensors and their role in Civil Engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2										1
2	1	2										2
3	1	3										3
4	2	2										

UNIT I **9 Hours**

INTRODUCTION

Definition of sensor transducer Block Diagram elements of measurement system classification of sensors transducers static characteristics accuracy precision resolution linearity, sensitivity, range, loading effect, threshold, dead time, dead zone, span.
Errors in measurement True value, static error, static correction, scale range and scale span, error calibration curve, readability, repeatability & reproducibility, drift and noise

UNIT II **9 Hours**

RESISTIVE TRANSDUCERS

Potentiometers-Linear POT, Rotary POT, characteristics of POT. Thermistors- Construction and its Resistance- Temperature characteristics. Thermocouples- Construction and its Resistance-emf characteristics INDUCTIVE TRANSDUCERS Principle of change of self inductance, Principle of change of mutual inductance, Linear variable differential transformer(LVDT), Rotary variable differential transformer(RVDT).

UNIT III **9 Hours**

CAPACITIVE TRANSDUCERS

Introduction-Variable area type-variable air gap type- differential arrangement in capacitive transducers, variation of dielectric constant for measurement of liquid level, variation of dielectric constant for measurement of displacement, advantages & disadvantages of Capacitive transducers . PIEZOELECTRIC TRANSDUCERS

Measurement of Force, Modes of operation of Piezoelectric crystals, properties of Piezoelectric crystals, use of Piezoelectric Transducers.

UNIT IV **9 Hours**

HALL EFFECT TRANSDUCERS

Hall effect element, Measurement of displacement, current and power. OPTICAL TRANSDUCERS

Vacuum photo emissive cell and its characteristics, semi conductor photo electric transducer- Photo conductive cell and its characteristics, photo diode and its characteristics, photovoltaic cell and its characteristics.

UNIT V **9 Hours**

DIGITAL AND SMART SENSORS

Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Civil Engineering

Total: 45 Hours

Reference(s)

1. A.K.Ghosh, Introduction to Measurements & Instrumentation, IIIrd edition, PHI
2. A.K.Sawhney & Puneet Sawhney, A Course in Mechnanical Measuremnets & Instrumentation,Dhanapat Rai & Co.
3. D.V.S.Murty, Transducers & Instrumentation, PHI.

21CE040 APPLICATION OF MATLAB FOR CIVIL ENGINEERING **3 0 0 3**

Course Objectives

- Understand the history and basics of matlab.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Implement simple MATLAB programs using input output operations.
2. Develop MATLAB programs using expressions and statements.
3. Implement MATLAB programs using control flow statements and strings.
4. Apply the concepts of functions and files in matlab programming.
5. Design applications using list, sets, tuples and dictionaries in matlab.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2										1
2	1	2										2
3	1	3										3
4	2	2										
5	2	2					1					

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language, algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

MATLAB interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative

programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python 3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2017

21CE041 APPLICATION OF R PROGRAMMING IN CIVIL ENGINEERING

3 0 0 3

Course Objectives

- Understand the history and basics of R Programming.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the functions, files, list, set tuples and dictionaries.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
l. 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.

Course Outcomes (COs)

1. Implement simple R Programming programs using input output operations.
2. Develop R Programming programs using expressions and statements.
3. Implement R Programming programs using control flow statements and strings.
4. Apply the concepts of functions and files in R Programmingprogramming.
5. Design applications using list, sets, tuples and dictionaries in R Programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2										1
2	1	2										2
3	1	3										3
4	2	2										
5	2	2					1					

UNIT I **9 Hours**

COMPUTATIONAL THINKING AND PROBLEM SOLVING

Fundamentals of Computing Identification of Computational Problems Algorithms building blocks of algorithms statements, state, control flow, functions, notation pseudo code, flow chart, programming language, algorithmic problem solving, simple strategies for developing algorithms iteration, recursion. Illustrative problems find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II **9 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

R Programming interpreter and interactive mode, debugging; values and types int, float, boolean, string, and list variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative

programs exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III **9 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else) Iteration state, while, for, break, continue, pass Fruitful functions return values, parameters, local and global scope, function composition, recursion Strings: string slices, immutability, string functions and methods, string module Lists as arrays. Illustrative programs square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV **9 Hours**

LISTS, TUPLES, DICTIONARIES

Lists list operations list slices list methods list loop mutability aliasing cloning lists list parameters Tuples tuple assignment tuple as return value Dictionaries operations and methods advanced list processing list comprehension Illustrative programs simple sorting histogram Students marks statement Retail bill preparation.

UNIT V **9 Hours**

FILES, MODULES, PACKAGES

Files and exception text files reading and writing files, format operator command line arguments, errors and exceptions, handling exceptions, modules, packages Illustrative programs word count, copy file, Voters age validation, Marks range validation.

Total: 45 Hours

Reference(s)

1. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python Revised and updated for Python 3.2, Network Theory Ltd., 2014.
3. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2015.
4. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2017

21CE042 RISK ASSESSMENT AND SAFETY MANAGEMENT

3 0 0 3

Course Objectives

- To explore the various risk and safety management for successful completion of Construction projects.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
l. 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.

Course Outcomes (COs)

1. Select the basics risk assessment for industrial safety and health
2. Identify hazards and its remedial measures in the construction industry
3. Identify the safety measures in handling construction equipments
4. Indicate the importance of environmental safety and the role of individual in prevention Of pollution
5. Illustrate fire safety installation and maintenance of sprinkler installation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2				3						2
2	3	2				1						2
3	3				2	3						1
4	2				1	3						2
5	2	1				3						1

UNIT I **9 Hours**

INTRODUCTION

Risk assessment and control- Legal Basis for Risk Assessment - Hazards, remedial measures - Safety and health policy- Motivation of employees - Workplace Precautions - Management responsibilities, Individual responsibilities - Training for Safety and Health- Insurance coverage of Industrial plant & personnel.

UNIT II **9 Hours**

CONSTRUCTION SAFETY CONSTRUCTION SAFETY

Quality and Safety Concerns in Construction -Organizing for Quality and Safety - Work and Material

Specifications - Importance of Safety during project construction - Accidents and their Causes - General precaution to hazardous atmosphere and materials - Safety facilities at construction sites - Training to projectstaff and operation staff - Emergency rescue equipment - Costs of Construction Injuries - Legal Implications.

UNIT III **9 Hours**

SAFETY MEASURES IN HANDLING CONSTRUCTIONEQUIPMENTS

General requirements of safety in concrete construction Handling of Concrete forms and shoring Safety measures for hoisting and erection of prefabricated elements OSHA (Occupational Safety and Healthy Administration) for Prestressing Operations Risk Assessment for erecting RC & Steel members Electrical safety in construction site.

UNIT IV **9 Hours**

ENVIRONMENTAL SAFETY

Scope and Importance of Environmental safety- Environmental impact assessment (EIA) - Environmental pollution - Sustainable development- Global warming, greenhouse effect, urbanization
- Role of Government in environment protection- National Committee on environmental Planning (NCP)- Environmental Appraisal Committee (EAC) - Role of individual in prevention of pollution

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Fire extinguishing appliances -Selection requirements, installation and maintenance - Sprinkler system - Maintenance of sprinkler installation - Pressure gauges, Installation of control valves - Fire protection requirements for buildings and riser system- Fire alarm Systems, Manually operated fire alarms - Smoke detectors, Fire extinguishing appliances in multi storied buildings, hotels etc.

Total: 45 Hours

Reference(s)

1. Risk assessment- A Practical Guide, 1993, Institution of Occupational Safetyand Health, UnitedKingdom
2. Rao.S and Saluja H.L., Electrical Safety, Fire Safety Engineering and Safety Management, KhannaPublishers, first edition, 1998
3. Grundy. J. ,Construction Technology, Viva Books Pvt. Ltd., 2006
4. R.K. Jain & Sunil S. Rao, Industrial safety health and environment Management system, KhannaPublishers, Secondedition, 2008
5. V.K. Jain, New Age International Publishers, 2nd Edition, First Print 1996 Re-print 2000

21OCE01 ENERGY CONSERVATION AND MANAGEMENT

3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings and
- To utilize the available resources in optimal ways

Course Outcomes (COs)

1. Classify and characterize the energy resources.
2. Illustrate the concept of green building.
3. Outline the sustainable construction practices.
4. Understand the ventilation and structural controls for thermal comfort in buildings.
5. Emphasis the significance of lighting and visual effects in buildings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	-										1		
2	1	2					2					1		1
3	1	2					2					1		1
4	1	2					2					1		1
5	1	2					2					1		1

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. Energy - Past & Present scenario of World; Renewable and Nonrenewable energy resources

UNIT II **9 Hours**

ENERGY CONSERVATION IN BUILDINGS

Principles of Planning of buildings: orientation, energy efficiency, utility. Components of building-classification of buildings. Green building - LEED building assessment standard – LEED certification process - Building rating system - Building energy issues – Building energy design strategies – Energy Auditing

UNIT III **9 Hours**

SUSTAINABLE CONSTRUCTION

Equipment use in excavations, foundation, concreting. Advanced Techniques in tunneling, under water construction, piling techniques, Innovations & efficiency in Highways, Railways & Harbours - linkages between economic and environmental outcomes

UNIT IV **9 Hours**

THERMAL COMFORT IN BUILDINGS

Natural Ventilation Principle of nature ventilation in buildings Cross-ventilation — position of openings – size of openings — control of openings: sashes, canopies, louvers wind shadow — humidity control: wind scoop

Structural Controls Solar control: internal blinds & curtains – heat absorbing glasses Sun’s position: effects

of angle of incidence – stereographic projection – shadow angles Shading devices: vertical & horizontal – design of shading devices

UNIT V **9 Hours**

LIGHTING AND VISUAL COMFORT IN BUILDINGS

Aims of good lighting and realization of the same Planning the brightness pattern considering the visual task, the immediate background of the task (central field & visual field) and the general Surroundings (peripheral field) Glare: direct, reflected & veiling Recommended values of illumination level for different occupancies as per the NBC

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
2. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008.
3. H. M. Raghunath, Irrigation Engieering, Wiley India (P) Ltd, 2011
4. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
5. M. Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, ISBN-10: 8173191409,1997.
6. Lal, P.M. Sarma, Priyangshu M, Wealth from Waste: Trends and Technologies, 3rd Edition, The Energy and Resources Institute, New Delhi, ISBN: 9788179934241, 2011.
7. W. McDonough, M. Braungart, Cradle to Cradle: Remaking the Way We Make Things, United States: North Point Press, ISBN-10: 0865475873, 2002.

21OCE02 GREEN BUILDINGS 3 0 0 3

Course Objectives

- To impart knowledge on the sustainable construction strategies
- To introduce the concept of green buildings.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

d. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Identify the requirements of green buildings
2. Explain the green building design process and assessment
3. Select a suitable sustainable landscaping and energy strategies for green building
4. Select a suitable sustainable hydrologic landscaping and energy strategies for green building
5. Illustrate green building commissioning and implementation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2	1										-	
3		2	3											-
4			3	2										-
5				2	3									

UNIT I **9 Hours**

SUSTAINABLE CONSTRUCTION AND GREEN BUILDING REQUIREMENTS

Ethics and sustainability - Increased CO2 trade-Sustainable construction - Major environmental and resource concerns - Green building movement and obstacles - Green building requirements -Perceived use of green building

UNIT II **9 Hours**

GREEN BUILDING PROCESS AND ASSESSMENT

Life Cycle Impacts of Materials and Product-Conventional versus green building delivery systems - Execution of green building process - Integrated design process - Ecological design -Merits and demerits -Historical perspective - LEED building assessment standard - LEED certification process - International building assessment standards - Building rating system in India and its future - Case study of a green building

UNIT III **9 Hours**

SUSTAINABLE LANDSCAPING AND ENERGY

Land and landscape approaches for green buildings -sustainable landscapes - Landscaping water efficiency Storm water management - Heat island mitigation - Building energy issues - Building energy design strategies - Building envelope - Active mechanical systems -Innovative energy optimization strategies - Smart buildings and energy management systems-Case study on smart buildings and energy management studies

UNIT IV **9 Hours**

BUILDING HYDROLOGIC SYSTEM AND MATERIAL LOOPS

High performance building water supply strategy - High performance building wastewater strategy - Green building materials issues and priorities - LCA of building materials and products - Emerging construction materials and products - Construction and demolition waste management Design for deconstruction and disassembly - Closing material loops in practice-Case study on LCA of buildings

UNIT V **9 Hours**

GREEN BUILDING IMPLEMENTATION

Site protection planning - Health and safety planning - Reducing the footprint of construction operations -Essentials of building commissioning - Costs and benefits of building commissioning- The economics of green buildings - Quantifying green building costs - Future directions in green buildings- Case study for high performance green buildings

Total: 45 Hours

Reference(s)

1. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008
2. M. Bauer, P. Mosle and M. Schwarz, Green Building: Guidebook for Sustainable Architecture, Springer - Verlag Berlin Heidelberg, 2010
3. Jerry Yudelson, Marketing Green Building Services: Strategies for success, Elsevier, 2008
4. Jerry Yudelson, Marketing Green Buildings: Guide for Engineering, Construction and Architecture, The Fairmont Press Inc., 2006
5. Angela. M. Dean, Green by Design: Creating a Home for Sustainable Living, Gibbs Smith Publication, 2003

21OCE03 DISASTER PREPAREDNESS AND PLANNING 3 0 0 3

Course Objectives

- To provide an exposure on the various elements of natural disasters
- To impart knowledge on measurement, effect and management techniques for different disasters

Programme Outcomes (POs)

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

f. 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.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Characterize the various natural and man- made disasters
2. Identify the various types of disasters in coastal and marine and techniques to control marine pollution
3. Explain the causes, effects of atmospheric pollution and land pollution
4. Analyze the inter-relationship between disasters and development
5. Interpret the importance of various disaster management cycle and framework

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				2								
2		1				3							2	
3		1				2	3							
4		1				2							1	
5		1				3	2						1	

UNIT I **9 Hours**

INTRODUCTION TO DISASTER MANAGEMENT

Contemporary natural and man- made disasters - Fundamentals of disasters-Causal factors of disasters- Poverty - Population growth - Rapid urbanization - Transitions in cultural practices - Environmental degradation -War and civil strife - Earthquakes -Tropical cyclones - Floods -Droughts - Environmental pollution - Deforestation -Desertification - Epidemics - Chemical and industrial accidents- Global Disaster Trends-Climate Change and Urban Disasters

UNIT II **9 Hours**

COASTAL AND MARINE DISASTERS

Hydrological-Coastal and marine disasters -Flood hazards- Control and management-Dams and dam bursts-Tsunami-Water and ground water hazards - Sea level rise -Coastal and marine degradation -

Marine pollution - Techniques of marine pollution control- Case study on Coastal and marine disasters

UNIT III **9 Hours**

ATMOSPHERIC AND LAND DISASTERS

Atmospheric disasters - Green house effect and global climate - Air pollution and acid rain - Ozone depletion - Forest related disasters - Bio diversity extinction - Deforestation and loss of biological diversity - genetic manipulation - Bio -safety and CBD- Land Degration and land use -Mining disasters- Droughts and famines- Case study on earthquake

UNIT IV **9 Hours**

INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources

UNIT V **9 Hours**

DISASTER MANAGEMENT CYCLE AND FRAMEWORK

Disaster Management Cycle-Paradigm Shift in Disaster Management Pre-Disaster-Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster- Evacuation-Disaster Communication-Search and Rescue-Emergency Operation Centre-Incident Command System-Relief and Rehabilitation-Post-disaster-Damage and Needs Assessment, Restoration of Critical Infrastructure-Early Recovery-Reconstruction and Redevelopment; IDNDR,Yokohama Stretegy, Hyogo Framework of Action

Total: 45 Hours

Reference(s)

1. B.K.Khanna, All you wanted to know about disasters, New India Publishing Agency, NewDelhi, 2005
2. William L Waugh, Living with hazards, dealing with disasters: An Introduction to Emergency Management, Amazon Publications, 2002
3. P.Jegadish Gandhi, Disaster mitigation and management Deep & Deep Publications, 2007
4. Patrick Leon Abbott, Natural Disasters, Amazon Publications, 2002
5. Ben Wisner, At Risk : Natural Hazards, People vulnerability and disasters, Amazon Publications, 2001
6. D.B.N.Murthy, Disaster management: text and case studies, Deep & Deep Publications, 2007

21OCE04 ENVIRONMENTAL IMPACT ASSESSMENT 3 0 0 3

Course Objectives

- To emphasize the need for EIA.
- To provide basic knowledge on the components, methods and quality control measures of EIA
- To make the students understand the importance of documentation and monitoring of EIA along with case studies.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Analyse the key features of EIA with reference to legislator aspects in India.
2. Analyse cost benefits and alternatives
3. Predict the impact of any project on environmental issues related to land, water, air, flora and fauna, noise, energy and socio-economics.
4. Practice the various documentation and report procedures for EIA.
5. Involve public to participate in the Environmental movements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	3											
2	1	2	3		1									
3	1	2	1											
4	1	1	1			2								
5	1	1					2	1	1					-

UNIT I **9 Hours**

INTRODUCTION

Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) - Environmental Risk Assessment (ERA) - Legal and Regulatory aspects in India - Types and limitations of EIA - - Issues in EIA - National - Cross sectoral - Social and cultural Terms of Reference in EIA

UNIT II **9 Hours**

COMPONENTS AND QUALITY ANALYSIS

Components - Screening - Setting - Analysis - Prediction of impacts - Mitigation - Matrices - Networks - Checklists - Impact Assessment techniques - Cost benefit analysis - Analysis of alternatives; Trends in EIA practice and evaluation criteria - Capacity building for quality assurance - Expert System in EIA - Formats of regulations

UNIT III **9 Hours**

PREDICTION, ASSESSMENT AND MITIGATION

Methods for Prediction and assessment of impacts on Air - Water - Soil - Noise - Biological - Cultural - Social - Economic environments - Standards and guidelines for evaluation - Options for mitigation of impacts- Policies for decision making

UNIT IV **9 Hours**

DOCUMENTATION AND MONITORING

Document planning - Collection and organization of relevant information - Use of visual display materials - Team writing - Reminder checklists - Environmental monitoring - Guidelines - Policies - Planning of monitoring programmes - Environmental Management Plan -Post project audit

UNIT V **9 Hours**

PUBLIC PARTICIPATION

Objectives of public participation - regulatory requirements- merits and de-merits - conducting public participation - conflict management - dispute resolution-Questionnaires for decision making-Case study on noyyal river pollution

Total: 45 Hours

Reference(s)

1. L. W. Canter, Environmental Impact Assessment, McGraw Hill, New York, 1996.
2. Policy Intervention Analysis: environmental Impact Assessment, Ritu Paliwal, Leena Srivastava, The Energy and Resources Institute (TERI), TERI Press, Durbari Seth Block,IHC Complex, Lodhi Road, New Delhi - 110 003, India, 2014
3. Handbook of Environmental Decision Making in India: An EIA Model (Handbooks Series), O.V.Nandimath, Oxford University Press of India, 2008
4. J. Petts, Handbook of Environmental Impact Assessment Vol. I and II, Blackwell Science, London, 1999.
5. The World Bank Group, Environmental Assessment Sourcebook Vol. I, II and III, The World Bank, Washington, 1991.

21OCE05 BUILDING SERVICES 3 0 0 3

Course Objectives

- To understand how a building can be made comfortable and safe with the services designed and installed
- To impart knowledge on basics of electrical wiring system
- To recognize the importance of fire detection and protection

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

Course Outcomes (COs)

1. Analyze the features of service machineries required for a building
2. Identify suitable electrical system and accessories to be installed during the construction of a building.
3. Identify the principles of illumination and Artificial light sources
4. Illustrate the working principle of Refrigerants and Air conditioning systems
5. Analyze the characteristics of fire safety equipments for different type of buildings

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1											
2	3	2	2											
3	3	3	1											
4	3	1											1	
5	1	2	3										2	

UNIT I **9 Hours**

MACHINERIES

Lifts and Escalators -Special features required for physically handicapped and elderly -DC/AC motors- Generators -Single / Three phase supply- Solar panels their installation and applications- Conveyors- Vibrators-Hot water boilers

UNIT II **9 Hours**

ELECTRICAL SYSTEMS IN BUILDINGS

Basics of electricity - Protective devices in electrical installations - Lightening arrester - Earthing- Types of earthing - ISI specifications - Types of wires, wiring systems - Planning electrical wiring for building - Main and distribution boards - Transformers and switch gears.

UNIT III **9 Hours**

PRINCIPLES OF ILLUMINATION

Visual tasks - Factors affecting visual tasks - Synthesis of light - Additive and subtractive synthesis of colour - Luminous flux - Candela - Solid angle illumination - Utilisation factor - Depreciation factor - MSCP - MHCP - Laws of illumination - Classification of lighting - Artificial light sources - LED lightings - Daylight factor- Luminous efficiency - Colour temperature - Colour rendering - Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types - Specifications of National Building Code of India

UNIT IV **9 Hours**

REFRIGERATION PRINCIPLES

Thermodynamics - Heat - Temperature - Change of state -Sensible heat - Latent heat of fusion, evaporation, sublimation - Saturation temperature - Super heated vapour - Subcooled liquid - Refrigerants - Vapour compression cycle - Starters - Air handling units -Water piping - Window type and packaged air-conditioners - Chilled water plant- Vapour Absorption Machine(VAM) - Air conditioning systems for different types of buildings

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Causes of fire in buildings - Safety regulations - NBC - Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes systems - Special features required for physically handicapped and elderly in building types - Heat and smoke detectors - Fire Fighting pump and water storage - Dry and wet risers - Automatic sprinklers-Fire fighting layout

Total: 45 Hours

Reference(s)

1. SP 7 (2005): National Building Code of India 2005
2. Roger Greeno and Fred Hall, Building Services Handbook (8th edition), Routledge Publishers, 2015.
3. G. Steffy, Architectural Lighting Design, John Wiley and Sons, 2008
4. J. Killinger and L. Killinger, Heating and Cooling Essentials, Goodheart-Wilcox Publishers, 2003
5. Electrical Safety, Fire Safety Engineering and Safety Management, Reprint, 2016, S.Rao& Prof. H.L.Saluja
6. ASHRAE, Fundamentals and Equipment, ASHRAE Inc., 2005

21OCE06 INDUSTRIAL WASTE MANAGEMENT 3 0 0 3

Course Objectives

- To provide basic knowledge on the management practices of solid and liquid waste
- To impart knowledge on the collection, transport and disposal of solid waste
- To emphasize the need for solid and liquid waste management

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Generalize the characteristics of Industrial Waste and their effect on the environment
2. Summarize cleaner production techniques for reuse, recycle and recovery
3. Analyze the characteristics of wastewater from major Industries and their reclamation concept
4. Identify the suitable treatment and disposal technique based on the characteristics of wastewater.
5. Characterize Hazardous waste and identify suitable treatment techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	2	2												2
3	2	2											1	
4	2	3	2											2
5	2	3	3										1	2

UNIT I **9 Hours**

INTRODUCTION

Types of industries and industrial pollution - Characteristics of industrial wastes - Population equivalent - Bioassay studies - effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health -Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

UNIT II **9 Hours**

CLEANER PRODUCTION

Waste management Approach - Waste Audit - Zero discharge - Volume and strength reduction - Material and process modifications - Recycle, reuse and byproduct recovery - Applications.

UNIT III **9 Hours**

POLLUTION FROM MAJOR INDUSTRIES

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants - Wastewater reclamation concepts.

UNIT IV **9 Hours**

TREATMENT TECHNOLOGIES

Equalisation - Neutralisation - Removal of suspended and dissolved organic solids - Chemical oxidation - Adsorption - Removal of dissolved inorganics - Combined treatment of industrial and municipal wastes - Residue management - Dewatering - Disposal.

UNIT V **9 Hours**

HAZARDOUS WASTE MANAGEMENT

Hazardous wastes - Sources & Characterization- collection, segregation-Physico chemical treatment - solidification - incineration -Secured land fills-Bioremediation of contaminated sites-Regulatory aspeets.

Total: 45 Hours

Reference(s)

1. M.N.Rao, A.K.Dutta, Wastewater Treatment, Oxford - IBH Publication, 1995.
2. W .W. Eckenfelder Jr., Industrial Water Pollution Control, McGraw-Hill Book Company, New Delhi, 2000
3. T.T.Shen, Industrial Pollution Prevention, Springer, 1999
4. R.L.Stephenson and J.B.Blackburn, Jr., Industrial Wastewater Systems Hand book, Lewis Publisher, New Yark, 1998
5. H.M.Freeman, Industrial Pollution Prevention Hand Book, McGraw-Hill Inc., New Delhi, 1995.
6. Bishop, P.L., Pollution Prevention: Fundamental & Practice, McGraw-Hill, 2000.

21OCE07 WEALTH FROM WASTE 3 0 0 3

Course Objectives

- To expose the students to the need of reuse and recycling of resources focusing on sustainability
- To emphasis the significance of energy and resource recovery from waste materials
- To prepare the students to design and optimize suitable resource utilization system from micro-level to macro-level

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. 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.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. 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.
m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.
n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Explain the composition and attributes of wastes and methods of resource recovery
2. Summarize thermo-chemical conversion of energy from RDF and fuel blending
3. Compare aerobic and anaerobic methods of resource recovery from organic wastes
4. Interpret the principles of industrial waste management and economic feasibility for reuse and recycling
5. Outline resource recovery options from disposable materials and disposal sites

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3								
2	1	3				2								2
3	1		2		3								1	
4	2	1	3											2
5		1	2			3								2

UNIT I **8 Hours**

FUNDAMENTALS OF SOLID WASTE MANAGEMENT

Classification and sources of wastes - Factors affecting MSW generation - Properties of wastes- Waste characterization methods - Waste collection systems - Unit operations and material flow in MRF with examples - Waste management hierarchy - Waste management policy.

UNIT II **10 Hours**

THERMOCHEMICAL CONVERSION

Thermo-chemical methods for energy production - Details of incineration, gasification and pyrolysis - Syngas utilization methods - Overview of RDF - Methods of fuel blending - Fuel composition and analysis - Cogeneration for CHP - Methods to improve fuel efficiency - Gas cleanup technologies - Fundamentals of densification - Carbonization for briquettes and pellets - Environmental considerations of mass burn.

UNIT III **10 Hours**

BIOCHEMICAL CONVERSION

Aerobic composting - Anaerobic digestion - Design aspects of biogas plant - Landfill gas recovery system - Principles of fermentation - Concept of MFC - Trans-esterification process - Biofuel processing - Biomass gasification - Organic waste for hydrogen production.

UNIT IV **10 Hours**

INDUSTRIAL WASTE MANAGEMENT

Principles of industrial waste management - Types of industrial wastes -Recycling options for plastics, paper, glass, metals, rubber and e-wastes - Partial replacement of materials in cement industry - Reuse of construction wastes - Economics of energy production from waste -Life cycle analysis - Purity of materials and market issues - Pollution control mechanisms in industries.

UNIT V **7 Hours**

EFFECTIVE WASTE DISPOSAL

Municipal waste as soil conditioner and fertilizer - Wasteland development - Design aspects of landfill - Disposal options for hazardous wastes - Recovery of materials from disposal sites.

Total: 45 Hours

Reference(s)

1. Lal, P.M. Sarma, Priyangshu M, Wealth from Waste: Trends and Technologies, 3rd Edition, The Energy and Resources Institute, New Delhi, ISBN: 9788179934241, 2011.
2. W. McDonough, M. Braungart, Cradle to Cradle: Remaking the Way We Make Things, United States: North Point Press, ISBN-10: 0865475873, 2002.
3. C. Parker, Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, ISBN 0853343527. DOI: https://doi.org/10.1016/0167-7799(86)90131-9,1985.
4. K. Shah, Basics of Solid and Hazardous Waste Management Technology, Prentice Hall, ISBN-10: 0139603786, 2005.
5. M. Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, ISBN-10: 8173191409,1997.
6. Begum, S., Rasul, M. G., & Akbar, D, An Investigation on Thermo Chemical Conversions of Solid Waste for Energy Recovery. World Academy of Science, Engineering and Technology, 62, 624-30.scholar.waset.org/1307-6892/9976, 2012.

21OCE08 RISK AND SAFETY MANAGEMENT 3 0 0 3

Course Objectives

- To explore the various risk and safety management for successful completion of Construction projects.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. 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.

m. Gradates will be able to apply technical skills and modern engineering tools with critical thinking and innovations for solving civil engineering problems.

n. Gradates will be able to design sustainable and smart infrastructure in the context of environmental, economical, and societal requirements and serve the community as ethical and responsible professionals.

Course Outcomes (COs)

1. Select the basics risk assessment for industrial safety and health
2. Identify hazards and its remedial measures in the construction industry
3. Identify the safety measures in handling construction equipments
4. Indicate the importance of environmental safety and the role of individual in prevention Of pollution
5. Illustrate fire safety installation and maintenance of sprinkler installation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3							2	3
2	3	2				1							2	3
3	3				2	3							1	2
4	2				1	3							2	3
5	2	1				3							1	2

UNIT I **9 Hours**

INTRODUCTION

Risk assessment and control- Legal Basis for Risk Assessment - Hazards, remedial measures - Safety and health policy- Motivation of employees - Workplace Precautions - Management responsibilities, Individual responsibilities - Training for Safety and Health- Insurance coverage of Industrial plant & personnel.

UNIT II **9 Hours**

CONSTRUCTION SAFETY CONSTRUCTION SAFETY

Quality and Safety Concerns in Construction -Organizing for Quality and Safety - Work and Material Specifications - Importance of Safety during project construction - Accidents and their Causes - General precaution to hazardous atmosphere and materials - Safety facilities at construction sites - Training to project staff and operation staff - Emergency rescue equipment - Costs of Construction Injuries - Legal Implications.

UNIT III **9 Hours**

SAFETY MEASURES IN HANDLING CONSTRUCTIONEQUIPMENTS

General requirements of safety in concrete construction Handling of Concrete forms and shoring Safety measures for hoisting and erection of prefabricated elements OSHA (Occupational Safety and Healthy Administration) for Prestressing Operations Risk Assessment for erecting RC & Steel members Electrical safety in construction site.

UNIT IV **9 Hours**

ENVIRONMENTAL SAFETY

Scope and Importance of Environmental safety- Environmental impact assessment (EIA) - Environmental pollution - Sustainable development- Global warming, greenhouse effect, urbanization
- Role of Government in environment protection- National Committee on environmental Planning (NCP)- Environmental Appraisal Committee (EAC) - Role of individual in prevention of pollution

UNIT V **9 Hours**

FIRE SAFETY INSTALLATION

Fire extinguishing appliances -Selection requirements, installation and maintenance - Sprinkler system - Maintenance of sprinkler installation - Pressure gauges, Installation of control valves - Fire protection requirements for buildings and riser system- Fire alarm Systems, Manually operated fire alarms - Smoke detectors, Fire extinguishing appliances in multi storied buildings, hotels etc.

FURTHER READING

Safety Activities of ILO (International Labour Organisation) Job site conditions. Fire Safety installations- Fire Detector Radiation detector- Case studies on fire Hazards in the construction industry

Total: 45 Hours

Reference(s)

1. Risk assessment- A Practical Guide, 1993, Institution of Occupational Safetyand Health, United Kingdom
2. Rao.S and Saluja H.L., Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers, first edition, 1998
3. Grundy. J. ,Construction Technology, Viva Books Pvt. Ltd., 2006
4. R.K. Jain & Sunil S. Rao, Industrial safety health and environment Management system, Khanna Publishers, Secondedition, 2008
5. V.K. Jain, New Age International Publishers, 2nd Edition, First Print 1996 Re-print 2002

21OCE09 ENERGY SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- To impart knowledge on the renewable energy resources
- To introduce the concept of energy source and technology.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
f. 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.
g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Identify the sources of energy system and resources
2. Explain the sources of energy, efficiency and their storage
3. Understand the energy efficiency and the environment
4. Select a suitable sustainable civil engineering project connected with energy sources
5. Illustrate the concept of green building

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1					2	3							
2	1					2								
3	1					2								
4	1					2	3							
5	1						2							

UNIT I **9 Hours**

INTRODUCTION TO ENERGY SCIENCE

Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment.

UNIT II **9 Hours**

ENERGY SOURCES

Overview of energy systems, sources, transformations, efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energy storages, high efficiency batteries).

UNIT III **9 Hours**

ENERGY AND ENVIRONMENT

Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the

economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and research policy.

UNIT IV **9 Hours**

CIVIL ENGINEERING PROJECTS CONNECTED WITH THE ENERGY SOURCES

Coal mining technologies, Oil exploration offshore platforms, Underground and under sea oil pipelines, Solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams, tunnels, penstocks, etc.; Nuclear reactor containment buildings and associated buildings, design and construction constraints and testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposal systems

UNIT V **9 Hours**

ENGINEERING FOR ENERGY CONSERVATION

Concept of Green Building and Green Architecture; Green building concepts (Green building encompasses everything from the choice of building materials to where a building is located, how it is designed and operated); LEED ratings; Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford University Press
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems andSustainability: Power for a Sustainable Future. Oxford University Press
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guideto Renewable Energy Technologies and Sustainable Living, Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set:Mathematics of Decision Making, Loulou, Richard; Waaub, XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A.(2006) Energy and the Environment, 2nd Edition, John Wiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World Energy assessment

21OCE10 CONCEPTS OF REMOTE SENSING 3 0 0 3

Course Objectives

- To deliver the fundamental principles of Remote Sensing and its limitations.
- To impart training on the image Interpretation and Analysis.
- To develop the GIS modeling techniques and applications

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. 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.

e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Identify the properties of sun energy radiations, its interactions with the atmosphere and with the objects on earth surface
2. Interpret the data from Images through acquisition, storage, manipulation, analysis and display of satellite data
3. Integrate Remote Sensing and GIS to perform raster and vector data analysis
4. Extrapolate the database concepts of GIS for the development of design specifications for developing and improving the imagery by selecting suitable data models.
5. Apply the principles and concepts of remote sensing and GIS techniques for some important applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2			2									
3	3	3			3									
4	3	3	3		3									
5	3	3			3									

UNIT I **9 Hours**

FUNDAMENTALS OF REMOTE SENSING

Definition and History of remote sensing - Indian Space Programs - Elements of remote sensing - Electromagnetic spectrum - Wavelength regions important to remote sensing - Particle and Wave theory - Stefan-Boltzman and Weins Laws - Atmospheric scattering and absorption - Atmospheric windows - Concept of Spectral Response and Spectral Signature - Spectral reflectance of EMR with earth surface - water, vegetation and soil - Platforms and Sensors

UNIT II **9 Hours**

IMAGE INTERPRETATION AND ANALYSIS

Concept and types of image interpretation - Basic elements of image interpretation - Visual interpretation keys - Types of Data Products - Digital Image Processing - Pre-processing - Image compression and enhancement techniques - Multispectral Image classification - Supervised and unsupervised

UNIT III **9 Hours**

GEOGRAPHICAL INFORMATION SYSTEM AND ITS ANALYSIS

GIS definition - Basic components of GIS - Data types - Spatial and non-spatial data - Raster and Vector Data - Analysis and structure of Raster and Vector data - Maps - Map projections - Types of map projections- Concept of GPS and its advantages.

UNIT IV **9 Hours**

DATA INPUT, EDITING AND ANALYSIS

Input methods - Data stream - Data Retrieval - Query Building - Simple Spatial Analysis - Overlay Technique - Topological analysis - Modeling surfaces-TIN -DEM - DTM - Slope Model - Integration of Remote Sensing and GIS

UNIT V **9 Hours**

MAJOR APPLICATIONS OF REMOTE SENSING AND GIS

Natural Resources Management -Land Cover and Land Use- Wasteland Management - Water Resources and Watershed management- Forest Resources - Natural Disaster Management-Land Slides, Flood Routing, Forest Fires and Earth Quakes.

Total: 45 Hours

Reference(s)

1. M. Anji Reddy, Remote sensing and Geographical Information Systems, Third Edition, BS Publications, India, 2006.
2. Basudeb Bhatta, Remote Sensing and GIS, Second Edition, Oxford University Press, New Delhi, 2017.
3. Kali Charan Sahu, A Text Book of Remote Sensing and Geographical Information Systems, Kindle Edition, Atlantic Publishers and Distributers (P) Ltd, New Delhi, 2008.
4. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image interpretation, John Willey and sons, inc. New York, 2002. 4. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image interpretation, John Willey and sons, inc. New York, 2002. 1. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image interpretation, John Willey and sons, inc. New York, 2002.