GOVERNMENT COLLEGE OF ENGINEERING, Salem - 11

(An Autonomous Institution affiliated to Anna University, Chennai)

B.E. DEGREE IN CIVIL ENGINEERING

CURRICULUM FOR 2018A REGULATIONS

FIRST SEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits L	T	P	C
THEORY										
1	18MA101	Matrices and Calculus	BS	40	60	100	3	1	0	4
2	18PH101	Physics – Mechanics	BS	40	60	100	3	1	0	4
3	18EE101	Basic Electrical and Electronic Engineering	ES	40	60	100	3	1	0	4
4	18ME101	Engineering Graphics and Design	ES	40	60	100	1	0	4	3
PRACTICAL										
5	18PH103	Physics Laboratory	BS	60	40	100	0	0	3	1.5
6	18CY102	Chemistry laboratory	BS	60	40	100	0	0	3	1.5
7	18EE102	Basic Electrical and Electronics Engineering Laboratory	ES	60	40	100	0	0	2	1
8	18EN103	Professional Communication Laboratory	HS	60	40	100	0	0	2	1
Mandatory courses (non- credit)										
9	18MC101	Induction program	MC							
		TOTAL		320	480	800	10	3	14	**20**

SECOND SEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits L	T	P	C
THEORY										
1	18EN101	Professional English	HS	40	60	100	2	0	0	2
2	18MA205	Differential Equations and Transforms	BS	40	60	100	3	1	0	4
3	18CY101	Chemistry	BS	40	60	100	3	1	0	4
4	18CS101	Fundamentals of Problem Solving and C Programming	ES	40	60	100	3	0	0	3
PRACTICAL										
5	18EN102	Professional English Laboratory	HS	60	40	100	0	0	2	1
6	18CS102	Computer Practice Laboratory	ES	60	40	100	0	0	4	2
7	18ME102	Workshop Manufacturing Practices	ES	60	40	100	1	0	4	3
		TOTAL		280	420	700	12	2	10	**19**

THIRD SEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	18MA302	Statistics and Numerical Methods	BS	40	60	100	3	1	0	4
2	18CY301	Biology for Engineers	BS	40	60	100	2	1	0	3
3	18ES205	Mechanics of Solids	ES	40	60	100	3	0	0	3
4	18CE301	Mechanics of Fluids	PC	40	60	100	3	0	0	3
5	18CE302	Surveying & Geomatics	PC	40	60	100	3	0	0	3
Theory cum Practical										
6	18EN301	Effective Technical Communication	HS	50	50	100	2	0	2	3
PRACTICAL										
7	18CE303	Surveying Practical	PC	60	40	100	0	0	4	2
8	18CE304	Computer Aided Building Drawing	PC	60	40	100	0	0	4	2
		TOTAL		340	460	**800**	16	2	10	**23**

FOURTH SEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	18CE401	Strength of Materials	PC	40	60	100	3	1	0	4
2	18CE402	Design of Steel Structural Elements	PC	40	60	100	3	0	0	3
3	18CE403	Engineering Geology	PC	40	60	100	2	0	0	2
4	18CE404	Water Supply Engineering	PC	40	60	100	3	0	0	3
5	18CE405	Applied Hydraulics and Fluid Machinery	PC	40	60	100	3	0	0	3
6	18CE406	Concrete Technology	PC	40	60	100	3	0	0	3
PRACTICAL										
7	18CE407	Material Testing & Evaluation Lab	PC	60	40	100	0	0	4	2
8	18CE408	Hydraulic EngineeringLaboratory	PC	60	40	100	0	0	4	2
Mandatory courses (non-credit)										
9	18CEMC01	Disaster Preparedness & Planning	MC	-	-	-	2	-	-	-
		TOTAL		320	480	**800**	19	1	8	**22**

FIFTHSEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	18CE501	Basic Structural Analysis	PC	40	60	100	3	0	0	3
2	18CE502	Mechanics of Soils	PC	40	60	100	3	0	0	3
3	18CE503	Water Resources Engineering	PC	40	60	100	3	0	0	3
4	18CE504	Design of Reinforced Concrete Elements	PC	40	60	100	3	0	0	3
5	18CE505	Waste Water Engineering	PC	40	60	100	3	0	0	3
6	18CE506	Transportation Engineering	PC	40	60	100	3	0	0	3
7	18MCIN04	Idiation Sprits		100	-	100	2	0	2	1
PRACTICAL										
8	18CE507	Geotechnical Laboratory	PC	60	40	100	0	0	4	2
9	18CE508	Environmental Engineering laboratory	PC	60	40	100	0	0	4	2
Mandatory courses(non-credit)										
10	18CEMC02	India Constitution	MC	-	-	-	2	-	-	-
		TOTAL		420	480	**900**	22	0	10	**23**

SIXTH SEMESTER (REQULAR STREAM)

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
THEORY										
1	18CEPExx	Professional Elective -I	PE	40	60	100	3	0	0	3
2	18CEPExx	Professional Elective -II	PE	40	60	100	3	0	0	3
3	18CEPExx	Professional Elective -III	PE	40	60	100	3	0	0	3
4	18CEPExx	Professional Elective -IV	PE	40	60	100	3	0	0	3
5	18CEPExx	Professional Elective -V	PE	40	60	100	3	0	0	3
6	18CEOEXX	Open Elactive-I	OE	40	60	100	3	0	0	3
7	18CEOEXX	Open Elactive-II	OE	40	60	100	3	0	0	3
		TOTAL								**21**

SIXTH SEMESTER (PROTOSEM STREAM)

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	18MEPS11	Applied Design Thinking (Open Elective-I)	PE	100	-	100	3	0	0	3
2	18MEPS12	Startup Fundamentals (Open Elective-II)	PE	100	-	100	3	0	0	3
3	18MEPS13	Computational Hardware (Professional Elective-I)	PE	100	-	100	3	0	0	3
4	18MEPS14	Coding for Innovators(Professional Elective-II)	OE	100	-	100	3	0	0	3
5	18MEPS15	Industrial Design & Rapid Prototyping Techniques (Professional Elective-III)	OE	100	-	100	3	0	0	3
6	18MEPS16	Industrial Automation/ Data Life Cycle Management (Professional Elective-IV)	OE	100	-	100	3	0	0	3
7	18MEPS17	Robotics /ML& MLOps (Professional Elective-V)	EEC	100	-	100	3	0	0	3
		TOTAL		700		**700**	21	0	0	**21**

SEVENTH HSEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	18CE601	Advanced Structural Analysis	PC	40	60	100	3	0	0	3
2	18CE602	Foundation Engineering	PC	40	60	100	3	0	0	3
3	18CE603	Engineering Economics, Estimation and Costing	PC	40	60	100	3	0	0	3
4	18CE604	Professional Practices, Ethics and Building by-laws	HS	40	60	100	2	0	0	2
		PRACTICAL								
5	18CE702	Design project	EEC	60	40	100	0	0	12	4
6	18CE605	Concrete Laboratory	PC	60	40	100	0	0	4	2
7	18CE606	Computer Aided Design and Drawing (Concrete & Steel)	PC	60	40	100	0	0	4	2
8	18CE701	Internship/Industrial training/Academic attachment		60	40	100	0	0	4	2
		TOTAL		320	480	**800**	17	0	8	**21**

EIGHTH SEMESTER

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
		THEORY								
1	18CE801	Construction Management	PC	40	60	100	3	0	0	3
2	18CEPExx	Professional Elective - VI	PE	40	60	100	3	0	0	3
		PRACTICAL								
3	18CE802	Project Work	EEC	80	120	200	0	0	10	5
		TOTAL		160	240	400	6	0	10	**11**

Civil Engineering Scheme of Instruction

Course component	Credits	Curriculum Content (% of total number of credits of the programme)
Humanities and Social Sciences	9	5.63
Engineering Sciences	19	11.9
Basic Sciences	26	16.25
Professional Core	70	43.75
Professional Elective	18	11.25
Open Elective	06	3.75
Empl.Enhancement Courses	12	7.5
Mandatory Course (Zero Credit)	0	0
Total	160	100

HS = Humanities and Social Sciences
BS = Basic Sciences
ES = Engineering Sciences
PC = Professional Core
PE = Professional Elective
OE = Open Electives
EEC = Employability Enhancement Courses

LIST OF ELECTIVES FOR B.E. CIVIL ENGINEERING

Professional Electives (PE)

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
Transportation Engineering										
1	18CEPE01	Traffic Engineering	PE	40	60	100	3	0	0	3
2	18CEPE02	Airports, Docks and Harbors Engineering	PE	40	60	100	3	0	0	3
3	18CEPE03	Integrated Traffic Planningand Management	PE	40	60	100	3	0	0	3
Construction Engineering and Management										
4	18CEPE04	Smart Materials and Smart Structures	PE	40	60	100	3	0	0	3
5	18CEPE05	Construction Techniques and Equipments	PE	40	60	100	3	0	0	3
6	18CEPE06	Project Safety Management	PE	40	60	100	3	0	0	3
7	18CEPE07	Repair and Rehabilitation of Structures	PE	40	60	100	3	0	0	3
Environmental Engineering										
8	18CEPE08	Industrial Waste Management	PE	40	60	100	3	0	0	3
9	18CEPE09	Hazardous WasteManagement	PE	40	60	100	3	0	0	3
10	18CEPE10	Air Pollution Monitoring and Control	PE	40	60	100	3	0	0	3
11	18CEPE11	Municipal Solid Waste Management	PE	40	60	100	3	0	0	3
12	18CEPE12	Marine Pollution Monitoring and Control	PE	40	60	100	3	0	0	3
13	18CEPE13	Environmental Impact Assessment	PE	40	60	100	3	0	0	3
Hydraulics										
14	18CEPE14	Open Channel Flow	PE	40	60	100	3	0	0	3
15	18CEPE15	River Engineering	PE	40	60	100	3	0	0	3
16	18CEPE16	Groundwater Engineering	PE	40	60	100	3	0	0	3
Hydrology & Water Resources Engineering										
17	18CEPE17	Irrigation Engineering	PE	40	60	100	3	0	0	3

18	18CEPE18	Water Shed Management	PE	40	60	100	3	0	0	3
19	18CEPE19	Hydrology	PE	40	60	100	3	0	0	3
Structural Engineering										
20	18CEPE20	Design of Bridges	PE	40	60	100	3	0	0	3
21	18CEPE21	Modern Structural Analysis	PE	40	60	100	3	0	0	3
22	18CEPE22	Storage Structures	PE	40	60	100	3	0	0	3
23	18CEPE23	Pre stressed Concrete Structures	PE	40	60	100	3	0	0	3
24	18CEPE24	Advanced Steel Structures	PE	40	60	100	3	0	0	3
25	18CEPE25	Tall Buildings	PE	40	60	100	3	0	0	3
26	18CEPE26	Prefabricated Structures	PE	40	60	100	3	0	0	3
27	18CEPE27	Design of CompositeStructures	PE	40	60	100	3	0	0	3
28	18CEPE28	Coastal Structures	PE	40	60	100	3	0	0	3
29	18CEPE29	Dynamics and Earthquake Resistant Design of Structures	PE	40	60	100	3	0	0	3
30	18CEPE30	Industrial Structures	PE	40	60	100	3	0	0	3
31	18CEPE31	Ferrocement Technology	PE	40	60	100	3	0	0	3
32	18CEPE32	Finite Elements Analysis	PE	40	60	100	3	0	0	3
33	18CEPE33	Experimental Techniques and Instrumentation	PE	40	60	100	3	0	0	3
34	18CEPE34	Ground Improvement Techniques	PE	40	60	100	3	0	0	3
Geotechnical Engineering										
35	18CEPE35	Introduction to Soil Dynamics and Machine Foundation	PE	40	60	100	3	0	0	3
36	18CEPE36	Soil Structure Interaction	PE	40	60	100	3	0	0	3
37	18CEPE37	Subsurface Investigation and Instrumentation	PE	40	60	100	3	0	0	3
38	18CEPE38	Fundamentals of Remote Sensing and GIS	PE	40	60	100	3	0	0	3
39	18CEPE39	Advanced SurveyingTechniques	PE	40	60	100	3	0	0	3

Open Electives (OE)

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
1	18CEOE01	Environmental Management	OE	40	60	100	3	0	0	3
2	18CEOE02	Disaster Mitigation and Management	OE	40	60	100	3	0	0	3
3	18CEOE03	Repair and Rehabilitation of Building Elements	OE	40	60	100	3	0	0	3
4	18CEOE04	Mechanics of Deformable bodies	OE	40	60	100	3	0	0	3

Mandatory Courses (MC)

Sl. No.	Subject Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Credits			
							L	T	P	C
1	18CEMC01	Induction Program	MC	-	-	-	0	0	0	0
2	18CEMC02	Disaster Preparedness & Planning	MC	-	-	-	2	0	0	0
3	18MC301	Indian Constitution	MC	-	-	-	2	0	0	0

18MA101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To know the use of matrix algebra needed by engineers for practical applications.
2.	To understand effectively the geometrical application of differential calculus and Beta, Gamma functions
3.	To familiarize with partial differentiation concepts and its applications
4.	To obtain the knowledge of multiple integration and their related applications
5.	To acquire the knowledge of vector differentiation and integration and its applications

UNIT I	MATRICES	9	+	3

Symmetric, Skew Symmetric and Orthogonal Matrices – Characteristic equation of a Matrix – Eigen values and Eigen vectors – Properties – Cayley-Hamilton theorem (excluding proof) – Diagonalization of Matrices -Reduction of quadratic form to canonical form by orthogonal transformation

UNIT II	CALCULUS	9	+	3

Curvature , Radius of Curvature (Cartesian coordinates) — Centre and Circle of curvature - Evolutes andInvolutes- Definite integrals and their properties – Beta and Gamma functions and their properties.

UNIT III	MULTIVARIABLE CALCULUS (DIFFERENTIATION)	9	+	3

Partial derivatives – Euler’s theorem for homogenous functions – Total Derivatives –Jacobians – Maxima,Minima and Saddle point- – Method of Lagrangian multipliers- Taylor’s series.

UNIT IV	MULTIVARIABLE CALCULUS (INTEGRATION)	9	+	3

Multiple integrals- Double integrals – Change of order of integration in double integrals – Change of variables(Cartesian to Polar) – Application to Areas – Evaluation of Triple integrals – Application to volumes

UNIT V	VECTOR CALCULUS	9	+	3

Vector differentiation- Gradient- Directional derivative - Divergence - Curl , Vector integration- Line integration- work done — Surface and Volume integrals - Green’s theorem , Gauss divergence and Stokes theorem (without proof) – Simple applications involving cubes and rectangular parallelepipeds.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Learn the fundamental knowledge of Matrix theory
CO2	:	Familiar with the concept of the differentiation and integration and its applications
CO3	:	Acquire skills in applications of Integral and Vector Calculus

Text Books:	
1.	Grewal. B.S, “Higher Engineering Mathematics”, 43rd Edition, Khanna Publications, Delhi, (2015).
2.	Veerarajan T., “Engineering mathematics for first year”, Tata McGraw Hill Education Pvt. Ltd., New Delhi,2009

Reference Books:	
1.	James Stewart, “Essential Calculus”, Cengage Learning, New Delhi, 2nd edition, 2013
2.	P. Kandasamy, K. Thilagavathy and K. Gunavathy,” Engineering Mathematics (For I year B.E., B.Tech)”,Nineth Edition, S. Chand & Co. Ltd. New Delhi, 2010
3.	Srimanta pal and Subath.C.Bhumia, “Engineering Mathematics”, Oxford university publications, NewDelhi, 2015
4.	Ewinkreyzig, “Advanced Engineering Mathematics”, 9th edition, John Wiley & Sons, 2006
5.	Sivaramakrishnadas.P, Ruknmangadachari.E. “Engineering Mathematics”, Pearson, Chennai & Delhi,2nd edition, 2013

18EE101	BASIC ELECTRICAL AND ELECTRONICSENGINEERING	L	T	P	C
(Common to Civil and Computer Science and Engineering)		3	1	0	4

Course Objectives:

1.	To understand and analyze basic electric circuits
2.	To study working principle of Electrical machines and transforms.
3.	To study basics of Electronics System
4.	To understand the concepts of Electrical Installation

UNIT I	DC CIRCUITS	9	+	3

Electrical circuit elements (R, L and C), voltage and current sources, Ohm's law, Kirchoff current and voltage laws, series and parallel circuits, analysis of simple electrical circuits with DC excitation, Simple problems. Superposition , thevenin's and Norton's theorem, Star — Delta transformation.

UNIT II	AC CIRCUITS	9	+	3

Introduction to single phase AC circuits, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Three phase AC circuits, voltage and current relations in star and delta connections.

UNIT III	ELECTRICAL MACHINES AND TRANSFORMERS	9	+	3

Construction, operation, types, Speed control of Shunt motor and applications of DC Motor, Construction and working of a three-phase induction motors. Working of single-phase induction motor and its applications. Ideal and practical transformer, Construction and working, losses and efficiency in transformers, Introduction to Three phase transformers.

UNIT IV	BASICS ELECTRONICS SYSTEM	9	+	3

Introduction - Basic structure of semiconductors devices- PN junction diode, Zener diode and V-I characteristics- BJT — CE, CB, CC configuration and working principle .Operational Amplifier-principle of operation ,Characteristics , Applications-Inverting Amplifier, Non inverting Amplifier, summing amplifier and differential amplifier.

Unit V	ELECTRICAL INSTALLATIONS	9	+	3

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthling, Basics of house wiring tools and components, types of house wiring. Batteries-Principle characteristics-Types and its applications- Introduction to UPS and SMPS.

Total (L+T)= 60 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Analyse the simple DC circuits.
CO2	:	Analyse the single and three phase AC circuits.
CO3	:	Understand the working principle of Electrical machines and transformers.
CO4	:	Analyse the fundamentals and characteristics of Diode , BJT and OPAMP .
CO5	:	Understand the concept of Electrical Installations.

Text Books:

1.	R.Muthu Subramaniyam, R. Salivaganan and K. A Muralidharan , "Basic Electrical and ElectronicsSecond Edition Engineering", Tata McGraw Hill, 2010.
2.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3.	D.C.Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2009.

Reference Books:

1.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
2.	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

18ME101	ENGINEERING GRAPHICS & DESIGN	L	T	P	C
		1	0	4	3

Course Objectives:

1. To impart knowledge on concepts, ideas and design of engineering products and to provide anexposure to CAD Modelling.
2. Standards of Engineering Drawing: Size, layout and folding of drawing sheets, lettering - Use of drafting instruments

UNIT I	PROJECTION OF POINTS, LINES AND PLANE SURFACES	9	+	3

General principles of orthographic projection- Projection of points, located in all quadrants — Projection of straight lines located in first quadrant — Determination of true lengths and true inclinations — Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II	PROJECTION OF SOLIDS	9	+	3

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular to onereference plane and also inclined to one reference plane by change of position method.

UNIT III	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	9	+	3

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to other — solids inclined position with cutting planes parallel to one reference plane- Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids — Prisms, pyramids cylinders and cones- Development of lateral surfaces of solids with square and cylindrical cutouts, perpendicular to the axis.

UNIT IV	ISOMETRIC PROJECTION	9	+	3

Principles of isometric projection –isometric scale - isometric projections of simple solids, truncated prisms,pyramids, cylinders and cones.

UNIT V	PERSPECTIVE PROJECTION	9	+	3

Perspective projection of prisms, pyramids and cylinders by visual ray and vanishing point methods.

Total (L+T)= 60 Periods

Note: Study of drafting software – Auto CAD – Coordinate System (Absolute, relative and polar)

Creation of simple figures like polygon, Drawing a plan of residential building, Creation of 3-D Models ofsimple objects and obtaining 2-D multi view drawing from 3-D model. (**Internal Assessment only)**

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the conventions and the methods of engineering drawing.
CO2	:	Understand the fundamental concepts of theory of projection.
CO3	:	Understand the development of different surfaces.
CO4	:	Develop the relationships between 2D and 3D environments.
CO5	:	Demonstrate computer aided drafting.

Text Books:

1.	Bhatt N.D, “Engineering Drawing”, Charotar publishing House, 2003
2.	Natarajan, K.V, “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, 2006.

Reference Books:

1.	Gopalakrishnana K.R, “Engineering Drawing", Vol. I and II, Subhas Publications, 1999.
2.	Dhananjay A. Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw HillPublishing Company Limited, 2008.
3.	Venugopal, K and Prabhu Raja, V., “Engineering Graphics”, New Age International (P) Ltd, 2008.
4.	Gill, P.S, “Engineering Drawing-Geometrical Drawing”, S.K Kataria and Sons, 2008.
5.	CAD Software Theory and User Manuals

18PH103	PHYSICS LABORATORY	L	T	P	C
(Common to All Branches of Engineering)		0	0	3	1.5

Course Objectives:

1.	To handle different measuring instruments.
2.	To understand the basic concepts of interference, diffraction, heat conduction and to measure theimportant parameters.

EXPERIMENTS

(Any EIGHT Experiments)

1.	Newton's rings – Determination of radius of curvature of a Plano convex lens.
2.	Carey Foster's bridge – Determination of specific resistance of the material of the wire
3.	Poiseuille's flow – Determination of Coefficient of viscosity of a liquid
4.	Spectrometer – Grating – Normal incidence – Determination of Wavelength of Mercury lines.
5.	Lee's disc – Determination of thermal conductivity of a Bad conductor.
6.	Ultrasonic interferometer – Determination of velocity of Ultrasonic Waves in Liquid
7.	Non-uniform bending – Determination of young's modulus of the material of the Bar
8.	Determination of Band gap of a given semi conductor
9.	Determination of Wavelength of laser using grating and determination of particle size using Laser
10.	Determination of Acceptance angle and Numerical Aperture of fiber

Total (P)= 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Handle different measuring instruments and to measure different parameters
CO2	:	Calculate the important parameters and to arrive at the final result based on the experimental measurements

18CY102	CHEMISTRY LABORATORY	L	T	P	C
(Common to all branches of Engineering For student admitted from 2018-2019 andonwards)		0	0	3	1.5

Course Objectives:

1.	To gain practical knowledge by applying theoretical principles and performing the following experiments

EXPERIMENTS

1.	Estimation of hardness of Water by EDTA
2.	Estimation of Copper in brass by EDTA
3.	Estimation of Alkalinity in water
4.	Estimation of Chloride in water sample (Iodimetry)
5	Conductometric titration of Strong Acid and Strong Base
6.	Conductometric titration of Mixture of acids and Strong base
7.	Determination of strength of Iron by Potentiometric method
8.	Estimation of Iron by Spectrophotometry
9.	Determination of molecular weight and degree of Polymerisation by Viscometry.
	NOTE: › All the nine experiments shall be offered.

Total (P)= 45 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	To know the applicability of the practical skill gained in various fields.
CO2	:	To know the composition of brass quantitatively and the molecular weight of polymers.
CO3	:	To understand the principle and applications of conductometric titrations, spectrometer and potentiometric titrations.

18EE102	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To impart hands on experience in use of measuring instruments, testing in transformers, and housewiring practices

EXPERIMENTS

1.	Verification of Kirchhoff's laws.
2.	Verification of Superposition theorem.
3.	Measurement of three-phase power in three-phase circuits
4.	Determination losses in single phase Transformer
5	Demonstration of cut-out sections of machines: induction machine (squirrel cage rotor), and single-phase induction motor
6.	Speed control of DC shunt motor
7.	Study of basic safety precautions, measuring instruments – voltmeter, ammeter, multi-meter, andElectrical components.
8.	VI Characteristics of PN Junction diode.
9.	House wiring
10.	Wiring for Fluorescent lamp.

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Get an exposure to DC and AC circuits.
CO2	:	Understand the loading characteristics of transformers
CO3	:	Know the parts of single-phase and three phase induction motors.
CO4	:	Get an exposure Electron devices
CO5	:	Make electrical connections by wires of appropriate ratings.

18EN103	PROFESSIONAL COMMUNICATION LABORATORY	L	T	P	C
(Common to All Branches)		0	0	2	1

Course Objectives:

1.	Improve their reading skills.
2.	Address an audience and present a topic.
3.	Acquire speaking competency in English.
4.	Strengthen their fluency in speaking

EXPERIMENTS

Methodology – Reading

1) Reading a story aloud with exact pronunciation, with intonation, and with expressing sense.
2) Reading poems for improving verbal skills, memory, and critical thinking.
3) Reading newspaper articles for strengthening the vocabulary and writing skills.
4) Reading homophones with exact pronunciation for expressing different meanings

Methodology – Speaking

1) Power point presentation – on general topics - for organising and structuring presentation.
2) Oral presentation -on basic technical ideas related to engineering.
3) Speaking on a given topic – current affairs, expressing opinion on social issues.
4) Describing a process – booking Ticket online, survey for starting a new office, sending an e-mail, etc.
5) Organising official events –compering,presenting welcome address, proposing vote of thanks

Total (P)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	read short passages fluently, avoiding mispronunciation, substitution, omission and transposition ofword-pairs
CO2	:	vocalize words without the aid of pictures.
CO3	:	develop a well-paced, expressive style of reading.
CO4	:	make effective oral presentations on technical and general contexts
CO5	:	describe a process with coherence and cohesion.

Text Books:	
1.	Norman Whitby. Business Benchmark — Pre-Intermediate to Intermediate, Students book, Cambridge University Press, 2014
Recommended Reading and Reference Sources:	
1.	Spoken English: A Self-Learning Guide. V.Sasikumar and P V Dhamija
2.	English Conversation Practice: Grant Taylor Paperback 1976ly. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur.CUP, 1981
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback – November 2012 Norman Lewis, Goyal Publishers andDistributors

18EN101	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

Course Objectives:

1. Master basic reading skills such as phonics, word recognition and meaningful division of sentences.
2. Read fast, decode accurately and remove oral reading errors that affect text meaning
3. Acquire and develop writing skills for academic, social and professional purposes
4. Gain skills in academic and functional writing tasks.

WRITING

1. Word Formation with Prefix and Suffix, Synonyms and Antonyms, Tenses, Parts of Speech, Common Errors in English (Subject –Verb Agreement, Noun-Pronoun Agreement, Prepositions, Articles, Conditional statements, Redundancies, Clichés etc), Voices

2. Email — Training Programme and related details, paper submission for seminars and conferences, Fixing an appointment, Arranging and Cancelling a meeting with team members, conference details, hotel accommodation, Reminder mails, Raising queries with team members, Congratulatory mails at work, arranging for a meeting with a foreign client, personal emails.

3. Letter Writing – Business and need based communication – Formats of official, personal and business letters, official leave and request applications (Bonafide certificate, course completion, conduct certificate, permission to arrange industrial visits) complaints, replies to queries from business customers, inviting dignitaries, accepting and declining invitations, placing orders, cover letter for a job application with resume.

4. Technical Report Writing — status reports — Work Done in the Project, Feasibility Reports on Office Accommodation, Introduction of New Products, Sales Promotion, Customers Feedback, Starting a New Company, Event Reports- Seminars, Conferences, Meeting, Recommendations and Checklists.

5. Charts- interpreting pie charts, graphs etc.,

READING

1. Understanding notices, messages, timetables, adverts, graphs, etc.- understanding meaning and purpose of short texts.
2. Gapped sentences – Meanings, collocations and meanings of individual words.

3. Reading passage with multiple choice questions – reading for gist and reading for specific information – skimming for general idea of and meaning and contents of the whole text.

4. Short reading passage; gap-filling – Grammar, especially prepositions, articles, auxiliary verbs, modalverbs, pronouns, relative pronouns and adverbs.

5. Short reading passages; sentence matching – Scanning – ability to pick out specific information in ashort text.

18CY101	CHEMISTRY	L	T	P	C
		3	1	0	4

Course Objectives:

1.	Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2.	Rationalize periodic properties of elements and the knowledge of acids and bases.
3.	Analyze the stereo chemical aspects of organic molecules and chemical reactions that are used in the synthesis of organic molecules
4.	Rationalize bulk properties and processes in thermodynamic aspects and its extension in electrochemical processes
5.	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

UNIT I	MOLECULAR STRUCTURE	9	+	3

Formation of molecular orbitals of diatomic molecules - energy level diagrams of — H_2, He_2, N_2, O_2, CO andNO - pi-molecular orbitals of butadiene and benzene;

Aromaticity- Huckel rule - concept of aromaticity - aromatic, non-aromatic and anti-aromatic molecules;

Crystal field theory - energy level diagrams for transition metal ions – octahedral and tetrahedral geometries -magnetic properties;

Band theory - band structure of solids- Fermi level - role of doping on band structures.

UNIT II	PERIODIC PROPERTIES AND ACID-BASE CONCEPTS	9	+	3

Effective nuclear charge – shielding effect, penetration of orbitals - variations of s, p, d and f orbital energies of atoms – Aufbau principle - electronic configuration of elements — periodic properties - atomic and ionic size, ionization energy, electron affinity and electro negativity - anomalous properties of second period elements - diagonal relationship;

Acids and bases - Bronsted-Lowry concept - Lewis concept - pH and pKa — problems — HSAB - buffer solutions – types- mechanism of buffer action- Henderson–Hasselbalch equation- derivation and problems.

UNIT III	STEREOCHEMISTRY AND ORGANIC REACTIONS	9	+	3

Stereoisomerism – geometrical isomerism – cis-trans and E-Z nomenclature – optical isomerism – symmetry, chirality, optical activity, enantiomer and diastereomers — absolute configuration - R-S notation - conformational analysis – Ethane, butane, cyclohexane;

Addition reaction — hydrogenation, halogenations - Markovnikov rule — Kharasch effect - hydration,hydrohalogenation, hydroboration;

Aliphatic nucleophilic substitution reaction –SN_1, SN_2 and SN_imechanism – electrophilic substitution reaction in benzene– mechanism - nitration, halogenations, sulfonation, alkylation and acylation;

Elimination reaction –E_1, E_2 and E_1CB- mechanism- Saytzeff rule – examples.

UNIT IV	USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA	9	+	3

Thermodynamic functions- internal energy, enthalpy, entropy and free energy- first and second law of thermodynamics - partial molar properties - Gibbs Duhem equation — variation of chemical potential with temperature and pressure – Third and Zeroth law of thermodynamics – definition only;

Free energy and EMF relation - single electrode potential - electrochemical series and its significance.- cell potential and its measurement (Poggendorff method only) - Nernst equation-derivation and problems- Standard cell potential and equilibrium constant relation- problems.

UNIT V	SPECTROSCOPY TECHNIQUES AND APPLICATIONS	9	+	3

Vibrational spectroscopy — principle - selection rule - harmonic and unharmonic oscillators -number of vibrational modes of poly-atomic molecules – overtones - Fermi resonance - instrumentation (block diagramonly);

Rotational spectroscopy- rotational spectra of rigid and non rigid diatomic rotators, simple polyatomic molecules like CO_2, NH_3,CH_4 and H_2O;

NMR - origin of NMR signal - chemical shift - factors affecting chemical shift and spin-spin coupling — application to ethanol, acetone and ethyl methyl ether.

Total (L+P)= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand in-depth knowledge of atomic and molecular orbitals based chemical aspects.
CO2	:	Realize the nature of periodic properties of elements and the knowledge of acids and bases
CO3	:	Grasp the knowledge of 3D structural aspects of organic molecules and chemical reactions that areused in the synthesis of organic molecules.
CO4	:	Substantiate the various processes involved in thermodynamic considerations and its involvement in electrochemical aspects
CO5	:	Aware of spectroscopic techniques in the field of molecular identification of materials

Text Books:

1.	P.R. Puri, L.R.Sharma and Madan S. Pathania,“Principle of physical chemistry” 47th Vishal PublishingCo, Jalandhar-8
2.	C. N. Banwell and E. M. Mccash, “Fundamentals of Molecular Spectroscopy”, Tata McGraw-HillPublishing Company Limited, New Delhi, 2009.
3.	Raj. K. Bansal — “A Text Book of Organic Chemistry” Revised 4th Ed.,(2005), New Age International Publishers Ltd., New Delhi.
4.	P.S. Kalsi — “Stereochemistry conformation and Mechanism”, 6th Ed., (2005), New Age International Publishers Ltd., New Delhi.

5.	J.D. Lee – “A New Concise Inorganic Chemistry”, 5th Edn., Oxford University Press, 2011.
6.	Wahid Malik, G.D.Tuli and R.D.Madan, “Selected Topic in Inorganic Chemistry”,S.Chand& Co., Ltd(2011).
Reference Books:	
1.	David.W.Ball, Physical Chemistry, Cengage Learning India Pvt. Ltd., New Delhi, 2009
2.	G.Aruldhas, Molecular structure and spectroscopy, second edition, PHI learning Pvt. Ltd., New Delhi,2008
3.	Cotton and Wilkinson – “Advanced Inorganic Chemistry”, 6th Ed., John Wiley & Sons, New York- 2004
4.	James E. Huheey, Ellen A. Keiter and Richard L. Keiter – “Inorganic Chemistry-Principles of Structureand Reactivity”, 4 thEdn., Pearson Education, 11^{th} Impression, 2011.
5.	F.A. Carey and R.J. Sund berg – “Advanced organic chemistry” Vol. I and II– 3rd Ed.,(1984), Plenum Publications
6.	Ernest. Eliel and Samuel H. Wilen — “Stereochemistry of Organic Compounds” — Wiley Student Ed.,(2006). John Wiley and Sons Pvt. Ltd., Singapore.

<table>
<tr><td>18CS101</td><td colspan="2">FUNDAMENTALS OF PROBLEM SOLVING AND C PROGRAMMING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="6">To express problem solving through programming</td></tr>
<tr><td>2.</td><td colspan="6">To practice the basic concepts of C programming language.</td></tr>
<tr><td>3.</td><td colspan="6">To provide the basics knowledge about array and strings to solve simple applications.</td></tr>
<tr><td>4.</td><td colspan="6">To use pointers and functions in the simple applications.</td></tr>
<tr><td>5.</td><td colspan="6">To review the elementary knowledge of structures and unions.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>UNIT I</td><td colspan="3">INTRODUCTION TO COMPUTER AND PROBLEM SOLVING</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="7">Problem formulation, Problem Solving methods, Need for logical analysis and thinking – Algorithm – Pseudocode – Flow Chart - Need for computer languages, Generation and Classification of Computers - Basic Organization of a Computer.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>UNIT II</td><td colspan="3">C PROGRAMMING BASICS AND CONTROL STATEMENTS</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="7">C Character set- Identifies and Keywords- Data Type- Declarations-Expressions-Statements and Symbolic constants- Operators – Arithmetic Operators – Unary operators – Relational and Logical Operators – Assignment operators – Conditional operators- Managing Input and Output operations- Decision Making- Branching and Looping statements.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>UNIT III</td><td colspan="3">ARRAYS AND STRINGS</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="7">Pre-processor directives-Storage classes-Arrays – Initialization – Declaration – one dimensional and two dimensional arrays. Strings - String operations – String handling functions-Simple programs-sorting-searching.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>UNIT IV</td><td colspan="3">FUNCTIONS AND POINTERS</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="7">Function – Library functions and user-defined functions – Function prototypes and function definitions – Call by value –Call by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>UNIT V</td><td colspan="3">STRUCTURES, UNIONS AND FILE</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="7">Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure – Passing structures to functions – Array of structures – Pointers to structures-Union-basic file operation.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7" align="right">Total (L+ T)= 45 Periods</td></tr>
</table>

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Formulate and apply logic to solve basic problems.
CO2	:	Write, compile and debug programs in C language.
CO3	:	Apply the concepts such as arrays, decision making and looping statements to solve real time applications
CO4	:	Solve simple scientific and statistical problems using functions and pointers
CO5	:	Write programs related to structures and unions for simple applications.

Text Books:	
1.	Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India)Pvt. Ltd., Pearson Education in South Asia, 2011. (Unit-I).
2.	E.Balagurusamy, “Programming in ANSI C” fourth Edition, Tata McGraw-Hill, 2008 (Unit II-V).
Reference Books:	
1.	Byron S Gottfried, “Programming with C”, Schaum’s Outlines, Second Edition, Tata McGraw-Hill, 2006
2.	Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education,2006
3.	Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.

18EN102	PROFESSIONAL ENGLISH LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1.	To acquire and develop listening skills for academic, social and professional purposes.
2.	To understand short conversations or monologues
3.	To master basic reading skills such as phonics, word recognition, and fluency
4.	Acquire and develop pre-intermediate level fluency in oral skills such as discourse management, grammar and vocabulary, pronunciation and interactive communication for academic, social and professional purposes
5.	Address an audience and present a topic.
6.	Express an opinion and justify it

Methodology - Listening

List of Audio files:

1. Job Responsibilities
2. Conversation between two employees on company culture
3. Emails
4. Description of gadgets
5. Interview with a leading industrialist
6. Office procedures – applying for permission, placing an order for office equipment,
7. Enquiries about orders and deliveries
8. Conversation between two people on general topics
9. Telephone Messages
10. Fixing and Cancelling appointments
11. Asking for directions
12. Rescheduling a travel plan
13. Tones : Rude and Polite
14. Conversation : Statements, Discussions, Debating, Accepting, Negotiating
15. Conferences ; Announcements about changes in schedules and sessions
16. Motivational Speech
17. TED Talk on Team Work
18. Describing charts and data
19. Presentation at an office
20. Short self-descriptions

METHODOLOGY: - Speaking

1. Self-Introduction — Personal information –Name, Home background, study details, area of interest, hobbies, strengths and weaknesses, projects and paper presentations if any, likes and dislikes in food, clothes, Special features of home town, Personal role models in life, goals and dreams, favorite inspirational quote.

2. Situational Role Play between Examiner and Candidate — Customer and Sales Manager, Hotel Manager and Organiser, Team Leader and Team member, Bank Manager and Candidate, Interviewer and Applicant, Car Driver and Client, Industrialist and Candidate, Receptionist and Appointment Seeker, New Employee and Manager, Employee and Employee, P.A. and Manager Schedule for training,

	Asking for directions, Seeking help with office equipment, Clarifying an error in the bill, Quality of Products, Buying a Product, Selling a Product, cancelling and fixing appointments, hotel accommodation, training facilities, dress code, conference facilities, faculty advisors and student, student and student, college Office personnel and student.

Total (L)= 30 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Infer, interpret and correlate routine, classroom-related conversation
CO2	:	Use a range of common vocabulary and context based idioms.
CO3	:	Comprehend native speakers when they speak quickly to one another, although the student mightstill have trouble.
CO4	:	Identify the most important words in a story/article.
CO5	:	Summarize the main ideas, key details, and inferred meanings from listening passages of up to fiveminutes.
CO6	:	Vocalize words without the aid of pictures
CO7	:	Make effective self-introductions
CO8	:	Study options, compare and contrasts the options
CO9	:	Exercise a choice, justify it by giving examples and illustrations.
C010	:	Construct a situation and to participate in conversations.

Text Books:

1.	Norman Whitby. Business Benchmark –Pre - Intermediate to Intermediate, Students Book, CambridgeUniversity Press, 2014

Recommended Reading and Reference Sources:

1.	Spoken English: A Self-Learning Guide. V. Sasikumar and P V Dhamija.
2.	English Conversation Practice: Grant Taylor Paperback 1976ely. Krishna Mohan, N P Singh
3.	Discussions that Work. Penny Ur. CUP, 1981
4.	http://www.onestopenglish.com/skills/speaking/speaking-matters/
5.	Speak Better Write Better English Paperback - November 2012 Norman Lewis, Goyal Publishers andDistributors.

18CS102	COMPUTER PRACTICE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To provide basic knowledge of creating Word documents and also producing mail merge
2.	To make use of basic functions, formulas and charts in Spread sheet
3.	To implement problem solving techniques.
4.	To promote the programming ability to develop applications for real world problems

EXPERIMENTS

A. Word Processing

1. Document creation, Text manipulation with Scientific notations, Table creation, Table formatting and Conversion
2. Letter preparation using Mail merge and Draw flow Charts using tools

B. Spread Sheet

3. Chart - Line, XY, Bar and Pie.
4. Formula - formula editor, Sorting and Import and Export features.
5. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.

C. Simple C Programming

6. Program using Control statements.
7. Program using Looping.
8. Program using Array.
9. Program using String.
10. Program using Function.
11. Program using Structures.
12. Program using Pointers.
13. Program using Files.

*** For programming exercises Flow chart and pseudo code are essential**

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Demonstrate the basic mechanics of Word documents and working knowledge of mail merge.
CO2	:	Demonstrate the use of basic functions and formulas in Spread sheet.
CO3	:	Apply good programming methods for program development.
CO4	:	Implement C programs for simple applications.

18ME102	WORKSHOP MANUFACTURING PRACTICES	L	T	P	C
		1	0	4	3

Course Objectives:

1.	To provide an exposure of basic engineering practices to the student
2.	To provide exposure to the students with hands on experience on various basic engineering practices inCivil and Mechanical Engineering

EXPERIMENTS

1.	Introduction to Safety measures and First aid.
2.	Study of Lathe -Welding methods and equipment's- Casting process and tools- Sheet metal and fittingtools-Carpentry tools and joints.
3.	Fitting: V-fitting, Square fitting, Curve fitting.
4.	Lathe: Facing, turning, taper turning and knurling.
5.	Welding: BUTT, LAP and T- joints.
6.	Foundry: Green sand preparation- mould making practice.
7.	Sheet metal: Cone, tray, cylinder.
8.	Carpentry: CROSS, T and DOVETAIL joints.
9.	Drilling: simple exercises.

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Prepare fitting of metal and wooden pieces using simple fitting and carpentry tools manually.
CO2	:	Prepare simple lap, butt and tee joints using arc welding equipment.
CO3	:	Prepare green sand moulding.
CO4	:	Prepare sheet metal components.
CO5	:	Prepare simple components using lathe and drilling machine.

Reference Books:

1.	Bawa, H.S, "Work shop Practice", Tata McGraw Hill Publishing Company Limited, 2007.

2.	Jeyachandran, K, Natarajan, K and Balasubramanian, S, “A Primer on Engineering PracticesLaboratory”, Anuradha Publications, 2007.
3.	Jeyapoovan, T, SaravanaPandian, M and Pranitha, S, “Engineering Practices Lab Manual”,VikasPuplishing House Pvt. Ltd, 2006.

18EN301	Effective Technical Communication	L	T	P	C
		2	0	2	3

Course Objectives:

To help students

1.	• to participate actively in technical writingactivities.
2.	• to apply technical information and knowledge in practicaldocuments.
3.	• to revise and edit draftseffectively
4.	• to develop professional workhabits.

Methodology		L

- Technical Writing – writing reports - project report and event report, newsletter,technical articles, draft writing, official notes, business letters, progress reports, and minutes of meetings.
- Basics of grammar – tenses, phrasal verbs, punctuations, prepositions, study ofadvanced grammar – sentences cohesion and coherence, Idioms andphrases.
- Developing Professional work habits, Self-development and Assessment, Personalgoal setting, career planning, E-mail etiquettes, Telephoneetiquettes.
- Interview preparation, power-point presentation, groupdiscussions.
- Speaking on advanced technical topics, project review, public speaking, defendingopinions, review of newspaperarticles.

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	*:*	Prepare error free technical document reports and drafts efficiently.
CO2	*:*	Wirte technical documents grammatically sound
CO3	*:*	Be creative in setting targets in the work place.
CO4	*:*	Answer questions posed by interiviewers confidentially
CO5	*:*	Form opinions, orgnaise ideas, illustrate points, explain and defend viewpoint.

Text Books/ Reference Books:

1.	David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York,2004
2.	Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843)
3.	Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
4.	Evans, D, Decision maker, Cambridge University Press, 2010.
5.	Sanjay kumar and Pushp Lata, Language and Communications skills for engineers, Oxford University press, India, 2018
6.	Muralikrishna, C and Sunita Mishra, Communication Skills for engineers, Pearson Education India ltd, 2011
7.	Ronald Carter, Michael Mc Carthy, Geraldine Mark and Anne O Keeffe, English Grammar Today, Cambridge University Press, India, 2016.

18MA302	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To understand the statistical averages and fitting of curves.
2.	To gain the knowledge of significance test for large and small samples.
3.	To obtain the knowledge about numerical interpolation, differentiation and integration.
4.	To acquire knowledge of numerical solution to first order ordinary differential equations usingsingle step and multi step methods.
5.	To gain the knowledge of numerical solution to second order partial differential equations byusing explicit and implicit methods.

Unit I	BASIC STATISTICS	12	+	0

Measures of Central tendency: Moments, Skewness and Kurtosis, Curve fitting by the Method of Least Squares –Fitting of straight lines, second degree parabolas and curves reducible to linear forms.

Unit II	TEST OF HYPOTHESIS	12	+	0

Test of significance: Large Sample tests for Single proportion, difference of proportions, single meanand difference of means- Small Sample test for single mean, difference of means and correlation co-efficient, test for ratio of variances - Chi-square test for goodness of fit and independence ofattributes.

Unit III	INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION	12	+	0

Solution of Algebraic and Transcendental equations by Newton-Raphson method- Solution of system of equations by Gauss Elimination and Gauss Seidal iterative methods - Interpolation using Newton's ForwardandBackwardformulae.Interpolationwithunequalintervals:Newton'sdivideddifference and Lagrange's formulae Numerical Differentiation and Integration: Trapezoidal rule and Simpson's 1/3 rule, Simpson's 3/8 rule.

Unit IV	NUMERICAL SOLUTION FOR ORDINARY DIFFERENTIAL EQUATIONS	12	+	0

Ordinary differential equations: Taylor series method- Euler and modified Euler's method- Runge- Kutta method of fourth order for solving first and second order differential equations- Milne's and Adam's predictor - corrector methods.

Unit V	NUMERICAL SOLUTION FOR PARTIAL DIFFERENTIAL EQUATIONS	12	+	0

Partial differential equations: Finite difference solution of two dimensional Laplace and Poisson equations- Implicit and Explicit methods for one dimensional heat equation (Bender Schmidt and Crank-Nicholson methods) - Finite difference explicit method for wave equation.

Total= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Learn about statistical averages and fitting the curves by Least Square Method
CO2	:	Acquire the techniques of interpolation.
CO3	:	Familiar with the numerical differentiation and integration
CO4	:	Solve the initial value problems for ordinary differential equations.
CO5	:	Find the numerical solution of partial differential equation by using Finite difference method.

Text Books:

1.	Veerarajan T, “Probability and Random Process (With Queuing theory)”, 4th Edition, Tata McGraw

	Hill Education Pvt. Ltd., New Delhi, 2016.
2.	Kandasamy.P, Thilagavathy.K, Gunavathi.K, “Numerical Methods” S.Chand& Co., New Delhi, 2005.
3.	Gupta, S.C. and Kapur, V.K., “Fundamentals of Mathematical Statistics”, S.Chand and Sons, New Delhi, 11thEdition 2014
Reference Books:	
1.	Fruend John, E. and Miller Irwin, “Probability and Statistics for Engineers”, 8thEdition, Prentice Hall India (P) Ltd, 2010.
2.	Gerald, C. F. and Wheatley, P.O., “Applied Numerical Analysis” , Sixth Edition , PearsonEducation Asia , New Delhi – 2002
3.	M.K.Venkataraman, “Numerical Methods”, National Publishing Company,2000
4.	Jain M.K.Iyengar, K & Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International (P) Ltd, Publishers 2003

18CY301	BIOLOGY FOR ENGINEERS	L	T	P	C
		2	1	0	3

Course Objectives:

1. To introduce students to modern biology with an emphasis on evolution of biology as a multi-disciplinary field and to make them aware of biological principles. The course will facilitate the students to:
   - Realize that all forms of life have the same buildingblocks.
   - Convey that without catalysis life would not have existed onearth.
   - Know the analysis of biological processes at the reduction level
   - Comprehend the fundamental principles of energy transactions are the same in physicaland biologicalworld.

   Understand the fundamentals about the molecular basis of coding and decoding

Unit I	BIOMOLECULES	9	+	0

Carbohydrates- classification - Glucose properties and structural elucidation –fructose, sucrose, starch - structure only; Amino acids- classification- amphoteric nature of amino acids - zwitter ion - isoelectric point reactions of amino acids; Vitamins - general characteristics- classification- functionand deficiency diseases.

Unit II	ENZYMES	9	+	0

Nomenclature - structure of enzymes – enzyme cofactors- properties of enzymes(catalytic properties, specificity, reversibility, sensitiveness to heat and inhibitors, colloidal nature)- mechanism of theenzyme action- lock and key mechanism and koshland induced fit mechanism -Factors affecting rateof enzyme reaction(temperature, pH, substrate concentration, enzyme concentration, water inhibitors, end product accumulation)- enzyme kinetics –michaelis-menten equation.

Unit III	MACROMOLECULES	9	+	0

Proteins- classification- structure of proteins- primary, secondary, tertiary and quaternary structure- properties of proteins- physical and chemical properties- colour reaction of proteins (biuret reaction, millions reaction, xanthoproteic reaction, ninhydrin reaction, azo dye reaction Hopkins Cole reaction)
-Protein synthesis- mechanism of protein synthesis.

Unit IV	METABOLISM	9	+	0

Thermodynamics as applied to biological systems - exothermic and endothermic versus endergonic and exergonic reactions- concept of equilibrium constant and its relation to standard free energy- spontaneity - structure of ATP; Glycolysis- definition- flow chart- steps involved in glycolysis- preparatory phase and pay off phase- kinds of reactions in glycolysis; Photosynthesis- definition- significance photosynthetic- pigments types- structure of pigments factors affecting photosynthesis-
external and internal factors.

Unit V	NUCLEIC ACIDS	9	+	0

Types-Structural components of nucleic acids- acid, pentose sugar and nitrogenous base- nucleoside – nucleotide and its functions - single and double helical structure of DNA-comparison between DNA and RNA- types of RNA- transcription -mRNA, tRNA and rRNA and their function - replication ofDNA- genetic codecharacteristics

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Appreciate that all types of life have the identical structural units
CO2	:	Highlight the idea that without catalysis, living beings would not have existed on earth.
CO3	:	Be familiar with the investigation of biological processes at the reduction level.
CO4	:	Figureoutthat the primaryprinciplesofenergytransactionsarealikeinphysicaland biological world.
CO5	:	Recognize the ground rules about the molecular basis of coding and decoding.

Text Books:	
1.	FJ.L.Jain, Sanjay jain and Nitin jain- “Fundamentals of Biochemistry” - Sixth edition, S.Chandand company Ltd., Ram nagar, 2005.
2.	Dr.A.V.S.S.Rama Rao-“ Text book of Biochemistry”- Text book of Biochemistry- First edition- UBS Publishers' Distributors Pvt. Ltd., 2008
3.	U. Satyanarayana –“ Biochemistry”-5th edition – Sri Padmavathi Publications Ltd.,2017.
Reference Books:	
1.	Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B.-“ Biology: A global approach”- Pearson Education Ltd
2.	Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H-“ Outlines of Biochemistry”- John Wiley and Sons
3.	By Nelson, D. L.; and Cox- “Principles of Biochemistry”- V Edition- M. M.W.H. Freeman and Company
4.	Stent, G. S.; and Calender-“ Molecular Genetics”- Second edition - R. W.H. Freeman andcompany, Distributed by Satish Kumar Jain for CBS Publisher

18ES205	MECHANICS OF SOLIDS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Understand the vectorial and scalar presentation of forces and momentum
2.	Understand the mechanical behaviour of materials.
3.	Understand the concept of stress and strain in different types of structures with different loading conditions.
4.	Familiarize about in the determination of shear force and bending moment in various types of beams with different loading conditions.
5.	Solve practical problems related to springs and shafts

Unit I	PROPERTIES OF SURFACE	9	+	0

System of forces – areas and volumes – centroid – centre of gravity – theorem of Pappus – Guildinus – First, second and product moment of inertia of various sections – Parallel axis and perpendicular axis theorem – polar moment of inertia – principal moment of inertia of plane areas

Unit II	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9	+	0

Stress and strain due to axial force – elastic limit – Hookes's law – factor of safety – lateral strain – Poisson's ratio – volumetric strain – changes in dimensions and volumes- shear stress – shear strain – relationship between elastic constants. Stepped bars – uniformly varying sections – composite bar –stresses due to temperature. Strain energy due to axial force- proof resilience and modulus of resilience

Unit III	SHEAR FORCE AND BENDING MOMENT DIAGRAMS	9	+	0

Relationship between load, shear force and bending moment – shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads and concentrated moment – maximum bending moment and point of contraflexure.

Unit IV	STRESSES DUE TO BENDING AND SHEAR	9	+	0

Theory of simple bending and assumptions – analysis of beams for stresses – stresses distribution at acrosssectionduetobendingmomentandshearforceforcantilever,simplysupportedand overhanging beams with different loading conditions.

Unit V	TORSION AND COMPLEX STRESSES (Two dimensions only)	9	+	0

Theory of torsion and assumptions – derivation of torsion formula – polar modulus – stresses in solid and hollow circular shafts – power transmitted by a shaft.
State of stress at a point – normal and tangential stresses and their planes – principal stresses and their planes – plane of maximum shear stress – analytical method

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Determine the resultant forces and moment for the given system
CO2	:	Analyse planar and spatial systems of forces and determine the centroid and moment of inertias.
CO3	:	Thorough understanding of fundamental concepts of stress and strain in mechanics of solids and structures

CO4	:	The ability to analyse the beams to determine shear force and bending moments
CO5	:	Sufficient knowledge in design shafts to transmit required power and springs for itsmaximum energy

Text Books:

1.	Bhavikatti S S strength of materials, Vikas Publishing House Pvt ltd., New delhi, Second edition2013
2.	Rajput RK, Strength of materials ,S.Chand& Company ltd, New Delhi, 2018
3.	Bansal R.K., Engineering Mechanics, Laxmi Publications (P) Ltd., 2015.
4.	Kottiswaran N, Engineering Mechaics, Sri Balaji Publications, 2010.
5.	Bansal R.K., Strength of materials , Laxmi Publications (P) Ltd., 20016.

Reference Books:

1.	Beer and Johnson, Vector Mechanics for Engineers: Statics and Dynamics Tata Mc Graw Hill,2017
2.	Kumar K.L., Engineering Mechanic, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
3.	Punmia B C Jain and Jain AK, Strength of materials and theory of structures, vols. I and II, XI Edition, Laxmi Publications P Ltd, New Delhi 2017
4.	Ramamurtham S and Narayanan R, Strength of Materials, Dhanpat Rai Publishing Company PvtLtd, Reprint 2014

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE301	MECHANICS OF FLUIDS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the basic property of fluid
2.	To gain knowledge of fluid static dynamic and kinematics
3.	To understand and solve the problem related to equations of motions
4.	To understand and solve the boundary layer problems
5.	To study the application of similitude

Unit I	FLUID PROPERTIES	9	+	0

Fluid and Fluid properties – density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension. Pressure – Pascal's law -Relationship between pressures – pressure measurements by manometers.

Unit II	FLUID STATICS & KINEMATICS	9	+	0

Fluid Statics: Hydrostatic forces on plane and curved surfaces – Total pressure and centre of pressure – equilibrium of floating and submerged bodies - Meta centre – metacentric height.
Fluid Kinematics: Flow visualization – types of flow – lines of flow - velocity and acceleration - Continuity equation (one, two and three dimensional forms) – Stream function – velocity potentialfunction – flow nets – Measurement of Velocity

Unit III	FLUID DYNAMICS	9	+	0

Equations of motion – Euler's equation of motion along a streamline - Bernoulli's equation – applications – Venturi meter, Orifice meter, Pitot tube, Laminar flow – viscous flow through pipes andbetween parallel plates – Hagen- Poiseuille equation. Turbulent flow – Darcy-Weisbach formula – Moody diagram.

Unit IV	FLOW THROUGH PIPES AND BOUNDARY LAYER	9	+	0

Major and minor losses of flow in pipes – Hydraulic Gradient Line – Total Energy Line - Pipes in seriesand in parallel – power transmission through pipes.
Definition of boundary layer – Thickness and classification – separation of boundary layer – Methods of preventing the separation.

Unit V	DIMENSIONAL AND MODEL ANALYSIS	9	+	0

Dimensional Analysis – Rayleigh's method, Buckingham's Pi-Theorem. Model analysis – Types of Similitude – Dimensionless numbers – Model Laws – classification of Models - Scale effect.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the fundamentals of Fluid Mechanics
CO2	:	Determine the properties of fluid and pressure and their measurement
CO3	:	Compute forces on immersed plane and curved plates
CO4	:	Apply continuity equation and energy equation in solving problems on flow through conduits
CO5	:	Compute the frictional loss in laminar and turbulent flows

Text Books:

1.	Bansal R.K., *Fluid Mechanics and Hydraulic Machines,* 9thEdition, Laxmi Publications(P) Ltd,New Delhi, 20013
2.	Modi P.N., Seth S.M., *Hydraulics and Fluid Mechanics Including Hydraulic Machines*, 14thEdition, Standard Book House, 2002.
3.	Rajput R.K., *A text book of Fluid Mechanics in SI Units*, S.Chand and Company, New Delhi, 2008

Reference Books:	
1.	Streeter, Victor L. and Wylie, Benjamin E., *Fluid Mechanics*, McGraw-Hill Ltd., 2010
2.	Jain AK, Fluid mechanics including hydraulic machines, Khanna Publication, 2015
3.	White FM, Fluid mechanics, Tata Mc Graw Hill, New Delhi, 2017
4.	Fox, Robert W. and Macdonald, Alan,T., *Introduction to Fluid Mechanics*, John Wiley & Sons,1995
5.	Subramanya K, Flid mechanics and hydraulic machines, Tata Mc Graw Hill, New Delhi 2010

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE302	SURVEYING AND GEOMATICS		L	T	P	C
			3	0	0	3

Course Objectives:

1.	To understand the importance of surveying in the field of civil engineering
2.	To study the basics of linear/angular measurement methods like chain surveying, compasssurveying
3.	To know the basics of levelling and theodolite survey in elevation and angular measurements
4.	To understand tacheometric surveying in distance and height measurements
5.	To get introduced to modern advanced surveying techniques involved such as Total station and GPS
6.	Operate a total station to measure distance, angles, and to calculate differences inelevation. Reduce data for application in a geographic information system,

Unit I	INTRODUCTION TO CHAIN AND COMPASS SURVEYING	9	+	0

Definition- Classifications - Basic principles- Classification - Field work and office work - Types of chain - methods of ranging a line – Maps-Scale, adjustment in wrong observations- uses of chain, cross - staff and optical square - sources and limits of error and their correction. Magnetic and true north, magnetic declination and its variation - Bearings - Prismatic compass - Surveyor's compass - compass survey - local attraction and its elimination - Traversing.

Unit II	LEVELLING AND ITS APPLICATIONS	9	+	0

Level line - Horizontal line - Datum - Bench marks -Levels and staves - temporary and permanent adjustments – Methods of levelling - Fly levelling - Check levelling - Procedure in levelling - Booking -Reduction - Curvature and refraction - Reciprocal levelling – Contouring - Methods -Characteristics and uses of contours

Unit III	THEODOLITE SURVEYING	9	+	0

Theodolite surveying – Study oftheodolite – Temporary and permanent adjustments – Measurementofhorizontalangelsbyreiterationandrepetition–Measurementofverticalangles- Trigonometrical surveying -Traversing – Co-ordinate system-Closing error and distribution – Conditions for closure - Omitted measurements- Triangulation of survey

Unit IV	TACHEOMETRIC SURVEYING AND CURVES	9	+	0

Tacheometric surveying – Principles – Methods – Stadia system –Fixed and Movable hair methods – Methods with staff held vertical and normal – Analytic lens – Subtense bar – Tangential method. Curves - Elements of simple, compound, Reverse and Transition curve – length of curve – Verticalcurves with application.

Unit V	CONSTRUCTION AND MODERN FIELD SURVEY SYSTEMS	9	+	0

Procedures for setting out a building - pipelines - sewers – Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications, Field Procedure for total station survey, Errorsin Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracy considerations

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Use conventional surveying tools such as chain/tape, compass, level in the field of civil engineering applications such as structural plotting and highway profiling
CO2	:	Apply the procedures involved in field work and to work as a surveying team
CO3	:	Plan a survey appropriately with the skill to understand the surroundings

CO4	:	Take accurate measurements, field booking, plotting and adjustment of errors can beunderstood
CO5	:	Invoke advanced surveying techniques over conventional methods in the field of civil engineering

Text Books:

1.	*Duggal, S.K. Surveying Vol. I and II, Tata McGraw Hill, 2004.*
2.	Punmia B.C., *Surveying, Vols. I, II and III,* Laxmi Publications, 1989.

Reference Books:

1.	Clark D., *Plane and Geodetic Surveying*, Vols. I and II, C.B.S. Publisher and Distributors, Delhi, Sixth Edition,1971.
2.	James M.Anderson and Edward M.Mikhail, *Introduction to Surveying*, McGraw-Hill BookCompany, 1985.
3.	Wolf P.R., *Elements of Photogrammetry*, McGraw-Hill Book Company, Second Edition, 1986.
4.	Robinson A.H., Sale R.D. Morrison J.L. and Muehrche P.C., *Elements of Cartography*, John Wiley and Sons, New York, Fifth Edition, 1984.
5.	HeribertKahmen and Wolfgang Faig, *Surveying*, Walter de Gruyter, 1995.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE303	SURVEYING PRACTICAL	L	T	P	C
		0	0	4	2

Course Objectives:

1	To know the importance of basic surveying equipment
2	To able to measure the linear and angular measurements with help of various equipment
3	To identify points in both vertical and horizontal plane by using Dumpy level
4	To estimate the stadia constants in stadia diaphragm
5	To able to handle the modern equipment such as EDM,GPS and Total station

List of Experiments:

1. Measurements of length using chain, Cross-staff and its accessories
2. Distance between the two inaccessible points using compass and compasstraversing
3. Plane table surveying: Radiation andIntersection
4. Differential Levelling using Dumpy level – Reduction by Rise and Fall & Height of Collimation Method
5. Road project –Longitudinal Sectioning and Cross Sectioning
6. Contouring
7. Theodolitetraversing
8. Heights and distances – Inaccessible stations – Single planemethod
9. Heights and distances – Inaccessible stations – Double planemethod
10. StadiaTacheometry
11. TangentialTacheometry.
12. SubtenseBar
13. Setting out works - Simple curve (right/left-handed).
14. Study of EDM &GPS
15. Setting out works – Buildings, Area Calculation using TotalStation

Total = 60 Periods

Course Outcomes:

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

CO1	:	handling the equipment Theodolite to find out the horizontal and vertical angles
CO2		find out the elevation of the required points with respect to reference plane
CO3		use the modern equipment like EDM, GPS and Total station with its applications
CO4		learn to set out the simple curve in the field
CO5		learn to set out the foundation of a building in the field

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE304	COMPUTER AIDED BUILDING DRAWING	L	T	P	C
		0	0	4	2

Course Objectives:	
1.	To impart knowledge on development and control rules satisfying orientation and functional requirements
2.	At the end of this course the student should be able to draft the building drawings manually
3.	At the end of this course the student should be able to draft the building drawings by usingComputer
EXPERIMENTS	
1.	Part-A Building drawing in accordance with development and control rules satisfying orientationand functional requirements for the following: (20 hours) 1. Residential buildings with load bearing walls (RCCroof) 2. RCC framedstructures 3. Office buildings (RCCroof) 4. Industrial Buildings-North light roof truss 5. Perspective view for smallbuildings
2.	Part-B Fundamental Commands of Drafting Software to Draft the building Drawings(10 Hours) Building drawing in accordance with development and control rules satisfying orientationand functional requirements using computer aided software for the following : (20 Hours) 1. Residential buildings with load bearing walls (RCCroof) 2. RCC framedstructures 3. Office buildings (RCC roof) Perspective view for smallbuildings
	Total 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	The students will be able to draft the plan, elevation and sectional views of the buildings manually
CO2	:	The students will be able to draft the plan, elevation and sectional views of the buildingsusing computer softwares.
CO3	:	The students will be able to draft the plan, elevation and sectional views of the framed buildings using computer softwares.
CO4	:	The students will be able to draft the plan, elevation and sectional views of theindustrial structures using computer softwares.

Reference Books:

1.	Verma B.P., Building Drawing- Khanna publishers.
2.	IS: 962-1967 Code of Practice for Architectural and Building Drawing.

E-References:

1.	https://nptel.ac.in/courses/112102101/- Computer Aided Design (NPTEL)
2.	https://www.autodesk.in/campaigns/autocad-tutorials-
3.	https://knowledge.autodesk.com/support/civil-3d/getting-startedl-

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE401	STRENGTH OF MATERIALS	L	T	P	C
		3	1	0	4

Course Objectives:

1.	To study the different methods of determining deflection of determinate and indeterminatebeam.
2.	To anlayse the column with different end conditions
3.	To impart knowledge on analysis of simple and special structures to find internal forces / stresses using various theorems / theories

Unit I	DEFLECTION OF DETERMINATE BEAMS	9	+	3

Governing differential equation –Double integration method- Macaulay's method Moment Area method -Strain energy and Dummy unit load approaches – Castigliano's first and second theorems.

Unit II	STATICALLY INDETERMINATE BEAMS	9	+	3

Propped cantilever beams – Fixed beams – Continuous beams – Theorem of three moments – Calculation of reactions – Bending Moment and Shear Force diagrams

Unit III	THEORY OF COLUMNS	9	+	3

Members subjected to axial Load – Slenderness ratio – End conditions – Buckling load for columns-Euler's theory – Assumptions and limitations – Rankin-Gordon formula – Empirical formula – Straight line formula – Columns subjected to eccentric loading

Unit IV	UNSYMMETRICAL BENDING AND SHEAR CENTRE	9	+	3

Stresses due to unsymmetrical bending of beams for symmetrical sections – Shear Centre - Definition – Shear centre for sections symmetrical about one axis – Moment of Inertia – Product of Inertia – Principal axes and Principal moment of Inertia – Deflection of beams due to unsymmetrical bending

Unit V	THIN ,THICK CYLINDERS AND ELASTIC FAILURES	9	+	3

Lame's equation – Hoop stress and radial stress distribution – Compound cylinders – Wire woundcylinders.
THEORIES OF ELASTIC FAILURE: Maximum principal stress theory – Maximum principal strain theory – Maximum shear stress theory - Maximum strain energy theory – Maximum shear strain energy theory – simple problems
Complex stresses – Stress at point- normal and tangential stresses and their planes – principal stress and planes – analytical method

Total (45+15)= 60 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply the principle of various theorems in measurement of slope and deflection
CO2	:	Different stress developed in thin, thick cylinders and spherical shells
CO3	:	Visualize the behavior of column for combined bending and axial loading
CO4	:	Demonstrate the different theories of failure for brittle and ductile materials
CO5	:	Apply the different methods in unsymmetrical bending analysis

Text Books:

1.	Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2007
2.	Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.

Reference Books:	
1.	Timoshenko.S.B. and Gere.J.M, “Mechanics of Materials”, Van Nos Reinbhold, New Delhi 1995.
2.	Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House, New Delhi 1997.
3.	Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
4.	Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co., New Delhi, 2003
5.	William A .Nash, “Theory and Problems of Strength of Materials”, Schaum’s Outline Series, Tata McGraw Hill Publishing company,2007

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongl

18CE402	DESIGN OF STEEL STRUCTURAL ELEMENTS (Use of IS 800 – 2007 & Steel tables are permitted)	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To learn IS 800-2007 code of practice for the design of Compression, Tension and Flexural members using various cross-sections
2.	To study the behaviour and design of compression and tension members using simple andbuilt-up sections
3.	To understand behaviour of flexural members and the design laterally restrained beams
4.	To study the design of bolted and welded connections and arranging field visit to industries

Unit I	INTRODUCTION	9	+	0

CONCEPTS OF STRUCTURE: Structural form: Classification of structures based on function, material and shape - different structural systems - basic structural requirements - stability, strength and stiffness. STRUCTURAL LOADS: Dead load - live load - wind load – dynamic and seismic load – thermal load – settlement load – buoyant load – snow load. DESIGN CONCEPTS: Design Process: Codes of practice - Working Stress Method - Limit State Method of Design - Probabilistic approach to design - load and resistance factor design. STEEL STRUCTURES: Introduction: Material - properties of steel– behavior-structural steel sections – Limit State Design
Concepts– Loads on Structures – load combinations – partial safety for materials – load safety factors. Other properties: durability – fatigue – fire protection.

Unit II	CONNECTIONS	9	+	0

Metal joining methods using welding, bolting – Design of bolted and welded joints – weld symbols – strength of fillet and butt welds - Efficiency of joints – High Tension bolts

Unit III	TENSION MEMBERS	9	+	0

Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shearlag

Unit IV	COMPRESSION MEMBERS	9	+	0

Types of compression members – Theory of columns – Current codal provision for compression member design – Slenderness ratio – Design of compression members – Design of lacing and batten – Design of column bases – Gusseted base

Unit V	BEAMS	9	+	0

Laterally supported beams: classification of sections – simple and compound sections – calculation of plastic modulus of section – flexural strength of beams- design considerations – behavior of web under shear – shear check – deflection check- bearing strength of web – buckling strength of web- web buckling –web crippling.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply the IS code of practice for the design of steel structural elements
CO2	:	Analyze the behavior of bolted connections and design them to tension, compression andbending members.
CO3	:	Design compression and tension members using simple and built-up sections

CO4	:	Design of steel beams with end conditions.

Text Books:	
1.	*Duggal S.K., Limit State Design of Steel Structures, Tata McGraw-Hill Publishing Company , New Delhi, 2010.*
2.	Subramanian N., *Design of Steel Structures*, First edition, OXFORD university press, 2008
3.	Jayagopal L S, 'Structural Steel Design", Vikas Publications, 2012
Reference Books:	
1.	Bhavikatti S. S., *Design of Steel Structures by Limit Method*, I.K. International Pvt Ltd, New Delhi, 2009.
2.	Ramchandra S., & Virendra Gehlot ., *Limit State Design of Steel Structures*, Standard Publication, New Delhi, 2009.
3.	*Teaching Resources for Structural Steel Design* – Vol. I & II, INSDAG, Kolkatta.
4.	*IS 800:2007 Code of practice for general construction steel*
5.	*SP 6 IS Structural steel Design Illustrated Hand book*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE403	ENGINEERING GEOLOGY	L	T	P	C
		2	0	0	2

Course Objectives:

1. To understand the importance of geological knowledge such as earth, earthquake, volcanism.
2. To apply this knowledge in projects such as construction of dams, tunnels, bridges, roads, airport and harbor as well as to choose types of foundations

UNIT I	PHYSICAL GEOLOGY	9	+	0

Introduction to role of geology in civil engineering – Various core and applied branches of geology – Interior structure of earth and composition – Introduction to Continental drifting & Plate Tectonics, Earthquakes and Volcanoes – Weathering and types – Geological work of river, wind, and groundwater.

UNIT II	MINERALOGY	9	+	0

Elementary knowledge on symmetry elements of important Crystallographic systems – Physical properties of common rock forming minerals – Properties and Engineering significance of the following minerals – Quartz family, Feldspar family, Augite, Hornblende, Biotite, Muscovite, Calcite, Garnet and Clay minerals — Elementary knowledge on Ore minerals, Coal and Petroleum.

UNIT III	PETROLOGY	9	+	0

Classification of rocks - Description, Occurrence, Distribution and Engineering properties of the following rocks: Igneous rocks – Granite, Syenite, Diorite, Gabbro, Pegmatite, Dolerite, Basalt and Rhyolite; Sedimentary rocks – Sandstone, Limestone, Shale, Conglomerate and Breccia; Metamorphic rocks - Quartzite, Marble, Slate, Phyllite, Gneiss and Schist.

UNIT IV	STRUCTURAL GEOLOGY	9	+	0

Attitudes of beds – Introduction to Geological maps and their importance in civil engineering projects - Uses of Clinometer and Brunton compass in geological mapping - Genesis and Classification of the following geological structures; Folds, faults and joints.

Unit V	GEOLOGICAL INVESTIGATIONS FOR CIVIL ENGINEERING	9	+	0

Introduction to Aerial and Satellite Remote sensing – Role of Geophysical investigations in civil engineering projects – Electrical resistivity and Seismic methods - Geological conditions necessary for the construction of Dams, Tunnels, Bridges and Road cuttings – Types, Causes and prevention of Landslides – Coastal erosion and coastal protection.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Identify the problems associated with underground excavations
CO2	:	Classify the rock mass using the reference data
CO3	:	Understand the failure criteria of rocks
CO4	:	Understand various natural hazards, their causes and effects.

Text Books:

1. Parbin Singh. A Text Book of Engineering and General Geology, S.K.Kataria and Sons, Delhi, Sixth Edition, 1998
2. Garg S.K. Physical and Engineering Geology, Khanna Publishers, Delhi, Third Edition, 1999

Reference Books:

1. Mahapatra G.B. A Text Book of Geology, CBS Publishers & Distributers, New Delhi, Third Edition, 2000.

2.	*Bell F.G. Fundamentals of Engineering Geology, BS Publications, Hyderabad, 2005.*
3.	*Gokhale K.V.G.K. Principles of Engineering Geology, BS Publications, Hyderabad, 2005*
4.	*Mahapatra G.B. A Text Book of Physical Geology, CBS Publishers & Distributers, Delhi, 1999*
5.	*P.C. Varghese Engineering Geology for Civil Engineers, PHI Leaarning Pvt. Ltd., New Delhi*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE404	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

To equip the students with the principles and design of water treatment and distribution.

Unit I	SOURCES OF WATER	9	+	0

Public water supply system – Planning, Objectives, Design period, Population forecasting; Waterdemand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

Unit II	CONVEYANCE FROM THE SOURCE	9	+	0

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

Unit III	WATER TREATMENT	9	+	0

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation –Clarifloccuator-Plate and tube settlers - Pulsator clarifier - sand filters - Disinfection - Residue Management –Construction,Operation and Maintenance aspects.

Unit IV	ADVANCED WATER TREATMENT	9	+	0

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems – RO Reject Management - Iron and Manganese removal - Defluoridation -Construction and Operation & Maintenance aspects – Recent advances.

Unit V	WATER DISTRIBUTION AND SUPPLY	9	+	0

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs – Functions – Network design – Economics – Analysis of distribution networks -Computerapplications – Appurtenances – Leak detection.

Principles of design of water supply in buildings – House service connection – Fixtures andfittings, systems of plumbing and types of plumbing.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	an insight into the structure of drinking water supply systems, including watertransport, treatment and distribution
CO2	:	an understanding of water quality criteria and standards, and their relation to publichealth
CO3	:	the ability to design and evaluate water supply project alternatives on basis of chosenselection criteria

Text Books:

1.	Garg, S.K. Environmental Engineering, Vol.IKhanna Publishers, New Delhi, 2010.
2.	Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
3.	Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2010.

Reference Books:

1.	Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development,Government of India, New Delhi, 2013.
2.	Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Plant.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE405	APPLIED HYDRAULICS AND FLUID MACHINERY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study open channel flow characteristics including hydraulic jump and surges.
2.	To study the performance characteristics of hydraulic machines
3.	To impart knowledge on basic concepts of open channel flow and types of flow.
4.	To impart knowledge about Classification of pumps and Air vessels, indicator diagrams.
5.	To develop the abilities to analyse flow characteristics in open channel and design hydraulic machines.

Unit I	OPEN CHANNEL FLOW	9	+	0

Open channel flow – Types and regimes of flow – Wide open channel – Specific energy – Critical flowand its computation. Uniform flow – Velocity measurement – Manning's and Chezy's formula – Determination of roughness coefficients – Determination of normal depth and velocity – Mosteconomical sections.

Unit II	VARIED FLOW	9	+	0

Dynamic equations of gradually varied flow – Assumptions – Draw down and back water curves - Characteristics of flow profiles — Profile determination – Graphical integration, direct step and standard step method - Hydraulic jump – Types – Energy dissipation – Flow through transitions.

Unit III	MOMENTUM PRINCIPLE	9	+	0

Impulse Momentum equation – Application of linear momentum principle – Impact of jet – forceexerted by a jet on normal, inclined and curved surfaces for stationary and moving cases – angularmomentum principle – construction of velocity vector diagrams – jet propulsion of ships.

Unit IV	HYDRAULIC TURBINES	9	+	0

Classification – working principles and design of Pelton wheel, Francis and Kaplan turbines – Velocity triangles – efficiencies – draft tube - theory and types – Specific speed – operating characteristics – Governing of turbines.

Unit V	PUMPS	9	+	0

Classification - Centrifugal pump – working principle –velocity triangle - minimum speed to startthe pump – multistage pumps – Specific speed - performance curves – Reciprocating pump– components and working – slip - indicator diagram and its variation - air vessel – working principleof Jet pump, Submersible pump and Gear pump.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Visualize fluid flow phenomena observed in Civil Engineering systems such as flow in a pipe, flow measurement through orifices, mouth pieces, notches and weirs
CO2	:	Analyze fluid flows in open channel hydraulics and devices such as weirs and flumes
CO3	:	Apply dimensional analysis
CO4	:	To study types of centrifugal Pumps, work done and efficiency of the different types centrifugal pumps and also study about performance of pumps & characteristic curves
CO5	:	To study about specific speed and performance characteristics of different types ofturbines

Text Books:

1. Ramamirtham S., *Fluid Mechanics and Hydraulics and Fluid Machines*, Dhanpat Rai and Sons,

	Delhi, 2014.
2.	Bansal R.K., *Fluid Mechanics and Hydraulic Machines*, 9thEdition, Laxmi Publications(P) Ltd, New Delhi, 2018.
Reference Books:	
1.	Subramanya K., *Flow in Open channels*, Tata McGraw-Hill Publishing Company, 1994.
2.	*Rama Durgaiah D., Fluid Mechanics and Machinery, New Age International Publishers, New Delhi, 2002.*
3.	Rajput R.K., *A text book of Fluid Mechanics in SI Units*, S.Chand and Company, New Delhi, 2016.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 – Strongly

18CE406	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

At the end of this course ,

1. The student shall have a good knowledge about constituent materials. To
2. get awareness about the properties of fresh and hardened concrete.
3. To understand the concept and procedure for concrete mix design as per IS code standards. To
4. know the types of special concretes.
5. To acquire awareness about quality control in concrete.

Unit I	MATERIALS AND THEIR PROPERTIES	9	+	0

Cement – constituents – tests on cement – types of cement – aggregates – M-Sand – properties and uses – classification of aggregates – properties and tests on aggregates – gradation – quality of water – admixtures – accelerators – retarders.

Unit II	PROPERTIES OF FRESH AND HARDENED CONCRETE	9	+	0

Properties of fresh concrete – workability – segregation – bleeding – properties of hardened concrete – strength – stress-strain characteristics – modulus of elasticity – shrinkage – creep – thermal conductivity – permeability – test for tension, compression and flexure – non-destructive tests.

Unit III	CONCRETE MIX DESIGN	9	+	0

Nominal mixes – design mixes – factors influencing the design – Theory and problems - ACI method, DOE method and IS method.

Unit IV	SPECIAL CONCRETES AND CONCRETING METHODS	9	+	0

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, vacuum concrete, gunite and shotcrete, epoxy injection, mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection. Light weight concrete – ready mix concrete – fibre reinforced concrete.

Unit V	QUALITY CONTROL	9	+	0

Frequency of sampling – statistical analysis of test results – standard deviation – coefficient of variation – characteristic strength – acceptance and rejection criteria.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Test all the concrete materials as per IS code
CO2	:	Design the concrete mix using ACI and IS code methods
CO3	:	Determine the properties of fresh and hardened of concrete
CO4	:	Design special concretes for specific applications
CO5	:	Ensure quality control while testing/ sampling and acceptance criteria

Text Books:

1.	Neville A.M *Properties Of Concrete*, Pearson publication, 2012
2.	Shetty M.S*Concrete technology, Volume I & II*, S.Chand and Company Ltd,Deihi 2003
3.	Santhakumar A.R *Concrete Technology*, Oxford university Press, NewDelhi, 2007
4.	Mehta K.P *Concrete Technology*, Chand & Co, NewDelhi, 2006

Reference Books:

1.	*Indian Standard Recommended Guide lines for Concrete Mix Design*, IS:10262 – 2009 , Bureau

	of Indian Standards, NewDelhi.
2.	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources forConcrete IS:383-1970 R2011, Bureau of Indian Standards, NewDelhi.
3.	Gambhir.M.L,*Concrete technology*, Volume I & II , Tata McGraw-HillBookCompany,Third print, 2003
4.	Krishnaraju N. *Design of Concrete Mixes*, CBS publishers. NewDelhi, 2002.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE407	MATERIAL TESTING & EVALUATION LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	At the end of this course the student should be able to evaluate the elastic constants of thematerials
2.	At the end of this course the student should be able to determine the strength of concrete and other properties.

EXPERIMENTS

1.	Tension test on mild steel specimen
2.	Deflection test on simply supported beam
3.	Deflection test on double cantilever beam
4.	Double shear test on mild steel rod
5.	Torsion test
6.	Test of springs i) Compression Spring ii) Tension spring
7.	Compression test on concrete cube
8.	Crushing test on bricks
9.	Hardness test on metals like mild steel, brass and aluminum
10.	Split tensile test on concrete
11.	Charpy Impact test

Total (P)= 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Evaluate Young Modulus, torsional strength, hardness and tensile strength of givenspecimens
CO2	:	Determine the strength of concrete
CO3	:	Find the compressive strength of concrete cubes and bricks
CO4	:	Find stiffness of open coiled and closed coiled springs

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE408	HYDRAULIC ENGINEERING LABORATORY	L	T	P	C
Course Objectives:		**0**	**0**	**4**	**2**

1	At the end of this course the student should be able to evaluate co-efficient of discharge ofvarious sections
2	At the end of this course the student should be able to evaluate the characteristics of pumpsand turbines
List of Experiments:	
1	Determination of co-efficient of discharge of flow through orifice
2	Determination of co-efficient of discharge of flow thorough mouth piece
3	Determination of co-efficient of discharge of flow over notches
4	Determination of co-efficient of discharge for venturimeter
5	Determination of co-efficient of discharge for orificemeter
6	Determination of friction factor of pipes
7	Determination of minor losses in pipes
8	Study on performance characteristics of Pelton wheel turbine
9	Study on performance characteristics of Kaplan turbine
10	Study on performance characteristics of Centrifugal pump
11	Study on performance characteristics of reciprocating pump
12	Study on performance characteristics of jet pump
13	Study on performance characteristics of self-priming pump
14	Study on performance characteristics of gear oil pump
	Total = 60 Periods

Course Outcomes:		
At the end of the course the student will be able to		
CO1	:	To measure flow in pipes and determine frictional losses.
CO2	:	Apply dimensional analysis for design of experimental procedures
CO3	:	Calibrate flow measuring devices used in pipes, channels and tanks
CO4	:	Determine fluid and flow properties
CO5	:	Characterize laminar and turbulent flow
CO6	:	To develop characteristics of pumps and turbines.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

<table>
<tr><td colspan="2">18CEMC01</td><td colspan="2">DISASTER PREPAREDNESS AND PLANNING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="4"></td><td>2</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="7">Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.</td></tr>
<tr><td>2.</td><td colspan="7">Critically evaluate disaster risk reduction and humanitarian response policy and practicefrom multipleperspectives.</td></tr>
<tr><td>3.</td><td colspan="7">Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflictsituations.</td></tr>
<tr><td>4.</td><td colspan="7">Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or thecountries they work in.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit I</td><td colspan="4">REPERCUSSIONS OF DISASTERS AND HAZARDS</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="8">Introduction, Disaster-Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts, And Famines, Landslides and
Avalanches, Man-made disaster: Nuclear Reactor, Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease, Epidemics, War and Conflicts.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit II</td><td colspan="4">DISASTER PRONE AREAS IN INDIA</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="8">Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches, AreasProne to Cyclonic and Coastal Hazards with Special Reference to Tsunami.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit III</td><td colspan="4">DISASTER PREPAREDNESS AND MANAGEMENT</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="8">Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard, Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit IV</td><td colspan="4">DISASTER MITIGATION</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="8">Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Unit V</td><td colspan="4">REHABILITATION OF ENVIRONMENT</td><td>9</td><td>+</td><td>0</td></tr>
<tr><td colspan="8">Disasters, Environment and Development - Factors affecting vulnerability such as impact ofdevelopmental projects and environmental modifications (including of dams, land use changes,
urbanization etc.), sustainable and environmental friendly recovery; reconstruction anddevelopment methods.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8" align="right">Total 45 Periods</td></tr>
<tr><td colspan="8">Course Outcomes:</td></tr>
<tr><td colspan="8">Upon completion of this course, the students will be able to:</td></tr>
<tr><td>CO1</td><td>:</td><td colspan="6">To identify the different disasters and its causes.</td></tr>
<tr><td>CO2</td><td>:</td><td colspan="6">To identify the vulnerable areas of disasters in India.</td></tr>
<tr><td>CO3</td><td>:</td><td colspan="6">To get knowledge about preparedness during disasters.</td></tr>
<tr><td>CO4</td><td>:</td><td colspan="6">To analyse the risk in disasters.</td></tr>
<tr><td>CO5</td><td>:</td><td colspan="6">To know the corrective measures to mitigate disasters.</td></tr>
<tr><td colspan="8">Text Books:</td></tr>
<tr><td>1.</td><td colspan="7">Sahni, Pardeep, “Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi. 4th Edition, 2011.</td></tr>
<tr><td>2.</td><td colspan="7">Goel S.L, “Disaster Administration and Management Text and Case Studies”, Deep & Deep</td></tr>
</table>

	Publication Pvt. Ltd., New Delhi, 2007.
Reference Books:	
1.	Nishith, R and Singh, A.K, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company,2007.

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	3	3	3	3	2	2	2
CO2	3	1	2	1	2	13	1	3	1	2	1	1	1	3	1
CO3	1	3	2	1	2	1	3	1	2	1	3	2	3	1	1
CO4	1	1	1	2	2	2	2	2	2	1	3	1	3	3	1
CO5	1	2	1	2	3	2	1	3	3	2	3	1	2	1	1

1 – Slightly
2 – Moderately
3 - Strongly

18CE501	BASIC STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To impart knowledge on force responses on beams, trusses, arches, suspension bridges analytically and using influence lines. To impart knowledge on Plastic analysis of structures.

Unit I	INDETERMINANCIES AND INFLUENCE LINES FOR STATICALLY DETERMINATE BEAMS ROLLING LOADS	9	+	0

Concept of Determinancy and Indeterminancy-static and Kinematic indeterminancies-examples - single concentrated load moving on the span – UDL longer than the span – UDL shorter than the span – two concentrated loads at a fixed distance apart - several concentrated loads(CONCEPT ONLY) – equivalent UDL. Influence lines for reactions, shear force and bending moment – Calculation of shear force and bending moment at a point – Calculation of position of load for maximum shear force and bending moment – Uniformly distributed load shorter than the span on simply supported beam – Concentrated loads - Absolute maximum shear force and bending moment.

Unit II	INFLUENCE LINES FOR STATICALLY INDETERMINATE BEAMS	9	+	0

Clark Maxwell's theorem of reciprocal deflection – Betti's theorem- Muller's Breslau's Principle and its applications to determine the influence lines for continuous beams(two span only) Analysis of plane trusses with maximum two redundant members by displacement and forcemethods-Trusses with lack of fit-Thermal stresses.

Unit III	THREE HINGED, TWO HINGED ARCHES	9	+	0

Symmetrical arches – Analysis of three hinged and two hinged arches – shear force Normal thrust and bending moment – Effect of rib – shortening – Parabolic arch subjected to UDL.

Unit IV	CABLES AND SUSPENSION BRIDGES	9	+	0

Analysis of cable under concentrated loads - Analysis of cable under UDL – Shape of cable under self-weight – Anchorage of suspension cables – shear force and bending moment in three hinged stiffened girders – Maximum bending moment due to single concentrated load – UDL - Two hinged stiffening girders.

Unit V	PLASTIC ANALYSIS OF STRUCTURES	9	+	0

Plastic moment capacity of sections – Plastic section modulus – Shape factor for rectangular, triangular, circular and hollow circular sections – Plastic hinge concept – Load factor – Plastic analysis – Basic theorems – Principle of virtual work – Determination of collapse load for simply supported beam, propped cantilever beam, fixed beam, continuous beam subjected to concentrated load and UDL – Collapse load for single storey single bay portal frames.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Use various classical methods for analysis of indeterminate structures
CO2	:	Determine the effect of support settlements for indeterminate structures
CO3	:	Apply the concepts of ILD and moving loads on determinate structures

CO4	:	Know the performance of cables and suspension bridges under external loads
CO5		Analysis the various structures in plastic behavior

Text Books:

1.	Devdas Menon "Structural Analysis", Narosa Publishers, 2010.
2.	Thandavamoorthy T.S., "Structural Analysis", Oxford Publishers, 2011.
3.	Punmia B.C., *Theory of structures - Vol. II*, Laxmi Publications (P) Ltd, 2004.
4.	Negi L.S. and Jangid R.S., *Structural Analysis*, Tata McGraw - Hill Publishing Company,New Delhi, 2007

Reference Books:

1.	Ramamurtham S "*Theory of structures",Dhanpat Raj Publications*
2.	*Timoshenko S.P. and Young D.H., Theory of Structures, McGraw – Hill Book Company, New Delhi, 1965.*
3.	Gupta S.P.,Pandit G.S and Rajesh Gupta, *Theory of structures-Vol I & II*, Tata McGraw-Hill Publishing Company Limited, New Delhi,1999
4.	Reddy C.S., *Basic Structural Analysis*, Tata McGraw-Hill Publishing Company Limited, New Delhi,1999

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE502	MECHANICS OF SOILS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Find index properties of soil, identify and classify the soil based on index properties.
2.	Acquire knowledge on the effect of ground water table on soil and to estimate stress distribution in soil.
3.	Learn the concept of permeability and seepage in soil including flow net.
4.	Gain knowledge on compaction and consolidation in soil and to find strength of soil.

Unit I	BASIC PROPERTIES OF SOILS	9	+	0

Soil formation – Soil problems in Engineering – Physical properties of soil – Phase relations – Index properties of soil – Grain size distribution – Atterberg's limits – Classification of soils – BIS classification – Field identification.

Unit II	STRESSES IN SOILS	9	+	0

Soil water –Static pressure in water-Effective stress concepts in soils – Capillary phenomenon – Vertical stress distribution in soils – Boussinesq equation – Vertical stress distribution diagrams - Line load – Uniformly loaded areas – Newmark's Influence Chart – Construction and Use – Approximate methods – Isobars – Westergaard's Analysis-ContactPressure.

Unit III	PERMEABILITY AND SEEPAGE	9	+	0

One dimensional flow through soil – Permeability – Darcy's Law – field and laboratory test- flowthrough stratified soil – Factors affecting permeability of soil.
Seepage pressure – Quick sand condition – Two dimensional flow – Laplace equation – Electrical analogy – Flow net – Methods of construction, properties and applications – application of sheet pile cut off and earth dam – Phreatic line.

Unit IV	COMPACTION AND CONSOLIDATION	9	+	0

Compaction – laboratory tests – Standard Proctor's Compaction test – Modified Proctor's Compaction – Moisture density relation – factors affecting compaction – Field compaction methods – Compaction control.
Consolidation – Components of settlement – Laboratory test – Terzaghi's One Dimensional Consolidation – Definition – Normally consolidated clay – Over Consolidated clay – Under Consolidated clay – e -log ρ relationship – Boundary condition – Time factor – Time rate of consolidation -√t and log t methods-Factors influencing compression behavior of soils.

Unit V	SHEAR STRENGTH	9	+	0

Shear strength of soil – importance and use – Mohr – Coulomb's theory – Laboratory test – Direct shear test – Triaxial Compression test – Types of Triaxial test based on drainage conditions – Unconfined Compression Test – Vane Shear test – Factors affecting the ShearStrength.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the importance of soil mechanics in civil engineering and to classify the soilbased on the tests conducted.
CO2	:	Do proper stress estimation for various types of foundation loads.
CO3	:	Solve any practical problems related to soil stresses estimation, permeability and seepage including flow net diagram
CO4	:	Solve practical problems related to consolidation settlement and time rate of settlement
CO5	:	Estimate shear strength of soil using the parameters obtained from different lab tests.

Text Books:	
1.	Punmia B.C *Soil Mechanics and Foundations*, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
2.	Gopal Ranjan and Rao A.S.R., *Basic and Applied Soil Mechanics,* New Age International Publishers (P) Ltd., New Delhi, 2016.
3.	Venkataramaiah, C., *Geotechnical Engineering*, New Age International Publishers, New Delhi,2017.
Reference Books:	
1.	Arora K.R., *Soil Mechanics and Foundation Engineering*, Standard Publishersand Distributors, New Delhi, 2009.
2.	BrajaM.Das, *Fundamentals of Geotechnical Engineering,* Thomson Asia Pst.Ltd, Singapore,2005.
3.	BrajaM.Das ,*Principles of Geotechnical Engineering*, Thomson Asia Pst.Ltd, Singapore,2008.

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	3	0	0	0	1	0	3	0	0
CO2	3	2	3	3	2	1	3	0	0	0	1	0	3	0	0
CO3	3	3	2	3	2	1	3	0	0	0	1	0	3	0	0
CO4	3	3	3	2	1	1	3	0	0	0	1	0	3	0	0
CO5	3	3	2	2	1	1	3	0	0	0	1	0	3	0	0

1 – Slightly
2 – Moderately
3 - Strongly

18CE503	WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To know the importance of hydraulic cycle, as water is the main source for the nature. Storage of water by means of reservoir and wells are taught.
2.	To impart the knowledge of hydrology that deals with the occurrence, distribution, movement and properties of water on the earth
3.	To impart the knowledge of various irrigation techniques.
4.	To undertstand the designs of various distribution system
5.	To deveop the abilities to know the distribution system.

Unit I	SURFACE WATER HYDROLOGY	9	+	0

Hydrologic cycle – Surface Water potential in India -Rain gauges – Types of rain gauges -Average rainfall over a basin by arithmetic mean, Thiessen polygon and Isohyetal method – Run off – Runoff process – abstractions- Infiltration, evaporation, transpiration, interception and depression storage – Estimation of Run off by empirical formula and infiltration indices. Storm Hydrograph and Unit Hydrograph – Flood estimation by Dicken’s formula.

Unit II	RESERVOIR PLANNING	9	+	0

Importance of Reservoirs - Purpose of storage work – Large Reservoirs in India and Tamil Nadu - Types of reservoirs– Investigation for reservoir planning – Selection of site for a reservoir – Zones ofstorage in reservoirs – Single and multipurpose reservoir – Determination of capacity of reservoir - Reservoir sedimentation and their control – Reservoir losses – Basics of flood routing.

Unit III	GROUND WATER HYDROLOGY	9	+	0

History of Groundwater Development in the world and India - Occurence of ground water – types of aquifers – storage coefficient – coefficient of transmissibility – Steady radial flow into a well located in unconfined and confined aquifers – description of various types of open and tube wells – Yield from an open well by constant level pumping test and recuperation test – Estimation of Yield (steady state condition) - Site selection for a tube well.

Unit IV	DISTRIBUTION SYSTEM	9	+	0

Classification of canals – canal alignment – Kennedy’s theory – Wood table – Lacey’s theory – Design of canal cross sections – Comparisons of two theories – Use of Garret’s diagram in channel design – Balancing depth of cutting – Design procedure for an irrigation channel – Longitudinal section of canal and schedule of area statistics – types of canal cross sections – component parts of a cross section – Construction and maintenance of canals – Canal lining – GIS application in distribution system.

Unit V	WATER LOGGING, DRAINAGE AND RIVER CONTROL	9	+	0

Water logging – importance, Causes and effects of water logging– Remedial measures – Drainage – Advantages – Types of drainage system – Rivers and their behavior – Objectives – Classification and method of river training works - GIS application.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Design various channel systems
CO2	:	Design head and cross regulator structures
CO3	:	Identify various types of reservoir and their design aspects
CO4	:	By the Establishes the understanding of cross drainage works and its design
CO5	:	Design different types of dams

Text Books:	
1.	Linsley R.K. and Franzini J.B, *Water Resources Engineering*, McGraw-Hill Inc, 2002.
2.	Sharma R.K. and Sharma T.K., *Hydrology and Water Resources Engineering*, Dhanpat Rai and Sons, 2017.
3.	Punmia B.C. and Pande B.B.Lal, *Irrigation and water Power Engineering*, Laxmi PublicationsPvt Ltd., New Delhi,2016.
4.	Santhosh Kumar Garg, *Hydrology and Water Resources Engineering* , Khanna Publications Pvt.Ltd.,New Delhi, 2002.
Reference Books:	
1.	Chow V.T. and Maidment, *Hydrology for Engineers*, McGraw-Hill Inc., Ltd., 2000.
2.	*Raghunath H.M., Hydrology, Wiley Eastern Limited,New Delhi,1990.*
3.	*Subramanya K., Engineering Hydrology, Tata-McGraw Hill , 1993.*
4.	*Sahasrabudhe S.D., Irrigation Engineering and Hydraulics Structures, Katson Publications,1990.*
5.	*Das M.M., Saikia M.D., Hydrology, Prentice Hall of India, 2008.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE504	Design of Reinforced Concrete Elements	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the concepts of different design philosophies related to Reinforced concretedesign and to study stress-strain behaviours of concrete and steel.
2.	To gain the knowledge of limit state design for flexure,shear,torsion and bond.
3.	To study the behaviour of columns subjected to axial load,eccentric load and use of interaction diagrams.
4.	To design the isolated foundation and staircases.

UNITI	DESIGN PHILOSOPHIES	9	+	0

Standard concrete mixes for RCC works – Types of reinforcements – Plain and deformed bars – Concepts of Working Stress Method, Ultimate Load Method and Limit State Method – Characteristic Strength and load – Partial Safety Factor – Stress-Strain behaviour of concrete and steel – Advantages – Codal specifications.

UNIT II	LIMIT STATE DESIGN FOR FLEXURE	9	+	0

Analysis, design and detailing of singly and doubly reinforced rectangular and flanged beams – Analysis, design and detailing of one way and two way rectangular slabs subjected to uniformly distributed load for various boundary conditions and corner effects.

UNIT III	LIMIT STATE DESIGN FOR,SHEAR,TORSION,BOND & ANCHORAGE	9	+	0

Design requirements as per IS code – Behaviour of RC beams in shear and torsion – Design and detailing of RC members for combined bending, shear and torsion- Behaviour of RC members inbond and anchorage

UNITIV	LIMIT STATE DESIGN OF COLUMNS	9	+	0

Types of columns – Braced and Unbraced columns – Design of short column for axial, uniaxial and biaxial bending – Interaction diagrams – Design concepts of long columns – Standard method of detailing RC columns.

UnitV	LIMIT STATE DESIGN OF FOOTINGS & STAIRCASES	9	+	0

Design of wall footing – Design of isolated footing – Square, Rectangular and Circular shape for axial load – Eccentrically loaded isolated footing – Design of staircase(ordinary & dog-legged).

Total (45+0)= 45 Periods

(Use of IS 456-2000 and tables and charts from SP16 are permitted)

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply the fundamental concepts of different design philosophies. Use IS code of practice to design the basic reinforced concrete elements
CO2	:	Analysis, design and to present detailing of reinforcement for flexure members.
CO3	:	Analysis, design and to present detailing of Slab and beam elements for bond, anchorage,shear and torsion.
CO4	:	Analysis ,design and detailing of Columns
CO5		Analysis ,design and detailing of Footings and staircases.

Text Books:

1.	"Reinforced Concrete Design" Unnikrishnan Pillai S &Devdas Menon, McGraw Hill Education (India) Private Ltd,Chennai 2018.
2.	Limit state Design of Reinforced Concrete Varghese P.C, 2013 PH1 Learning P.Ltd. Delhi.

Reference Books:

1.	Sinha S.N. Reinforced Concrete Design, Tata McGraw Hill Publishing Company Ltd., NewDelhi ,2017.
2	Punmia B.C., Ashok Kumar Jain & Arun Kumar Jain ., Limit State Design of ReinforcedConcrete, Laxmi Publications Pvt. Ltd., New Delhi, 2016.
3.	Karve S.R and Shah V.L. Limit State Theory and Design of Reinforced Concrete, Structures Publications, Pune 2017.
4.	Krishna Raju N., Design of Reinforced Concrete Structures, CBS Publishers & Distributors, NewDelhi,2017.
5.	IS 456:2000 Plain and Reinforced concrete Code of practice (Third Revision).
6.	SP :16 Design aids for Reinforced Concrete to IS 456-1978.
7.	SP : 34 – 1987 Hand book on Concrete Reinforcement and Detailing.
8.	IS 875(Part 1)-1987: Code of Practice for Design Loads (Other Than Earthquake) For Buildings and Structures. Part 1: Dead Loads--Unit Weights of Building Materials and Stored Materials (Second Revision)
9.	IS 875(Part 2)-1987: Code of Practice for Design Loads (Other Than Earthquake) For Buildingsand Structures. Part 2: Imposed Loads (Second Revision)
10.	IS 875(Part3)-2015: Wind Loads on Buildings andStructures
11.	IS 875(Part4)-1984:snowloads
12.	IS 875(Part5)-1987:special loads and combinations

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE505	WASTE WATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	The subject aims to give the students, the knowledge about the sewage water and waste water treatment.
2.	Students are introduced to the new world of waste water treatment technologies which prevails in the current scenario.
3.	Students, at the end of the semester will have complete ability to analysis the type of sewageand the treatment to be carried out to reuse the water.

Unit I	SEWERAGE SYSTEM	9	+	0

Definition – classification – systems of sewerage – quantity of sewage – Fluctuation in flow pattern – estimation and storm runoff – design flow for separate and combined system – hydraulics ofsewers – self cleansing velocities – full flow / partial flow conditions – sewer sections – material for sewers - sewerjoints–jointingmaterials–sewerlayingunder variousconditions–testonsewers–sewer maintenance – sewer appurtenances –sewage pumping – types of pumps.

Unit II	WASTE WATER CHARACTERISTICS & PRIMARY TREATMENT	9	+	0

Characteristics and composition of sewage – physical and chemical analysis – DO and BOD and their significances – cycles of decomposition – fundamentals of microbiology of wastewater – preliminary and primary treatment – screens – skimming tank – grit chamber – design of proportional flow weir– principle, types of sedimentation – design of sedimentation tanks.

Unit III	BIOLOGICAL TREATMENT OF WASTEWATER	9	+	0

Basic principles of biological treatment – Activated sludge process – recirculation – diffuser – mechanical aeration – Process modifications – oxidation ditch – Trickling filter – Principles anddesign –NRC equation – RBC Principle – Principles and design of waste stabilization ponds – Principle and design of a lagoon - septic tanks and effluent disposal system.

Unit IV	SLUDGE MANAGEMENT & HOUSE DRAINAGE	9	+	0

Objectives of sludge treatment – properties and characteristics of sludge – sludge thickening – sludge digestion – drying beds – conditioning and dewatering – sludge disposal – Sanitary fixturesand fitting – Pipe system – general layout of house drainage – street connections.

Unit V	SEWAGE DISPOSAL	9	+	0

Methods – dilution – self purification of streams – oxygen sag curve – Streeter Phelp’s model -wastewater reclamation techniques – land disposal – sewage farming – deep well injection – Eutrophication – recycles and reuse of wastewater.

Total 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Network of pipes, pumps, and force mains for the collection of wastewater, or sewage,from a community.
CO2	:	Water Negatively affected in quality by humans by changing its physical and chemical properties like colour, odor.
CO3	:	Harnesses the action of bacteria and other microorganisms to clean water
CO4	:	It is an integral part of any modern municipal waste water treatment
CO5	:	Biological processes are used to remove contaminants and produce treated wastewaterthat is safe enough for release into the environment.

Text Books:	
1.	Garg S.K., *Waste Water Engineering*, Khanna publishing Co., New Delhi - 2007.
2.	Punmia B.C., Ashok Jain, *Environmental Engineering(Vol.-II),Wastewater Engineering*, Laxmi Publications, New Delhi , 2008.
Reference Books:	
1.	Duggal K.N., *Elements of Public Health Engineering*, S.Chand and Co., 2007.
2.	*Manual on Sewerage and Sewage Treatment, CPHEEO, Government of India, New Delhi, 1983.*
3.	*Hand Book on Water Supply and Drainage*, SP 35, B.I.S., New Delhi,1987.
4.	Metcalf and Eddy,M.C., *Wastewater Engineering – Treatment &Reuse*,TataMcGraw-Hill Publications, New Delhi,2003.
5.	Birdie G.S., *Water Supply and Sanitary Engineering*, DhanpatRai and sons, 2007.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE506	TRANSPORTATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. The objective of the course is to educate the students on various components of highway engineering
2. To educate the design concepts of components of railway engineering.
3. The course enables the students to develop skill on evaluation and maintenance.

UNITI	HIGHWAY PLANNING AND ALIGNMENT	9	+	0

Highway Development in India - Jayakar Committee Recommendations and Realisations- Requirements of Ideal Alignment- Factors Controlling Highway Alignment-Engineering Surveys for Alignment - Conventional Methods and Modern Methods (Remote Sensing, GIS and GPS techniques)-Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements – Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths [IRC Standards], Cross sections of different Class of Roads.

UNITII	GEOMETRIC DESIGN OF HIGHWAYS	9	+	0

Design of Horizontal Alignments – Superelevation, Widening of Pavements on Horizontal Curves and Transition Curves [Derivation of Formulae and Problems] Design of Vertical Alignments – Rolling, Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves-SightDistances - Factors affecting Sight Distances, Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance [Derivations and Problems in SSD and OSD]-Geometric Design of Hill Roads [IRC Standards Only]

UNITIII	HIGHWAY MATERIALS, CONSTRUCTION, MAINTENANCEAND OPERATION	9	+	0

Desirable Properties of Highway Materials-Bitumen - Penetration, Ductility, Viscosity, Binder content and Softening point Tests.Construction Practice - Water Bound Macadam Road, Bituminous Road and Cement Concrete Road [as per IRC and MORTH specifications]Highway Drainage [IRC Recommendations]Types of defects in Flexible pavements –Surface defects, Cracks,Deformation,Disintegration – Symptoms, Causes and Treatments.Types of Pavement, Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural Cracks Spalling of Joints and Mud Pumping – and Special Repairs.

UNITIV	RAILWAY PLANNING AND DESIGN	9	+	0

Role of Indian Railways in National Development -Engineering Surveys for Track Alignment – Obligatory points - Conventional and Modern methods (Remote Sensing, GIS & GPS, EDM and other equipments)Permanent Way, its Components and Functions of each Component:Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps -Sleepers – Functions, Materials, Density. Ballasts – Functions, Materials, Ballastless Tracks Geometric Design of Railway Tracks – Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves (Derivations of Formulae and Problems)

Unit V	RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION	9	+	0

Points and Crossings - Design of Turnouts, Signalling, Interlocking, Construction & Maintenance – Conventional, Modern methods and Materials, Track Drainage Track Modernisation– Automated maintenance and upgrading, Technologies, Re-laying of Track, Lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.

		Total 45 Periods
Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Carry out surveys involved in planning and highway alignment
CO2	:	Design cross section elements, sight distance, horizontal and vertical alignment
CO3	:	Determine the characteristics of pavement materials
CO4	:	On completing the course, the students will have the ability to Plan and Design variouscivil Engineering aspects of Railways.
Text Books:		
1.	Khanna K., Justo C.E.G., *Highway Engineering* revised 10thedition Khanna Publishers, Roorkee, 2014.	
2.	Kadiyali L. R, *Traffic Engineering and Transport Planning*, Khanna Publishers, New Delhi,2019.	
3.	ChandolaS.P.Transportation Engineering-2019	
Reference Books:		
1.	Sharma S.K., *Principles Practice and Design of Highway Engineering*, S.Chand& Co Ltd. New Delhi, 2006.	
2.	Guidelines of Ministry of Road Transport and Highways, Government of India.	
3.	Agarwal M.M., *Indian Railway Track*, 14thEdition, Prabha and Co., New Delhi, 2002.	
4.	Saxena S.C. Highway & Traffic Engineering, 2014.	
E-References:		
1.	https://nptel.ac.in/downloads/105101087/- Transportation Engineering (Highways)	
2.	https://nptel.ac.in/courses/105107123/- Transportation Engineering (Railways)	
3.	https://nptel.ac.in/courses/105101087/19- Pavement design	

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE507	GEOTECHNICAL LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	To learn the methods of finding index properties of soil by conducting various tests in thelaboratory.
2.	To Classify the type of soil based on the index properties of soil.
3.	To Study the methods to stabilize or improve the properties of soil by adding admixtures.
4.	To find the shear parameters and shear strength of soil from laboratory and field tests.

EXPERIMENTS

1.	Determination of Moisture Content by Oven drying method
2.	Determination of Moisture Content by Pycnometer method
3.	Determination of Grain Size Distribution by Sieve Analysis
4.	Determination of Specific Gravity of Soil grains
5.	Determination of Relative Density of Sand
6.	Determination of Atterberg's Limits of Soil
7.	Determination of OMC and Maximum Dry Density by Standard Proctor Compaction Test
8.	Determination of Field Density by Core Cutter Method
9.	Determination of Field Density by Sand Replacement Method
10.	Determination of Permeability of soil by Constant Head Method
11.	Determination of Permeability of soil by Variable Head Method
12.	Determination of Shear Parameters of non-cohesive soil by Direct Shear Test
13.	Determination of Shear Parameters of Cohesion less soil by Vane Shear Test
14.	Determination of Shear Parameters of Cohesive soil by Unconfined Compression Test
15.	Determination of CBR Value by California Bearing Ratio Test
16.	Determination of Grain Size Distribution by Hydrometer Analysis (Demonstration)
17.	Determination of Settlement in soil due to primary consolidation by One DimensionalConsolidation Test (Demonstration)
18.	Determination of Shear Parameters of Cohesive soil by Tri axial Compression Test (Demonstration)
19.	Determination of Safe Bearing Capacity of soil by Standard Penetration Test (Demonstration)
20.	Determination of Ultimate Bearing Capacity and Probable Settlement by Plate Load Test (Demonstration)

Total 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Learn to find the index properties properties of soil by conducting laboratory tests.
CO2	:	To Identify and to classify the type of soil.
CO3	:	To stabilize soil by adding admixtures
CO4	:	To find the shear parameters and shear strength of soil from laboratory and field tests.

Reference Books:

1.	IS 2720 Part I to Part XXVIII – Code of Practices for testing the soil,2005.
2.	Apparao K.V.S and Rao V.C.S., "Soil Testing Laboratory Manual & Question Bank", University Science Press, New Delhi, 2017.

CO-PO-PSO MAPPING

CO / P O	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO1 2	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	0	1	0	1	1	1	2	3	3	1
CO2	3	3	3	3	3	1	1	2	1	0	1	1	3	3	2
CO3	3	3	3	3	3	3	3	1	0	0	0	2	3	3	1
CO4	3	3	3	3	3	2	3	1	1	0	1	1	3	2	1

1 – Slightly
2 – Moderately
3 – Strongly

18CE508	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives: The objectives of this course is to

1.	Introduce the students about how the common environmental experiments relating to waterand wastewater quality are performed.
2.	Quantify the dosage requirement for coagulation process
3.	Determine the physical, chemical and biological characteristics of water and wastewater
4.	Be aware of the procedure for determining ph and turbidity values for water and sewage bythe students.
5.	Make the students to get know which tests are appropriate for given environmental problems.

EXPERIMENTS

1.	Determination of pH value for the given water sample
2.	Determination of Turbidity value for the given water sample
3.	Determination of Alkalinity present in the given sample of water
4.	Determination of Hardness(Total, temporary and permanent) present in the given watersample
5.	Determination of Chlorides present in the given sample of water
6.	Determination of Sulphates present in the given sample of water
7.	Determination of Total, Dissolved, Suspended, Volatile and Fixed Solids
8.	Determination of Optimum coagulant dose using jar test apparatus
9.	Determination of Residual Chlorine present in the given water sample
10.	Determination of Dissolved Oxygen present in the given water sample
11.	Determination of B.O.D for the given sample
12.	Determination of C.O.D for the given sample

Total 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Perform common environmental experiments relating to water and wastewater quality,and know which tests are appropriate for given environmental problems.
CO2	:	Obtain the necessary background for subsequent courses in environmental engineering.
CO3	:	Quantify the concentration of salts in water andwastewater
CO4		Recommend the degree of treatment required for the water and wastewater
CO5		Examine the conditions for the growth of micro-organisms

Reference Books:

1.	Environmental Engineering Laboratory Manual, B Kotaiah, N Kumara Swamy, 1994,Charotar Books Distributors
2.	NEERI. 1988. *Manual o f Water and Waste Analysis,* National EnvironmentalEngineering Research Institute, Nagpur, Maharastra (India)
3.	*Chemistry for Environmental Engineering and Science* ,Sawyer, C. N., McCarty, P. L., and Perkin, G.F., , 5th edition McGraw-Hill Inc., 2002

E-References:

1.	https://studylib.net/doc/18517687/lab-manual---civil-and-environmental-engineering

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18MC301	Indian Constitution	L	T	P	C
		2	0	0	0

Course Objectives:

1.	Learn the salient features of the Indian Constitution.
2.	List the Fundamental Rights and Fundamental Duties.
3.	Present a systematic analysis of all dimensions of Indian Political System.
4.	Understand the power and functions of the Parliament, the Legislature and the Judiciary.

UNITI

Union and its Territory – Citizenship–Fundamental Rights–Directive Principles of State Policy–Fundamental Dutie

UNITII

The Union–The States–The Union Territories–The Panchayats–The Municipalitie

UNITIII

The Co-operative Societies–The scheduled and Tribal Areas–Relations between the Union and the States–Finance, Property, Contracts and Suits–Trade and Commerce within the territory of India.

UNITIV

Services under the Union, the States – Tribunals – Elections– Special Provisions –Relating to certain Classes.

Unit V

Languages–Emergency Provisions – Miscellaneous–Amendment of the Constitution.

Course Outcomes:

On completion of the course, students will

understand the emergence and evolution of the Indian Constitution

Explain the key concepts of Indian Political System.

Describe the role of constitution in a democratic society.

Present the structure and functions of the Central and State Governments, the Legislature and theJudiciary

Reference Books:

1) SubhashC.Kashyap, *Our Constitution*, National Book Trust, 2017.

2) Durga Das Basu, *Introduction to the Constitution of India*, Lexis Nexis, 2015.

3) M.V.Pylee, *Constitutional History of India*, S.Chand publishing, 2010

4) Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, 1999.

18CE601	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives: The objectives of this course is to

1.	impart Knowledge on students about advanced methods of analysis of structures
2.	impart Knowledge on students about the analysis of structures using slope deflection andmoment distribution methods
3.	Understand about the matrix method and its applications for computer-based analysis of structure.
4.	Know about the basics of Finite Element Method and its application
5.	Make the students to analyse the indeterminate structures by using various methods

Unit I	SLOPE DEFLECTION METHOD	9	+	0

Slope deflection equations-Analysis of continuous beams-Analysis of single storey single bayrectangular portal frames with and without side sway.

Unit II	MOMENT DISTRIBUTION METHOD	9	+	0

Analysis of continuous beams - Carry over factor – Distribution factor – Analysis of single storey single bay – Symmetry and anti-symmetry structures.

Unit III	MATRIX FLEXIBILITY METHOD	9	+	0

Analysis of continuous beams, Indeterminate frames and trusses with maximum two degrees ofstatic indeterminacy.

Unit IV	MATRIX STIFFNESS METHOD	9	+	0

Analysis of continuous beams, Indeterminate frames and trusses with maximum two degrees ofkinematic indeterminacy.

Unit V	FINITE ELEMENT METHOD	9	+	0

Introduction – Discretisation of a structure – Displacement functions – Truss element – Beamelement – Plane stress and plane strain - Triangular elements.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, The students will

CO1	:	Have the knowledge on classical methods (SDM & MDM) of analysis of indeterminatestructures.
CO2	:	:understand the concepts of FEM
CO3	:	understand the procedures to be followed for various methods of analysis ofindeterminate structures
CO4	:	Be able to Analyse indeterminate structures using force and displacement matrixmethods
CO5	:	Be able to analyse the indeterminate structures and frames by using classical and modern method of analysis

Text Books:

1.	Punmia B C., *Theory of Structures Vol. II*, Laxmi Publications (P) Ltd., New Delhi. 2004.
2.	Devados Menon, *Structural Analysis*, Narosa Publishing House, NewDelhi, 2009.
3.	Rajasekaran S., Sankara Subramanian G., Computational Structural Mechanics, PHI, India,2010.
4.	Vaidyanathan, R. and Perumal, P., “structural Analysis – Vol. II”, Laxmi Publications, New Delhi, 2016

Reference Books:

1.	Negi L.S and JangidR.S.,*Structura Analysis*, Tata McGraw-Hill Publishing Company

	Limited,NewDelhi,1997
2.	*Manickaselvam V.K., Elements of Matrix and Stability Analysis of structures , Khanna Publishers, 1999, New Delhi.*
3.	Pandit G.S and Gupta S.P.,*Structural Analysis-A matrix approach*, TataMcGraw-HillPublishing Company Limited,NewDelhi, 2006.
4.	DevadosMenon,*Advanced Structural Analysis*, Narosa Publishing House, NewDelhi, 2009.
E-References:	
1.	https://nptel.ac.in/downloads/105105109/

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE602	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	At the end of the course student will acquire the knowledge in soil exploration .
2.	At the end of the course student will know about the bearing capacity, shallow and deepfoundations
3.	At the end of the course student will know about the earth pressure and stability of slopes3.

Unit I	SOIL EXPLORATION AND SELECTION OF FOUNDATION	9	+	0

Soil exploration methods – Disturbed and Undisturbed sampling – Samplers – Depth of Exploration – Number and Spacing of boreholes – Sounding tests – Standard Penetration Test, Static Cone and Dynamic Cone Penetration Tests – Bore log.
Requirements of good foundation – factors governing location and depth- Types of foundation – Choice of foundation – Floating Foundation – Foundation on Expansive soil.

Unit II	BEARING CAPACITY OF SOIL AND SETTLEMENT	9	+	0

Bearing Capacity – Terzhaghi's Bearing Capacity Equation – Types of Failure – Effect of Water Table – Skempton's Formula – Bearing Capacity based on IS method- Effect of eccentricity of load on bearing capacity of soil – Bearing Capacity based on 'N' value - Allowable bearing pressure – Plate Load test – Methods of Improving Bearing Capacity of soil.
Settlement – immediate and time dependent settlement – Differential settlement – Causes – BIS Code provisions – Proportioning of Footing.

Unit III	PILE FOUNDATION	9	+	0

Classification of Piles – Functions – Merits – Load Carrying Capacity – Static Analysis – Dynamic Analysis – Pile load test – Pile group – Spacing and Group action – Efficiency of Pile group – Engineering News Formula – Hammers – Settlement – Negative Skin Friction – uplift capacity - Construction of Under Reamed Pile Foundation.

Unit IV	STABILITY OF SLOPES	9	+	0

Stability of Slopes – Infinite and Finite Slopes – Types of Failure – Culmann's methods –Swedish Slip Circle Method – Friction Circle method – Bishop's method – Taylor's Stability Number – Slope protective measures.

Unit V	EARTH PRESSURE ON RETAINING WALLS	9	+	0

Plastic equilibrium in soils – Active and Passive states – Rankine's theory – Cohesionless and cohesive soils – Couloumb's wedge theory – Earth pressure on retaining walls of simple configurations – Stability of retaining walls.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Characterise soil investigation for any civil engineering construction
CO2	:	Analyse earth retaining structures for any kind of soil medium
CO3	:	Estimate bearing capacity using IS code methods
CO4	:	Design proper foundations for any kind of shallow foundation system
CO5	:	Estimate pile and pile group capacity for any kind of soil including group efficiency andnegative

Text Books:

1.	Punmia B.C Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., New Delhi, 2017.
2.	Purushothama Raj P, *Soil Mechanics and Foundation Engineering*, Perason Education, 2008
3.	Gopal Ranjan and Rao A.S.R., *Basic and Applied Soil Mechanics*, New AgeInternational Publishers (P) Ltd., New Delhi, 2016.

4.	*Venkataramaiah, C., Geotechnical Engineering, New Age InternationalPublishers, New Delhi, 1995.*
5.	Punmia B.C *Soil Mechanics and Foundations*, Laxmi Publications Pvt. Ltd., New Delhi, 1995.
Reference Books:	
1.	Swamisaran, *Analysis and Design of Structures – Limit State Design*, OxfordIBH Publishing Co-Pvt. Ltd., New Delhi, 1998.
2.	Som N.N and Das S.C., *Theory and Practice of Foundation Design*, Prentice Hall Pvt. Ltd., New Delhi, 2003.
3.	Arora K.R., *Soil Mechanics and Foundation Engineering*, Standard Publishers and Distributors, New Delhi, 1997.

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	1	3	1	2	0	0	0	3	0	0
CO2	3	3	3	2	2	2	3	1	2	0	0	0	3	0	0
CO3	3	3	3	3	2	2	3	1	2	0	0	0	3	0	0
CO4	3	3	3	2	1	2	3	1	2	0	0	0	3	0	0
CO5	3	3	2	3	1	1	3	1	2	0	0	0	3	0	0

1 – Slightly
2 – Moderately
3 – Strongly

18CE603	ENGINEERING ECONOMICS, ESTIMATION& COSTING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	An idea of how structures are built and projects are developed on the field.
2.	An understanding of modern construction practices.
3.	A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics.
4.	A basic ability to plan, control and monitor construction projects with respect to time and cost.
5.	An idea of how to optimise construction projects based on costs.
6.	An idea how construction projects are administered with respect to contract structuresand issues.
7.	An ability to put forward ideas and understandings to others with effectivecommunication processes.

UNIT I	BASIC ECONOMICS	9	+	0

Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policiesand Application. Theory of the Firm and Market Structure. Basic Macro-economic Concepts(including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies.Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

UNIT II	FINANCING	9	+	0

Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary andFinancial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions;Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

UNIT III	COST AND BREAK EVEN ANALYSIS	9	+	0

Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control – Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.

UNIT IV	INDIAN ECONOMY	9	+	0

Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

Unit V	ESTIMATION AND COST ANALYSIS OF STRUCTURES	9	+	0

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

Total (L+T)= 45 Periods

Course Outcomes:		
Upon completion of this course, the students will be able to:		
CO1	:	Have an idea of Economics in general, Economics of India particularly for public sectoragencies and private sector businesses
CO2	:	Be able to perform and evaluate present worth, future worth and annual worth analyseson one of more economic alternatives.
CO3	:	Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on oneor more economic alternatives.
CO4	:	Be able to understand the technical specifications for various works to be performed for aproject and how they impact the cost of a structure.
CO5		Be able to quantify the worth of a structure by evaluating quantities of constituents,derive their cost rates and build up the overall cost of the structure.
CO6		Be able to understand how competitive bidding works and how to submit a competitivebid proposal.

Text Books:	
1.	Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand
2.	Prasad L.M., Principles and Practice of Management, S Chand & Sons, 2010
3.	Dutta, B.N., Estimating and Costing in Civil Engineering, UBS Publishers & Distributors Pvt. Ltd., 2007
4.	Kohli, D.D and Kohli, R.C., A Text Book of Estimating and Costing (Civil), S.Chand& Company Ltd., 2007
Reference Books:	
1.	Barthwal R.R., *Industrial Economics - An Introductory Text Book*, New Age
2.	*Khan M.Y. and Jain P.K., Financial Management, McGraw-Hill Publishing Co., Ltd*
3.	*Varshney R.L. and Maheshwary K.L., Managerial Economics, S Chand and Co*
4.	*Harold Koontz & Heinz Weihrich, Essentials of Management, T.M.H. Publications, 2007*
5..	*PWD Data Book.*
6.	*Tamilnadu Transparencies in Tender Act, 1998.*
7.	*Standard Bid Evaluation Form, Procurement of Goods or Works, The World Bank, April 1996.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE604	PROFESSIONAL PRACTICE, ETHICS & BUILDING BY-LAWS	L	T	P	C
		2	0	0	2

Course Objectives:

1	To make the students understand the types of roles they are expected to play in the society as practitioners of the civil engineering profession.
2	To develop some ideas of the legal and practical aspects of their profession.

Unit I	PROFESSIONAL PRACTICE –RESPECTIVE ROLES OF VARIOUS STAKEHOLDERS :	9	+	0

Government (constituting regulatory bodies and standardization organizations, prescribing norms toensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards ofpractice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress,IIA/ COA,ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI); Contractors (role governed by contracts and regulatory Acts and Standards);Manufacturers/ Vendors/ Service agencies (role governed by contracts and regulatory Acts and Standards).Professional Ethics – Definition of Ethics,Professional Ethics, Business Ethics,Corporate Ethics, Engineering Ethics, Personal Ethics; Code of Ethics ; Profession, Professionalism, Professional Responsibility, Professional Ethics; Conflict of Interest, Gift Vs Bribery, Environmental breaches, Negligence, Deficiencies in state-of-the-art; Vigil Mechanism, Whistleblowing, protected disclosures.

Unit II	GENERAL PRINCIPLES OF CONTRACTS MANAGEMENT:	9	+	0

*Indian Contract Act, 1972 andamendments*covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders,Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications; Critical /“Red Flag” conditions; Contract award & Notice To Proceed;Variations& Changes in Contracts; Differing site conditions; Cost escalation; Delays,Suspensions& Terminations; Time extensions & Force Majeure; Delay Analysis; Liquidated damages & Penalties; Insurance & Taxation; Performance and Excusable Non-performance;Contract documentation; Contract Notices; Wrong practices in contracting (Bid shopping,Bid fixing, Cartels); Reverse auction;Case Studies; Build-Own-Operate & variations; Public-Private Partnerships; International Commercial Terms.

Unit III	ARBITRATION,CONCILIATION AND ADR (Alternative Dispute Resolution) system:	9	+	0

Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interimmeasures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and courtassistance; Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation,
mediation and arbitration,confidentiality, resort to judicial proceedings, costs; Dispute ResolutionBoards; Lok Adalats.

Unit IV	ENGAGEMENT OF LABOUR & OTHER CONSTRUCTION-RELATEDLAWS:	9	+	0

Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017,NBC 2017

Unit V	**LAW RELATING TO INTELLECTUAL PROPERTY:**	**9**	**+**	**0**

Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957,Meaning of copyright – computer programs, Ownership of copyrights and assignment,Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition,Rights and obligations of patentee, Duration of patents – law and policy considerations,Infringementand
related remedies.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	To familiarise the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethicsgoverning the profession.
CO2	:	To give a good insight into contracts and contracts management in civil engineering,dispute resolution mechanisms; laws governing engagement of labour
CO3	:	To give an understanding of Intellectual Property Rights, Patents
CO4	:	To make the students understand the types of roles they are expected to play in thesociety as practitioners of the civil engineering profession.

Text Books:

1	Dutt (1994), Indian Contract Act, Eastern Law House
2	Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration

Reference books

1	Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. ProfessionalOffset
2	Avtarsingh (2002), Law of Contract, Eastern Book Co.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE605	CONCRETE LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1.	This course will help students to know about the properties of different building materials.
2.	To implement the idea of material properties in order to make mix design and for designof various building members.
3.	To prepare the students to effectively link theory with practice and application and to demonstrate background of the theoretical aspects in concrete technology
4.	To prepare the students to have hands on experiments and to have exposure toequipment and machines
5.	To motivate the students to take up higher studies and innovative research projects

EXPERIMENTS

1.	Determination of Normal consistency and setting time tests on cement
2.	Determination of Fineness test on cement
3.	Determination of Soundness test on cement
4.	Determination of Aggregate Crushing and Impact Value
5.	Determination of Aggregate Abrasion Test
6.	Determination of Specific gravity of Cement
7.	Concrete mix Design using IS method
8.	Determination of Compressive strength of cement
9.	Determination of Slump test on fresh concrete
10.	Determination of Compaction factor test on fresh concrete
11.	Determination of quality of Hardened concrete using Ultrasonic concrete tester (NDT)
12.	Determination of compressive strength of concrete cubes by Rebound Hammer tester(NDT)

Total = 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Know the techniques to characterize various construction materials throughrelevant tests.
CO2	:	test all the concrete materials as per IS code
CO3	:	design the concrete mix using IS code
CO4	:	Determine the properties of fresh and hardened concrete
CO5	:	Conduct tests on concrete using NDT methods

Reference Books:

1.	Building and Construction Materials: Testing and Quality Control- Testing and Quality Control ,M. L. Gambhir,Dhanpat Rai & sons New – Delhi,2014
2.	Laboratory manual on concrete technology; Hemant Sood, CBS Publishers,First edition ,2016
3.	Concrete Technology (Theory & Practice) S.ChandPublications,Eighth edition,2018

CO-PO-PSO MAPPING

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

1 – Slightly 2 – Moderately 3 - Strongly

18CE606	COMPUTER AIDED DESIGN AND DRAWING (Concrete and Steel)	L	T	P	C
		0	0	4	2

Course Objectives:

1. This course will help students to perform structural design for different elements implanting manually and through drafting process.

EXPERIMENTS

1.	Design and drawing of RCC cantilever retaining wall with reinforcement details
2.	Design and drawing of Counterfort retaining wall with reinforcement details
3.	Design and drawing of RCC slab with reinforcement details
4.	Design and drawing of RCC Tee beam bridges for IRC Loading with reinforcement details
5.	Design and drawing of RCC Circular overhead water tank with reinforcement details
6.	Design and drawing of RCC rectangular underground water tank with reinforcement details
7.	Design and drawing of Plate girder bridge with detailed drawings on connections
8.	Design and drawing of Truss girder bridge with detailed drawing on connection
	Total = 60 Periods

Course Outcomes:

After the successful completion of the practical session, the students will be able to

CO1	:	Acquire hands on experience on designing the concrete structures
CO2	*:*	Acquire hands on experience on designing the steel structures
CO3	*:*	Preparation of structural drawings of concrete structures technically
CO4	*:*	Preparation of structural drawings of steel structures technically
CO5	*:*	Analyse the RCC and Steel structures with safe limits and checking the design.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CE801	Construction Management	L	T	P	C
		3	0	0	3

Course Objectives: The objectives of this course is to

1.	Learn basic concepts about planning
2.	Study about the legal implications of contract, common, and regulatory law to manage a construction project
3.	Understand construction accounting and cost control
4.	Understand construction risk management and quality assurance and control
5.	Train the students with the latest and the best in the rapidly changing fields of Construction Engineering, Technology and Management

UNIT I	CONSTRUCTION PLANNING	9	+	0

Basic concepts in the development of construction plans-choice of Technology and Construction method-Defining Work Tasks- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems

UNIT II	SCHEDULING PROCEDURES AND TECHNIQUES	9	+	0

Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads, lags and windows-Resource oriented scheduling-Scheduling with resource constraints and precedence -Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost trade offs -Improving the Scheduling process – Introduction to application software

UNIT III	COST CONTROL MONITORING AND ACCOUNTING	9	+	0

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

UNIT IV	QUALITY CONTROL AND SAFETY DURING CONSTRUCTION	9	+	0

Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

Unit V	ORGANIZATION AND USE OF PROJECT INFORMATION	9	+	0

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information -Organizing information in databases-relational model of Data bases-Other conceptual Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the nuances of management functions
CO2	:	Analyze the framework of a business organization
CO3	:	Adopt an empirical approach toward business situations
CO4	:	Apply various Project Management techniques
CO5		Implement roles of team players

Text Books:

1.	Chitkara, K.K. *Construction Project Management Planning, Scheduling and Control*, Tata McGraw-Hill Publishing Co., New Delhi, 1998.
2.	Punmia B.C. and Khandelwal, Project planning and Control with PERT and CPM, Laxmi

	Publications, New Delhi, 2002.
Reference Books:	
1.	Ghalot P.S., Dhir D.M., Construction Planning and Management,Wileyeastern Limited, 1992.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

LIST OF ELECTIVES FOR B.E CIVIL ENGINEERINGPROFESSIONAL ELECTIVES

TRANSPORTATION ENGINEERING

18CEPE01	TRAFFIC ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	The students acquire comprehensive knowledge of traffic surveys and studies suchas 'Volume Count', 'Speed and delay', 'Origin and destination', 'Parking', 'Pedestrian' and 'Accident surveys'
2.	They achieve knowledge on design of 'at grade' and 'grade separated' intersections.
3.	They also become familiar with various traffic control and traffic management measures.

UNIT I	INTRODUCTION	9	+	0

Significance and scope, Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency (Problems), Components of Traffic Engineering- Road, Traffic and Land Use Characteristics

UNIT II	TRAFFIC SURVEYS AND ANALYSIS	9	+	0

Surveys and Analysis - Volume, Capacity, Speed and Delays, Origin and Destination, Parking, Pedestrian Studies, Accident Studies and Safety Level of Services- Problems

UNIT III	TRAFFIC CONTROL	9	+	0

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 IV	GEOMETRIC DESIGN OF INTERSECTIONS	9	+	0

Conflicts at Intersections, Classification of Intersections at Grade, - Channelized and Unchannelized Intersection - Grade Separators (Concepts only), Principles of Intersection Design,
Elements of Intersection Design, Channelization and Rotary design (Problems), Grade Separators

Unit V	TRAFFIC MANAGEMENT	9	+	0

Traffic Management- Traffic System Management (TSM) and Travel Demand Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes - Introduction to Intelligence Transport System (ITS)

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply the principles of the transportation planning process and demand estimation
CO2	:	Analyse the trip production and trip attraction models
CO3	:	Analyse the growth factor, gravity and opportunity models
CO4	:	Apply the mode choice behaviour and mode split models

Text Books:

1.	Khanna K., Justo C.E.G., *Highway Engineering* revised 10thedition Khanna Publishers, Roorkee, 2014.
2.	Kadiyali L. R, *Traffic Engineering and Transport Planning*, Khanna Publishers, New Delhi,2019.

Reference Books:

1.	Subhash C.Saxena, A Course in Traffic Planning andDesign,Dhanpat Rai

	Publications, New Delhi, 1989.
2.	Saltar S.A., Highway Traffic Analysis and Design, Prentice Hall, New Jersey, 2002.
3.	Guidelines of Ministry of Road Transport and Highways, Government of India.
4.	Indian Roads Congress (IRC) specifications: Guidelines and special publications on Traffic Planning and Management
E-References:	
1.	https://nptel.ac.in/courses/105101008/1- Fundamentals of Traffic flow
2.	https://nptel.ac.in/courses/105101008/27- Intersection control
3.	https://nptel.ac.in/courses/105101008/50- Traffic engineering and management

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE02	AIRPORTS, DOCKS AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	The course imparts the knowledge of planning and design of airports, docks and harbour structure
2.	The course imparts the knowledge of construction of airports, docks and harbour structure
3.	The course imparts the knowledge of maintenance of airports, docks and harbour structure

UNIT I	AIRPORT PLANNING AND DESIGN	9	+	0

Advantages and Limitations of Air Transport, Components of Airports-Airport Planning – Air traffic potential, Site Selection, Design of Components, Cost Estimates, Evaluation and Institutional arrangements-Runway Design- Orientation, Cross wind Component, Wind rose Diagram (Problems), Geometric Design and Corrections for Gradients (Problems), Drainage.

UNIT II	TAXIWAY DESIGN AND AIRPORT LAYOUTS	9	+	0

Taxiway Design – Geometric Design Elements, Minimum Separation Distances, Design Speed,Airport Drainage -Airport Zoning - Clear Zone, Approach Zone, Buffer Zone, Turning Zone, Clearance over Highways and Railways-Airport Layouts – Apron, Terminal Building, Hangars,Motor Vehicle Parking Area and Circulation Pattern, Case studies of Airport Layouts-Airport Buildings – Primary functions, Planning Concept, Principles of Passenger Flow, Passenger Facilities.

UNIT III	VISUAL AIDS AND AIR TRAFFIC CONTROL	9	+	0

Visual Aids – Runway and Taxiway Markings, Wind Direction Indicators, Runway and Taxiway Lightings-Air Traffic Control – Basic Actions, Air Traffic Control Network Helipads, Hangars, Service Equipments.

UNIT IV	HARBOUR ENGINEERING	9	+	0

Definition of Terms - Harbours, Ports, Docks, Tides and Waves, Littoral Drift, Sounding, Area, Depth, Satellite Ports Requirements and Classification ofHarbours
Site Selection & Selection Investigation – Speed of water, Dredging, Range of Tides, Waves and Tidal Currents, Littoral Transport with Erosion and Deposition, Anchoring Grounds, Geological Characteristics, Winds & Storms- Proximity to Towns/Cities, Utilities, Construction Materials,Coast Lines

Unit V	DOCKS AND OTHER STRUCTURES	9	+	0

Dry and Wet Docks,, Planning and Layouts- Entrance, Position of Light Houses, Navigating Terminal Facilities – Port Buildings, Warehouse, Transit Sheds, Inter-modal Transfer Facilities, Navigational Aids Coastal Structures- Piers, Breakwaters, Wharves, Jetties, Quays, Spring FendersCoastal Shipping, Inland Water Transport and Container Transportation. Pipe Ways, Rope Ways.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Plan for airport, harbour, docks and coastal structures
CO2	:	Design for airport and its components
CO3	:	Construct airport, docks and harbour
CO4	:	Protect the harbour, docks and coastal structures

Text Books:

1.	Khanna S.K, Arora M.G, *Airport Planning and Design*, NemchandAnd Brothers, Roorkee,2007.
2.	Bindra S P., *A Course in Docks and Harbour Engineering*, Dhanpat Rai and Sons, New Delhi, 1992.

3.	Hasmukh PranshankerOza, Gautam H. Oza., Dock and Harbour Engineering CharotarPublishing House, 1999
Reference Books:	
1.	RangwalaS.C ,Rangwala P.C , *Airport Engineering*, Charotar Publishing House Pvt. Limited, 2008
2.	Shahani P.B., *Airport Techniques*, 2nd edition, Oxford Publications, New Delhi
3.	Srinivasan R., *Harbour, Dock and Tunnel Engineering*, Charotar Publishing House, Anand, India, 1995.
4.	Norman J. Ashford , Paul H. Wright, *Airport Engineering*, John Wiley & Sons Inc; 1st edition
E-References:	
1.	https://nptel.ac.in/courses/114106025/ - Ocean Engineering (Harbour and Docks)
2.	https://nptel.ac.in/courses/105104098/7- Advanced Transportation Engineering (Runway design)
3.	https://nptel.ac.in/courses/105107123/- Transportation Engineering II (Air Transports)

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE03	INTEGRATED TRAFFIC PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To give an overview of Traffic engineering and traffic regulation
2.	To impart knowledge on traffic management and traffic safety
3.	To develop knowledge in the integrated approach in traffic planning

UNIT I	TRAFFIC PLANNING AND CHARACTERISTICS	9	+	0

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town ,country ,regional and all urban infrastructure – Towards Sustainable approach. – land use & transport and modal integration.

UNIT II	TRAFFIC SURVEYS	9	+	0

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT III	TRAFFIC DESIGN AND VISUAL AIDS	9	+	0

Intersection Design - channelization, Rotary intersection design – Signal design – Coordination of signals –– Grade separation - Traffic signs including VMS and road markings – Significant roles oftraffic control personnel - Networking pedestrian facilities & cycle tracks.

UNIT IV	TRAFFIC SAFETY AND ENVIRONMENT	9	+	0

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration ofpublic transportation – Promotion of non-motorized transport.

Unit V	TRAFFIC MANAGEMENT	9	+	0

Area Traffic Management System - Traffic System Management (TSM) with IRC standards –- Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education.

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Analyse traffic problems and plan for traffic systems various uses
CO2	:	Perform surveys and forecast traffic
CO3	:	Design Channels, Intersections, signals and parking arrangements
CO4	:	Develop Traffic management Systems

Text Books:

1.	Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013
2.	Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
3.	Salter. R.I and Hounsell N.B, "Highway Traffic Analysis and design", Macmillan PressLtd.1996.

Reference Books:

1.	Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of HighwayEngineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011

2.	Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
3.	SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994
4.	John E Tyworth, "Traffic Management Planning, Operations and control", Addison Wesly Publishing Company, 1996
E-References:	
1.	https://nptel.ac.in/courses/105101008/5- Traffic measurement procedures
2.	https://nptel.ac.in/courses/105101008/17- Traffic flow modelling
3.	https://nptel.ac.in/courses/105101008/48- Intelligent transportation system

CO-PO-PSO MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	0	1	1	1	1	1	3	3	3	1
CO2	2	3	1	2	1	0	3	3	2	2	1	0	3	0	1
CO3	3	3	3	3	3	0	3	2	2	2	1	1	3	3	3
CO4	3	2	1	3	3	0	3	2	2	3	3	3	1	2	1

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE04	SMART MATERIALS AND SMART STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives: The objectives of this course is to

1.	Learn about different types of smart materials
2.	Study about advanced measuring instrument
3.	Understand about sensors and its functions
4.	Study about various actuator materials and their role
5.	Learn about Data acquisition system

Unit I	INTRODUCTION	9	+	0

Introduction to smart materials and structures – Instrumented structures functions and response –Sensing systems – Self diagnosis – Signal processing consideration – Actuation systems and effectors.

Unit II	MEASURING TECHNIQUES	9	+	0

strain measuring techniques using electrical strain gauges, types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

Unit III	SENSORS	9	+	0

Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strainmeasurement – Inductively Read Transducers – The LVOT – Fiber optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors– Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.

Unit IV	ACTUATORS	9	+	0

Actuator techniques – Actuator and actuator materials – Piezoelectric and electrostrictive material – Magnetostructure material – Shape memory alloys – Electro orheological fluids– Electromagneticactuation – Role of actuators and actuator materials.

Unit V	SIGNAL PROCESSING AND CONTROL SYSTEMS	9	+	0

Data acquisition and processing – Signal processing and control for smart structures – Sensors as geometrical processors – Signal processing – Control system – Linear and Non-linear.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply the knowledge on the self diagnosis, functions and response of various smartmaterials
CO2	:	Acquire thorough knowledge on instrumentation for measuring strains, load and deflection
CO3		Apply the concepts of sensors parameters and characteristics
CO4		Have an insight into actuator techniques, SMA
CO5	:	Demonstrate the concepts of signal processing and control system

Text Books:

1.	L. S. Srinath – *Experimental Stress Analysis* – Tata McGraw-Hill, 1998
2.	Brain Culshaw – *Smart Structure and Materials Artech House* – Borton. London-1996

Reference Books:

1.	J. W. Dally & W. F. Riley – *Experimental Stress Analysis* – Tata McGraw-Hill,1998

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	2	2	3	2	2	2	2	0	2
CO2	3	2	3	2	3	2	2	2	3	2	2	2	2	0	2
CO3	2	3	1	3	2	3	3	3	2	3	1	3	3	1	3
CO4	3	2	3	3	2	3	2	2	2	3	0	1	1	1	2
CO5	2	3	3	2	3	1	3	2	3	2	3	1	2	1	3

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE05	CONSTRUCTION TECHNIQUES AND EQUIPMENTS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	The main objective of this course is to impart basic knowledge in Construction methods, equipments, machineries and fire safety principles.

Unit I	MODERN CONSTRUCTION METHODS	9	+	0

Open excavation, shafts and tunnels, pier and caisson foundation . Basement construction -construction Methods – supporting the excavations- control of ground water- requirements of form work – economy in form work – materials for forms – arrangements forms for slabs, beams, columns,walls, culverts, stairs etc – removal of forms - shoring and underpinning- basement waterproofing.

Unit II	CONSTRUCTION TECHNIQUES	9	+	0

Construction Methods for Bridges, roads, railways, dams, harbours, river works and pipelines - Construction techniques for Earth moving, excavating , drilling, blasting, tunneling and hoisting and erection

Unit III	CONSTRUCTION EQUIPMENTS	9	+	0

Equipment for: Earth moving, excavating, drilling and blasting.
Equipment for: Dredging, tunneling, hoisting, erection and dewatering - Equipment for Flooring – dewatering and floors finishing.
Equipment for production of concrete – Crushers- feeders- screening equipment – batching andmixing equipment – Conveyors – Vibrators – Concrete mixers - hauling, pouring and pumping equipment – transporters.

Unit IV	MACHINERIES AND ELECTRICAL SYSTEMS IN BUILDINGS	9	+	0

Lifts and Escalators – Special features required for physically handicapped and elderly. Basics of electricity-Single/Three phase supply-Protective devices in electrical installations – Earthing for safety–Typesofearthing–ISspecifications-Planningelectricalwiringforbuilding-Mainand distribution boards.

Unit V	ILLUMINATION & FIRE SAFETY	9	+	0

Luminous flux-Candela-Solid angle illumination-Utilisationfactor-Depreciation factor-MSCP-MHCP- Lans of illumination-Classification of lighting- Artificial light sources-Spectral energy distribution- Luminous efficiency-Color temperature-Color rendering.
Design of modern lighting-Lighting for stores, offices, schools, hospital and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.
Causes of fire in buildings – Safety regulations – NBC – Planning considerations in buildings like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. systems.
Special features required for physically handicapped and elderly in building types – Heat and smoke detectors – Fire alarm system, snorkel ladder.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Know the different construction techniques and methods.
CO2	:	Select,maintain and operate hand and power tools and equipments used in the bridges,roads,railways and dams.
CO3	:	Know the methods and techniques involved in the construction of various sub structures.
CO4	:	Understand the importance of electric safety in buildings
CO5	:	Know the principles on illumination and fire safety.

Text Books:	
1.	Antil J M., *Civil Engineering Construction*, McGraw Hill Book Co., 1982
2.	Peurifoy, R.L.,Ledbette. W.B *Construction Planning , Equipment and Methods* McGraw Hill Co, 2000
3.	Ratay., R.T Hand Book of *Temporary Structures in Construction*, McGraw Hill,1984 Ambrose E.R., *Heat Pumps and Electric Heating* , John Wiley and Sons,Inc.,New York 1968
4.	Hopkinson and Kay J.D. ,*The lighting of buildings* , Faber and Faber, London
Reference Books:	
1.	Koerner ,R.M,*Construction& Geotechnical Methods in Foundations Engineering*, McGraw Hill, 1984
2.	Varma M., *Construction Equipment and its Planning & Application*, Metropolitain Books Co., 1979
3.	Smith R.C, Andres, C.K *Principles and Prentice of Heavy Construction*, Prentice Hall, 1986
4.	Francis D.K.Ching – *Architecture, Form, Space and Order*-V.N.R NY., 1999
5.	William Severns H. and Julian Fellows R. *Air-Conditioning and Refrigeration*, John Wiley and Sons,London,1988
6.	Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998.
7	*National Building Code*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE06	PROJECT SAFETY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the various safety concepts and requirements applied to construction projects
2.	To learn the details about safety programmes
3.	To understand the contractual obligations
4.	To study the various methods of designing for safety
5.	To acquire a knowledge about owners and designers outlook

Unit I	CONSTRUCTION ACCIDENTS	9	+	0

Accidents and their Causes –Human Factors in Construction Safety – Costs of Construction Injuries – Occupational and Safety Hazard Assessment – Legal Implications.

Unit II	SAFETY PROGRAMMES	9	+	0

Problem Areas in Construction Safety – Elements of an Effective Safety Programme – Job-Site Safety Assessment – Safety Meetings – Safety Incentives

Unit III	CONTRACTUAL OBLIGATIONS	9	+	0

Safety in Construction Contracts – Substance Abuse – Safety Record Keeping.

Unit IV	DESIGNING FOR SAFETY	9	+	0

Safety Culture – Safe Workers – Safety and First Line Supervisors – Safety and Middle Managers – Top Management Practices, Company Activities and Safety – Safety Personnel – Sub contractual Obligation – Project Coordination and Safety Procedures – Workers Compensation.

Unit V	OWNERS' AND DESIGNERS' OUTLOOK	9	+	0

Owner's responsibility for safely – Owner preparedness – Role of designer in ensuring safety – Safetyclause in design document.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	know various constructions safety concepts.
CO2	:	Carryout various safety programmes
CO3	:	Challenge contractual obligations task

Text Books:

1.	Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
2.	.Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and HealthManagement, Prentice Hall Inc., 2001.

Reference Books:

1.	Tamilnadu Factory Act, Department of Inspectorate of factories, Tamil Nadu. Health Management, Prentice Hall Inc.,2001.
2.	Chris Hendrickson and Tung Au, *Project Management forConstruction – Fundamentals Concepts for Owners, Engineers, Architects and Builders,*Prentice Hall, Pitsburgh,2000.

CO-PO-PSO MAPPING

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

1 – Slightly 2 – Moderately 3 - Strongly

18CEPE07	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives: The objectives of this course is to

1.	study the various types and properties of repair materials
2.	learn various distress and damages to concrete structures
3.	understand the importance of maintenance of structures
4.	assess the damage to structures using various tests
5.	learn various repair techniques of damaged structures, corroded structures

Unit I	MAINTENANCE AND REPAIR STRATEGIES	9	+	0

Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance variousaspects of inspection , assessment procedure for evaluating a damaged structure, causes of deterioration.

Unit II	SERVICEABILITY AND DURABILITY OF CONCRETE	9	+	0

Quality assurance for concrete construction, concrete properties- strength, permeability, thermal properties and cracking- effects due to climate, temperature, chemical, corrosion- Design and construction errors-effects of cover thickness and cracking.

Unit III	MATERIALS AND TECHNIQUES FOR REPAIR	9	+	0

Special concretes and mortar, concrete chemical, special elements for accelerated strength gain, expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vaccum concrete, gunite and shotcrete, epoxy injection, mortar repair for cracks,
shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosionresistant steels, coatings and cathodic protection.

Unit IV	REPAIRS,REHABILITATION AND RETROFITTING OF STRUCTURES	9	+	0

Strengthening of Structural elements, deflection, cracking, chemical disruption, weatheringcorrosion, wear, fire, leakage and marine exposure.

Unit V	DEMOLITION TECHNIQUES	9	+	0

Demolition methods by machines,explosives,Advanced techniques-Demolition sequences,dismantlingtechniques,safety precautions in dismantling and demolition, Engineered demolition techniques for dilapidated structures- case studies

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	demonstrate the condition of structures
CO2	:	Inspect and evaluate the damaged structure
CO3	:	Implement the repairing techniques of a structure
CO4		Identify and Use different materials for repairing works
CO5	:	Demonstrate the dismantling and demolishing structures

Text Books:

1.	Shetty, M.S.,*Concrete Technology- Theory and Practice*, S. Chand and company, NewDelhi,2019
2.	Repair and protection of concrete structures by Noel P.Mailvaganam, CRC Press,1991.
3.	CPWD: Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt. of India , 2002, updated reprint 2011

Reference Books:

1.	SanthakumarA.R,*TrainingCoursenotesonDamageAssessmentandRepair in Lowcost*

	housing, "RHDC.NBO" Anna University, july 1992.
2.	RaikarR.N.,*Learningfromfailures- deficienciesindesign,constructionandservices–* R &Dcentre (SDCPL), raikar bhavan, Bombay,1987
3.	Palaniyappan, N., *Estate management*, Anna Institute of Management, Chennai,1992.
4.	Lakshmipathy, M. etal., *Lecture notes of workshop on Repairs and Rehabilitation of structures*, 29-30thoctober 1999.
E-References:	
1.	https://nptel.ac.in/courses/114106035/38

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

ENVIRONMENTAL ENGINEERING

18CEPE08	INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. This subject deals with the pollution from major industries and methods of controlling thesame. The students are expected to know about the polluting potential of major industries in the country and the methods of controlling the same.

Unit I	**INTRODUCTION**	**9**	**+**	**0**

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	**CLEANER PRODUCTION ORGANISATION**	**9**	**+**	**0**

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications

Unit III	**POLLUTION FROM MAJOR INDUSTRIES**	**9**	**+**	**0**

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steelplants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

Unit IV	**TREATMENT TECHNOLOGIES**	**9**	**+**	**0**

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 V	**HAZARDOUS WASTE MANAGEMENT**	**9**	**+**	**0**

Hazardous wastes - Physico chemical treatment – solidification – incineration – Secured land fills.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the polluting potential of major industries
CO2	:	Carry out various methods to control the pollutants

Text Books:

1.	M.N.Rao&A.K.Dutta, *Wastewater Treatment*, Oxford - IBH Publication, 1995.
2.	W .W. Eckenfelder Jr., *Industrial Water Pollution Control,* McGraw-HillBook Company, NewDelhi, 2000.

Reference Books:

1.	T.Shen, *Industrial Pollution Prevention*, Springer, 1999
2.	R.L.Stephenson and J.B.Blackburn, Jr., *Industrial Wastewater Systems Hand book*, Lewis Publisher, New Yark, 1998
3.	H.M.Freeman, *Industrial Pollution Prevention Hand Book*, McGraw-Hill Inc., New Delhi,1995.
4.	Bishop, P.L., *Pollution Prevention: Fundamental & Practice*, McGraw-Hill, 2000.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE09	**HAZARDOUS WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To impart knowledge and skills in the collection, storage, transport, treatment, disposaland recycling options for hazardous wastes including the related engineeringprinciples, design criteria, methods and equipments

Unit I	**SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK**	**9**	**+**	**0**

Types and Sources of hazardous wastes – Need for hazardous waste management – Salient features of Indian legislations on management and handling of hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes, plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participationfor waste management.

Unit II	**WASTE CHARACTERIZATION AND SOURCE REDUCTION**	**9**	**+**	**0**

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 – Waste exchange - Extendedproducer responsibility - Recycling and reuse

Unit III	**STORAGE, COLLECTION AND TRANSPORT OF WASTES**	**9**	**+**	**0**

Handling and segregation of wastes at source – storage and collection of hazardous wastes – Analysis of Collection systems -Need for transfer and transport – Transfer stations Optimizing waste allocation – compatibility, storage, labeling and handling of hazardous wastes –hazardous waste manifests and transport.

Unit IV	**WASTE PROCESSING TECHNOLOGIES**	**9**	**+**	**0**

Objectives of waste processing – material separation and processing technologies - biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration - solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the contextof operation of facilities, handling of materials and impact of outputs on the environment

Unit V	**WASTE DISPOSAL**	**9**	**+**	**0**

Waste disposal options –Disposal in landfills -Landfill Classification, types and methods –site selection - design and operation of sanitary landfills, secure landfills andlandfill bioreactors –leachate and landfill gas management –landfill closure and environmental monitoring –Rehabilitation of open dumps –landfill remediation

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
CO2	:	Define andexplain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrialwaste

CO3	:	Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

Text Books:	
1.	George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2.	Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vansandEnvironmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, NewYork, 2001.
Reference Books:	
1.	1. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.
2.	2. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore,2002.
3.	3. Paul TWilliams, Waste Treatment and Disposal, Wiley, 2005

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE10	AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1.	This subject covers the sources, characteristics and effects of air and noise pollution and the methods of controlling the same. The student is expected to know about source inventory andcontrol mechanism.
2.	In general, the project brings: Contribution to the overall sustainability of the area.Improvement of overall waste management in the area.
3.	Increased recycling levels and reduction of organic waste in landfills.

Unit I	SOURCES AND EFFECTS OF AIR POLLUTANTS	9	+	0

Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles.

Unit II	DISPERSION OF POLLUTANTS	9	+	0

Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate - Atmospheric stabilityand turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications

Unit III	AIR POLLUTION CONTROL	9	+	0

Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment - gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries.

Unit IV	AIR QUALITY MANAGEMENT	9	+	0

Air quality standards – Air quality monitoring – Preventive measures - Air pollution control efforts – Zoning – Town planning regulation of new industries – Legislation and enforcement – EnvironmentalImpact Assessment and Air quality

Unit V	NOISE POLLUTION	9	+	0

Sources of noise pollution – Effects – Assessment - Standards – Control methods - Prevention

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Causes of air pollution
CO2	:	Effects of air and noise pollution
CO3	:	Effective air pollution management

Text Books:

1.	Anjaneyulu, D., *Air Pollution and Control Technologies*, AlliedPublishers,Mumbai, 2002.
2.	Rao, C.S., *Environmental Pollution Control Engineering*, Wiley Eastern Ltd., New Delhi, 1996.

Reference Books:

1.	RaoM.N., and Rao H. V. N., *Air Pollution Control*, Tata-McGraw-Hill, New Delhi, 1996.
2.	W.L.Heumann, *Industrial Air Pollution Control Systems*, McGraw-Hill, New York, 1997
3.	Mahajan S.P., *Pollution Control in Process Industries*, Tata McGraw-Hill Publishing Company, New Delhi, 1991.
4.	Peavy S.W., Rowe D.R. and Tchobanoglous G. *Environmental Engineering*, McGraw Hill, New Delhi, 1985.
5.	Garg, S.K., *Environmental Engineering Vol. II*, Khanna Publishers, New Delhi

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE11	MUNICIPAL SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	This subject covers the various sources and characterisation of municipal solid wastes and theon-site/off-site processing of the same and the disposal methods.
2.	The student is expected to know about the various effects and disposal options for the municip solidwaste.
3.	Provide efficient and economical refuse collection, recycling, and disposal services.

Unit I	SOURCES AND TYPES OF MUNICIPAL SOLID WASTES	9	+	0

Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes;characteristics – methods of sampling and characterization-Effects of improper disposal of solidwastes – public health effects. Principle of solid waste management – social & economic aspects- Public awareness- Role of NGOs- Legislation.

Unit II	ON-SITE STORAGE & PROCESSING	9	+	0

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

Unit III	COLLECTION AND TRANSFER	9	+	0

Methods of Collection – types of vehicles – Manpower requirement – collection routes- transferstations – selection of location, operation & maintenance; options under Indian conditions.

Unit IV	OFF-SITE PROCESSING	9	+	0

Processing techniques and Equipment; Resource recovery from solid wastes – composting,incineration, Pyrolysis - options under Indian conditions.

Unit V	DISPOSAL	9	+	0

Dumping of solid waste; sanitary lands fills – site selection, design and operation of sanitary landfills – Leachate collection & treatment.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Sources and characterization of municipal solid wastes
CO2	:	On-site/off-site processing of municipal solid wastes and disposal methods.
CO3	:	Effective municipal solid waste management

Text Books:

1.	George Tchobanoglousetc.al.,*Integrated Solid Waste Management*, McGraw-Hill,Publishers,1993.

Reference Books:

1.	B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, *WasteManagement*,Springer, 1994.
2.	*Manual on Municipal Solid Waste Management*, CPHEEO, Ministry of Urban Development, Government of India,NewDelhi, 2000
3.	R.E.Landreth and P.A.Rebers, *Municipal Solid Wastes – problems and Solutions*,LewisPublishers, 1997
4.	Peavy S.W., Rowe D.R. and Tchobanoglous G. *Environmental Engineering*, McGraw Hill, New Delhi, 1985.
5.	Garg, S.K., *Environmental Engineering Vol. II*, Khanna Publishers, New Delhi

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE12	MARINE POLLUTION MONITORING AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives:

1.	This subject educated the students about Coastal and Marine environment, ocean dynamics, sources of marine pollution and methods for monitoring, modeling and control.
2.	The subject deals with the method for monitoring the marine pollution.
3.	The subject cover modelling and controlling methods of marine pollution.

Unit I	MARINE ENVIRONMENT	9	+	0

Seas and oceans, Continental area, Coastal zone, Properties of sea water, Principles of Marine Geology, coastal features –Beaches, Estuaries, Lagoons– The oceans andclimate

Unit II	OCEAN HYDRODYNAMICS	9	+	0

Wave Theory, Waves in shallow waters –Refraction, Diffraction and Shoaling, Approximationsfor deep and shallow water conditions –Tidal Classification-
General circulation of ocean waters-Ocean currents -Coastal sediment transport -
Onshore offshore sediment transport -Beach formation and coastal processes -Tsunamis, stormsurge, El Nino effect.

Unit III	MARINE POLLUTION SOURCES AND EFFECTS	9	+	0

Sources of Marine Pollution –Point and non-point sources, Pollution caused by Oil Exploration, Dredging, Offshore Structures, Agriculture Impacts of pollution onwater quality and coastal ecosystems –Marine discharges and effluent standards

Unit IV	MONITORING OF MARINE POLLUTION	9	+	0

Basic measurements -Sounding boat, lead lines, echo sounders –current meters -tide gauge -use ofGPS – Measurement of coastal water characteristics –sea bed sampling
–Modeling of Pollutant transport and dispersion -Oil Spill Models -Ocean Monitoring satellites – Applications of Remote Sensing and GIS in monitoring marine pollution

Unit V	MARINE POLLUTION CONTROL AND ICZM	9	+	0

Design of out falls -Pollution Control strategies –Selection of optimal Outfall locations -National and International Treaties, Coastal Zone Regulation–Total Maximum Daily Load applications –Protocolsin Marine Pollution – ICZM and Sustainable Development

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Abilitytoknowaboutmarineenvironmentandwouldhavelearntthephysicalconcepts lying behind the oceanic curents and natural processes of various activities happening overthe marineenvironment.
CO2	:	Acquired knowledge on the marine pollution and the effect of the same on the ecology
CO3	:	Should have gained knowledge on remote sensing and various other techniquesfor measuring and monitoring oceanic environmentparameters
CO 4	:	Should have acquired knowledge on control of marine pollution and sustainabledevelopment

Text Books:

1.	Marine Pollution (5^{th}Edition) R.B. Clark, C. Frid and M Atttrill Oxford Science Publications,

	2001
2.	Marine pollution Dr.P.C.Sinha ,Anmol Publications Pvt. Ltd, 1998
Reference Books:	
1.	Problems of Marine Pollution : India and Canada, Raghavan, Sudha , Eastern Book Corporation,Delhi, India,
2.	Laws, E.A., Aquatic pollution, an introductory text. John Wiley and Sons, Inc., New York, 2000

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE13	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	This subject deals with the various impacts of infrastructure projects on the components of environment and method of assessing the impact and mitigating the same.
2.	The student is expected to know about the various impacts of development projects onenvironment and the mitigating measures.
3.	The subject deals with to identify, predict and evaluate the economic, environmental andsocial impact of development activities.

Unit I	**INTRODUCTION**	9	+	0

Impact of development projects under Civil Engineering on environment - Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – EIA capability and limitations – Legal provisions on EIA.

Unit II	**METHODOLOGIES**	9	+	0

Methods of EIA –Check lists – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case studies

Unit III	**PREDICTION AND ASSESSMENT**	9	+	0

Assessment of Impact on land, water and air, noise, social, cultural flora and fauna- Mathematical models- public participation – Rapid EIA.

Unit IV	**ENVIRONMENTAL MANAGEMENT PLAN**	9	+	0

Plan for mitigation of adverse impact on environment – options for mitigation of impact on water, airand land, flora and fauna; Addressing the issues related to the Project Affected People – ISO 14000

Unit V	**CASE STUDIES**	9	+	0

EIA for infrastructure projects – Bridges – Stadium – Highways – Dams – Multi-storey Buildings – Water Supply and Drainage Projects

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Impacts of development projects on environment
CO2	:	Mitigating measures on environmental impact accessment
CO3	:	Safe environmental plan to avoid Impacts on water, air, land, flora and fauna

Text Books:

1. Canter, R.L., *Environmental Impact Assessment*, McGraw-Hill Inc., New Delhi, 1996.

Reference Books:

1. Shukla, S.K. and Srivastava, P.R., *Concepts in Environmental Impact Analysis*, Common Wealth Publishers, New Delhi, 1992.
2. John G. Rau and David C Hooten (Ed)., *Environmental Impact Analysis Handbook*, McGraw-Hill Book Company, 1990
3. Judith Petts, *Handbook of Environmental Impact Assessment Vol. I & II*, BlackwellScience,1999.

CO-PO-PSO MAPPING

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

1 – Slightly 2 – Moderately 3 - Strongly

HYDRAULICS

18CEPE14	**OPEN CHANNEL FLOW**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	To introduce Open Channel Flow to students, explaining the types of open channel and their behaviours, the causes and principles of such behaviours, and applications open channels.
2.	To impart knowledge about Hydraulic Slope and Hydraulic Curve.
3.	To impart knowledge about Critical depth and velocity, Hydraulic jumps.
4	To apply fundamental concepts and techniques of hydraulics and hydrology in the analysis and operation of water resources systems
5.	To analyse flow characteristics in open channel and design hydraulic machines.

Unit I	**INTRODUCTION**	**9**	**+**	**0**

Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels, Review of Uniform flow: Standard equations, hydraulically efficient channel sections, compound sections.
Energy-depth relations: Concept of specific energy, specific force, critical flow, critical depth, hydraulic exponents, and channel transitions.

Unit II	**GRADUALLY VARIED FLOW (GVF)**	**9**	**+**	**0**

Equation of gradually varied flow and its limitations, flow classification and surface profiles, Control sections. Computation methods and analysis: Integration of varied flow equation by analytical, graphical and advanced numerical methods, Transitions of subcritical and supercritical flow, flow in curved channels.

Unit III	**Rapidly Varied Flow (RVF)**	**9**	**+**	**0**

Characteristics of rapidly varied flow, Classical hydraulic jump, Evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, Hydraulic jump in gradually and suddenly expanding channels, submerged hydraulic jump, rolling and sky jump, use of jump as an energy dissipater
Rapidly varied unsteady flow: Equation of motion for unsteady flow, "Celerity" of the gravity wave, deep and shallow water waves, open channel positive and negative surge.

Unit IV	**Spatially Varied Flow (SVF)**	**9**	**+**	**0**

Basic principles, Differential SVF equations for increasing and decreasing discharge, Classifications and solutions, Numerical methods for profile computation, Flow over side-weir and Bottom-rack.

Unit V	**Flow measurement:**	**9**	**+**	**0**

Flow measurement by sharp crested and broad crested weirs, critical depth flumes, sluice gate, Free overfall Flumes – Parshall flume, Venturiflume, Cut throat flume

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the causes of soil erosion
CO2	:	Carry out conservation measures in a watershed
CO3	:	Know about water harvesting and groundwater recharging structures

Text Books:

1.	Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008.

2.	Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2009.
Reference Books:	
1.	Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998.
2.	*Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE15	RIVER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To acquire a wide knowledge on rivers required to make an integrated river basic management plan based on natural & social sciences and engineering& technology.
2.	To know the relation to river systems, long term environmental changes of rivers and their factors, river flows and river channel processes, river and lake ecological systems.
3.	To study the recent characteristics of flood disasters, integrated river basinplanning including flood control,
4.	To understand the sustainable reservoir management, nature restoration, and sediment transport management
5.	To develop the abilities to design the protection works.

Unit I	INTRODUCTION	9	+	0

Introduction, classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Sediment transport and budgets, River morphology and various classification schemes.

Unit II	BEHAVIOUR OF RIVER	9	+	0

Behaviour of Rivers: Introduction, River Channel patterns, Straight river channels, causes, characteristics and shapes of meanders and control, cutoff, Braided Rivers, Bed forms, Instability ofrivers, Hydraulic geometry, Delta formation and control

Unit III	MECHANICS OF RIVER	9	+	0

Mechanics of Alluvial Rivers, Rivers and restoration structures, Socio-cultural influences and ethics of stream restoration.

Unit IV	ANALYSES AND DESIGN OF RIVER	9	+	0

Bio-engineering Techniques, Classification review, Natural Channel Design Analysis, Time Series, Analysis of flow, Sediment and channel geometry data.

Unit V	River Training and Protection Works	9	+	0

River Training and Protection Works: Introduction, Classification of River Training, Types of River training works, Protection for Bridges with reduced waterway, Design of Guide Band, embankmentand spurs/dampners and other river/ flood protection works.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Design various channel systems
CO2	:	Design head and cross regulator structures
CO3	:	Identify various types of reservoir and their design aspects

Text Books:

1.	Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008.
2.	Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2009.

Reference Books:

1.	Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998.
2.	*Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE16	GROUND WATER ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To prepare the students for a successful career as hydrologist and water resources engineers.
2.	To develop the ability among students to synthesis data and technical concepts for application in ground water resources engineering
3.	To study the quality of groundwater. Well solutions in confined, leaky, and unconfined aquifers.
4.	To study the nature, hydrology, mechanics, technology of ground water engineering
5.	have the abilities to manage and develop groundwater resources

Unit I	FUNDAMENTALS OF GROUNDWATER	9	+	0

Introduction – Groundwater in Hydrological cycle - Vertical distribution of groundwater – Porosity and types – Permeability - Laboratory tests - Aquifers and types – Confined; Uncofined and Semi- confined – Springs and types.

Unit II	GROUNDWATER FLOW AND WELL HYDRAULICS	9	+	0

Darcy's Law – Specific yield – Specific retention - Storage coefficient – Transmissivity – General groundwater floe equations – Steady and unsteady flow – Steady unidirectional flow in confined and unconfined aquifers – Steady radial flow in confined and unconfined aquifers – Unsteady radial flow in confined aquifer – Theis Method – DupuitForchheimer assumptions- Jacob method- Recovery test

Unit III	GROUNDWATER EXPLORATION	9	+	0

Introduction to geophysical methods – Electrical resistivity methods – Wenner and Schlumberger methods of groundwater exploration – Seismic Reflection and Refraction Methods – Remote sensing techniques for groundwater exploration – Well logging and types - Collector wells and Infiltration galleries.

Unit IV	GROUNDWATER QUALITY	9	+	0

Chemistry of groundwater – Major ions and Trace elements in groundwater – Drinking water quality – BIS and WHO Standards - Classification of groundwater based on Hardness and TDS – Irrigation water quality – Salinity and alkalinity hazard – SAR, Percent Sodium and Residual Sodium Carbonate – Water quality representation diagrams - Sea water intrusion-causes and control

Unit V	GROUNDWATER DEVELOPMENT	9	+	0

Watershed management - Conjunctive use - Artificial recharge of groundwater – Small scale and Large scale rain water harvesting techniques – Case studies.

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the causes of soil erosion
CO2	:	Carry out conservation measures in a watershed
CO3	:	Know about water harvesting and groundwater recharging structures

Text Books:

1. Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008.
2. Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2009.

Reference Books:

1. Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998.
2. *Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

HYDROLOGY & WATER RESOURCE ENGINEERING

18CEPE17	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:

1. The main objective of this course is to impart basic knowledge in Irrigation Engineering andWater Management.
2. To take up the basic concepts of irrigation and construction of various hydraulic structures.
3. To introduce students to basic concepts of water, plants, their interactions, as well asirrigation and drainage systems design, planning and management.
4. To study the elementary hydraulic design of different structures and theconcepts of maintenance shall also form part.
5. To develop the abilities to know the land development and irrigation management.

Unit I	INTRODUCTION	9	+	0

Need, advantages and disadvantages of Irrigation - Environmental effects - Types of Irrigation systems - Gravity irrigation, canals, Tanks, Wells and Irrigation galleries - Water lifts. Soil -water - plant relationship: Soil and its function - Physical properties of soil and their importance in relationto irrigation - Classes and availability of soil water - Movement of water in soils - Measurement of soil moisture - Crop growth and moisture relationship - Salt problems in soil and effect of salts onplant growth.

Unit II	IRRIGATION REQUIREMENT	9	+	0

Evaporation, Evapo transpiration, Consumptive use and its estimation - Crop factor - Lysimeters - Effective rain fall and irrigation requirements - Water requirements of various crops - Duty of water - Quality of irrigation water.

Unit III	METHODS OF IRRIGATION	9	+	0

Surface, subsurface and overhead methods - Check basin, border & furrow, Drip and sprinklerirrigation - Irrigation efficiency, Depth, Rate and frequency of irrigation - Irrigation schedule.

Unit IV	DESIGN OF CHANNELS	9	+	0

Design of unlined and lined channels for irrigation - Location and design of canal regulationstructures - Cross drainage structures - Measuring devices.

Unit V	LAND DEVELOPMENT AND IRRIGATION MANAGEMENT	9	+	0

Reclamation and management of saline and alkaline soils, water logging, Causes and remedial measures - Design, construction and maintenance of drainage systems. Management of irrigationsystem - water charge assessment and water use management.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Assess the irrigation needs of crops
CO2	:	Design weirs on pervious foundation
CO3	:	Design gravity dam and earthen dam
CO4	:	Design the canal systems
CO5	:	Select and design canal fall

Text Books:

1. PunmiaB.C.andLal ,B.B., *Irrigation and Water Power Engineering*, Standard Publishers & Distributors, New Delhi, 2016.
2. Sharma R.K., and Sharma. T.K., *Irrigation Engineering* ,S.Chand& Company Ltd, New Delhi, 2002.
3. SahasraBudhe,Irrigation Engineering and Hydraulic Structures, S.K.Kataria& Sons,

	NewDelhi-110002;2012
Reference Books:	
1.	A.M.Michael, *Irrigation Theory and Practice,* Vikas Publishing House Pvt. Ltd., 2004.
2.	*Hansen V.E., et.al., Irrigation Principles and Practices, John Wiley & Sons, 2001.*
3.	*Sharma R.K., Text Book of Irrigation Engineering and Hydraulic Structures, Oxford & IBH Publishing Co., 2007.*
4.	*Michael A.M., Irrigation Theory and Practice, Vikas Publishing House, New Delhi, 2004.*
5.	Das M.M, Saikia, M.S *Irrigation and water power Engineering*, PHI, Learning, (P) Ltd, New Delhi, 2009.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE18	WATER SHED MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To impart basic knowledge in Water shed Management.
2.	To Identify the causes of soil erosion
3.	To know the conservation measures in a watershed
4.	To design the water harvesting and groundwater recharging structures
5.	To learn the methods and design of water shed structures.

Unit I	INTRODUCTION	9	+	0

Introduction, concept of Watershed, need for Watershed Management, concept of sustainable development.

Unit II	WATER SHED CONCEPTS	9	+	0

Hydrology of small Watersheds – Determination of Runoff – Emperical formulae – Flood estimation by Dicken's formula – Watershed Management.

Unit III	METHODS OF IRRIGATION	9	+	0

Principles of soil erosion, causes of soil erosion, types of soil erosion, estimation of soil erosion fromsmall watersheds – prevention of soil erosion.

Unit IV	DESIGN OF CHANNELS	9	+	0

Control of soil erosion, methods of soil conservation – structural and non-structuralmeasures. Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures.

Unit V	LAND DEVELOPMENT AND IRRIGATION MANAGEMENT	9	+	0

Artificial recharge of groundwater in small watersheds, methods of artificial recharge. Reclamationof saline soils, Micro farming, Biomass management on the farm.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the causes of soil erosion
CO2	:	Carry out conservation measures in a watershed
CO3	:	Know about water harvesting and groundwater recharging structures

Text Books:

1.	Chatterjee, S. N., Water Resources Conservation and Management, Atlantic Publishers, 2008.
2.	Murthy, V.V.N., Land and Water Management, Khalyani Publishers, 2009.

Reference Books:

1.	Muthy, J. V. S., Watershed Management, New Age International Publishers, 1998.
2.	*Suresh Rao, Soil and Water Conservation Practices, Standard Publishers, 1998.*

CO-PO-PSO MAPPING

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

CO5																

18CEPE19	HYDROLOG Y	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the components of the hydrological cycle.
2.	To know the mechanics of rainfall, its spatial and temporal measurement and theirapplications will be understood.
3.	To analyse and study the applications of probability distribution of rainfall and run off shall also be understood.
4.	To develop the ability among students to synthesis data and technical concepts forapplication in hydrology and water resources engineering
5.	To learn simple methods of flood routing and basics of ground water hydrology.

Unit I	PRECIPITATION	9	+	0

Hydrologic cycle – Types of precipitation – Forms of precipitation – Measurement of Rainfall – Spatial measurement methods – Temporal measurement methods – Frequency analysis of pointrainfall – Intensity, duration, frequency relationship – Probable maximum precipitation.

Unit II	ABSTRACTION FROM PRECIPITATION	9	+	0

Losses from precipitation – Evaporation process – Reservoir evaporation – Infiltration process – Infiltration capacity – Measurement of Infiltration – Infiltration Indices – Effective rainfall.

Unit III	HYDROGRAPHS	9	+	0

Factors affecting Hydrograph – Base flow separation – Unit hydrograph – Derivation of unit hydrograph – S curve hydrograph – Unit hydrograph of different durations - Synthetic Unit Hydrograph

Unit IV	FLOODS AND FLOOD ROUTING	9	+	0

Flood frequency studies – Recurrence interval – Gumbel's method – Flood routing – Reservoir floodrouting – Muskingum's Channel Routing – Flood control

Unit V	: GROUND WATER HYDROLOGY	9	+	0

Types of aquifers – Darcy's law – Dupuit's assumptions – Confined Aquifer – Unconfined Aquifer – Recuperation test – Transmissibility – Specific capacity – Pumping test – Steady flow analysis only.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the concepts of hydrograph, S-hydrograph, Unit hydrograph and IUH
CO2	:	Estimate the hydrological parameters
CO3	:	Carry out statistical and probability analysis of hydrological data
CO4	:	Demonstrate the concepts of hydrological systems
CO5	:	Develop regression models for the analysis of hydrological data

Text Books:

1	Chow V.T. and Maidment, Hydrology for Engineers, McGraw-Hill Inc., Ltd., 2000
2	Subramanya K., Engineering Hydrology, Tata McGraw-Hill Publishing Co., Ltd., 2017
3 .	Raghunath H.M., Hydrology, Wiley Eastern Ltd., 2011

Reference books

1	Singh V.P., Hydrology, McGraw-Hill Inc., Ltd., 2000
2	Jaya Rami Reddy P., A text book of Hydrology, Laxmi Publications Pvt Ltd.,2008
3	Patra K.C.Hydrology and Water resources Engineering, Narosa publishing house, Newdelhi-2006

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 – Strongly

STRUCTURAL ENGINEERING

18CEPE20	DESIGN OF BRIDGES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study various types of bridges and its loading conditions.
2.	To analyze and design of several types of bridges and their sub structures.
3.	To design of various types of bearings.

Unit I	GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGES	**9**	+	**0**

Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts , Tee beam and slab bridges.

Unit II	LONG SPAN RC BRIDGES	**9**	+	**0**

Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Archbridges – Box culverts – Segmental bridges.

Unit III	PRESTRESSED CONCRETE BRIDGES	**9**	+	**0**

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load anddead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

Unit IV	STEEL BRIDGES	**9**	+	**0**

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

Unit V	BEARINGS AND SUBSTRUCTURES	**9**	+	**0**

Different types of bearings – Design of bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Analyze and design of short span RC bridges
CO2	:	Have a thorough knowledge on the design principles of Long span RC bridges
CO3	:	Analyze and design of Prestressed Concrete bridges
CO4	:	Analyze and design of Steel bridges
CO5	:	Design Bearings and sub structures of bridges.

Text Books:

1.	Jagadeesh.T.R. and Jayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd. 2004
2.	Johnson Victor, D. "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. New Delhi, 2001.
3.	Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008
4.	Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.

Reference Books:

1.	Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990
2.	Rajagopalan. N. "Bridge Superstructure", Alpha Science International, 2006

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE21	MODERN STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To Study the Energy Concepts in Structures.
2.	To acquire knowledge in model analysis of structures, analysis of structures by stiffness and flexibility methods
3.	To have a basic knowledge about the finite element analysis ofstructures.
4.	To make students to analyse the frames and grids through matrix methods approach.
5.	To enable the students to have basic knowledge in analysis of structures through energytheorems.

Unit I	ENERGY CONCEPTS IN STRUCTURES	9	+	0

Introduction – Strain Energy – Symmetry of the Stiffness And Flexibility Matrices – Strain Energy in Terms of Stiffness And Flexibility Matrices – Stiffness And Flexibility Coefficients in Terms of Strain Energy – Additional properties of [a] and [k] – another Interpretation of coefficients $a_{ij}$and k_{ij}– Betti'slaw–ApplicationsofBetti'slaw:Forcesnotatthecoordinates–Strainenergyinsystems and in Elements.

Unit II	THE FLEXIBILITY METHOD	9	+	0

Statically Determinate Structures –Indeterminate Structures-Choice of Redundant Leading to Ill and Well Conditioned Matrices-Transformation to One Set of Redundant to Another-Internal Forces due to Thermal Expansion and Lack of Fit-Reducing the Size of Flexibility Matrix-Application to Pin-Jointed Plane Truss-Continuous Beams-Frames-Grids.

Unit III	THE STIFFNESS METHOD	9	+	0

Introduction-Development of Stiffness Method- Stiffness Matrix for Structures with zero Force atsome Coordinates-Analogy between Flexibility and Stiffness-Lack of Fit-Stiffness Matrix with Rigid Motions-Application of Stiffness Approach to Pin Jointed Plane Trusses-Continuous Beams-Frames-Grids-Space Trusses and Frames.

Unit IV	MODEL ANALYSIS	9	+	0

Structural similitude, Model material and model making., use of models, model analysis, structural and dimensional analysis, Buckingham Pi theorem, applications, Muller Breslau principle for indirect model analysis, use of Begg'sEney's and R.P.I. deformeters and moment indicator, design of models for direct and indirect analysis.

Unit V	INTRODUCTION TO FINITE ELEMENT METHOD	9	+	0

Discretisation of a structure-element functions-selection of element fields-development of nodal load vectors-numbering systems. Computation of nodal displacements-advantages of finite element method. Application of finite element method to one and two- dimensional plane stress strainelements.

Total (L+T)=45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	To apply the knowledge of mathematics, science, and engineering to understand about the determinate-indeterminate structures.
CO2	:	To identify, formulate and solve engineering problems using matrix methods.
CO3	:	To use the model analysis for engineering practice.
CO4	:	To use the finite element method for engineering practice.
CO5	:	To apply various theorems and their applications in analyzing structures.

Text Books:

1.	Dr. Devadas Menon., “Advanced Structural Analysis”, Narosa Publishing House, New Delhi,2009
2.	Pandit G.S. and Gupta S.P., “Structural Analysis-A Matrix Approach”, Tata McGraw-Hill PublishingCompany Limited, New Delhi, 1997
3.	Dr. T.P. Ganesan, “Model analysis of Structures’, Universities Press Hyderabad, 2000.
4.	Rajasekaran.S., “Finite Element Analysis in Engineering Design”, Wheeler Publishing,2000.
Reference Books:	
1.	K. Rubinstein.F.M., “ Matrix Computer Methods of Structural Analysis”, Prentice Hall, Inc. N.J., 1966
2.	Reddy C.S., “Basic Structural Analysis”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997
3.	Krishnamoorthy C.S., “Finite Element Analysis- Theory and Programming”, Second Edition, Tata McGraw Hill Publishing Co.,2004.
E-References:	
1.	https://nptel.ac.in/courses/105106050/

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE22	STORAGE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To introduce the student to basic theory and concepts of design of storage structures likesteel and concrete tanks, bunkers and silos.
2.	Design of Steel, Concrete and Prestressed Concrete Water Tanks
3.	Design of Steel and Concrete Bunkers and Silos.

UNIT I	STEEL WATER TANKS	9	+	0

Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams – Design of staging – Base plates – Foundation and anchor bolts – Design of Pressed steel water tank – Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder – Design of staging and foundation.

UNIT II	CONCRETE WATER TANKS	9	+	0

Design of Circular tanks – Hinged and fixed at the base – IS method of calculating shear forces and moments – Hoop tension – Design of Intze tank – Dome – Ring girders – Conical dome – Staging – Bracings – Raft foundation – Design of rectangular tanks – Approximate methods and IS methods – Design of underground tanks – Design of base slab and side wall – Check for uplift.

UNIT III	STEEL BUNKERS AND SILOS	9	+	0

Design of square bunker – Jansen's and Airy's theories – IS Codal provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams – Design of cylindrical silo – Side plates – Ring girder – stiffeners.

UNIT IV	CONCRETE BUNKERS AND SILOS	9	+	0

Design of square bunker – Side Walls – Hopper bottom – Top and bottom edge beams – Design of cylindrical silo – Wall portion – Design of conical hopper – Ring beam at junction

Unit V	PRESTRESSED CONCRETE WATER TANKS	9	+	0

Principles of circular prestressing – Design of Prestressed concrete circular water tanks.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Learn the basic theory and concepts of designing the steel and concrete storage structures like Water tank, Bunkers and silos
CO2	:	Design of Steel and Reinforced Concrete Water tanks
CO3	:	Design of Steel and Reinforced Concrete Bunkers and Silos
CO4	:	Design of Prestressed Concrete Water tank

Text Books:

1.	Rajagopalan K., "Storage Structures", Tata McGraw Hill, New Delhi, 1998.
2.	Krishna Raju N., "Advanced Reinforced Concrete Design", CBS Publishers and Distributors,New Delhi, 1998.

Reference Books:

1.	Punmia B.C, Ashok Kumar Jain, Arun K.Jain, "R.C.C. Designs Reinforced Concrete Structures", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2.	Gambhir. M.L., "Design of Reinforced Concrete Structures", Prentice Hall of India Private Limited, 2012.

E-References:

1.	You tube – Technical Civil – Design of Water Tanks(different types) - Part 1 to Part 9

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE23	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the importance of prestressing technique in concrete structures
2.	To estimate the losses and defelction in prestressed member due to effect of prestress
3.	To able to design the prestressing members subjected flexure, shear and bond
4.	To able to design the end blocks of prestressing members by different method
5.	To apply the prestressing technique in different application

Unit I	INTRODUCTION	9	+	0

Principles – Pretensioning – Post tensioning – Types of prestressing – Systems of prestressing – Comparison of prestressed concrete with reinforced concrete Materials characteristics of concrete –Characteristics of high tensile steel.
Theory and behaviour of prestressed concrete beams in bending – calculating fibre stresses for various sections (Rectangle, I, T) of simply supported beam due to prestressing force, dead load andexternal live load – Stress method – Moment of Resistance method – Load balancing method.

Unit II	LOSSES AND DEFLECTIONS	9	+	0

Various losses in prestressed concrete members – causes for losses in prestressed concrete – calculatio of losses – losses due to elastic shortening of pretensioned and post tensioned members – losses due to creep, shrinkage of concrete – relaxation losses – friction and anchorage losses.
Deflection of prestressed concrete flexural members due to prestressing force, dead load, live load – BISCode provisions – Effect of tendon Profile on deflection – Calculation of elastic short term deflection for simply supported beams – deflections due to creep effect – calculation of long term deflection.

Unit II	DESIGN OF PRESTRESSED CONCRETE BEAMS	9	+	0

Pre Tensioned and Post Tensioned simply supported rectangle, I and T sections- Stress method – Designfor flexure, bond and shear- IS Codeprovisions.

Unit IV	DESIGN OF END BLOCKS	9	+	0

Introduction – Stress distribution in end block – Anchorage zone stresses – Guyon and Magnellmethod.

Unit V	CIRCULAR PRESTRESSING, TENSION MEMBERS & CONTINUOUS BEAMS ,COMPOSITE AND PARTIAL PRESTRESSING	9	+	0

Design of prestressed concrete pipes and tanks – Tension members - Poles and sleepers – Continuousbeams – Concordant Cable Profile.
Types of composite construction – Transformation of composite sections – flexural analysis ofcomposite simply supported beams – calculation of stresses – Partial prestressing.

Total (45+0)= 45 Period

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Differentiate pre-tesioned and post – tensioned prestressed concrete
CO2	:	Design a prestressed concrete beam accounting for losses and deflection
CO3	:	Design the prestressing members subjected to stress function
CO4	:	Design the anchorage zone for post tensioned members
CO5	:	Know the partial and circular prestressing technique in various structures.

Text Books:

1.	Sinha, N.C and Roy. S.K., *Fundamentals of prestressed concrete* S.Chand and Co. Ltd1998.
2.	Krishnaraju.N., *Prestressed Concrete*, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002

3	Raja Gopalan N. “Prestressed Concrete”, Narosa Publishing House, New Delhi, 2002.
Reference Books:	
1.	Lin , T.Y., and Ned .Burns, *Design of prestressed concrete structures*, John Wiley & Sons, International Edition, New York, 1995.
2.	Dayaratnam.P., *Prestressed Concrete Structures*, Oxford and IBH Publishing Company Pvt. Ltd., New Delhi, 1982
3.	Mallic S.K. and Gupta A.P., *Prestressed concrete*, Oxford and IBH publishing Co. Pvt. Ltd. 1997.
4.	Ramaswamy G.S., *Modern prestressed concrete design,* Arnold Heinimen,New Delhi, 1990

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE24	ADVANCED STEEL STRUCTURES	L	T	P	C
(Use of IS 800 – 2007, IS 6533-1971, IS 801 & IS 811 & Steel tables are permitted)		3	0	0	3

Course Objectives:

1.	To introduce the student to basic theory and concepts of beam to column connections, built-upgirders, and light gauge structures.
2.	Behaviour and design of beam-columns.
3.	Different configuration of roof truss, and its components behaviour and design of members oftruss..

Unit I	**CONNECTIONS**	**9**	**+**	**0**
Design of bolts and weld connections (Stiffened and Seated connections) – Beam to Beam Connections-Beam to Column Connections				
Unit II	**BUILT-UP GIRDER**	**9**	**+**	**0**
Design of Plate girders bolted and welded –Design of stiffeners and splices-Gantry girder				
Unit III	**BEAM-COLUMNS**	**9**	**+**	**0**
Introduction-Behaviour of Beam-columns-Elastic-Torsional buckling-nominal strength-instability inthe plane of bending- beam-column under biaxial loading-interaction equations for local capcity check-code design procedure-problems.				
Unit IV	**: ROOF TRUSS**	**9**	**+**	**0**
Roof Trusses – different configuration of truss-Roof and Side coverings – Design of purlin andelements of truss; end bearing				
Unit V	**LIGHT GAUGE STEEL STRUCTURES**	**9**	**+**	**0**
Types of cross sections - local buckling and lateral buckling - concepts of elastic width – design of compression and tension members, beams, deflection of beams and design of beam webs.				

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	design welded plate girder and other components and Gantry girder
CO2	:	Connections between beam and columns
CO3	:	carry out wind load calculations for tall structures and design of steel chimneys
CO 4		design the cold-formed steel beams and columns.

Text Books:

1.	Duggal S.K., *Limit State Design of Steel Structures*, Tata McGraw-HillPublishing Company , New Delhi, 2010.
2.	Subramanian N., *Design of Steel Structures*, First edition, OXFORD university press, 2008
3.	Bhavikatti S S., *Design of Steel Structures by Limit Method*, I.K. InternationalPvt Ltd, New Delhi, 2009.

Reference Books:

1.	Chandra R., *Limit State Design of Steel Structure Vol – I & II*, ScientificPublisher, New Delhi,2009.
2.	Ramachandra S., & Virendra Gehlot D.,*Limit State Design of Steel Structures* –, **Standard Publication, New Delhi,2009**
3.	Dayaratnam P., *Design of Steel Structures*, Second Edition, S. Chand & Company,2003

4.	*Teaching Resources for Structural Steel Design – Vol.I& II*, INSDAG, Kolkatta
5.	*IS 800:2007 Code of practice for general construction steel*
6.	*SP 6 IS Structural steel Design Illustrated Hand book*
7.	*IS 875:1987 Code of practice for Design loads (other than earthquake) forbuildings and structures (Part – I) Dead loads (Part – II) Live loads (Part – III) Wind loads(2015)*
8.	*IS: 801-1967, Code of practice for use of cold-formed light gauge steelstructural members in general building construction*
9.	*IS: 811-1987, Cold Formed Light Gauge Structural Steel Sections.*

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE25	**TALL BUILDINGS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	The design aspects and analysis methodologies of tall buildings is introduced. The stabilityanalysis of tall buildings is another imperative in this course.

Unit I	**DESIGN CRITERIA AND MATERIALS**	**9**	**+**	**0**

Development of High Rise Structures - General Planning Considerations - Design philosophies -Materials used for Construction - High Strength Concrete - High Performance Concrete - Self Compacting Concrete - Glass - High Strength Steel.

Unit II	**LOADING**	**9**	**+**	**0**

Gravity Loading - Dead Load - Live Load - Live load reduction technique - Impact Load - Construction Load - Sequential Loading. Lateral Loading - Wind load - Earthquake Load.Combination of Loads.

Unit III	**BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS**	**9**	**+**	**0**

Factors affecting growth, Height and Structural form. High rise behaviour of Various structural systems - Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames,tubular structures, cores, outrigger - braced and hybrid mega systems.

Unit IV	**ANALYSIS AND DESIGN**	**9**	**+**	**0**

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist, computerised general three dimensional analysis.

Unit V	**STABILITY OF TALL BUILDINGS**	**9**	**+**	**0**

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundationrotation.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	behaviour of tall buildings subjected to lateral building.
CO2	:	Rudimentary principles of designing tall buildings as per the existing codes.
CO3	:	Stability evaluation of tall buildings with respect to various factors

Text Books:

1.	Bryan Stafford Smith, Alex coull, “Tall Building Structures, Analysis and Design”, John Wiley and Sons, Inc., 1991.
2.	Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 2011

Reference Books:

1.	Lin.T.Y, StotesBurry.D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.
2.	Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
3.	Wolfgang Schueller "High Rise Building Structures", John Wiley and Sons,New York 1977

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE26	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

At the end of this course the student shall be able to appreciate modular construction, industrialised construction and shall be able to design some of the prefabricated elements and also have the knowledge of the construction methods using these elements

Unit I	**INTRODUCTION**	**9**	+	**0**

Need for prefabrication – Principles – Materials – Modular coordination – Standarization – Systems – Production – Transportation – Erection.

Unit II	**PREFABRICATED COMPONENTS**	**9**	+	**0**

Behavior of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls

Unit III	**DESIGN PRINCIPLES**	**9**	+	**0**

Disuniting of structures- Design of cross section based on efficiency of material used – Problems indesign because of joint flexibility – Allowance for joint deformation.

Unit IV	**JOINTS IN STRUCTURAL MEMBERS**	**9**	+	**0**

Joints for different structural connections – Dimensions and detailing – Design of expansion joints

Unit V	**DESIGN FOR ABNORMAL LOADS**	**9**	+	**0**

Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Understand the principles of prefabrication behavior and construction of structural components
CO2	:	Design the joints in structural connections and have a knowledge of codal provisions to design the structure for abnormal loads
CO3	:	Design the joints in structural connections and have a knowledge of codal provisions to design the structure for abnormal loads

Text Books:

1	CBRI, *Building materials and components*, India, 1990
2	Gerostiza C.Z., Hendrikson C. and Rehat D.R., *Knowledge based process planning for construction and manufacturing*, Academic Press Inc., 1994

Reference books

1	Koncz T., *Manual of precast concrete construction, Vols. I, IIandIII,* Bauverlag,GMBH,1971.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE27	DESIGN OF COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To study the behaviour and design of Steel concrete composite elements and structures.
2.	To investigate the failure and fracture characteristics

Unit I	**INTRODUCTION**	**9**	**+**	**0**

Introduction to steel - concrete composite construction – Composite action – Serviceability and - Construction issues.

Unit II	**DESIGN OF CONNECTIONS**	**9**	**+**	**0**

Shear connectors – Types – Design of connections in composite structures – Degree of shearconnection – Partial shear interaction.

Unit III	**DESIGN OF COMPOSITE MEMBERS**	**9**	**+**	**0**

Design of composite beams, slabs, columns, - design of composite trusses.

Unit IV	**COMPOSITE BOX GIRDER BRIDGES**	**9**	**+**	**0**

Introduction - behaviour of box girder bridges - design concepts.

Unit V	**CASE STUDIES**	**9**	**+**	**0**

Case studies on steel - concrete composite construction in buildings - seismic behaviour ofcomposite structures.

Total= 45 Periods

Course Outcomes:

CO1	On the completion of this course students will be in a position to gain knowledge about the composite structures
CO2	They will be able to design connections in composite structures
CO3	At the end of this course students will be in a position to design composite beams, columnsand trusses
CO4	students will be in a position to design box-girder bridges including the related connections
CO5	They will get exposure on case studies related to steel-concrete constructions of buildings.

Text Books:

1.	Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns andFrames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2.	Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.

Reference Books:

1	Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	3	2	2	2	2	0	2
CO2	2	2	2	2	3	2	1	2	3	2	2	2	2	0	2
CO3	3	3	3	3	3	3	3	1	2	3	1	3	3	1	3
CO4	3	2	1	3	2	2	2	2	2	3	0	1	1	1	2
CO5	2	2	3	2	3	2	3	2	3	2	3	1	2	1	3

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE28	COASTAL STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Study the concept of wave theories, forces and analysis of offshore structures.
2.	Develop an understanding of basic concepts in coastal engineering such as the linear andnon linear wave theory, energy propagation in waves.
3.	Design simple coastal structures such as helipads, jacket tower etc.
4.	Make the students to design platforms, mooring cables and pipe lines.
5.	Make the students to know about the modeling of foundation, fixed jacket platform etc.

UNIT I	WAVE THEORIES	9	+	0

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT II	FORCES OF OFFSHORE STRUCTURES	9	+	0

Wind forces, wave forces on small bodies and large bodies - current forces and use of Morisonequation.

UNIT III	OFFSHORE SOIL AND STRUCTURE MODELLING	9	+	0

Different types of offshore structures, foundation modeling, fixed jacket platform structuralmodeling

UNIT IV	ANALYSIS OF OFFSHORE STRUCTURES	9	+	0

Static method of analysis, foundation analysis and dynamics of offshore structures.

Unit V	DESIGN OF OFFSHORE STRUCTURES	9	+	0

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

Total (L+T)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO 1	:	Determine the forces due to ocean waves
CO 2	:	Analyze and design offshore structures
CO 3	:	Construct platform, helipads, jackets, towers etc.,
CO 4	:	Design offshore structures
CO 5	:	Differentiate different offshore structures and todo foundation and structure modelling

Text Books:

1.	API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design - API Publishing Services, 2005
2.	Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
3.	Chakrabarti, S.K., Hydrodynamics of Offshore Structures, WIT press, 2001

Reference Books:

1.	Jawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983.
2.	James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.
3.	Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, 1991.

4.	Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.
E-References:	
1.	https://nptel.ac.in/courses/114106035/

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2		1	2	2	2	2				2		1
CO2		2	1	2			1		2			1	1	2	
CO3				1	1			1	1	1	2		2	2	1
CO4			2				1							2	1
CO5				1	2		1		1	1	1	1			21

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE29	**DYNAMICS AND EARTHQUAKE RESISTANT DESIGN OFSTRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	To study the theory of vibrations
2.	To learn about the multiple degree of freedom system
3.	To understand the knowledge about seismic effect on building
4.	To acquire a knowledge about peak acceleration and liquefaction
5.	To study about the design methodology

Unit I	**THEORY OF VIBRATIONS**	**9**	**+**	**0**

Difference between static forces and dynamic excitation – Concept of inertia and damping – Typesof Damping – Degrees of freedom – SDOF Idealisation – Equations of motion of SDOF system for mass as well as base excitation – Free vibration of SDOF system – Response to harmonicexcitation – Impulse and response to unit impulse – Duhamel integral

Unit II	**MULTIPLE DEGREE OF FREEDOM SYSTEM**	**9**	**+**	**0**

Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of modesuperposition (No derivations).

Unit III	**ELEMENTS OF SEISMOLOGY**	**9**	**+**	**0**

Causes of Earthquake – Geological faults – Tectonic plate theory – Elastic rebound – Epicentre – Hypocentre – Primary, shear and Raleigh waves – Seismogram – Magnitude and intensity ofearthquakes – Magnitude and Intensity scales – Spectral Acceleration - Information on some disastrous earthquakes

Unit IV	**RESPONSE OF STRUCTURES TO EARTHQUAKE**	**9**	**+**	**0**

Response and design spectra – Design earthquake – Concept of peak acceleration – Site specific response spectrum – Effect of soil properties and damping – Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.

Unit V	**DESIGN METHODOLOGY**	**9**	**+**	**0**

IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquake on structures.

Total = 45 Periods

Course Outcomes:

1	Apply the basics of Earthquake Engineering
2	Demonstrate the dynamics of structural system under earthquake load
3	Analyze the influence of the structural / geometrical design in building characteristics
4	Demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements
5	Apply codal provisions on different types of structures

Text Books:

1.	Damodarasamy S.R. and Kavitha S. Basics of Structural Dynamics and Aseismic Design,PHI learning private Ltd, New Delhi-1, 2009

Reference Books:

1.	D Paz, M., Structural Dynamics – Theory & Computation, CSB Publishers &Distributors, Darga Ganj, New Delhi-2, 2004.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE30	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

Course Objectives:

1.	At the end of this course the student shall be able to design the important industrialstructures
2.	At the end of course functional requirements of the building
3.	At the end course the student should be able to understand the design of steel and RCstructures and prefabrication.

Unit I	PLANNING	9	+	0

Classification of Industries and Industrial structures – General requirements for industries likcement, chemical and steel plants – types of frames – bracings – crane girders and columns workshop sheds - - Planning and layout of buildings and components.

Unit II	FUNCTIONAL REQUIREMENTS	9	+	0

Lighting – Ventilation – Accounts – Fire safety – Guidelines from factories act.

Unit III	DESIGN OF STEEL STRUCTURES	9	+	0

Industrial roofs – Crane girders – Mill buildings – Design of bunkers and silos

Unit IV	DESIGN OF R.C. STRUCTURES	9	+	0

Concrete Silos and bunkers – Chimneys – Principles of folded plates and shell roofs(Theory only) – Machin foundations (Theory only).

Unit V	PREFABRICATION	9	+	0

Principles of prefabrication – Prestressed precast roof trusses- Functional requirements for Precas concreteunits

Total (45+0)= 45 Periods

Course Outcomes:

1	Students will gain the knowledge about lighting, fire safety and ventilation
2	Students will gain the knowledge on the advanced structures namely bunkers, silos
3	Students will gain the knowledge in the need of prefabrication with current trend.

Text Books:

1.	Duggal S.K., *Limit State Design of Steel Structures*, Tata McGraw-Hill Publishing CompanNew Delhi, 2010.
2	Subramanian N., *Design of Steel Structures*, First edition, OXFORD universitypress, 2008.
3	Reinforced *Concrete Structural elements* – P. Purushothaman.

Reference Books:

1.	Henn W. *Buildings for Industry, vols.I and II*, London Hill Books, 1995
2.	*Handbook on Functional Requirements of Industrial buildings, SP32 – 1986,* Bureau of Indian Standards, New Delhi 1990
3.	Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Structural Engineering Research Centre, Madras, 1982

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE31	FERROCEMENT TECHNOLOGY	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To impart knowledge on the material properties of ferrocement, construction methods
2.	To implement design of ferrocement technology in building construction, hydraulic structures and soil retaining structures.

Unit I	INTRODUCTION	9	+	0

Definition, historical background, Constituent materials-cement mortar, skeletal steel, mesh reinforcement-Types of meshes, distinct characteristics of ferrocement versus reinforced concrete, Similarities between ferrocement and reinforced concrete applications.

Unit II	MECHANICALPROPERTIES:	9	+	0

Behaviour of ferrocement in tension, cracking and multiple cracking behavior, maximum elongation at failure, stress at first cracking, elastic modulus in tension, behaviour of ferrocement in bending-load versus deflection response, impact strength, leakage, fireresistance, durability.

Unit III	PRACTICAL DESIGN GUIDELINES:	9	+	0

Allowable stresses under maximum service load, maximum crack width, fatigue life, durability and corrosion, deflection limitation. Practical design parameters for ferrocement - cover, thickness and mesh opening, skeletal reinforcement depth, minimum volume fraction of reinforcement, minimum volume fraction in water retaining structures, fibers, number of meshlayers, bending members – hybrid fiber reinforcement, wire diameter, fineness of matrix.
Guidelines for good construction.

Unit IV	FERROCEMENT IN BUILDING CONSTRUCTION:	9	+	0

Construction methods-Skeletal Armature method, Closed mould method, Integral Mould method, Open mould method- ferrocement precast walls, hollow floors, hollow beams, roofingunits, earthquake resistant structures, cost comparision with conventional construction.

Unit V	HYDRAULIC AND SOIL RETAINING STRUCTURES IN FERROCEMENT:	9	+	0

Water retaining structures- Design and method of fabrication and casting, storage tanks of various types, foot bridges-canal lining. Soil retaining structure - Ferrocement counterfort retaining wall, Ferrocement containers for storing granular materials, Method of precasting.

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	To give a good insight about the ferrocement technology
CO2		To gain the knowledge about the mechanical properties of ferrocement
CO3	:	To give an understanding of construction methods

CO4	:	The students will be able to design the ferrocement structures
CO5		To make the students understand the hydraulic structures and soil retaining structures

Text Books:	
1	B R Paul and R P Pama. Published by International Ferrocement Information Centre. A.I.T.Bangkok, Thailand
2	State-of-the-art report and guide for Design,Construction and Repairs of Ferrocement; ACI committee Report. No ACI549R- 88 and ACI 549.1R.88. Published by American Concrete Institute, Detroit, USA
Reference books	
1	Ferrocement and laminated cementitious composites A E Naaman. Publisher: Techno-press, Ann Arbor, Michigan, U S A
2	Ferrocement- Materials and applications; Publication SP 61, A C I Detroit. U S A

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	2	2	2	3	2	2	2	2	0	2
CO2	2	2	2	2	3	2	1	2	1	2	2	2	2	0	2
CO3	3	3	2	3	3	3	3	3	2	3	1	3	3	1	3
CO4	3	3	3	3	2	3	2	2	2	3	2	1	1	1	2
CO5	2	3	1	2	3	2	3	3	3	2	3	1	2	1	3

1 – Slightly
2 – Moderately
3 - Strongly

<table>
<tr><td>18CEPE32</td><td colspan="2">FINITE ELEMENT ANALYSIS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="6">At the end of this course the student shall have a basic knowledge of finite element method and shall be able to analyse linear elastic structures that he has studied about in corecourses, using finite element method.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit I</td><td colspan="2">ELEMENTS OF ELASTICITY</td><td>9</td><td>+</td><td>0</td><td></td></tr>
<tr><td colspan="7">Basic principles of structural mechanics – Equations of equilibrium – Strain displacementrelations –Stressstrainrelations–Planestressandplanestraincases–PrinciplesofVirtualworkand minimum potential energy.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit II</td><td colspan="2">DIRECT STIFFNESS METHOD</td><td>9</td><td>+</td><td>0</td><td></td></tr>
<tr><td colspan="7">Steps in direct method of FEA – Element stiffness matrix – Global stiffness matrix – Boundaryconditions – Problems on simple beams and Trusses.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit III</td><td colspan="2">FINITE ELEMENTS</td><td>9</td><td>+</td><td>0</td><td></td></tr>
<tr><td colspan="7">Discretization - Basic element shapes - Element properties – Node numbering procedure – Convergence requirements – Generalised co-ordinates – Natural co-ordinates – Shape functions for linear & quadratic models – Stiffness matrix – Nodal load vector – Static condensation – Simpleproblems.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit IV</td><td colspan="2">INTRODUCTION TO ISOPARAMETRIC ELEMENTS</td><td>9</td><td>+</td><td>0</td><td></td></tr>
<tr><td colspan="7">Concept of sub, iso, super parametric elements – Gauss quadrature – Examples in one and two dimensional elements</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Unit V</td><td colspan="2">SOLUTION TECHNIQUES</td><td>9</td><td>+</td><td>0</td><td></td></tr>
<tr><td colspan="7">Different solvers – Variational approach – Weighted mean residual methods like Collocation method, Subdomain method, Galerkin method and Least square method – Simple problems only.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7" align="right">Total = 45 Periods</td></tr>
<tr><td colspan="7">Course Outcomes:</td></tr>
<tr><td>1</td><td colspan="6">Students who successfully complete this course will have demonstrated an ability toPerformfinite element formulations for simple engineering problems.</td></tr>
<tr><td>2</td><td colspan="6">Analyze linear 1D problems like bars and trusses; 2D structural problems using CST elementand analyse the axi-symmetric problems with triangular elements.</td></tr>
<tr><td>3</td><td colspan="6">write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and applynumerical integration to solve; 1D and 2D; stiffness integrations</td></tr>
<tr><td>4</td><td colspan="6">Solve linear 2D structural beams and frames problems; 1Dheat conduction and convection heat transfer problems.</td></tr>
<tr><td>5</td><td colspan="6">Evaluate the Eigenvalues and Eigenvectors for stepped bar and beam, explain nonlineargeometric and material non linearity.</td></tr>
<tr><td colspan="7">Text Books:</td></tr>
<tr><td>1.</td><td colspan="6">Tirupathi R. Chandrupatla and Ashok D. Belugundu , “Introduction to Finite Elements in Engineering”, Third Edition, Prentice Hall India Pvt Ltd, 2011</td></tr>
<tr><td>2</td><td colspan="6">P.Seshu, “Textbook of Finite Element Analysis”, Prentice Hall India Pvt Ltd, 2008.</td></tr>
<tr><td colspan="7">Reference Books:</td></tr>
<tr><td>1.</td><td colspan="6">Rajasekaran.S., “Finite Element Analysis in Engineering Design”, Wheeler Publishing,2000.</td></tr>
<tr><td>2.</td><td colspan="6">S.S.Rao, “The Finite Element Method in Engineering”, Buttersworth-Heinemann publishing,2000</td></tr>
</table>

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	3	1	1	0	1	0	2	3	1
CO2	3	3	2	3	2	1	3	1	1	0	1	0	2	3	1
CO3	3	3	2	3	3	1	2	1	1	0	1	0	2	3	1
CO4	3	3	2	3	3	1	3	1	1	0	1	0	2	3	1
CO5	3	3	2	3	2	1	2	1	1	0	1	0	2	3	1

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE33	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1	To make students aware of various measurement techniques and experimental planning anprocedures adopted in laboratory.

Unit I	STRAIN GAUGES	9	+	0

Definition of Gauge length, sensitivity and range – Characteristics of an ideal strain gauge – Different types of mechanical strain gauges for use in metal and concrete specimens – Optical strain gauge – Acoustic strain gauge – Pneumatic strain gauge – Merits anddemerits.

Unit II	ELECTRICAL STRAIN GAUGES	9	+	0

Inductance, capacitance and piezo-electric gauges – Bonded and unbounded resistance gauges and their application in stress analysis – Fixing technique and measurement of strains – Rosettes – Determination of principal strains using rosettes – Use of Murphy"s construction for drawing circle ofstrains – Mohr"s stress circle – Analyticalsolution.

Unit III	PHOTOELASTICITY	9	+	0

*Principles – Maxwell"s*stress optic law – Plane and circularly polarised light and their use in photo elasticity – Polariscopes – Diffusion type, lense type and reflection type polariscopes –Isochromatics and Isoclinics – Model materials – Calibration methods for finding material fringe value – Model fringe value – Examples of beam flexure and *diametrically loaded circularplates.*

Unit IV	MODEL ANALYSIS	9	+	0

Direct and indirect models – Laws of structural similitude – Choice of scales – Limitation of model studies - Buckingham piktheorem – Dimensional analysis – Model materials – Begg"sdeformeter andits use in model analysis – Simple design of models for direct *and indirect model analysis.*

Unit V	BRITTLE COATINGS	9	+	0

Historical review – Stress Coat – Ceramic coatings – Application – Moire fringe method of stresanalysis.

Total = 45 Periods

Course Outcomes:

1	Students will be able toSelect the appropriate strain gauges for strain measurements
2	Principles behind the photo elasticity
3	Knowledge in model analysis and predict the behavior of prototypes.

Text Books:

Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi,2004.

1.	T.K.Roy, "Experimental Analysis of Stress and Strains", S.Chand and Company Ltd.,New Delhi, 2000.
2.	Hetenyi. M., Hand Book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1966.

Reference Books:

1.	J.W.Dally and W.F.Riley, "Experimental Stress Analysis", McGraw Hill Book, New York, 1990. Delhi, 2001.
2.	L.S. Srinath, "Experimental Stress Analysis", Tata-McGraw Hill Book Company, New

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

GEOTECHNICAL ENGINEERING

18CEPE34	**GROUND IMPROVEMENT TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1.	The student is expected to identify basic deficiencies of various soil deposits
2.	To learn the various techniques of drainage and dewatering
3.	To know about various in-situ treatment of soil samples
4.	To study the details about earth reinforcement
5.	To understand about the grouting techniques

Unit I	: **INTRODUCTION**	**9**	**+**	**0**

Role of ground improvement in foundation engineering - methods of ground improvement – Geotechnicalproblemsinalluvial,lateriteandblackcottonsoils-Selectionofsuitableground improvement techniques based on soil condition.

Unit II	: **DRAINAGE AND DEWATERING**	**9**	**+**	**0**

Drainage techniques - Well points - Vacuum and electro-osmotic methods - Seepage analysis for two dimensional flow-fully and partially penetrating slots in homogeneous deposits (Simple cases only).

Unit III	**: INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS**	**9**	**+**	**0**

In-situ densification of cohesionless and consolidation of cohesive soils -Dynamic compaction and consolidation – Vibro-flotation - Sand pile compaction - Preloading with sand drains and fabric drains – Stone columns – Lime piles - Installation techniques only - relative merits of variousmethods and their limitations.

Unit IV	**EARTH REINFORCEMENT**	**9**	**+**	**0**

Concept of reinforcement - Types of reinforcement material - Applications of reinforced earth – useof Geotextiles for filtration, drainage and separation in road and otherworks.

Unit V	**GROUT TECHNIQUES**	**9**	**+**	**0**

Types of grouts - Grouting equipment and machinery - Injection methods - Grout monitoring – Stabilisation with cement, lime and chemicals - Stabilisation of expansive soils.

Total= 45 Periods

Course Outcomes:

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

CO1	:	Demonstrate the various ground improvement techniques
CO2	:	Carry out insitu treatment of cohesionless and cohesive soils
CO3	:	Apply the geotextile material in practice
CO4	:	Know the grouting equipment and monitoring

Text Books:

1	Purushothama Raj P., Ground Improvement Techniques, Tata McGraw- Hill PublishingCompany, New Delhi, 1995
2	Koerner R.M., Construction and Geotechnical Methods in FoundationEngineering, McGraw-Hill, 1994.
3	Moseley M.P., Ground Improvement , Blackie Academic and Professional, Chapman and Hall, Glasgow, 1993

REFERENCE:

1	Jones J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1995

2	Koerner R.M., Design with Geosynthetics, (3rd Edition) Prentice Hall, New Jersey

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE35	INTRODUCTION TO SOIL DYNAMICS AND MACHINEFOUNDATION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	Assess dynamic properties of soil.
2.	Demonstrate various vibration isolation techniques.
3.	Design of Machine foundation.

UNIT I	**INTRODUCTION**	**9**	**+**	**0**
Vibration of elementary systems - vibratory motion - single degree freedom system-free and forced vibration with and withoutdamping.				
UNIT II	**WAVES AND WAVE PROPAGATION**	**9**	**+**	**0**
Wave propagation in an elastic homogeneous isotropic medium - Raleigh, shear and compression waves-waves in elastic half space.				
UNIT III	**DYNAMIC PROPERTIES OF SOILS**	**9**	**+**	**0**
Elastic properties of soils - coefficient of elastic, uniform and non-uniform compression – shear - effect of vibration dissipative properties of soils - determination of dynamic properties of soil - codal provisions.				
UNIT IV	**DESIGN PROCEDURES**	**9**	**+**	**0**
Design criteria -dynamic loads - simple design procedures for foundations under reciprocatingmachines - machines producing impact loads - rotary type machines.				
Unit V	**VIBRATION ISOLATION**	**9**	**+**	**0**
Vibration isolation technique-mechanical isolation-foundation isolation-isolation by location-isolation by barriers- active passive isolation tests				

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Assess dynamic properties of soil.
CO2	:	Demonstrate various vibration isolation techniques.
CO3	:	Design of machine foundation.

Text Books:

1.	Swamisaran, “Soil Dynamics and Machine Foundations”, Galgotia Publications Pvt.Ltd.,1999
2.	S.Prakesh& V.K Puri, Foundation for machines, McGraw-Hill 1999
3.	Srinivasulu, P & Vaidyanathan, Hand book of Machine Foundations, McGraw-Hill, 1996.

Reference Books:

1.	Kameswara Rao, “Vibration Analysis and Foundation Dynamics”, Wheeler Publishing, New Delhi,1998.
2.	IS code of Practice for Design and Construction of Machine Foundations, McGraw-Hill, 1996.
3.	Moore P.J., “Analysis and Design of Foundation for Vibration”, Oxford and IBH, 1995.
4.	Kameswara Rao, “Dynamics Soil Tests and Applications”, Wheeler Publishing, New Delhi, 2003

CO-PO-PSO MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	0	0	0	2	2	3	3	0
CO2	3	3	3	3	3	3	2	1	0	1	1	1	3	2	0
CO3	3	3	3	3	3	3	1	0	0	0	1	1	3	3	1

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE36	SOIL STRUCTURE INTERACTION	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To understand the mechanism of soils, their interactive behaviour, analysis, its influences inthe design parameters through design charts and software packages.

Unit I	SOIL-FOUNDATION INTERACTION	9	+	0

Introduction to soil - Foundation interaction problems, Soil behaviour, Foundation behaviour, Interface, behaviour, Scope of soil-foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.

Unit II	PLATE ON ELASTIC MEDIUM	9	+	0

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.

Unit III	PLATE ON ELASTIC MEDIUM	9	+	0

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis offinite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

Unit IV	ELASTIC ANALYSIS OF PILE	9	+	0

Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis ofpile group, Interaction analysis, Load distribution in groups with rigid cap.

Unit V	LATERALLY LOADED PILE	9	+	0

Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis,Interaction analysis, and pile raft system, solutions through influence charts

Total (45+0)= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Know about soil response models
CO2	:	Analyze beams of finite length
CO3	:	Know about numerical analysis of finite plate and elastic analysis of pile

Text Books:

1.	Saran, S, Analysis and desaign of substructures, Taylor & Francis Publishers, 2006.
2.	Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 199
3	McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geotechnics (6th Edition), Prentice Hall, 2002.
4	Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
5	Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980
6	Bowels J.E., “Analytical and Computer Methods in Foundation”, McGraw Hill Book Co. New York.

Reference Books:

1.	Scott, R.F. Foundation Analysis, Prentice Hall, 1981.

2.	Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978.
3.	ACI 336, Suggested Analysis and Design Procedures for CombinedFootingsand Mats, American Concrete Institute, Dehit,1988.

CO-PO-PSO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	1	0	1	2	3	1	1
CO2	3	3	3	3	3	3	3	2	1	0	1	2	3	1	1
CO3	3	3	3	3	3	3	2	2	1	0	1	2	3	1	1

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE37	SUBSURFACE INVESTIGATION AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1	To understand the importance of site investigation.
2	To know the techniques of soil exploration.
3	To collect and preserve soil samples and the field tests to be conducted.
4	To introduce the instrumentation in soil engineering.

Unit I	SCOPE AND OBJECTIVES OF EXPLORATION	9	+	0

Scope and objectives, planning and exploration program, methods of exploration, exploration forpreliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic and electrical methods.

Unit II	EXPLORATION TECHNIQUES	9	+	0

Methods of boring and drilling, non-displacement and displacement methods, drilling in difficult subsoil conditions, stabilization of boreholes, bore logs.

Unit III	SOIL SAMPLING	9	+	0

Sampling, disturbed and undisturbed soil sampling advanced sampling techniques, offshoresampling, shallow penetration samplers, preservation and handling of samples.

Unit IV	FIELD TESTING IN SOIL EXPLORATION	9	+	0

Field tests, penetration tests, procedures and methods, data interpretation, Field vane shear, Insitu shear and bore hole shear test, pressuremeter test, utility, correction and data interpretation, plate load test–monotonic and cyclic; field permeability test.

Unit V	INSTRUMENTATION	9	+	0

Instrumentation in soil engineering, strain gauges, resistance and inductance type, load cells, earth pressure cells, settlement and heave gauges, piezometers and slope indicators, inclinometer, case studies.

Total = 45 Periods

Course Outcomes:

CO1	Know the scope and objectives of soil exploration.
CO2	Aware of different exploration techniques available to explore soil.
CO3	Know methods of sampling and to preserve them.
CO4	Choose suitable methods to do subsurface investigation and to interpret the data collected.
CO5	Aware of the instruments to be used for sub surface investigation.

Text Books:

1.	Hunt, R.E., Geotechnical Engineering Investigation Manual, McGraw Hill, 2005.
2.	Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Hand Book, a NostrandReinhold 2010
3.	Alam Singh and Chowdhary, G.R., Soil Engineering in Theory and Practice, Volume-2, Geotechnical testing and instrumentation, CBS Publishers and Distributors,NewDelhi, 2015.

Reference Books:

1.	Mair, R.J. and Wood, P.M., Pressuremeter Testing Methods and Interpretation, Butter-worths, 2013
2.	Dunnicliff, J., and Green, G.E., Geotechnical Instrumentation for Monitoring Field Performance,John Wiley, 2008
3.	Day, R.N., Geotechnical and Foundation Engineering, Design and Construction, McGraw-HiLLS,2015.

CO-PO-PSO MAPPING

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	2	0	0	1	1	2	3	2	1
CO2	3	3	3	3	1	0	1	0	0	0	0	1	3	3	2
CO3	3	3	3	3	3	1	2	0	0	0	0	0	3	2	0
CO4	3	3	3	3	3	0	1	0	0	3	3	3	3	2	1
CO5	3	3	3	3	3	1	1	1	1	1	0	1	3	1	1

1 – Slightly
2 – Moderately
3 – Strongly

18CEPE38	FUNDAMENTALS OF REMOTE SENSING AND GIS	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To possess knowledge on Remote Sensing Techniques and their applications in civil engineering projects.
2.	To Know about main Remote Sensing Systems and programs (sensors, platforms, etc.) and assess its potential to spatial analysis
3.	To Know and use GIS and its geo-processes and functions.
4.	To Use diverse techniques and instruments adequately to measure, locate and find bearingson a map and in afield.
5.	To Understand main concepts that define Geographic Information Systems

Unit I	INTRODUCTION	9	+	0

Definition and types of remote sensing – Wave and Quantum theories – Radiation principle - Components of Electromagnetic Spectrum – Energy balance equations – Components of ideal and real remote sensing system – Energy interaction with Atmosphere – Different types of scattering and absorption - Atmospheric windows – Energy interaction with surface features – Spectral signatures of Vegetation, soil andwater.

Unit II	PLATFORMS AND SENSORS	9	+	0

Aerial and space platforms – Aerial camera - Vertical and Oblique Aerial Photographic techniques - Classification of Satellites based on orbits and purposes - Synoptivity and Repetivity – Resolution and Types - Multistage, Multisensor, Multispectral, Multitemporal and Multipurposeconcepts.
Orbital and sensor characteristics of the following remote sensing satellites; LANDSAT, SPOT, IRS and IKONOS.

Unit III	IMAGE INTERPRETATION	9	+	0

Visual Interpretation of Satellite Imageries – Elements of interpretation - Interpretation keys – Digitalimage processing – Image Rectification and Restoration - Image Enhancement - Image Classification – Filtering – Low and High Pass filters

Unit IV	GEOGRAPHICAL INFORMATION SYSTEM	9	+	0

Components of GIS – Hardware, Software and Organizational set up – Data – Spatial and Non spatial – Maps – Types of Maps – Types of Georeferencing - Data input – Digitization – Scanning – Data Editing – Raster and Vector data analysis – Overlaying, Buffering – Generation of DEM - Data presentation

Unit V	APPLICATIONS OF REMOTE SENSING AND GIS	9	+	0

Merits and Limitations of Remote Sensing – Applications of Remote Sensing and GIS in the following fields; Surveying, Water resources, Geological mapping, Route location, Site selection for major civil engineering projects, Disaster and mitigation studies, Coastal zone management and Environmental Engineering

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Demonstrate the concepts of Electro Magnetic energy, spectrum and spectral signature curves
CO2	:	Apply the concepts of satellite and sensor parameters and characteristics of different platforms

CO3	:	Apply the concepts of DBMS in GIS
CO 4	:	Analyze raster and vector data and modelling in GIS
CO 5	:	Apply GIS in land use, disaster management, ITS and resource information system

Text Books:

1.	Thomas M. Lillesand, RaiphW.Kiefer, *Remote Sensing and Image Interpretation*,John Wiley and Sons, New York, Seventh Edition, 2015.
2.	Peter A. Burrough, Rachael A. McDonnell. Principles of Geographical Information Systems, Oxford University Press, Third Edition, 2015.

Reference Books:

1.	Robert A. Schowengerdt, *Remote Sensing-Models and Methods for Image Processing*, AcademicPress – An Imprint of Elsevier, California, Second Edition, 2006.
2.	Paul J. Curran, *Principles of Remote Sensing*, English Language Book Society/Longman, 1988.
3.	Anji Reddy M., *Text Book of Remote Sensing and Geographical Information System*, BS Publications, Hyderabad, Third Edition, 2006.
4.	Anand P.A, Rajesh Kumar V., *Principles of Remote Sensing & GIS*, Sri VengateswaraPublishers, Kumbakonam, First Edition, 2003.

E-References:

1.	**https://nptel.ac.in/courses/105102015/**

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEPE39	ADVANCED SURVEYING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:

1. At the end of the course the student will possess knowledge about advanced techniques in surveying.
2. The students will understand the basic principle behind the surveying techniques.

Unit I	BASICS OF SURVEYING	9	+	0

Methods of measuring distance, historical development, basic principles, classifications, applications and comparison with conventional surveying.

Unit II	FUNDAMENTALS OF ELECTRONICS	9	+	0

Fundamentals of electronics, resonant circuits, semiconductors, Lasers, Cathode ray tube, photo multiplier tube, transducers, oscillators, frequency mixing, modulation and demodulation, Kerrcell modulator, measurement of phase difference, reflectors and power sources.

Unit III	PROPAGATION OF ELECTROMAGNETIC WAVES	9	+	0

Definition, classification, applications, propagation properties, wave propagation at lower and higher frequencies. Refractive index, factors affecting, computation of group refractive index for light and near infrared waves at standard conditions and ambient conditions, reference refractive index.

Unit IV	ELECTROMAGNETIC DISTANCE MEASURING SYSTEM	9	+	0

Electro-optical system, measuring principle, working principle, sources of error, infrared EDM instruments, Laser EDM instruments and total station. Microwave system, measuring principle, working principle, sources of error, microwave EDM instruments, comparison with Electro-optical system.

Unit V	MODERN EQUIPMENTS	9	+	0

Total Station-Applications In various fields-Basics of Geographical information system (GIS) and Geographical Positioning system (GPS), Principles, Applications.

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Apply advanced surveying techniques in different fields of civil engineering
CO2	:	Select the advanced surveying technique which is best suited for a work
CO3	:	Apply total station and EDM in distance measurement and traversing
CO4	:	Demonstrate the principles of the earth surface, its projections and different coordinates involved in map making
C05	:	Apply GPS in transportation engineering, structural engineering and land use planning

Text Books:

1. Burnside, C.D. *Electromagnetic distance measurement* Crosby Lock wood staples, U.K. 1971.

Reference Books:

1. Rueger, J.M. *Electronic Distance Measurement*, Springer-Verlag, Berlin, 1990.
2. Laurila, S.H. *Electronic Surveying in Practice*, John Wiley and Sons Inc, 1983.
3. Soastamoinen, J.J. Surveyor's guide to electro-magnetic Distance Measurement, Adam HilgerLtd., 1967.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

OPEN ELECTIVES

18CEOE01	Environmental Management	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart an understanding of systems approach to Environmental Management as per ISO 14001 and skills for environmental performance in terms of legal compliance, pollution prevention and continual improvement.

Unit I	ENVIRONMENTAL MANAGEMENT STANDARDS	9	+	0

Unique Characteristics of Environmental Problems - Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts - Business Charter for Sustainable Production and Consumption –Tools, Business strategy drivers
and Barriers -Evolution of Environmental Stewardship –Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources.

Unit II	PREVENTIVE ENVIRONMENTAL MANAGEMENT	9	+	0

Pollution control Vs Pollution Prevention - Opportunities and Barriers –Cleaner production and Clean technology, closing the loops, zero discharge technologies
Four Stages and nine approaches of Pollution Prevention -Getting management commitment – Analysis of Process Steps-source reduction, raw material substitution, toxic use reduction and elimination, process modification – material balance – Technical, economical and environmental feasibility evaluation of Pollution Prevention options in selected industries –Preventive
Environmental Management over Product cycle.

Unit III	ENVIRONMENTAL MANAGEMENT SYSTEM	9	+	0

EMS, ISO 14000 - EMS as per ISO 14001–benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – environmental aspect and impact analysis – legal and other requirements-objectives and targets – environmental management programs –structure and responsibility –training awareness and competence-communication –documentation and document control –
operational control –monitoring and measurement –management review.

Unit IV	ENVIRONMENTAL AUDIT	9	+	0

Environmental audit – role of auditing – history – definitions audit methodology – evaluationaudit results – audit reports – case studies.

Unit V	APPLICATIONS	9	+	0

Applications of EMS , Waste Audits and Pollution Prevention- cost benefit analysis in environmental Problems.
Water quality management – concepts – riparian rights – monitoring programmes – technologytransfer – common effluent treatment concept.
Air quality management – emission inventory – ambient air quality in the region – spotting ofviolations – corrective measures – technology transfer.
Solid waste management – land pollution from solid and liquid wastes - spotting of violations – corrective measures – technology transfer.

Total (45+0)= 45 Periods

Course Outcomes: On completion of the course, the student is expected to be able to	
1	Understand the necessity of environmental management that will be caused by projects or industries.
2	Gain the Knowledge about the legal requirements of Environmental management andauditing.
3	Lead pollution prevention assessment team and implement waste minimization options.
4	Develop, Implement, maintain and Audit Environmental Management systems for Organisations.

Text Books:	
1.	1.Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems –astep by step guide" Earthscan Publications Ltd, London, 1999.
2.	ISO 14001/14004: Environmental management systems –Requirements and Guidelines – International Organisation for Standardisation, 2004.

Reference Books:	
1.	1.ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002.
2.	Paul LBishop „Pollution Prevention: Fundamentals and Practice", McGraw -Hill International, Boston,2000.
3.	Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEOE02	DISASTER MITIGATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1.	To provide students an exposure to disasters, their significance and types.
2.	To ensure that students begin to understand the relationship between vulnerability disasters,disaster prevention and risk reduction
3.	To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)

Unit I	INTRODUCTION TO DISASTERS	9	+	0

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability- Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‟ts during various types of Disasters.

Unit II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9	+	0

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

Unit III	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	9	+	0

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 IV	DISASTER RISK MANAGEMENT IN INDIA	9	+	0

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

Unit V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS	9	+	0

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management

Total = 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:		
CO1	:	Differentiate the types of disasters, causes and their impact on environment and society
CO2	:	Assess vulnerability and various methods of risk reduction measures as well as mitigation
CO3	:	Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

Text Books:	
1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
Reference Books:	
1.	Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2.	Government of India, National Disaster Management Policy,2009.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

18CEOE03	REPAIR AND REHABILITATION OF BUILDING ELEMENTS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To get the knowledge on causes of deterioration of structure2. To know about the assessment of distressed structures3.To get the knowledge on maintenance of building systems, 4.To know about the repairing of structures and 5. To gain knowledge about the techniques involved in the demolition procedure

Unit I	MAINTENANCE AND REPAIR STRATEGIES	9	+	0

Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection , assessment procedure for evaluating a damaged structure, causes of deterioration.

Unit II	MAINTENANCE OF ELECTRICITY AND DOMESTIC WATER PUMPSYSTEMS	9	+	0

Load rating of lighting devices and usual house hold appliances, electric supply from street line to building,devices for alternate supply during power failure, importance of earth leakage circuit breaker (ELCB),Maintenance of electric system inbuildings.
General specifications of water pumps, centrifugal pumps, jet pumps and submersible pumps, general rules in operation of water pumps. Maintenance of the sump.

Unit III	MATERIALS AND TECHNIQUES FOR REPAIR	9	+	0

Materials for Repair: Special concretes and mortar concrete chemicals construction chemicals Expansive cement polymer concrete sulphur infiltrated concrete Ferro cement Fibre reinforced concrete Rust eliminators and polymers coating for rebars foamed concrete dry packvacuum concrete asphalt sheeting Techniques for Repairs Gunniting, grouting and Shotcrete Epoxyinjection

Unit IV	REPAIRS,REHABILITATIONAND RETROFITTING OF BUILDINGSYSTEMS	9	+	0

Repairs of RC beams and columns damaged by steel corrosion,repair of rising dampness in walls,repair of efflorescence effect,repair of cracks in concrete structures,repair of rain water,ground water leakage in buildings.

Unit V	DEMOLITION TECHNIQUES	9	+	0

Engineered demolition techniques for dilapidated structures- case studies

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Carry out the damage assessment and Rapid Visual inspection of a building showing signs of deterioration and thus should be able to detect the possible cause /source of deterioration.
CO2	:	Know how to Maintain and repair the building systems like electricity,plumbing etc.

CO3	:	Know how of the Concrete repair industry equipped with variety of repair materials and

		techniques.
CO 4		know what to do the various repair works in building systems.
CO 5	:	Demonstrate the dismantling and demolishing structures

Text Books:

1.	Varghese P.C., *Maintenance Repair Rehabilitation and Minor Works of Buildings*, PHI Learning pvt.ltd.,New Delhi,2014

Reference Books:

1.	Santhakumar A.R, *Training Course notes on Damage Assessment and Repair in Low cost housing*, "RHDC.NBO" Anna University, july 1992.
2.	Shetty, M.S.,*Concrete Technology-Theory and Practice*, S. Chandand company, New Delhi,1992
2.	RaikarR.N.,*Learningfromfailures- deficienciesindesign,constructionandservices–* R &D centre (SDCPL), raikar bhavan, Bombay,1987
3.	Palaniyappan, N., *Estate management*, Anna Institute of Management, Chennai,1992.
4.	Lakshmipathy, M. etal., *Lecture notes of workshop on Repairs and Rehabilitation of structures*, 29-30th october 1999.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 – Strongly

18CEOE04	MECHANICS OF DEFORMABLE BODIES	L	T	P	C
		3	0	0	3

Course Objectives:

To get the knowledge on simple stresses, Hooke's Law, Bending and Shear, Bending stress, Torsion and Springs, Mechanical behaviour of materials under static and dynamic loading

Unit I	**SIMPLE STRESSES , BEHAVIOUR OF COMPOSITE SECTIONS , THERMAL STRESSES**	**9**	**+**	**0**

Mechanical properties of solids –Hooke's law ,principle of super position ,Bars of varying sections –Elastic constants – composite sections – determination of stress , strain , deformation – Temperature stress ,strain

Unit II	**BENDING AND SHEAR**	**9**	**+**	**0**

Types of beams – shear force and bending moment. Theory of simple bending- Analysis of stress-load carrying capacity. Shear stress distribution of simple beams of different cross sections

Unit III	**TORSION AND SPRINGS**	**9**	**+**	**0**

Torsion of circular shaft - Hollow and solid circular section, torsional rigidity-stepped shaft-Twist and torsional stiffness-compound shaft-shafts springs-Stiffness and deflection of helical springs , leaf spring

Unit IV	**MECHANICAL BEHAVIOUR OF MATERIALS UNDER STATIC LOADS**	**9**	**+**	**0**

Tension tests – stress – strain diagram , Elastic and plastic regions – True stress – strain propertiesin tension – fracture under tensile loads – compression and Torsion tests – stress concentration – Residnal stresses

Unit V	**MECHANICAL BEHAVIOUR OF MATERIALS UNDER DYNAMIC LOADS**	**9**	**+**	**0**

Fatigue loading and Fatigue fracture – Fatigue tests – Empirical relations between variable stress and mean stress – Fatigue stress concentration Factors – Cumulative Damage – Endurance limit –Impact – notched - Bar Impact tests , Charpy Impact tests – Izod Impact tests – Elevated temperature – Creep tests – Isochronous curves – stress Relaxation – Parametric methods

Total= 45 Periods

Course Outcomes:

Upon completion of this course, the students will be able to:

CO1	:	Analyse the mechanical behavior of static & dynamic loads
CO2	:	Know how to analyse bending and shear of various beams, stress strain and deformation of structures

Text Books:

1.	James M.Gere , Mechanics of Materials, Brooke/Cole Thomson Learning, 5 Ed., 2001.
2.	Dr.R.Vaithiyanathan , Dr.P.Perumal&Lingeswari ", Mechanics of Solids and Structures Volume-I" Sci- tech publications, India(Pvt) Chennai-17.

3.	Srinath L.S; - Strength of materials – Macmillan India Limited – New Delhi,2017
Reference Books:	
1.	Popov.E.P., “Engineering Mechanics of solids”, Prentice- Hall of India, New Delhi
2.	Beer F.P and Johnston R, “Mechanics of Materials”, McGraw- Hill book Co, Third Edition
2.	Timoshenko S.P., “Elements of Strength of Materials”, Tata McGraw- Hill, New Delhi
3.	Nash W.A., “Theory and Problems in Strength of Materials”, Schuam outline Series, McGraw- Hill BookCo., New York.
4.	Rajput. R.K., “Strength of Materials”, S. Chand &Co,Delhi, Third Edition, 2003.

CO-PO-PSO MAPPING

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

1 – Slightly
2 – Moderately
3 - Strongly

PROTOSEM COURSES SYLLABUS

18MEPS11	**APPLIED DESIGN THINKING**		**Semester**			**VI**
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	The course enables product innovators and early-stage startup founders to learn the customer development process
2	To familiarize with the tools & techniques & validate the inherent risks by linking their progress to customer-motivation, customer-commitment & customer-acceptance.
3	To learn the system thinking concepts by reverse engineering technique.

Unit I	**DESIGN THINKING PRINCIPLES**	**9**	**0**	**0**	**9**

Exploring Human – Centered Design – Understanding the innovation process, discovering areas of opportunity, interviewing &empathy –building techniques, Mitigate validate risk with FIR(Forge Innovation Rubric) – Case Studies.

Unit II	**CUSTOMER-CENTRIC INNOVATION**	**9**	**0**	**0**	**9**

Importance of customer-centric innovation – Problem Validation and Customer Discovery – Understanding problem significance and problem incidence- Customer Validation. Target user, User persona & user stories. Activity : Customer development process – Customer interviews and field visit.

Unit III	**APPLIED DESIGN THINKING TOOLS**	**9**	**0**	**0**	**9**

Concept of Minimum Usable Prototype(MUP) – MUP challenge brief – Designing & Crafting the value proposition – Designing and Testing Value Proposition: Design a compelling value proposition: Process, tools and techniques of Value Proposition Design.

Unit IV	**CONCEPT GENERATION**	**9**	**0**	**0**	**9**

Solution Exploration, Concepts Generation and MUP design – Conceptualize the solution concept: explore, iterate and learn; build the right prototype: Assess capability, usability and feasibility. Systematic concept generation; evaluation technology alternatives and the solution concepts.

Unit V	**SYSTEM THINKING & REVERSE ENGINEERING**	**9**	**0**	**0**	**9**

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components – Re-Engineering a complex system.

Total = 45 Periods

Text Books:

1	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
2	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
3	Proposition Design: How to Create Products and Services Customers Want, Wiley
4	Donella H. Meadows, (2015), "Thinking in Systems -A Primer", Sustainability Institute.
5	Tim Brown,(2012) "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Business.

Reference Books:	
1	https://www.ideou.com/pages/design-thinking#process
2	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-innovations-49f253c a8624
3	https://blog.forgeforward.in/product-innovation-rubric-adf5ebdfd356
4	https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
5	https://blog.forgeforward.in/user-guide-for-product-innovation-rubric-857181b253dd 6
6	https://blog.forgeforward.in/startup-failure-is-like-true-lie-7812cdfe9b85

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Define & treat various hypotheses to mitigate the inherent risks in product innovations	L1: Remembering
CO2	Design the solution concept based on the proposed value by exploring various alternate solutions to achieve value-price fit.	L6: Creating
CO3	Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching.	L3: Applying
CO4	Apply system thinking to reverse engineer a product/prototype and understand its internal correlations.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	1	1	1	1	1	1	1	2	2	3
CO2	2	2	3	2	2	1	1	1	1	1	1	1	3	3	2
CO3	1	2	2	1	1	3	1	1	3	3	1	1	1	1	1
CO4	2	3	3	3	3	2	2	1	2	2	1	1	3	3	3
AVG	**1.75**	**2.5**	**2.5**	**2.25**	**2**	**1.75**	**1.25**	**1**	**1.75**	**1.75**	**1**	**1**	**2.25**	**2.25**	**2.25**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS12	STARTUP FUNDAMENTALS			Semester			VI
PREREQUISITES		Category			Credit		3
		Hours/Week	L	T	P		TH
			3	0	0		3

Course Learning Objectives

1	Learn the science of to transforming an innovative idea into high-growth enterprises.
2	To understand the basic concepts of IPR, and develop a patent draft for a potential IP

Unit I	**ENTREPRENEURIAL MINDSET & METHOD**	**9**	**0**	**0**	**9**
Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures.					
Unit II	**IDEA TO ENTERPRISE**	**9**	**0**	**0**	**9**
Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning					
Unit III	**MINIMUM VIABLE BUSINESS**	**9**	**0**	**0**	**9**
Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Funding Opportunities					
Unit IV	**INTELLECTUAL PROPERTY**	**9**	**0**	**0**	**9**
Introduction and the need for Intellectual Property Rights - IPR Genesis and Development - Copyright - Trademark - Trade Secret - Geographical Indicators - Industrial Designs - Types of Patent – Sample Patent Application - IPR in INDIA; Global trends - Patent fees					
Unit V	**PRIOR ART SEARCH AND PATENT DRAFTING**	**9**	**0**	**0**	**9**
Prior Art Search - IP Licensing – IP Commercialization - IP Infringement- Case Study on Apple vs Samsung, Case study on basmati rice. The invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies on patent drafting					
Total = 45 Periods					

Text Books:

1	Steven Blank and Bob Dorf, (2012), The Startup Owner’s Manual: The Step-by-Step Guide for Building a Great Company, K&S Ranch
2	Dr Saras Sarasvathy, (2008), Effectuation: Elements of Entrepreneurial Expertise, New Horizons in Entrepreneurship series.
3	Elizabeth Verkey, (2005), Law of Patents, Eastern Book Company
4	Prabuddha Ganguli, (2017), Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education; 1st edition

Reference Books:	
1	WIPO Intellectual Property Handbook https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
2	https://assets.entrepreneur.com/static/20220301113822-Marketing.pdf
3	https://www.deluxe.com/blog/startup-fundamentals-guide/
4	https://www.forbes.com/sites/allbusiness/2018/07/15/35-step-guide-entrepreneurs-starting-a-business/?sh=69a6031e184b

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Develop an entrepreneurial mindset to identify, assess, shape & act on opportunities.	L3: Applying
CO2	Demonstrate the potential of an innovative idea to create economic value, as a startup	L2: Understanding
CO3	Understand the scientific process to explore a viable business model	L2: Understanding
CO4	Demonstrate knowledge on the fundamental concepts of Intellectual Property	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	2	1	2	2	2	3	3	1	1	2
CO2	2	2	3	1	1	1	1	2	2	1	3	2	2	2	2
CO3	1	2	2	2	1	1	1	1	1	1	3	2	1	1	1
CO4	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1
AVG	**1.25**	**1.75**	**2**	**1.25**	**1**	**1.25**	**1**	**2**	**1.5**	**1.25**	**2.5**	**2**	**1.25**	**1.25**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS13	COMPUTATIONAL HARDWARE				Semester		VI
PREREQUISITES		**Category**	**PE**		**Credit**		**3**
		Hours/Week	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	To learn basic concepts of Embedded Systems by familiarizing the functionalities of embedded platforms with development boards.
2	To understand the core concepts of GPIO Pins, Functionality of peripherals, Selection of I/O devices , Usage of Internal functions, and Communication protocols.
3	To familiarize the current technologies and protocols used in the Internet of Things (IoT) and to learn the Cloud services.

Unit I	**BASICS OF EMBEDDED SYSTEM**	**9**	**0**	**0**	**9**

Embedded Platform: Architecture and working - Factors for Microcontroller/Microprocessor selection. Arduino - Boards and schematics – Tool chain - Setup and Configuration - Input/Output Configurations and Access - Libraries - Digital I/O - ADC - Analog I/O - Timers, Interrupts - Pulse Width Modulation - Display: 7-segment , LCD , OLED.

Unit II	**BASICS OF RASPBERRY PI**	**9**	**0**	**0**	**9**

Raspberry Pi: Raspberry pi Board - Processor - Setup and Configuration - Installing Python IDLE using Command Terminal - General Purpose I/O Pins - Protocol Pins - GPIO Access - Pulse Width Modulation - Network Libraries - Web services - Twitter APIs - Twitter Bot - Interfacing pi with camera modules.

Unit III	**SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**

Interfacing of Sensors and Actuators **-** Sensors: Introduction, Characteristics: Analog - Potentiometer, Temperature Sensor, Soil Moisture Sensor, LDR - Digital - PIR Sensor, Smoke Sensor, Infrared - Sensor, Ultra- Sonic Sensor. Actuators - Introduction, Characteristics and working with relay, DC motors, Servo motor, Stepper motor and its drivers.

Unit IV	**COMMUNICATION PROTOCOLS**	**9**	**0**	**0**	**9**

Protocols - Wired: RS232 Standard **-** UART, SPI, I2C - Comparative study of wired protocols - Implementation of wired Serial Communication protocols Wireless: Standards - Bluetooth, RF - Comparative study of wireless protocols - Implementation of wireless Serial Communication protocols.

Unit V	**INTERNET OF THINGS**	**9**	**0**	**0**	**9**

Definition and Architecture of IoT, Building blocks of IoT, Programming with IoT protocols - MQTT, CoAP - Connecting embedded target board to Web, Basics networking in IoT: creating a web page - Creating a server on target board - Controlling I/O peripherals from the webpage, Embedded Application Development, Creating communication between different nodes - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.

Total = 45 Periods

Text Books:

1	Raj Kamal, “ Embedded Systems - SoC, IoT, AI and Real-Time Systems”, 4th Edition, McGraw Hill, 2020.
2	Mohit Arora, “Embedded System Design”, 1st Edition, Learning Bytes Publishing, 2016.
3	Elecia White, “Making Embedded Systems”, 1st Edition, Shroff/ O’ Reilly, 2012.
4	Jack Ganssle, “ The Firmware Handbook”, 1st Edition, Newnes, 2004.

Reference Books:	
1	https://juniorfall.files.wordpress.com/2011/11/arduino-cookbook.pdf
2	https://drive.google.com/file/d/13s0m3lHPEFP2f2aCuVNRWeBZNKXWKTW5/view?ts=6231cab 3
3	https://ptolemy.berkeley.edu/books/leeseshia/releases/LeeSeshia_DigitalV2_2.pdf 4.
4	https://www.riverpublishers.com/pdf/ebook/RP9788793519046.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand and implement the functions & Capabilities of embedded platforms for easy prototyping.	L2: Understanding
CO2	Identify the type of sensors and actuators for required applications.	L3: Applying
CO3	Develop communication between devices using different protocols.	L3: Applying
CO4	Develop IoT based systems with wireless network connections and accessing devices over cloud.	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	2	2	2	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
AVG	**3**	**2.25**	**2.75**	**2**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS14	CODING FOR INNOVATORS				Semester	VI
PREREQUISITES		**Category**			**Credit**	**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Learning Objectives						
1	To learn and express creativity using coding skills.					
2	To gain knowledge of Python programming with hands-on experience.					
3	To demonstrate a problem solving using OOPs concepts.					
4	To learn basics of Linux by familiarizing the concepts of management and file structure.					
5	To practise full stack development using cloud platform.					
Unit I	**PROGRAMMING PARADIGMS**		**9**	**0**	**0**	**9**
Need for programming - Outside box thinking to solve problems - Need for algorithms and data structures - Flowcharts & Algorithms - Memory Allocation - Conditions and loops - Creating effective functions - Case studies - Visual Programming - Types of programming languages & paradigms - Getting started with development - Build & test an algorithm - best practices						
Unit II	**BASIC OF PROGRAMMING**		**9**	**0**	**0**	**9**
Introduction to Python: statements, variables, functions, operators, modules, conditional statements, loop statements, Lists: list operations, traversing a list, slicing a list - Text Handling: Strings, string functions, conversion functions, Dictionaries - File Operations: File open, close, read, copy, word frequency, creating word histograms from text file.						
Unit III	**OOPS 5**		**9**	**0**	**0**	**9**
OOPS- Why OOPS- verticals- implementation in python - Classes and Objects, Methods, Constructors and Destructors, Inheritance, Polymorphism, Abstraction, Encapsulation.						
Unit IV	**SOFTWARE DEVELOPMENT TO DELIVERY**		**9**	**0**	**0**	**9**
Software Engineering - Life Cycle (Tools), Agile Methodologies - Framework - Why Frameworks - Software Testing(Tool Based) - Data Structures - Database Management System - A case study to experiment from Development to Deployment(D2D) - Source code management and version control - GitHub - GitHub Actions - GitBash - Continuous Integration - Platform as service - Heroku - Build Packs AWS- Anaconda						
Unit V	**OPERATING SYSTEMS**		**9**	**0**	**0**	**9**
Introduction to Linux - Process Management - Process Scheduling - Memory Management - Storage Management - System calls - File System Structure - Multithreading - Multicore Programming - Deadlock Handling - Disk Structure - Disk Management - Dockers - Kubernetes						
						Total = 45 Periods

Text Books:	
1	Zed A. Shaw, “Learn Python 3 the Hard Way”, 3rd edition, Addison-Wesley Professional, 2013.
2	Silberschatz Abraham, “Operating System Concepts”, 9th edition, John Wiley & Sons Inc (Sea) Pte Ltd, 2016.
3	Paul Barry, "Head-First Python", 2nd edition, O'Reilly Media, Inc, 2016.
4	Anton Spraul, “Think Like a Programmer”, 1st edition, No Starch Press, 2012.

E-References :	
1	https://www.geeksforgeeks.org/python-programming-language/
2	https://www.guru99.com/python-tutorials.html
3	https://www.tutorialspoint.com/python/python_tutorial.pdf

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the aspects of programming protocols	L2: Understanding
CO2	Develop optimized code for real-world problems	L3: Applying
CO3	Build full-stack development to deployment	L3: Applying
CO4	Demonstrate problem solving and continuous development	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	3	0	0	0	0	0	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	2	2
CO3	3	2	3	1	3	0	0	0	0	0	0	0	3	2	2
CO4	2	3	2	1	2	0	0	0	0	0	0	3	2	1	1
AVG	**2.5**	**2.5**	**2.5**	**1.25**	**2.75**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**2.5**	**1.5**	**1.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS15	INDUSTRIAL DESIGN AND RAPID PROTOTYPING TECHNIQUES		Semester			VI
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives	
1	Learn to design a UI/UX design and develop an android application.
2	Provide working CAD model for prototype development.
3	Knowledge in hardware, 3D Printers and Laser cutters.
4	Acquire basic knowledge in designing electrical circuits and fabrication of electronic devices.

Unit I	UI / UX	9	0	0	9
Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in the industry -User engagement ethics - Design alternatives					
Unit II	**APP DEVELOPMENT**	**9**	**0**	**0**	**9**
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.					
Unit III	**INDUSTRIAL DESIGN**	**9**	**0**	**0**	**9**
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing					
Unit IV	**MECHANICAL RAPID PROTOTYPING**	**9**	**0**	**0**	**9**
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - **Mechanical Prototyping:** 3DPrinting and classification - Laser Cutting and engraving - RD Works - Additive manufacturing					
Unit V	**ELECTRICAL RAPID PROTOTYPING**	**9**	**0**	**0**	**9**
Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA					
					Total = 45 Periods

Text Books:	
1	Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)
2	Samar Malik, Autodesk Fusion 360 - The Master Guide.
3	Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability, Pearson,3rd edition (2014)

E - References:	
1	https://www.adobe.com/products/xd/learn/get-started.html
2	https://developer.android.com/guide
3	https://help.autodesk.com/view/fusion360/ENU/courses/
4	https://help.prusa3d.com/en/category/prusaslicer_204

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Create quick UI/UX prototypes for customer needs	L6: Creating
CO2	Develop web application to test product traction / product feature	L3: Applying
CO3	Develop 3D models for prototyping various product ideas	L3: Applying
CO4	Built prototypes using Tools and Techniques in a quick iterative methodology	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	3	0	0	0	1	1	0	0	2	1	1
CO2	3	3	3	2	3	0	0	0	1	1	0	0	3	2	2
CO3	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
CO4	3	2	3	2	3	0	0	0	1	1	0	0	3	2	2
AVG	**2.75**	**2.25**	**3**	**2**	**3**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2.75**	**1.75**	**1.75**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS16	INDUSTRIAL AUTOMATION DATA LIFE CYCLE MANAGEMENT			Semester		VI
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Acquire conceptual knowledge in Industrial Controllers by scaling of on-board devices and embedded board interfacing with various I/O peripherals.
2	Learn PLC by working on internal features and also interfacing with Sensors and actuators along HMI concept using SCADA and standard communication protocols.
3	To work with FPGA boards and RT controllers for reprogrammable embedded applications using LabVIEW
4	Understand the concepts and design electronics circuits

Unit I	INDUSTRIAL CONTROLLERS - I	9	0	0	9

Industrial Controllers - Introduction to RIO Controllers - Platform - Connection and Configuring controllers - Accessing onboard devices - Module SOM - Interfacing with Input and Output devices - Interfacing protocol based Analog and Digital sensors - Acquiring and Data Logging from sensors - Interfacing Actuators: Relay, DC Motor, Servo Motor - Creating standalone applications.

Unit II	INDUSTRIAL CONTROLLERS - II	9	0	0	9

Industrial Controllers - II - PLC - Introduction - Mode of Operation - IEC 61131 Programming languages for PLC - Programming & sequence control - Instruction set - Scan Time - Timers - Counters - Interfacing with Input/Output devices - Interfacing with Sensors - Interfacing with Actuators - Interfacing with Human Machine Interface - Commissioning and operational safety of PLC – SCADA.

Unit III	INDUSTRIAL COMMUNICATION PROTOCOLS	9	0	0	9

Serial Communication Protocols - I2C, SPI - Serial Field bus protocols CAN, PROFIBUS - Ethernet, HTTP, TCP/UDI, WiF, Cloud data logging. Multi-sensor communication, Data parsing between Embedded platforms. Comparative study of Industrial communication protocols - Implementation of Industrial Communication protocols.

Unit IV	FPGA AND RT CONTROLLER PROGRAMMING	9	0	0	9

Introduction to FPGA - Architecture - Operations in FPGA programming - FPGA Programming in LabVIEW and implementation in myRIO - Introduction to RT controllers - Architecture - Programming RT Controllers - Creating standalone applications.

Unit V	INDUSTRIAL CIRCUIT BOARD DESIGN	9	0	0	9

Designing basics circuits and to simulate in environment setup - Component selection - Creating libraries - Schematic design - Design rules, supply & communication track rules - Component and footprint editor - Understanding component package types - Test point creation for measurement - PCB Layout, placement rules - Footprint, 3D models, BoMs - Generating GERBER and output documentation.

Total = 45 Periods

Text Books:	
1	Ed Doering, NI myRIO Project Essential Guide, National Instruments, 2016.
2	Willian Bolton, Programmable Logic Controllers, 6th edition, Newnes Publications, 2015
3	Richard Zurawski, Industrial Communication Technology Handbook, Second edition, CRC Press, 2014
4	Simon Monk, Make Your Own PCBs with EAGLE, McGraw Hill Education, 2014.
References Books:	
1	Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun, 3rd edition, Prentice Hall
2	Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, Fourth edition, Pearson Education, 2016
3	Michael J. Hamill, Industrial Communications and Control Protocols, PDH centre, 2016
4	Ema Design Automation, The Hitchhiker's Guide to PCB Design, First edition, Blurb Publishers, December 2021

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the usage of controllers in an industrial environment	L2: Understanding
CO2	Build Real-Time systems for Industrial embedded monitoring and controlling deterministic applications	L3: Applying
CO3	Communicate between devices at different levels using industrial protocols	L3: Applying
CO4	Understand the process involved in PCB design using EDA tools and fabricate it	L2: Understanding

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3	0	0	0	0	0	0	0	3	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	2	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	3	2.25	2.75	1.75	3	0	0	0	0	0	0	0	3	2.75	2.5

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

18MEPS17	ROBOTICS/ML&MLOps			Semester		VI
PREREQUISITES		**Category**	**EE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Learn the fundamentals of ROS
2	Understand the requirements and choose the right sensors and actuators for the application development
3	Create Bot in the virtual environment and simulate it to know the functionalities of the system developed
4	Learn the basics of Robotics Vision System
5	Integrate ROS and Computer Vision to build systems for various use cases

Unit I	**INTRODUCTION TO ROBOT KINEMATICS**	**9**	**0**	**0**	**9**
Introduction to Robotics - Transformations - Forward Kinematics - Kinematics equations - Link transformations - Inverse Kinematics - Kinematic analysis - Numerical Inverse Kinematic Solutions - Analytical Inverse Kinematic Solutions					
Unit II	**SELECTION OF SENSORS AND ACTUATORS**	**9**	**0**	**0**	**9**
Introduction - Sensors & Actuators - Types - Selection criteria - Design considerations: Motor sizing - Selection of motors based on torque and speed characteristics - Hardware Interface & Assembly					
Unit III	**INTRODUCTION TO ROBOT OPERATING SYSTEM**	**9**	**0**	**0**	**9**
Introduction to ROS framework and prerequisites - Understanding communications in ROS - ROS Ecosystem - Introduction to ROS programming - ROS nodes, topics, messages - ROS services - ROS Tools and Utilities - URDF , Rviz - Simulation - Gazebo - ROS Motion					
Unit IV	**INTRODUCTION TO ROBOTICS VISION SYSTEM**	**9**	**0**	**0**	**9**
Image basics - Image Processing - Histograms - Gray scale, Color, Equalization - Smoothing and blurring/filtering - Averaging, Gaussian, Median, Bilateral - Thresholding - Simple, Adaptive, Otsu - Gradients and Edge detection - Laplacian, Sobel, Canny - Contours - Camera calibration					
Unit V	**INTEGRATION OF ROS AND COMPUTER VISION**	**9**	**0**	**0**	**9**
Introduction - Installation - CV Bridge - Image publisher node - Image subscriber node - Nodes building and launching - Building real world applications					
					Total = 45 Periods

Text Books:

1	Introduction to Robotics: Mechanics and Control by John J Craig, Pearson Publishers.
2	Robot Operating System (ROS) for Absolute Beginners by Lentin Joseph, A press; Publishers (2018).
3	Learning OpenCV by Gary Bradski, Adrian Kaehler, O'Reilly Media, Inc.

Reference Books:	
1	https://www.intechopen.com/chapters/379
2	https://www.plantengineering.com/articles/eight-selection-criteria-for-actuation-components/
3	https://www.controleng.com/articles/tips-on-sensor-selection/
4	https://www.toptal.com/robotics/introduction-to-robot-operating-system
5	https://www.thomasnet.com/articles/automation-electronics/machine-vision-systems/
6	https://automaticaddison.com/working-with-ros-and-opencv-in-ros-noetic/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand kinematics considerations of robot	L2: Understanding
CO2	Selection of sensors and actuators according to application	L3: Applying
CO3	Utilize the ROS environment to simulate and communicate between robot	L3: Applying
CO4	Develop algorithms to extract features and data from image	L3: Applying
CO5	Utilize the open CV for robotic applications	L3: Applying

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	0	0	0	0	0	0	0	3	3	2
CO2	3	3	2	1	2	0	0	0	0	0	0	0	3	3	3
CO3	3	2	3	2	3	0	0	0	0	0	0	0	3	3	3
CO4	3	3	3	2	3	0	0	0	0	0	0	0	3	3	2
AVG	**3**	**2.5**	**2.75**	**1.5**	**2.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**2.5**

0: No correlation, 1: Low correlation, 2: Medium correlation, 3: High correlation

DEPARTMENT OF CIVIL ENGINEERING

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I	VERTICAL II	VERTICAL III
Structural Engineering	**Environmental Engineering**	**Construction Engineering and Management**
18CEH101 Bridge Engineering	18CEH201 Industrial Wastewater Treatment	18CEH301 Smart Materials and Smart Structures
18CEH102 Repair & Rehabilitation of Structures	18CEH202 Environmental Impact and Risk Assessment	18CEH302 Construction Techniques and Equipment
18CEH103 Industrial Structures	18CEH203 Environmental Management & Sustainable development	18CEH303 Project Safety Management
18CEH104 Prefabricated Structures	18CEH204 Environmental Legislations in India	18CEH304 Sustainable and Green Building Technology
18CEH105 Finite Elements Analysis	18CEH205 Environmental Microbiology	18CEH305 Functional Planning in Building Services
18CEH106 Experimental Techniques and Instrumentation	18CEH206 Waste Management Techniques	18CEH306 Building Valuation
18CEH107 Advanced Concrete Technology	18CEH207 Unit Operations and Processes in Water and WasteWater Treatment	18CEH307 Quality Control and Assurance in Construction

VERTICAL I - STRUCTURAL ENGINEERING										
Sl. No.	**Subject Code**	**Course Title**	**CAT**	**CA Marks**	**End Sem. Marks**	**Total Marks**	**Credits**			
							L	**T**	**P**	**C**
1.	18CEH101	Bridge Engineering	PE	40	60	100	3	0	0	3
2.	18CEH102	Repair & Rehabilitation of Structures	PE	40	60	100	3	0	0	3
3.	18CEH103	Industrial Structures	PE	40	60	100	3	0	0	3
4.	18CEH104	Prefabricated Structures	PE	40	60	100	3	0	0	3
5.	18CEH105	Finite Elements Analysis	PE	40	60	100	3	0	0	3
6.	18CEH106	Experimental Techniques and Instrumentation	PE	40	60	100	3	0	0	3
7.	18CEH107	Advanced Concrete Technology	PE	40	60	100	3	0	0	3
VERTICAL II - ENVIRONMENTAL ENGINEERING										
Sl. No.	**Subject Code**	**Course Title**	**CAT**	**CA Marks**	**End Sem. Marks**	**Total Marks**	**Credits**			
							L	**T**	**P**	**C**
8.	18CEH201	Industrial Wastewater Treatment	PE	40	60	100	3	0	0	3
9.	18CEH202	Environmental Impact and Risk Assessment	PE	40	60	100	3	0	0	3
10.	18CEH203	Environmental Management & Sustainable development	PE	40	60	100	3	0	0	3
11.	18CEH204	Environmental Legislations in India	PE	40	60	100	3	0	0	3
12.	18CEH205	Environmental Microbiology	PE	40	60	100	3	0	0	3
13.	18CEH206	Waste Management Techniques	PE	40	60	100	3	0	0	3
14.	18CEH207	Unit Operations and Processes in Water and Waste Water Treatment	PE	40	60	100	3	0	0	3
VERTICAL III - CONSTRUCTION ENGINEERING AND MANAGEMENT										
Sl. No.	**Subject Code**	**Course Title**	**CAT**	**CA Marks**	**End Sem. Marks**	**Total Marks**	**Credits**			
							L	**T**	**P**	**C**
15.	18CEH301	Smart Materials and Smart Structures	PE	40	60	100	3	0	0	3
16.	18CEH302	Construction Techniques and Equipment	PE	40	60	100	3	0	0	3
17.	18CEH303	Project Safety Management	PE	40	60	100	3	0	0	3
18.	18CEH304	Sustainable and Green Building Technology	PE	40	60	100	3	0	0	3

19.	18CEH305	Functional Planning in Building Services	PE	40	60	100	3	0	0	3
20.	18CEH306	Building Valuation	PE	40	60	100	3	0	0	3
21.	18CEH307	Quality Control and Assurance in Construction	PE	40	60	100	3	0	0	3

VERTICAL I – STRUCTURAL ENGINEERING

18CEH101	BRIDGE ENGINEERING		Semester			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Basic Structural Analysis, Foundation Engineering Transportation Engineering		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To impart knowledge about loads on bridges and selection of type of bridge for the site condition.
2	To impart knowledge about the super structure by various methods.
3	To impart knowledge about the trussed bridge and plate girder bridges.
4	To impart knowledge about reinforced concrete slab and T beam bridges and prestressed concrete bridges.
5	To impart knowledge about the appropriate sub structural systems, bearings and expansion joints for the bridges.

Unit I	INTRODUCTION	9	0	0	9

History of bridges - Components of a bridge - Classification of road bridges - Selection of site and initial decision process - Survey and alignment; Geotechnical investigations and interpretations. River Bridge: Selection of Bridge site and planning - Collection of bridge design data - Hydrological calculation Road Bridges - IRC codes - Standard Loading for Bridge Design - Influence lines for statically determinate and indeterminate structures - Transverse distribution of Live loads among deck longitudinal - Load combinations for different working state and limit state designs Railway Bridges: Loadings for Railway Bridges; Railroad data. Pre-design considerations - Railroad versus Highway bridges.

Unit II	SUPERSTRUCTURES	9	0	0	9

Bridge decks – Structural forms and behavior – Choices of superstructure types – Behavior and modeling of bridge decks – Simple beam model – Plate model – Grillage method – Finite Element method - Different types of superstructures (RCC and PSC); Longitudinal Analysis of Bridge. - Transverse Analysis of Bridge - Temperature Analysis - Distortional Analysis - Effects of Differential settlement of supports - Reinforced earth structures

Unit III	DESIGN OF STEEL BRIDGES	9	0	0	9

Design of Truss Bridges – Design of Plate girder bridges.

Unit IV	DESIGN OF RC AND PSC BRIDGES	9	0	0	9

Design of slab bridges – T beam bridges – PSC bridges.

Unit V	SUBSTRUCTURE, BEARINGS AND EXPANSION JOINTS, PARAPETS AND RAILINGS	9	0	0	9

Substructure - Pier; Abutment - Wing walls- Importance of Soil-Structure Interaction - Types of foundations - Open foundation- Pile foundation- Well foundation- Simply supported bridge- Continuous Bridge - Bearings and Expansion Joints - Different types of bridge bearings and expansion joints - Parapets and Railings for Highway Bridges

Total= 45 Periods

Text Books:

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	Jagadeesh. T. R. And Jayaram. M. A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd., 2004
4	Raina. V. K., Concrete Bridge Practice, Tata McGraw Hill Publishing Company, New Delhi, 1991.

Reference Books:	
1	N. Rajagopalan, Bridge Superstructure, Narosa Publishing House, New Delhi, 2006.
2	Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990.
3	IRC:6-2000 Standard specifications and code of practice for road bridges.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify loads on bridges and selection of type of bridge for the site condition.	Remember
CO2	Analyze the super structure by various methods.	Understand
CO3	Design the trussed bridge and plate girder bridges.	Create
CO4	Design reinforced concrete slab and T beam bridges and prestressed concrete bridges.	Create
CO5	Decide the appropriate sub structural systems, bearings and expansion joints for the bridges.	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**	**3**	**-**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**1**	**1**	**3**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
CO3	**3**	**1**	**3**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO4	**3**	**1**	**3**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO5	**3**	**1**	**3**	**-**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
Avg	**2.6**	**1**	**3**	**-**	**2**	**2**	**2.2**	**-**	**-**	**-**	**-**	**-**	**2.4**	**-**	**-**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>18CEH102</td><td colspan="4">REPAIR AND REHABILITATION OF STRUCTURES</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="3">PREREQUISITES</td><td>Category</td><td>PE</td><td colspan="3">Credit</td><td>3</td></tr>
<tr><td colspan="3" rowspan="2">Construction Materials and Technology,
Concrete Technology</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="9">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="8">Study the various types and properties of repair materials</td></tr>
<tr><td>2</td><td colspan="8">Learn various distress and damages to concrete structures</td></tr>
<tr><td>3</td><td colspan="8">Understand the importance of maintenance of structures</td></tr>
<tr><td>4</td><td colspan="8">Assess the damage to structures using various tests</td></tr>
<tr><td>5</td><td colspan="8">Learn various repair techniques of damaged structures, corroded structures</td></tr>
<tr><td>Unit I</td><td colspan="3">MAINTENANCE AND REPAIR STRATEGIES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection, assessment procedure for evaluating a damaged structure, causes of deterioration- NDTtest – Introduction to nonlinear NDT test</td></tr>
<tr><td>Unit II</td><td colspan="3">SERVICEABILITY AND DURABILITY OF CONCRETE</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Quality assurance for concrete construction, concrete properties- strength, permeability, thermal properties and cracking- effects due to climate, temperature, chemical, corrosion- Design and construction errors-effects of cover thickness and cracking.</td></tr>
<tr><td>Unit III</td><td colspan="3">MATERIALS AND TECHNIQUES FOR REPAIR</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Special concretes and mortar, concrete chemical, special elements for accelerated strength gain, expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, 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. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection.</td></tr>
<tr><td>Unit IV</td><td colspan="3">REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Strengthening of Structural elements, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.</td></tr>
<tr><td>Unit V</td><td colspan="3">DEMOLITION TECHNIQUES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Demolition methods by machines, explosives, Advanced Techniques-Demolition sequences, dismantling techniques, safety precautions in dismantling and demolition, Engineered demolition techniques for dilapidated structures- case studies</td></tr>
<tr><td colspan="9" align="right">Total= 45 Periods</td></tr>
</table>

<table>
<tr><td colspan="2">Text Books:</td></tr>
<tr><td>1</td><td>Shetty, M.S.,Concrete Technology- Theory and Practice, S. Chand and company, New Delhi,2019</td></tr>
<tr><td>2</td><td>Repair and protection of concrete structures by Noel P.Mailvaganam, CRC Press,1991.</td></tr>
<tr><td>3</td><td>CPWD: Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt. of India, 2002, updated reprint 2011</td></tr>
<tr><td colspan="2">Reference Books:</td></tr>
<tr><td>1</td><td>Santhakumar A.R,Training Course notes on Damage Assessment and Repair in Low-Cost Housing, “RHDC.NBO” Anna University, July 1992.</td></tr>
</table>

2	Raikar R.N., Learning from failures- deficiencies in design, construction and services – R &D Centre (SDCPL), Raikar Bhavan, Bombay,1987
3	Palaniyappan, N., Estate management, Anna Institute of Management, Chennai,1992.
4	Lakshmipathy, M. etal., Lecture notes of workshop on Repairs and Rehabilitation of structures,29-30th October 1999.
5	https://nptel.ac.in/courses/114106035/38

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate the condition of structures	Understand
CO2	Inspect and evaluate the damaged structure	Analyze
CO3	Implement the repairing techniques of a structure	Analyze
CO4	Identify and use different materials for repairing works	Apply
CO5	Demonstrate the dismantling and demolishing structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO2	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO3	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO4	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO5	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
Avg	**1**	**-**	**2**	**2**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH103	INDUSTRIAL STRUCTURES			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Design of Steel Structural Elements Advanced Steel Structures Prestressed Concrete Structures		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Learning Objectives						
1	To understand the requirements and planning of industrial structures					
2	To understand functional requirements of structures					
3	To analyze and design the steel industrial structures					
4	To analyze and design R.C industrial structures					
5	To know the concepts of prefabrication					
Unit I	**PLANNING**		**9**	**0**	**0**	**9**
Classification of Industries and Industrial structures – General requirements for industries like cement, chemical and steel plants – types of frames – bracings – crane girders and columns – workshop sheds - -Planning and layout of buildings and components						
Unit II	**FUNCTIONAL REQUIREMENTS**		**9**	**0**	**0**	**9**
Lighting – Ventilation – Accounts – Fire safety – Guidelines from factories act.						
Unit III	**DESIGN OF STEEL STRUCTURES**		**9**	**0**	**0**	**9**
Industrial roofs – Crane girders – Mill buildings – Design of bunkers and silos						
Unit IV	**DESIGN OF R.C. STRUCTURES**		**9**	**0**	**0**	**9**
Concrete Silos and bunkers – Chimneys – Principles of folded plates and shell roofs – Machine foundations						
Unit V	**PREFABRICATION**		**9**	**0**	**0**	**9**
Principles of prefabrication – Prestressed precast roof trusses- Functional requirements for Precast concrete units						
						Total= 45 Periods

Text Books:	
1	Duggal S.K., Limit State Design of Steel Structures, Tata McGraw-Hill Publishing Company, New Delhi, 2019.
2	Subramanian N., Design of Steel Structures, First edition, OXFORD university press, 2022
3	Purushothaman.P, Reinforced Concrete Structural Elements: Behaviour, Analysis and Design, Tata McGraw-Hill Publishing Company, 1984.
Reference Books:	
1	Henn W. Buildings for Industry, VolI and II, London Hill Books, 1995
2	Handbook on Functional Requirements of Industrial buildings, SP32 – 1986, Bureau of Indian Standards, New Delhi 1990
3	Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Structural Engineering Research Centre, Madras, 1982

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Acquire knowledge on planning of industrial structures.	Remember
CO2	Describe the functional requirements of structures	Understand
CO3	Analyze and Design steel industrial structures	Analyze
CO4	Analyze and Design R.C. industrial structures	Create
CO5	Explain the concepts of Prefabrication	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-	2	2	-	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	2	-	-
CO5	-	1	1	-	-	-	-	-	-	-	-	1	2	-	-
Avg	3	2	2.25	2	-	-	-	-	-	-	-	1.6	2	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH104	PREFABRICATED STRUCTURES		Semester			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Construction Materials, Design of Reinforced Concrete Elements		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To impart knowledge to students on modular construction,
2	To know about construction of different prefabricated elements
3	To acquire knowledge in different manufacturing methods.
4	To know about techniques for erection of prefabricated elements
5	To learn about various applications of prefabricated structures

Unit I	**GENERAL PRINCIPLES OF FABRICATION**	**9**	**0**	**0**	**9**

Comparison with monolithic construction – Types of prefabrication – site and plant prefabrication – Economy of prefabrication – Modular coordination – Standardization – Planning for Components of prefabricated structures – Disuniting of structures – Design of simple rectangular beams and I beams – Handling and erection stresses – Elimination of erection stresses – Beams, columns - Symmetrical frames.

Unit II	**PREFABRICATED ELEMENTS**	**9**	**0**	**0**	**9**

Roof and floor panels – Ribbed floor panel, Hollow core, concrete roof, massive slab floors – Pros and Cons – Wall panels – Footings – Joints for different structural connections – Effective sealing of joints for water proofing – Provisions for non-structural fastenings – Expansion joints in pre-cast construction.

Unit III	**PRODUCTION TECHNOLOGY**	**9**	**0**	**0**	**9**

Choice of production setup – Manufacturing methods – Support system – Conveyor system – Aggregate system – Fabrication process – Main, Secondary and Subsidiary process – Stationary and mobile production – Planning of production setup– Storage of precast elements – Dimensional tolerances – Acceleration of concrete hardening.

Unit IV	**HOISTING TECHNOLOGY**	**9**	**0**	**0**	**9**

Equipment for hoisting and erection – Techniques for erection of different types of members like Beams, Slabs, Wall panels and Columns – Vacuum lifting pads – Design consideration – Risk identification and control – Control methods – Advantages and Disadvantages of using hoisting technology.

Unit V	**APPLICATIONS**	**9**	**0**	**0**	**9**

Designing and detailing of precast unit for factory structures – Purlins, Principal rafters, roof trusses, lattice girders, gable frames – Single span single storeyed frames – Single storeyed buildings – slabs, beams and columns – Precast concrete frame, wall and floor construction process and benefits.

Total= 45 Periods

Text Books:

1	Hubert Bachmann, Alfred Steinle, Precast Concrete Structures, 2nd Edition,2019
2	S.Elliott Kim.Precast Concrete Structures, 2nd Edition,2017
3	L.Mokk, "Prefabricated Concrete for Industrial and Public Structures", Publishing House of the Hungarian Academy of Sciences, Budapest,1st Edition,1964.
4	I. T. Koncz, "Manual of Precast Concrete Construction", Vol. I, II, III & IV, Berlin,1st Edition,1971

Reference Books:

1	CBRI, "Building materials and components", India, 1990.

2	C.Z. Gerostiza, C Hendriksonand D.R.Rehat., Knowledge based process planning for construction And manufacturing, Academic Press Inc., 2012.
3	Structural Design Manual, “Precast Concrete Connection Details”, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Discuss the knowledge on the basics of prefabricated structure design principles.	Understand
CO2	Analyse the behaviour of various prefabricated structural members, floors, stairs, roofs and walls	Analyse
CO3	Summarize the Production and Storage of Precast elements	Understand
CO4	Summarize the hoisting methods of different structural elements	Understand
CO5	Explain the applications of various prefabricated units	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	-	1	-	-	-	-	-	1	-	-
CO2	3	1	1	1	1	-	1	-	-	-	2	-	1	1	-
CO3	3	1	1	-	1	-	1	-	2	-	2	-	-	-	1
CO4	3	1	1	-	1	-	1	-	2	-	2	-	-	-	1
CO5	3	1	3	2	1	-	1	-	-	-	-	1	-	2	-
Avg	3	1	1.4	1.3	1	-	1	-	2	-	2	1	1	1.5	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH105	FINITE ELEMENT ANALYSIS		Semester			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Strength of Materials, Advanced Structural Analysis		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To acquire knowledge about the basis of Finite Element theory, computer implementation of this theory and its practical applications.
2	To understand various basic energy and weighted residual methods
3	To Familiarize with principles of structural mechanics
4	To impart knowledge on isoparametric and axisymmetric elements
5	To study about the shape functions for linear and quadric models

Unit I	**ELEMENTS OF ELASTICITY**	**9**	**0**	**0**	**9**

Basic principles of structural mechanics – Equations of equilibrium – Strain displacement relations –Stress strain relations– Plane stress and plane strain cases–Principles of Virtual work and minimum potential energy.

Unit II	**DIRECT STIFFNESS METHOD**	**9**	**0**	**0**	**9**

Steps in direct method of FEA – Element stiffness matrix – Global stiffness matrix – Boundary conditions – Problems on simple beams and Trusses.

Unit III	**ANALYSIS OF 2D/3D ELEMENTS**	**9**	**0**	**0**	**9**

Discretization - Basic element shapes - Element properties – Node numbering procedure – Convergence requirements – Generalised co-ordinates – Natural co-ordinates – Shape functions for linear & quadratic models – Stiffness matrix – Nodal load vector 2D or 3 D– Static condensation – Simple problems.

Unit IV	**INTRODUCTION TO ISOPARAMETRIC ELEMENTS**	**9**	**0**	**0**	**9**

Concept of sub, iso, super parametric elements – Gauss quadrature – Examples in one- and two-dimensional elements

Unit V	**SOLUTION TECHNIQUES**	**9**	**0**	**0**	**9**

Different solvers – Variational approach – Weighted mean residual methods like Collocation method, Sub domain method, Galerkin method and Least square method – Simple problems only.

Total= 45 Periods

Text Books:

1	Tirupathi R. Chandrupatla and Ashok D. Belugundu , “Introduction to Finite Elements in Engineering”, Third Edition, Prentice Hall India Pvt Ltd, 2011
2	P.Seshu, “Textbook of Finite Element Analysis”, Prentice Hall India Pvt Ltd, 2008.

Reference Books:

1	Rajasekaran.S., “Finite Element Analysis in Engineering Design”, Wheeler Publishing,2000.
2	S.S.Rao, “The Finite Element Method in Engineering”, Buttersworth-Heinemann publishing, 2000
3	Desai C S

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Understand the basic concepts involved in FEM theory	Understand
CO2	Apply the concepts on simple structural elements	Apply
CO3	Determine linear, quadratic and cubic shape functions for interpolation (for 1D, 2D and 3D Problems).	Analyze
CO4	Familiarise the formation of isoparametric elements	Analyze
CO5	Analyse elements subjected to axisymmetric	Analyze

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-	3	-	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	3	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	-	3	-	-
CO5	3	2	2	1	1	-	-	-	-	-	-	-	3	-	-
Avg	3	2.4	1.4	1	1	-	-	-	-	-	-	-	3	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH106	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION			Semester			
PREREQUISITES			Category	PE	Credit		3
NIL			Hours/Week	L	T	P	TH
				3	0	0	3

Course Learning Objectives

1	To learn analytical experimental methods using sophisticated instruments and interpretation of experimental data
2	To impart knowledge about the fundamental concepts of vibration measurement and signal acquisition.
3	To learn about the fundamental theory and use a device to measure a physical phenomenon.
4	To impart knowledge about the distress measurements
5	Understand the advanced non-destructive testing instruments used in construction industry

Unit I	FORCE AND STRAIN MEASUREMENTS	9	0	0	9

Strain gauges, Principle, Types, Performance and Uses-Photo elasticity, Principle and applications – Hydraulic jack and pressure gauges – Electronic load cell – Proving rings – Calibration of testing machines

Unit II	VIBRATION MEASUREMENTS	9	0	0	9

Characteristics of structural vibrations – Linear Variable Differential Transducer (LVDT) – Transducers for velocity and acceleration measurements – Vibration meter – Seismographs – Vibration analyzer – Electro dynamic exciters – Display and recording of signals – Cathode Ray Oscilloscope – XY plotters – Chart plotters – Digital and Acquisition systems - Principles and Applications.

Unit III	ACOUSTICS AND WIND FLOW MEASUREMENTS	9	0	0	9

Principles of pressure and flow measurements – Pressure transducer – Sound level meter – Venturi Meter and Flow meters – Wind tunnel and its use in structural analysis – structural modeling - Direct and indirect model analysis

Unit IV	DISTRESS MEASUREMENTS	9	0	0	9

Diagnosis of distress in structures- Crack observation and measurement – Corrosion of reinforcement in concrete– Half cell, construction and use – damage assessment – Controlled blasting for demolition

Unit V	NON-DESTRUCTIVE TESTING METHODS	9	0	0	9

Load testing of structures, buildings, bridges and towers – Rebound hammer – Ultrasonic testing, principle and applications – Moiré fringes – brittle coatings – Holography – Use of lasers for structural testing.

Total= 45 Periods

Text Books:

1	Sadhu Singh, “Experimental Stress Analysis” Khanna Publishers, New Delhi, 2009.
2	Karthick and Balaji S, “Applications and Techniques for Experimental Stress Analysis”, 2019.
3	Srinath L.S., et al, Experimental Stress Analysis, Tata McGraw Hill Co., New Delhi, 1984.

Reference Books:

1	Dalley.J.WandRiley.W.F., “Experimental Stress Analysis”, Tata McGraw Hill Book Co.
2	Sironi R.S and Radha Krishna H.C.,Mechanical Measurements, New Age International (P) Ltd.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Familiarize with various types of force and strain measuring devices	Understand
CO2	Select a measuring device for a vibration measurement	Remember
CO3	Conduct experiments to measure acoustics and wind flow	Apply
CO4	Measure the distress on structures.	Apply
CO5	Apply non destructive testing techniques on structures.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
CO2	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
CO3	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
CO4	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
CO5	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
Avg	1	1	-	2	3	-	-	-	-	1	-	-	-	3	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH107	ADVANCED CONCRETE TECHNOLOGY		Semester			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Construction materials and Construction Technology		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	Have a good knowledge about constituent materials in concrete.
2	Understand the concept and procedure for concrete mix design as per IS code standards.
3	Get awareness about the properties of fresh and hardened concrete.
4	Understand about the durability properties and NDT on concrete.
5	Know about the types of special concrete.

Unit I	**CONCRETE MATERIALS**	**9**	**0**	**0**	**9**

Cement -Review of manufacturing process- chemical composition, Bogue's compounds, mechanism of hydration-heat of hydration-Aggregate-Review of types, sampling and testing, artificial aggregates - Chemical Admixtures- types, uses, mechanism of action - effects on properties of concrete - Mineral admixtures- types, chemical composition – physical characteristics - effects on properties of concrete - Rheology – basic concepts – Bingham model.

Unit II	**MIX PROPORTIONING**	**9**	**0**	**0**	**9**

Mix design - nominal mix- design mix – concept of mix design - variables of proportioning -general considerations - factors considered in the design of concrete mix- various methods ofmix design - design of concrete mix as per IS 10262-2019 - Statistical quality control of concrete – mean strength – standard deviation – coefficient of variation – sampling - testing - acceptance criteria.

Unit III	**PROPERTIES OF CONCRETE**	**9**	**0**	**0**	**9**

Properties of fresh concrete- workability-factors affecting workability - slump test compaction factor test- Vee Bee consistometer test- Properties of hardened concrete -modulus of elasticity, compressive strength, split tensile strength, flexural strength- effect of water cement ratio – maturity concept- Creep - factors affecting creep - effect of creep-Shrinkage-factors affecting shrinkage - plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage.

Unit IV	**DURABILITY & NDT OF CONCRETE**	**9**	**0**	**0**	**9**

Durability of concrete- Factors affecting durability - permeability- cracking-reinforcement corrosion; carbonation, chloride penetration, sulphate attack, acid attack, fire resistance; frost damage, alkali silica reaction, concrete in sea water -.

Non-destructive testing of concrete surface hardness test- ultrasonic pulse velocity method - penetration resistance- pull-out test core cutting - measuring reinforcement cover.

Unit V	**SPECIAL TOPICS IN CONCRETE TECHNOLOGY**	**9**	**0**	**0**	**9**

Special concretes - lightweight concrete-heavy weight concrete - high strength concrete –high performance concrete - self compacting concrete -roller compacted concrete– fibre reinforced concrete - polymer concrete-pumped concrete - ready mix concrete – green concrete. Special processes and technology - sprayed concrete; underwater concrete, mass concrete; slip form construction, prefabrication technology- 3D concrete printing. Light Emitting concrete, ,Glasscrete, Hempcrete, Bio concrete, Self-healing concrete smart concrete, coconut shell aggregate concrete, geopolymer concrete, concrete with agricultural waste, ferrocement

Total= 45 Periods

Text Books:

1	Neville A.M., "Properties of Concrete", Trans-Atlantic Publications, Inc.; 5e, 2016.

2	Shetty M.S *Concrete Technology*, S.Chand and Company Ltd, New Delhi 2022.
3	Santha Kumar A.R *Concrete Technology*, Oxford university Press, NewDelhi, 2022.
4	Mehta K.P *Concrete Technology*, Chand & Co, NewDelhi, 2006.
Reference Books:	
1	*Indian Standard Recommended Guide lines for Concrete Mix Design*, IS:10262 – 2019, Bureau of Indian Standards, New Delhi.
2	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete IS:383-1970 R2011, Bureau of Indian Standards, New Delhi.
3	Gambhir. M.L*Concrete technology*, Volume I &II , Tata McGraw-Hill Book Company, Third print, 2003.
4	Krishna Raju N. *Design of Concrete Mixes*, CBS publishers. New Delhi, 2002.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To recall the properties and testing procedure of concrete materials as per IS code	Remember
CO2	To design concrete mix using IS Code Methods.	Apply
CO3	To describe the procedure of determining the properties of fresh and hardened concrete	Remember
CO4	To explain nondestructive testing of concrete	Remember
CO5	To describe the various special types of concretes	Remember

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**-**	**-**	**1**	**-**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**2**
CO2	**-**	**-**	**2**	**3**	**3**	**1**	**2**	**-**	**2**	**2**	**-**	**2**	**2**	**-**	**2**
CO3	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**2**
CO4	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**2**	**-**	**2**
CO5	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**2**	**-**	**2**
Avg	**-**	**-**	**1.5**	**3**	**2**	**1**	**2**	**2**	**1.5**	**2**	**-**	**2**	**2**	**-**	**2**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

VERTICAL II – ENVIRONMENTAL ENGINEERING

<table>
<tr><td>18CEH201</td><td colspan="2">INDUSTRIAL WASTEWATER TREATMENT</td><td colspan="4">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To identify the sources and types of industrial wastewater</td></tr>
<tr><td>2</td><td colspan="6">To assess the waste minimization techniques</td></tr>
<tr><td>3</td><td colspan="6">To evaluate and design industrial wastewater treatment technologies</td></tr>
<tr><td>4</td><td colspan="6">To plan common effluent treatment plants for treatment of industrial wastewater and disposal of sludge</td></tr>
<tr><td>5</td><td colspan="6">To determine the appropriate treatment methods for wastewater of various industries.</td></tr>
<tr><td>Unit I</td><td colspan="2">INTRODUCTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry –Sources and types of industrial wastewater – Nature and Origin of Pollutants – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling - generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.</td></tr>
<tr><td>Unit II</td><td colspan="2">INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Prevention & Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period –Implementing & Promoting Pollution Prevention Programs in Industries.</td></tr>
<tr><td>Unit III</td><td colspan="2">INDUSTRIAL WASTEWATER TREATMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Electrodialysis & Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.</td></tr>
<tr><td>Unit IV</td><td colspan="2">WASTEWATER REUSE AND RESIDUAL MANAGEMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.</td></tr>
<tr><td>Unit V</td><td colspan="2">VARIOUS INDUSTRIAL WASTEWATER</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining–Pharmaceuticals–Sugar and Distilleries-sugar and diary textiles</td></tr>
<tr><td colspan="7" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Eckenfelder, W.W., “Industrial Water Pollution Control”, Mc-Graw Hill Publishers, 2000.

2	LawranceK.Wang, Yung Tse Hung, Howard H.Lo and Constantine Yapijakis "Handbook of Industrial and Hazardous waste Treatment", Second Edition, 2004.
Reference Books:	
1	Metcalf & Eddy/ AECOM, "Water reuse Issues, Technologies and Applications", The Mc Graw- Hill companies, 2007
2	Nelson Leonard Nemerow, "Industrial waste Treatment", Elsevier, 2007.
3	Waste water Treatment for pollution control and reuse by Soli. J. Arceivala, Shyam. R. Asolekar, Tata Mcgraw Hill, 2007

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the sources and types of wastewaters and its nature	Identify
CO2	Gain knowledge of Prevention & Control of Industrial Pollution	Remember
CO3	Suggest the suitable treatment technologies for the treatment of wastewater.	Evaluate
CO4	Know about CETP and reuse of treated wastewater.	Analyze
CO5	Assess the characteristics and treatment systems for wastewater from various industries	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	-	-	-	-	-	-	-	1	1	1	2
CO2	-	-	2	1	-	2	1	1	1	1	-	-	2	1	1
CO3	-	-	3	1	-	1	-	-	-	-	-	-	1	-	1
CO4	-	1	3	2	2	3	2	1	2	2	2	1	3	1	2
CO5	2	-	2	3	1	1	3	1	2	2	3	2	1	1	3
Avg	1.5	1	2.2	1.8	1.5	1.8	2	1	1.7	1.7	2.5	1.3	1.6	1.0	1.8
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH202	ENVIRONMENTAL IMPACT AND RISK ASSESSMENT			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Environmental Law and Legislations in India		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To expose the students to the need and usefulness of EIA and ERA in environmental management and to develop the skill to prepare environmental management plan.
2	To illustrate the methodology, documentation of EIA and to know about the various impacts of development projects on environment.
3	To identify, predict and evaluate the economic, environmental and social impact of development activities and to know about the various impacts of development projects on environment and the mitigating measures.
4	To develop the skills to prepare environmental management plan using modern tools
5	To provide knowledge related to the broad field of environmental risk assessment and tools that can be used in predicting and managing human health risks

Unit I	INTRODUCTION	9	0	0	9

Environmental Impact Assessment (EIA): Objectives, Principles of Process, Screening of projects- Legal provisions on EIA. Environmental risk assessment framework-Hazard identification.

Unit II	METHODOLOGIES	9	0	0	9

Methods of EIA –Check lists and Documentation – Matrices – Networks – Cost-benefit analysis – Analysis of alternatives – Case studies- Multi-storey Buildings, Bridges, Highways, Dam and Water supply projects

Unit III	PREDICTION AND ASSESSMENT	9	0	0	9

Prediction Methodologies-Assessment of Impact on land, water and air, noise, social, cultural flora and fauna- Mathematical models- public participation – Limitation of EIA- Case studies Multi-storey Buildings, Bridges, Highways, Dam and Water supply projects

Unit IV	ENVIRONMENTAL MANAGEMENT PLAN	9	0	0	9

Environment Protection Acts in India: Air, Water, Lake and River action programmes; Coastal zone management; pollution control boards, Management plans using GIS and RS tools

Unit V	ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT	9	0	0	9

Environmental hazards and risks- Tools for Environmental Risk Assessment-Risk Perception and Communication-Risk assessment methodologies- Exposure Assessment and Dose Response Analysis-Emergency Preparedness Plans -Case studies-practical applications

Total= 45 Periods

Text Books:

1	Canter, R.L., Environmental Impact Assessment, McGraw-Hill Inc., New Delhi, 1996.
2	Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003
3	“ENVIRONMENTAL IMPACT ASSESSMENT” for Department of Technical education, Govt of Uttarakhand

Reference Books:

1	Shukla, S.K. and Srivastava, P.R., Concepts in Environmental Impact Analysis, Common Wealth Publishers, New Delhi, 1992.
2	John G. Rau and David C Hooten (Ed)., Environmental Impact Analysis Handbook, McGraw-Hill Book Company, 1990
3	Judith Petts, Handbook of Environmental Impact Assessment Vol. I & II, Blackwell Science, 1999.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the importance of EIA and ERA in project development	Understand
CO2	Apply the mathematical modeling for EIA	Apply
CO3	Analyze different environmental attributes and selecting the environmental parameters affecting project	Analyze
CO4	Prepare the environmental management plan including the preparation, implementation and mitigation aspects	Create
CO5	Evaluate and predict the human health risks	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	3	2	1	1	1	1	1	1	-	2
CO2	3	2	1	2	3	3	2	-	1	1	2	2	2	-	2
CO3	3	2	1	3	3	3	2	-	1	1	2	2	2	-	2
CO4	-	2	1	-	1	2	2	1	3	1	2	2	3	-	3
CO5	-	1	-	1	-	1	2	1	2	1	1	1	1	-	2
Avg	1.2	1.4	0.6	1.2	1.4	2.4	2	0.6	1.6	1	1.6	1.6	1.8	-	2.2
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH203	ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE DEVELOPMENT		Semester			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Environmental Impact and Risk Assessment Environmental Law and Legislations in India		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Learning Objectives						
1	To study the variable natures of our environmental resources and to understand their importance associated with our societal life.					
2	To study the variable categories of pollutants and their controlling measures					
3	To impart an understanding of systems approach to Environmental Management as per ISO 14000 and to evaluate the management plan using GIS tools					
4	To impart skills for environmental performance in terms of legal compliance, pollution prevention and continual improvement.					
5	To impart skills for the managing the usage of our natural resources without disrupting balance and stability of the natural system.					
Unit I	**ENVIRONMENTAL RESOURCES**		**9**	**0**	**0**	**9**
Non-renewable resources-Mineral use and exploitation; fossil fuels. Renewable resources: Water resources-supply, demand, dams-benefits and problems; Soil and Land resources- Structure, formation, erosion, conservation of soil, agricultural practices, land use, degradation and desertification; Fisheries- Inland and marine fisheries, aquaculture, overharvesting; Forest resources- Timber, Medicinal plants, fuel-wood, deforestation, forest management- Management of renewable and non-renewable resources; Sustainable use						
Unit II	**ENVIRONMENTAL POLLUTION**		**9**	**0**	**0**	**9**
Definition of pollution and pollutants; types of pollution-Air, Water,Soil, Noise, thermal, nuclear; causes of pollution, effects of pollution and control measures; Liquid and Solid waste management, nuclear holocausts. Case studies: leather industry, flyash, thermal stations, nuclear power plants						
Unit III	**ENVIRONMENTAL MANAGEMENT SYSTEM**		**9**	**0**	**0**	**9**
Environmental Management Systems; ISO14000 series; Environmental auditing: Environmental Impact Assessment; Life cycle assessment; Human health risk assessment. Management plans using GIS and RS tools						
Unit IV	**ENVIRONMENTAL LAW AND POLICY**		**9**	**0**	**0**	**9**
Environmental Law and Policy – Objectives; Polluter pays principle, Precautionary principle; The Water and Air Acts with amendments; The Environment (Protection) Act (EPA) 1986; National Green Tribunal Act, 2010; National Environment Policy; Principles of International Law and International treaties.						
Unit V	**ENERGY-ENVIRONMENT AND SUSTAINABLE DEVELOPMENT**		**9**	**0**	**0**	**9**
Energy and Environment: Energy sources – overview of resources and reserves; Renewable and non-renewable energy sources; Energy-Environment nexus Sustainable Development: Definition and concepts of sustainable development; Sustainable development goals; Hurdles to sustainability; Environment and economics.						
						Total= 45 Periods

Text Books:	
1	"Natural Resources Conservation & Management" , K.K.SINGH -MD PUBLICATIONS PVT LTD
2	"Environmental Pollution " by N.MANIVASAKAM,2021

3	ISO 14001/14004: Environmental management systems –Requirements and Guidelines – International Organisation for Standardisation, 2004.
4	Fundamental Concepts in Environmental Studies by Dr.D.D Mishra
Reference Books:	
1	ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002.
2	Paul LBishop „Pollution Prevention: Fundamentals and Practice", McGraw -Hill International, Boston,2000.
3	Environmental Management Systems: An Implementation Guide for Small and Medium-Sized Organizations, Second Edition, NSF International, Ann Arbor, Michigan, January 2001
4	Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems –a step by step guide" Earthscan Publications Ltd, London, 1999.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the importance of variable natural resources	Understand
CO2	Understand the necessity of environmental management that will be caused by projects or industries.	Understand
CO3	Develop, Implement, maintain and Audit Environmental Management systems for Organizations.	Understand/ Evaluate
CO4	Gain the Knowledge about the legal requirements of Environmental management and auditing	Remembering
CO5	Understand eco-friendly business in order to achieve sustainable development	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	-	-	3	1	1	1	-	1	3	3	-	-
CO2	-	1	3	-	-	3	1	1	1	-	1	3	3	-	-
CO3	1	1	1	2	2	3	1	-	2	2	3	2	3	-	-
CO4	-	1	1	-	-	3	1	1	2	2	1	2	1	-	-
CO5	1	1	3	2	1	3	3	-	2	-	3	3	3	-	-
Avg	0.4	1	2	0.8	0.6	3	1.4	0.6	2	0.8	1.8	2.6	2.6	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH204	ENVIRONMENTAL LEGISLATIONS IN INDIA			Semester			
PREREQUISITES		**Category**	**PE**	**Credit**			**3**
Water Supply Engineering, Waste Water Engineering		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	To know the pollution control acts for water pollution.
2	To know the pollution control acts forair pollution
3	To impart knowledge of National and international Environmental Policies and gain knowledge about decision making on environmental policies
4	To impart knowledge of the management and handling of Industrial solid waste.
5	To impart knowledge of the management and handling of E- waste.

Unit	Title	L	T	P	TH
Unit I	**THE WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974**	**9**	**0**	**0**	**9**
Definitions-Salient features-Powers & functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP) Act-Case studies on water polluting industries-Textile dyeing, Paper Mills-Electroplating, Starch industries-inventorisation of new water polluting industry and its management-field visits.					
Unit II	**THE AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981**	**9**	**0**	**0**	**9**
Definition-Salient features- Powers & functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management - field visits					
Unit III	**THE ENVIRONMENT (PROTECTION) ACT, 1986**	**9**	**0**	**0**	**9**
Genesis of the Act-Salient features-Role of Central Government-various notifications and rules – prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification-Sitting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals(NGT),Environmental courts & Public interest litigation -Case studies					
Unit IV	**REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT**	**9**	**0**	**0**	**9**
Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes - Municipal solid wastes e-waste-Salient features-Responsibilities of occupier/generator/local bodies/PCBs- Monitoring and compliance mechanisms-consent clearance, Authorization, Registration procedures for industry specific-Issues & Challenges-Best practices-Case studies on lead refining, engineering units, hospitals, plastic units, Municipal landfills -field visits					
Unit V	**ELECTRONIC WASTE (MANAGEMENT AND HANDLING) RULES 201**	**9**	**0**	**0**	**9**
Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers' responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centers-field visits.					
					Total= 45 Periods

Text Books:

1	P.Leelakrishnan., "Environmental Law in India", Lexis Nexis 4th edition 2016.

2	Stuart Bell and Donald., “Environmental Law”, McGillinary sixth edition 2005
3	Shyam Divan and Armin Roseneranz, “Environmental law and policy in India”, Oxford University Press, New Delhi, 2017.
4	K.R.Gupta. “Environmental legislation in India”, Atlantic 2006.
5	E WASTE MANAGEMENT IN INDIA (2009), Electronics for you, www. efymag.com
Reference Books:	
1	Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, “Integrated Solid Waste Management”, McGraw- Hill, New York, 1993
2	CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
3	Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans, “Environmental Resources Management, Hazardous waste Management”, Mc-Graw Hill International edition, New York, 2001.
4	Vesilind P.A., Worrell W and Reinhart, “Solid waste Engineering”, Thomson Learning Inc., Singapore, 2002
5	David ong., “Source book on environmental Law”, 2001
6	www.envfor.nic.in

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Summarize the pollution control acts for water pollution	Understand
CO2	Summarize the pollution control acts for air pollution	Understand
CO3	Understand the National and international Environmental Policies and Apply the knowledge in Planning and decision making of Environmental policies	Apply
CO4	Understand the management and handling of Industrial solid waste and E- waste	Understand
CO5	Understand the management and handling of E- waste	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	-	-	1	1	-	-	-
CO2	1	1	2	-	-	1	3	1	-	-	-	1	1	-	-
CO3	-	1	-	-	-	2	3	2	-	-	1	1	-	-	-
CO4	2	3	-	2	-	-	2	1	-	1	2	1	2	-	1
CO5	-	2	1	3	-	1	1	1	-	1	-	1	-	-	-
Avg	0.6	1.4	0.6	1	-	0.8	2.2	1	-	0.4	0.8	1	0.6	-	0.2
3/2/1 – indicates strength of correlation (3- High, 2- Medium, 1- Low)															

18CEH205	ENVIRONMENTAL MICROBIOLOGY			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
NIL		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the basics of microbiology relevant to environmental engineering for students with little prior knowledge of the subject
2	To study the morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae and their role in nutrient cycle.
3	To understood the role microbial metabolism in a waste water treatment plant.
4	To know the role of microorganisms in contaminated water and the diseases caused.
5	To gain knowledge to conduct and test the toxicity due to various natural and synthetic products in the environment

Unit I	**CLASSIFICATION AND CHARACTERISTICS**	**9**	**0**	**0**	**9**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology

Unit II	**MICROBES AND NUTRIENT CYCLES**	**9**	**0**	**0**	**9**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, bio safety in Laboratory – Extreme Environment – archae bacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Microorganism in nutrient cycle.

Unit III	**METABOLISM OF MICRO ORGANISMS**	**9**	**0**	**0**	**9**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb's cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics

Unit IV	**PATHOGENS IN WASTEWATER**	**9**	**0**	**0**	**9**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coli forms - total coli forms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □ -oxidation, β-oxidation, nitrification and denitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V	**TOXICOLOGY**	**9**	**0**	**0**	**9**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching

Total= 45 Periods

Text Books:

1	Hurst, C.J. Manual of "Environmental Microbiology". 3rd Edition. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199- X.2007
2	Grerard J. Tortora, Berdell R. Funke, Christine and L. Case. Microbiology: An Introduction. Benjamin Cummings, U.S.A. 2004
3	StanleyE. Manahan, "Environmental Science andTechnology", Lewis Publishers.2000

Reference Books:	
1	Frank C. Lu and Sam Kacew, LU"s Basic Toxicology, Taylor & Francis, London 5th Ed, 2003
2	Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. McGraw Hill, New York 2006
3	SVS. Rana, "Essentials of Ecology and Environmental Science", 3rd revised Edition, Prentice Hall of India Private Limited, 2007
4	Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understood the basics of microbiology and their diversity and on the genetic material in the living cell.	Understand
CO2	Understood and Describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem	Understand
CO3	Understood the role of microbial metabolism in a wastewater treatment plant.	Understand
CO4	Understood the role of microorganisms in a contaminated water and the diseases caused.	Understand
CO5	Evaluate test on toxicity due to various natural and synthetic products in the environment	Evaluate

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	1	-	-	3	3	-	-	1	-	1	1	-	-
CO2	-	-	-	-	-	3	3	-	-	1	-	1	1	-	-
CO3	-	2	1	-	-	3	3	-	-	1	1	1	1	-	-
CO4	-	1	1	-	-	3	3	-	1	1	1	1	-	-	-
CO5	2	1	1	2	-	3	3	-	3	2	-	2	2	-	-
Avg	0.4	1.2	0.8	0.4	-	3	3	-	0.8	1.2	0.4	1.2	1.0	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH206	WASTE MANAGEMENT TECHNIQUES			Semester			
PREREQUISITES		**Category**		**PE**	**Credit**		**3**
NIL		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the characteristics, types and sources of solid wastes and the present scenario of solid waste management
2	To evaluate on-site processing, recycling and reuse of waste
3	To evaluate the need for economics in collection and transportation of solid waste and clearly discuss various types of collection systems
4	To gain knowledge about off-site processing of solid wastes and its recovery
5	To concise idea on various disposal options for solid waste

Unit	Title	L	T	P	TH
Unit I	**SOURCES AND TYPES OF SOLID WASTES**	**9**	**0**	**0**	**9**
Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes; characteristics – methods of sampling and characterization-Effects of improper disposal of solid wastes – public health effects. Principle of solid waste management – social & economic aspects- Public awareness- Role of NGOs- Legislation.					
Unit II	**ON-SITE STORAGE & PROCESSING**	**9**	**0**	**0**	**9**
On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.					
Unit III	**COLLECTION AND TRANSFER**	**9**	**0**	**0**	**9**
Methods of Collection – types of vehicles – collection equipment – collection routes- transfer stations – selection of location, operation & maintenance; options under Indian conditions.					
Unit IV	**OFF-SITE PROCESSING**	**9**	**0**	**0**	**9**
Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.					
Unit V	**DISPOSAL**	**9**	**0**	**0**	**9**
Impacts of open dumping, site investigation and selection, sanitary land filling - Types, design criteria and design, Liners – Leachate collection & treatment.					
					Total= 45 Periods

Text Books:

1	Tchobanoglous G., Theissen H., and EIiassen R., “Solid Waste Engineering Principles and Management Issues”, McGraw Hill, New York.
2	Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill.

Reference Books:

1	Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government ofIndia, NewDelhi, 2014.
2	Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, New Delhi, 1985.
3	Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the characteristics, types and sources of solid wastes and the present scenario of solid waste management	Remember
CO2	Analyze On-site processing of municipal solid wastes and apply knowledge for recycling and reuse of waste	Understand
CO3	Learn the collection methods of solid waste and to transfer it to the disposal site	Apply
CO4	Know about off-site processing of solid wastes and its recovery	Remember
CO5	Apply the effective solid waste disposal methods	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	2	-	-	2	-	-	-	-	-	-	2	2	1
CO2	-	3	-	-	-	2	1	-	-	-	1	-	3	2	2
CO3	1	-	2	-	-	3	-	-	-	-	1	-	2	2	-
CO4	1	2	1	-	1	2	1	1	1	1	1	-	3	1	2
CO5	2	1	1	1	1	1	2	-	2	-	1	1	3	1	1
Avg	1.3	1.8	1.5	1.0	1.0	2.0	1.3	1.0	1.5	1.0	1.0	1.0	2.6	1.6	1.5
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH207	UNIT OPERATIONS AND PROCESSES IN WATER AND WASTE WATER TREATMENT				Semester		
PREREQUISITES		**Category**	**PE**	**Credit**			**3**
Waste Water Engineering		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	To understand the various general unit operations in waste water treatment.
2	To examine the physical unit operations and chemical unit processes.
3	To gain the knowledge about chemical unit processes and to examine the biological unit processes
4	To apply the unit operations and processes in waste water treatment methods
5	To apply the unit operations and processes in Sludge disposal methods

Unit I	**GENERAL UNIT OPERATIONS**	**9**	**0**	**0**	**9**

Important Unit Operation- Gas Transfer, Ion transfer, Solute stabilization, Solids Transfer, Nutrient transfer- Miscellaneous operations- Solid concentration and stabilization

Unit II	**PHYSICOCHEMICAL TREATMENT PROCESSES**	**9**	**0**	**0**	**9**

Role of Physical Unit operations – Preliminary Treatments-Screening, Principles of screening– different types of screens – Flow equalization and Aeration-Types - Skimming tank – grit chamber- Studies on filtration –characteristics of filter media – Coagulation and Flocculation -Sedimentation and Chemical Clarification-Types of settling- Batch studies on settling.

Unit III	**CHEMICAL AND BIOLOGICAL UNIT PROCESSES**	**9**	**0**	**0**	**9**

Chemical Unit processes-Chemical precipitation, Adsorption, Water softening -Disinfection, Ion exchange, Electro dialysis – Photocatalysis

Biological Unit Processes-SVI-Aerobic process-Trickling filter, Activated sludge process, lagoons- An-aerobic process-sludge digestion, lagoons or ponds

Unit IV	**METHODS OF TREATMENT OF WASTEWATER**	**9**	**0**	**0**	**9**

Conventional Treatment Methods-Preliminary processes-Primary treatment-Biological treatment, their functions and efficiencies - Advanced waste water treatment- tertiary treatment- Application of unit operations and processes in wastewater treatment methods.

Unit V	**METHODS OF SLUDGE PROCESSING AND DISPOSAL**	**9**	**0**	**0**	**9**

Sludge treatment processes-sludge thickening or concentration- Anaerobic digestion-Aerobic Digestion- Sludge Conditioning-Sludge Dewatering-Final disposal of sludge-Application of unit operations and processes in Sludge processing and disposal methods.

Total= 45 Periods

Text Books:

1	METCALF & EDDY, “Wastewater Engineering Treatment Disposal Reuse”, Tata McGraw-Hill, New York, 2003 5th edition,2013
2	“WASTE WATER ENGINEERING”, Dr. B.C. Punmia, Er. Ashok K. Jain, Dr. Arun K. Jain, LAXMI PUBLICATIONS(P)LTD
3	S.K.GARG, “Water supply engineering” and “Sewage waste disposal and air pollution engineering” (VOL 1 & 2), Khanna Publishers, 2017.

Reference Books:

1	KARIA.G.L, “Wastewater treatment- Concepts and design approach”, PHI learning private ltd, 2013.

2	WEBER, W.J. Physicochemical processes for water quality control, John Wiley and sons, New York, 1983. 5. S.K.GARG, "Water supply
3	"WATER SUPPLY ENGINEERING", Dr.B.C.Punmia, Er. Ashok K.Jain, Dr.ArunK.Jain, LAXMI PUBLICATIONS (P) LTD

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understood the various general unit operations in waste water treatment.	Understand
CO2	Examine the physical unit operations and chemical unit processes.	Analyse
CO3	Develop the knowledge about chemical unit processes and to examine the biological unit processes	Apply
CO4	Categorize the unit operations and processes in waste water treatment methods	Analyse
CO5	Categorize the unit operations and processes in Sludge disposal methods	Analyse

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	1	-	-	2	-	1	1	2	2	2	-	2
CO2	3	3	1	1	-	-	2	-	1	1	2	2	2	-	2
CO3	3	3	1	1	-	-	2	-	1	1	2	2	2	-	2
CO4	2	2	1	1	-	1	2	-	1	2	2	2	3	-	2
CO5	2	2	1	1	-	1	2	-	1	2	2	2	3	-	2
Avg	2.2	2.0	0.8	1	-	0.4	2	-	1	1.4	2	2	2.4	-	2
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

VERTICAL III – CONSTRUCTION ENGINEERING AND MANAGEMENT

18CEH301	**SMART MATERIALS AND SMART STRUCTURES**		**Semester**			
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Construction Materials and Technology		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives	
1	To Learn about different types of smart materials
2	To Study about advanced measuring instrument
3	To Understand about sensors and its functions
4	To Study about various actuator materials and their role
5	To Learn about Data acquisition system

Unit I	**INTRODUCTION**	**9**	**0**	**0**	**9**
Introduction to smart materials and structures – Instrumented structures functions and response – Sensing systems – Self-diagnosis – Signal processing consideration – Actuation systems and effectors.					
Unit II	**MEASURING TECHNIQUES**	**9**	**0**	**0**	**9**
Strain measuring techniques using electrical strain gauges, types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.					
Unit III	**SENSORS**	**9**	**0**	**0**	**9**
Sensing Technology – Types of Sensors – Physical Measurement using Piezo Electric Strain measurement – Inductively Read Transducers – The LVOT – Fibre optic Techniques. Chemical and Bio-Chemical sensing in structural Assessment – Absorptive chemical sensors –Spectroscopes – Fibre Optic Chemical Sensing Systems and Distributed measurement.					
Unit IV	**ACTUATORS**	**9**	**0**	**0**	**9**
Actuator techniques – Actuator and actuator materials – Piezoelectric and electro strictive material – Magneto structure material – Shape memory alloys – Electrorheological fluids– Electromagnetic actuation – Role of actuators and actuator materials.					
Unit V	**SIGNAL PROCESSING AND CONTROL SYSTEMS**	**9**	**0**	**0**	**9**
Data acquisition and processing – Signal processing and control for smart structures – Sensors as geometrical processors – Signal processing – Control system – Linear and Non-linear.					
					Total= 45 Periods

Text Books:	
1	U. C. Jindal – Experimental Stress Analysis – Pearson Education India, 1st Edition,2012
2	Brain Culshaw – Smart Structure and Materials – Artech House – Borton. London, 7th Edition,2004
Reference Books:	

1	J. W. Dally & W. F. Riley – Experimental Stress Analysis – Tata McGraw- Hill,2nd Edition,1978

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the knowledge on the self-diagnosis, functions and response of various smart materials	Understand
CO2	Explain the knowledge on instrumentation for measuring strains, load and deflection	Understand
CO3	Discuss the concepts of sensors parameters and characteristics	Understand
CO4	Explain about actuator techniques and Materials	Understand
CO5	Discuss the concepts of signal processing and control system	Understand

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO2	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO3	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO4	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
CO5	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
Avg	**1**	**-**	**-**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH302	CONSTRUCTION TECHNIQUES AND EQUIPMENT		Semester			
PREREQUISITES		Category	PE	Credit		3
Construction Practice		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To impart knowledge about the various construction techniques, practices and equipments
2	To impart knowledge about the various construction procedures for sub to super structure
3	To study equipment needed for construction of various types of structures from foundation to super structure.
4	To attain adequate knowledge in various tunneling techniques and piling techniques.
5	To introduce the students to advanced earthwork equipments.

Unit I	EARTHWORK AND MATERIAL HANDLING EQUIPMENTS	9	0	0	9

Fundamentals of earth work operations-Selection of equipment for earth work- Types of earth work equipment-Tractors, Motor graders, Scrapers, Front end waders, Earth movers. Material handling equipment-Forklifts and related equipment-Portable material bins-conveyors-hauling equipment

Unit II	EQUIPMEMTS FOR AGGREGATE PRODUCTION AND CONCRETING	9	0	0	9

Crushers-Feeders-screening equipment-handling equipment-batchingand mixing equipment, hauling, pouring and pumping equipment, RMC equipment

Unit III	OTHER CONSTRUCTION EQUIPMENTS	9	0	0	9

Equipment for Concreting Equipment for Foundation, Pile driving equipment, micro piling-Equipment for compaction - Equipment for dewatering and grouting Rehabilitation techniques.

Unit IV	SUBSTRUCTURE CONSTRUCTION	9	0	0	9

Techniques for box jacking, pipe jacking, diaphragm wall construction-piling techniques-driving well and caisson-cofferdam -sheet piles-dewatering and stand by plant equipment for underground open excavation

Unit V	SUPERSTRUCTURE CONSTRUCTION	9	0	0	9

Vacuum dewatering for concrete flooring-Techniques for continuous concreting operations - Concrete paving technology-Erection techniques of fall structures-pre stressing in high rise structures- aerial transporting

Total= 45 Periods

Text Books:

1	Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning,Equipment and Methods", 5th Edition, McGraw Hill, Singapore, 1995.
2	Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997."Concrete Technology, Theory and Practice", S. Chand and Company Ltd, New Delhi, 2008.
3	Varghese, P.C. " Building construction", Prentice Hall of India Pvt. Ltd, New Delhi,2007. 4. Shetty, M.S,
4	Hopkinson and Kay J.D. *The lighting of buildings*, Faber and Faber, London

Reference Books:

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, New Delhi, 1983.
5	Gambhir, M.L, " Concrete Technology", Tata McGraw Hill Publishing Company Ltd,New Delhi,2004

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Apply engineering fundamentals and analysis to the planning, selection utilization of earthwork and material handling equipment	Apply
CO2	Describe Concreting and aggregate production equipment its application and utilization	Apply
CO3	Demonstrate various Equipment for Construction and Rehabilitation works.	Understand
CO4	Identify Sub-structure construction techniques and explain their utilization in Construction Industry	Understand
CO5	Apply appropriate techniques for the construction of Super-structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	3	-	3	1	-	-	-	-	2	-	1
CO2	-	-	-	2	2	2	1	1	-	-	-	-	2	-	1
CO3	-	-	-	2	2	2	1	2	-	-	-	-	2	-	1
CO4	-	-	-	2	2	3	2	3	-	3	-	-	2	-	1
CO5	-	-	-	2	2	3	2	3	-	3	-	-	2	-	1
Avg	-	-	-	5	5.5	5	4.5	5	-	3	-	-	5	-	2.5
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH303	PROJECT SAFETY MANAGEMENT			Semester			
PREREQUISITES		**Category**	**PE**	**Credit**			**3**
NIL		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives

1	To know the basics of project & construction management & safety standards.
2	To understand the concepts of construction planning and scheduling in terms of safety in the construction.
3	To know the basis safety in material handling, storage and staking of construction materials.
4	To understand the safety concepts of machinery and equipment management.
5	To understand the various rules and regulations involved in safety in construction.

Unit I	**SAFETY ISSUES IN CONSTRUCTION**	**9**	**0**	**0**	**9**
Introduction to Construction Industry- Safety issues in construction- Human factors in construction safety management. Roles of various groups in ensuring safety in construction industry. Framing Contract conditions on safety, and related matters. Relevance of ergonomics in construction safety.					
Unit II	**SAFETY IN CONSTRUCTION OPERATIONS & CODAL PROVISIONS**	**9**	**0**	**0**	**9**
Safety in various construction operations- Excavation- under- water works- under- pinning & shoring Ladders & Scaffolds- Tunneling- Blasting- Demolition- Pneumatic caissons- confined Space Temporary Structures. Indian Standards on construction safety- National Building Code Provisions on construction safety.					
Unit III	**MATERIAL HANDLING**	**9**	**0**	**0**	**9**
Safety in material handling and equipments-Safety in storage & stacking of construction materials.					
Unit IV	**CONSTRUCTION EQUIPMENTS & ITS SAFETY**	**9**	**0**	**0**	**9**
Safety in these of construction equipments- Vehicles, Cranes, Tower Cranes, Lifting gears, Hoists & Lifts, Wire Ropes, Pulley blocks, Mixers, Conveyors, Pneumatic and hydraulic tools in construction. Temporary power supply.					
Unit V	**CONTRACT LABOR (R&A) ACT AND CENTRAL RULES**	**9**	**0**	**0**	**9**
Definitions, Registration of Establishments, Licensing of Contractors, Welfare and Health provisions in the Act and the Rules, Penalties, Rules regarding wages. Building & Other Construction Workers (RE&CS) Act,1996 and Central Rules, 1998: Applicability, Administration, Registration, Welfare Board & Welfare Fund, Training of Building workers, General Safety, Health & Well fare provisions, Penalties.					
					Total= 45 Periods

Text Books:

1	Kumar Neeraj Jha, "Construction Project Management, Theory and Practices" Pearson Education India, 2nd Edition,2015.
2	Srinath L S, "PERT/CPM Principles and Applications", Affiliated East West Press (P) ltd, 3 rd Edition 2002.
3	Chitkara, K.K. "Construction Project Management Planning, Scheduling and Control", Tata McGraw-Hill Publishing Co., New Delhi, 3rd Edition 2014.

4	Punmia B C and Khandelwal K K, “Project Planning and Control with PERT and CPM”, Laxmi Publications, 4thEdition 2016.
5	Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamentals Concepts for Owners, Engineers, Architects and Builders”, Prentice Hall, Pitsburgh, 3rd Reprint 2012.
Reference Books:	
1	Civil Engineering Project Management 4Th Edition by Twort; Gordon Rees, Taylor & Francis
2	Handbook of Civil Engineering (Ready Reference for Practicing Engineers) By Prof. V. N. Vazirani & Prof. S.P. Chandola.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Carry out the resource planning, pre-contract planning and prepare safety measurements for projects.	Remember
CO2	Identify and smoothen the level of safety demand during project execution.	Understand
CO3	Handling the resources and safety management simultaneously.	Create
CO4	Managing safety in equipment and machinery requirements.	Analyze
CO5	Knowing and satisfies the Codal requirements and Laws	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
CO2	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
CO3	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
CO4	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
CO5	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
Avg	-	-	-	-	3	1	3	1	2	-	1	2	3	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>18CEH304</td><td colspan="2">SUSTAINABLE AND GREEN BUILDING TECHNOLOGY</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">Construction Materials and Technology, Environmental Science and Engineering</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To Know various aspects of green buildings</td></tr>
<tr><td>2</td><td colspan="6">To Use different steps involved in measuring environmental impact assessment.</td></tr>
<tr><td>3</td><td colspan="6">To Relate the construction of green building with prevailing energy conservation policy and regulations.</td></tr>
<tr><td>4</td><td colspan="6">To Know and identify different green building construction materials.</td></tr>
<tr><td>5</td><td colspan="6">To Learn different rating systems and their criteria</td></tr>
<tr><td>Unit I</td><td colspan="2">INTRODUCTION TO GREEN BUILDING AND DESIGN FEATURES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Definition of Green Building, Benefits of Green Building, Components/ features of Green Building, Site selection, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.
Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, advanced passive heating and cooling techniques, waste reduction during construction.</td></tr>
<tr><td>Unit II</td><td colspan="2">ENERGY AUDIT AND ENVIRONMENTAL IMPACT ASSESSMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Meaning, Necessity, Procedures, Types, Energy Management Programs.
Introduction, EIA regulations, Steps in environmental impact assessment process, Benefits of EIA, Limitations of EIA, Environmental clearance for civil engineering projects.</td></tr>
<tr><td>Unit III</td><td colspan="2">ENERGY AND ENERGY CONSERVATION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Renewable Energy Resources:Solar Energy, Wind Energy, Ocean Energy, Hydro Energy, Biomass Energy.
Non-renewable Energy Resources: Coal, Petroleum, Natural Gas, Nuclear Energy, Chemical Sources of Energy, Fuel Cells, Hydrogen, Biofuels. Introduction, Specific objectives, present scenario, Need of energy conservation, LEED India Rating System and Energy Efficiency. Energy-saving houses, Green House, Passive house, Passive house construction, Low-energy house, Zero-energy house, Energy consulting, Energy efficiency:</td></tr>
<tr><td>Unit IV</td><td colspan="2">PRINCIPLES AND PLANNING OF GREEN BUILDING</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Features: Salient features of Green Building, Environmental design (ED) strategies for building construction.
Process: Improvement in environmental quality in civil structure Materials: Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, green roofing.
Housing modernization and management (building and construction safety, energy efficiency in housing, Property Refurbishment / Upgrade / Modernization / Renovation - Modular kitchens, bathrooms</td></tr>
<tr><td>Unit V</td><td colspan="2">RATING SYSTEM</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Introduction to (LEED) criteria, Indian Green Building council (IGBC) Green rating, Green Rating for Integrated Habitat Assessment. (GRIHA) criteria Heating Ventilation Air Conditioning (HVAC) unit in green Building Functions of Government organization working for Energy conservation and Audit(ECA) - National Productivity council (NPC) Ministry of New and Renewable Energy (MNRE) Bureau of Energy efficiency (BEE) -BER (Building Energy Rating) - Certificates – Plumbing and Electrical to heating efficiency</td></tr>
<tr><td colspan="7" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hobouken, NewJersey, 3rd Edition, 2012.
2	Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, NewDelhi, 4th Edition, 2021
Reference Books:	
1	O.P. Gupta, Energy Technology, Khanna Publishing House, NewDelhi
2	Jagadeesh, K S, Reddy Venkatta Rama &Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers, New Delhi.
3	Sam Kubba., Handbook of Green Building Design and Construction, Butterworth- Heinemann.
4	Means R S, Green Building - Project Planning and Cost Estimating, John Wiley &Sons
5	Sharma K V, Venkataseshaiah P., Energy Management and Conservation, IK International.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the concepts of Green Building and its Design Features.	Understand
CO2	Assess Environmental Impacts.	Evaluate
CO3	Explain the concept of Energy and Energy Conservation.	Understand
CO4	Discuss the Principles and Planning of Green Building.	Understand
CO5	Summarize the green Building Functions in various organizations.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	1	2	3	-	-	1	2	1	2	-	-
CO2	-	1	1	2	-	-	-	1	-	2	-	-	1	3	-
CO3	-	-	3	-	3	-	-	-	-	2	-	-	-	-	-
CO4	1	-	-	-	3	-	-	-	-	2	2	-	-	-	-
CO5	1	1	2	3	3	-	-	-	-	3	2	-	-	3	-
Avg	1	1	2	2	2.5	2	3	1	-	2	2	1	1.5	3	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH305	FUNCTIONAL PLANNING IN BUILDING SERVICES			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Construction Materials		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To study general planning considerations and development control rules for different types of buildings
2	To understand the relevant code and manuals for designing of building services
3	To apply the principles of electrical and lighting and plumbing services for different uses in buildings
4	To Plan and design the requirements for HVAC systems, fire-fighting and other necessary services for a various types building
5	To incorporate the integrated planning and designing of necessary building services for better usage of buildings

Unit I	GENERAL PLANNING	9	0	0	9

classifications of buildings, Planning permissions, permitted activity, Area and height limitations, Community open spaces and amenities – Green Buildings-Intelligent buildings

Unit II	ELECTRICAL SYSTEMS AND INSTALLATIONS	9	0	0	9

Basics of electricity – Single and three phase supply- Protective devices in electrical installation – types of earthing, Planning electrical wiring for building-Electrical layout for residential buildings

Unit III	LIGHTING AND PLUMBING SERVICES	9	0	0	9

Classification of Lighting, -Energy conservation in lighting-Minimum level of illumination required for different types of buildings.

Principles of Water supply and distribution, Sanitation in buildings, Water Conservation measures – Plan and design of storm water drainage and rain water harvesting system. –Decentralized wastewater treatment system.

Unit IV	HEATING VENTILATION AND AIR CONDITIONING	9	0	0	9

Behavior of Heat Propagation, General methods of Thermal Insulation- Basic principles of Ventilation-Systems of ventilation, Basic principles and essentials of Air Conditioning

Unit V	FIRE FIGHTING AND MISCELLANEOUS SERVICES	9	0	0	9

Classification of buildings based on occupancy- fire fighting protection and fire resistance rating, planning considerations in building for Fire protection-fire detection and fire fighting installation in buildings.

Miscellaneous: Building safety and security systems - Elevators and Escalators their standards and uses - Acoustic services - Necessity of integrated planning and designing of different services in buildings

Total= 45 Periods

Text Books:

1	National Building Code of India -2005

Reference Books:

1	Development Control Rules by Chennai Metropolitan Development Agency - 2006

2	Energy Conservation Building Code – 2007
3	CPHEEO Manual on Sewerage and sewage treatment systems – 2013
4	Manual for environmental clearance for large construction projects – by Ministry of environment, forest and climate change.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Apply the general planning considerations and development control rules for different types of buildings	Apply
CO2	Understand the Relevant code and manuals for designing of building services	Understand
CO3	Apply the principles of electrical and lighting and plumbing services for different uses in buildings	Apply
CO4	Plan and design the requirements for HVAC systems, fire fighting and other necessary services for a various types building	Apply
CO5	Incorporate the integrated planning and designing of necessary building services for better usage of buildings	Apply

COURSE ARTICULATION MATRIX

COs/ POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	**2**	-	**2**	**2**	**2**	**3**	-	-	**3**	**1**	**3**	-	-
CO2	-	-	**2**	-	**3**	**2**	**2**	**3**	-	-	**3**	**2**	**3**	-	-
CO3	-	-	**2**	-	**3**	**3**	**3**	**3**	-	-	**3**	**2**	**3**	-	-
CO4	-	-	**3**	-	**3**	**3**	**3**	**3**	-	-	**3**	**2**	**3**	-	-
CO5	-	-	**3**	-	**3**	**3**	**3**	**3**	-	-	**3**	**2**	**3**	-	-
Avg	-	-	**2.4**	-	**2.8**	**2.6**	**2.6**	**3**	-	-	**3**	**1.8**	**3**	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH306	BUILDING VALUATION				Semester		
PREREQUISITES		**Category**	**PE**	**Credit**			**3**
Construction Materials, Concrete Technology		**Hours/Week**	**L**	**T**	**P**		**TH**
			3	**0**	**0**		**3**

Course Learning Objectives	
1	To study the different methods of valuation
2	To understand procedure of depreciation for all building.
3	To study rental Process, Calculations of Rent and Lease for Building
4	To Understand the Valuation of land
5	To Study the Environmental issues in valuation

Unit I	**INTRODUCTION TO VALUATION**	**9**	**0**	**0**	**9**
Definitions -Necessity of valuation -Valuation of building- Methods of Valuation-factors affecting the valuation building- Various types of valuation-Cost from record-Cost by detailed Measurement-Cost by plinth area methods.					
Unit II	**VALUATION ON DEPRECIATION**	**9**	**0**	**0**	**9**
Age of building- Effective age- Economic life and Remaining life- Depreciated replacement cost- Depreciation method of valuation Capitalized value – sinking fund – Escalation					
Unit III	**RENTAL FIXATION OF BUILDINGS**	**9**	**0**	**0**	**9**
Fixation of Rent-Gross rent-Net rent- Calculation of Standard rent-Methods of rental Calculation-rent Statement-Fixation and Calculation of Rent of government building- Mortgage-lease-building lease-Occupational lease-Easement.					
Unit IV	**VALUATION OF LAND**	**9**	**0**	**0**	**9**
Land Characteristics– Cost approach to values – Market approach to values– Income approach to values – limitation-Factors to be consider for land valuation-Valuation of Properties-valuation of special type of properties-Valuation of Agricultural lands.					
Unit V	**ENVIRONMENTAL ISSUES IN VALUATION**	**9**	**0**	**0**	**9**
Environment and Valuation – Difference between the market price and the negative value consequent on environmental impact – Environmental issues of air pollution, water pollution, environmental factors and their effects, measures to restore the damage cost to cure –Outlines of environmental legislation-Laws related to environmental protection acts-Case studies. Necessity –– Valuation of land – Buildings – Lease.					
					Total= 45 Periods

Text Books:	
1	Dutta BN, Estimating & costing in Civil Engineering, UBS Publishers & Distributors Pvt. Ltd, 28th Edition 2020
2	Theory and practice of Valuation, Roshan H, Namavati, Lakshmi Book Deport Pvt Ltd, 1ST January 2016
3	Rangwala SC Estimating &Costing, CCharotar Publishing House Pvt Ltd, 1ST January 2017
4	Valuation of Immovable Properties, K.Dhivakar, Star Color Park India Pvt Ltd, 1ST January 2021
Reference Books:	
1	M. Chakraborty, Estimation, costing, Specification & Valuation in Civil Engineering, Charotar Publishing House Pvt Ltd1st January 2006

2	Valuation of Relating of standard Rent, Roshan H,Namavati, Lakshmi Book Deport Pvt Ltd, 1^{ST} January 2016
3	Valuation of Real Property, Shymles Datta, Syamales Datta Pvt Ltd, 1^{st} Edition 2016
4	Law of Land Acquisition and Compensation, V.G.Ramachandran Eastern Book Co 8^{th} Edition 2020.
5	Environmental Protection Act 1986.Universal/ LexisNexis, 31 December 2020

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand knowledge in valuation of building.	Understand
CO2	Analyze the Depreciation values of building.	Analyze
CO3	Evaluate the Rental Fixation of Building.	Evaluate
CO4	Understand knowledge in valuation of land.	Understand
CO5	Remember the Environmental issues in Valuation	Remember

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
CO2	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
CO3	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**2**	**-**
CO4	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**
CO5	**2**	**2**	**3**	**-**	**1**	**2**	**3**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**-**
Avg	**2**	**2.2**	**1.8**	**-**	**1.2**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**2.4**	**-**
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEH307	QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION			Semester		
PREREQUISITES		**Category**	**PE**	**Credit**		**3**
Construction Management		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To impart basic knowledge about the basics of quality management and quality plan.
2	To introduce the students about the preparation of quality system documentation.
3	To make the students acquire a wide knowledge in the key drivers on methods about the quality policies.
4	To learn the methods of techniques and their needs for quality assurance and quality control
5	To make the students understand the quality construction techniques

Unit I	**QUALITY MANAGEMENT**	**9**	**0**	**0**	**9**

Introduction – Definitions and objectives – Factor influencing construction quality - Responsibilities and authority - Quality plan - Quality Management Guidelines – Quality circles.

Unit II	**QUALITY SYSTEMS**	**9**	**0**	**0**	**9**

Introduction - Quality system standard – ISO 9000 family of standards – Requirements –Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification.

Unit III	**QUALITY PLANNING**	**9**	**0**	**0**	**9**

Quality Policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – Taguchi’s concept of quality – Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.

Unit IV	**QUALITY ASSURANCE AND CONTROL**	**9**	**0**	**0**	**9**

Objectives - Regularity agent, owner, design, contract and construction-oriented objectives, methods - Techniques and needs of QA/QC - Different aspects of quality - Appraisals, Factors influencing construction quality - Critical, major failure aspects and failure mode analysis, -Stability methods and tools, optimum design - Reliability testing, reliability coefficient and reliability prediction.

Unit V	**QUALITY IMPROVEMENT TECHNIQUES**	**9**	**0**	**0**	**9**

Selection of new materials - Influence of drawings, detailing, specification, standardization - Bill preparation - Construction activity, environmental safety, social and environmental factors - Natural causes and speed of construction - Life cycle costing - Value engineering and value analysis.

Total= 45 Periods

Text Books:

1	James, J.O’ Brian, Construction Inspection Handbook – Quality Assurance and Quality Control, Van Nostrand, New York, 1989.
2	Kwaku, A., Tena, Jose, M. Guevara, Fundamentals of Construction Management and Organisation, Reston Publishing Co., Inc., Virginia, 1985.
3	Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, Tata McGraw Hill, 1993

Reference Books:	
1	Hutchins.G, ISO 9000, Viva Books, New Delhi, 2000
2	Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw-Hill, 1989.
3	John L. Ashford, The Management of Quality in Construction, E & F.N.Spon, New York, 1989.
4	Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, England. 1998.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand basic knowledge about the basics of quality management and quality plan.	Understand
CO2	To know the preparation of quality system documentation and their Standards.	Remember
CO3	Understanding the methods about the quality policies.	Understand
CO4	Apply the methods of techniques and their needs for quality assurance/ quality control and failure modes	Apply
CO5	To create the bill preparation for quality construction techniques	Create

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	1	-	1	-	-	1	1	-	-	2	-	-
CO2	2	-	-	-	-	-	-	-	-	3	2	2	1	-	-
CO3	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-
CO4	-	-	-	1	3	-	-	-	-	-	1	1	1	-	-
CO5	1	1	-	1	3	-	-	-	-	-	1	1	1	-	-
Avg	1.5	1	-	1	3	1	-	-	1	2	1.2	1.2	1.2	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

GOVERNMENT COLLEGE OF ENGINEERING, SALEM

REGULATION 2018 A - VERTICALS FOR MINOR DEGREE

VERTICAL - I	VERTICAL - II	VERTICAL - III	VERTICAL - IV	VERTICAL - V	VERTICAL - VI
Civil Engineering	**Computer Science and Engineering**	**Electronics and Communication Engineering**	**Electrical and Electronics Engineering**	**Mechanical Engineering**	**Metallurgical Engineering**
18CEM01 Construction Materials	18CSM01 Programming in C++	18ECM01 Electron Devices	18EEM01 – Network Analysis and Synthesis	18MEM01 Engineering Thermodynamics	18MTM01 Advanced Physical Metallurgy
18CEM02 Building Construction & Equipment	18CSM02 Advanced Data Structures and Algorithms	18ECM02 Digital Electronics	18EEM02 – Signals and Systems	18MEM02 Fluid Mechanics and Machinery	18MTM02 Metallurgical Thermodynamics and kinetics
18CEM03 Concrete Technology	18CSM03 Computer Organization and Design	18ECM03 Electronic Circuits (EC-I & EC-II, LIC)	18EEM03 – Linear and Digital Electronics Circuits	18MEM03 Manufacturing Processes	18MTM03 Mechanical Behaviour of Materials
18CEM04 Environmental Engineering	18CSM04 Advanced Operating Systems	18ECM04 Signal Processing	18EEM04 – Microprocessor and Microcontrollers	18MEM04 Materials Engineering	18MTM04 Rate Processing in Metallurgy
18CEM05 Basics of Transportation Engineering	18CSM05 Data Communication and Computer Networks	18ECM05 Microprocessors and Microcontrollers	18EEM05 – Control Systems	18MEM05 Kinematics of Machinery	18MTM05 Corrosion and Surface Engineering
18CEM06 Repair and Rehabilitation Structures	18CSM06 Programming Essentials in Python	18ECM06 Analog and Digital Communication	18EEM06 – Measurement and Instrumentation	18MEM06 Hydraulics and Pneumatics	18MTM06 Characterization of Materials
18CEM07 Green Building Technology	18CSM07 Advanced Database System Concepts	18ECM07 Communication Networks (CN)	18EEM07 – Electrical Machines	18MEM07 Design of Machine Elements	18MTM07 Automotive, Aerospace and Defense Materials
-----	18CSM08 Virtualization and Cloud Computing	18ECM08 Fundamentals of IoT	18EEM08 – Electric Drives and Control	18MEM08 Heat and Mass Transfer	-----
-----	-----	18ECM09 Wireless Sensors and Networking (WSN)	18EEM09 – Electric Vehicle and Control	18MEM09 Metrology and Quality Control	-----
-----	-----	18ECM10 Basics of Embedded Systems	18EEM10 –Electric Energy Conservation and Auditing	18MEM10 Dynamics of Machinery	-----

LIST OF MINOR DEGREE - VERTICALS

S.No.	Course Code	Course	Cat	Hours/Week			Credits	Maximum Marks		
				L	T	P		CA	FE	Total
CIVIL ENGINEERING										
1	18CEM01	Construction Materials	OE	3	0	0	3	40	60	100
2	18CEM02	Building Construction & Equipment’s	OE	3	0	0	3	40	60	100
3	18CEM03	Concrete Technology	OE	3	0	0	3	40	60	100
4	18CEM04	Environmental Engineering	OE	3	0	0	3	40	60	100
5	18CEM05	Basics of Transportation Engineering	OE	3	0	0	3	40	60	100
6	18CEM06	Repair and Rehabilitation of Structures	OE	3	0	0	3	40	60	100
7	18CEM07	Green Building Technology	OE	3	0	0	3	40	60	100
COMPUTER SCIENCE AND ENGINEERING										
1	18CSM01	Programming in C++	OE	3	0	0	3	40	60	100
2	18CSM02	Advanced Data Structures and Algorithms	OE	3	0	0	3	40	60	100
3	18CSM03	Computer Organization and Design	OE	3	0	0	3	40	60	100
4	18CSM04	Advanced Operating Systems	OE	3	0	0	3	40	60	100
5	18CSM05	Data Communication and Computer Networks	OE	3	0	0	3	40	60	100
6	18CSM06	Programming Essentials in Python	OE	3	0	0	3	40	60	100
7	18CSM07	Advanced Database System Concepts	OE	3	0	0	3	40	60	100
8	18CSM08	Virtualization and Cloud Computing	OE	3	0	0	3	40	60	100
ELECTRONICS AND COMMUNICATION ENGINEERING										
1	18ECM01	Electron Devices	OE	3	0	0	3	40	60	100
2	18ECM02	Digital Electronics	OE	3	0	0	3	40	60	100
3	18ECM03	Electronic Circuits	OE	3	0	0	3	40	60	100
4	18ECM04	Signal Processing	OE	3	0	0	3	40	60	100
5	18ECM05	Microprocessors and Microcontrollers	OE	3	0	0	3	40	60	100

6	18ECM06	Analog and Digital Communication	OE	3	0	0	3	40	60	100
7	18ECM07	Communication Networks	OE	3	0	0	3	40	60	100
8	18ECM08	Fundamentals of IoT	OE	3	0	0	3	40	60	100
9	18ECM09	Wireless sensors and networking	OE	3	0	0	3	40	60	100
10	18ECM10	Basics of Embedded systems	OE	3	0	0	3	40	60	100
ELECTRICAL AND ELECTRONICS ENGINEERING										
1	18EEM01	Linear and Digital Electronics Circuits	OE	3	0	0	3	40	60	100
2	18EEM02	Microprocessors and Microcontrollers	OE	3	0	0	3	40	60	100
3	18EEM03	Control Systems	OE	3	0	0	3	40	60	100
4	18EEM04	Measurements and Instrumentation	OE	3	0	0	3	40	60	100
5	18EEM05	Electrical Machines	OE	3	0	0	3	40	60	100
6	18EEM06	Electric Drives and Control	OE	3	0	0	3	40	60	100
7	18EEM07	Electric Vehicles and Control	OE	3	0	0	3	40	60	100
8	18EEM08	Electrical Energy Conservation and Auditing	OE	3	0	0	3	40	60	100
9	18EEM09	SMPS and UPS	OE	3	0	0	3	40	60	100
10	18EEM10	Utilization of Electrical Energy	OE	3	0	0	3	40	60	100
MECHANICAL ENGINEERING										
1	18MEM01	Engineering Thermodynamics	OE	3	0	0	3	40	60	100
2	18MEM02	Fluid Mechanics and Machinery	OE	3	0	0	3	40	60	100
3	18MEM03	Manufacturing Processes	OE	3	0	0	3	40	60	100
4	18MEM04	Materials Engineering	OE	3	0	0	3	40	60	100
5	18MEM05	Kinematics of Machinery	OE	3	0	0	3	40	60	100
6	18MEM06	Hydraulics and Pneumatics	OE	3	0	0	3	40	60	100
7	18MEM07	Design of Machine Elements	OE	3	0	0	3	40	60	100
8	18MEM08	Heat and Mass Transfer	OE	3	0	0	3	40	60	100
9	18MEM09	Metrology and Quality Control	OE	3	0	0	3	40	60	100

10.	18MEM10	Dynamics of Machinery	OE	3	0	0	3	40	60	100
METALLURGICAL ENGINEEING										
1	18MTM101	Advanced Physical Metallurgy	OE	3	0	0	3	40	60	100
2	18MTM102	Thermodynamics and Kinetics in Metallurgy	OE	3	0	0	3	40	60	100
3	18MTM103	Mechanical Behaviour of Materials	OE	3	0	0	3	40	60	100
4	18MTM104	Rate Processes in Metallurgy	OE	3	0	0	3	40	60	100
5	18MTM105	Corrosion and Surface Engineering	OE	3	0	0	3	40	60	100
6	18MTM106	Materials Characterization	OE	3	0	0	3	40	60	100
7	18MTM107	Automotive, Aerospace and Defence Materials	OE	3	0	0	3	40	60	100

B.E. – CIVIL ENGINEERING - MINOR DEGREE

18CEM01	**CONSTRUCTION MATERIALS**			**Semester**			
PREREQUISITES		**Category**		**OE**	**Credit**		**3**
NIL		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	To study the characteristics and Properties of Stones and Brick
2	To impart knowledge on Cement, Aggregate and Mortar
3	To understand the behaviour of concrete and seasoning timber
4	To study the Parts and types of flooring and roofing
5	To study carpentry, arches, lintels and finishing works.

Unit I	**STONES, BRICKS**	**9**	**0**	**0**	**9**

Building Stone –classification of rocks-characteristics of good building stone – deterioration and preservation of stone work – tests on stones - Bricks- manufacture of clay bricks -classification - tests on bricks- bricks for special use- refractory bricks.

Unit II	**CEMENT, AGGREGATES, MORTAR**	**9**	**0**	**0**	**9**

Cement- composition- manufacturing process-wet and dry processes. Aggregates –coarse and fine aggregates-characteristics and function. Mortar- properties- uses- types of mortars- selection of mortars for various Civil Engineering construction.

Unit III	**CONCRETE, TIMBER AND OTHER MATERIALS**	**9**	**0**	**0**	**9**

Concrete- ingredients - principles of hardened concrete- Special concrete- types.
Timber- characteristics- seasoning-preservation- Panels of laminates. Glass- properties- uses. Steel- Uses - market forms. Aluminum and other metallic materials for construction.

Paints, Varnishes and Distempers-types-properties.

Unit IV	**FLOORING AND ROOFING**	**9**	**0**	**0**	**9**

Components of floor- selection of flooring materials- suitability of floors for various applications. damp proof course, causes of dampness- effect of dampness - requirements of good stairs - classification of stairs -Roofs - types of roofs- requirements - pitched roof - lean to roof-gable roof-hip roof-flat roof-RCC roof.

Unit V	**CARPENTARY, ARCHES, LINTELS AND FINISHING WORKS**	**9**	**0**	**0**	**9**

Location of doors and windows - size of doors - types of doors - fixture and fastenings for doors and windows - arches - classification - stability of an arch - lintels - classification of lintels - steel lintel. scaffolding - component parts - shoring - methods of plastering - defects in plastering - pointing - objectives- methods of pointing

Total= 45 Periods

Text Books:	
1	B.C. Punmia, Building Construction, Laxmi Publications; Eleventh edition -2021
2	S.C.Rangwala, Building Construction,CharotarPublishing House Pvt. Ltd, 34th Edition - 2022
3	P. Purushothama Raj., Building Construction Materials and Techniques, Pearson Education India, First Edition - 2017
Reference Books:	
1	Shetty M.S., Concrete Technology (Theory and Practice), S.Chand& Company Ltd.,2021.
2	Rangwala S.C., Engineering Materials (Material Science) revised and enlarged by Rangwala K.S. and Rangwala P.S., Charotar Publishing House, 2010.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify and characterize and properties of Stone and brick	Remember
CO2	Understand the manufacturing process of cement and functions of mortar	Understand
CO3	Identify the age of timber and preservation methods of timber	Remember
CO4	Differentiate the types of roofing and flooring	Understand
CO5	Understand the miscellaneous works such as carpentry, lintels, Arch, etc.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-	2	3	-	-	-	-	-	-	-	-
CO3	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO4	1	-	2	-	2	3	2	-	-	-	-	-	-	-	-
CO5	1	-	-	-	3	-	2	-	-	-	-	-	-	-	-
Avg	1	2	2	-	2	3	2	-	-	-	-	-	-	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

<table>
<tr><td>18CEM02</td><td colspan="6">BUILDING CONSTRUCTION & EQUIPMENT</td><td colspan="2">Semester</td><td></td></tr>
<tr><td colspan="3">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td colspan="3">3</td></tr>
<tr><td colspan="3" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td colspan="3">TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td colspan="3">3</td></tr>
<tr><td colspan="10">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="9">Able to gain basic knowledge in construction methods.</td></tr>
<tr><td>2</td><td colspan="9">Able to gain basic knowledge in equipment.</td></tr>
<tr><td>3</td><td colspan="9">Able to gain basic knowledge in machineries.</td></tr>
<tr><td>4</td><td colspan="9">Able to gain basic knowledge in fire safety principles.</td></tr>
<tr><td>5</td><td colspan="9">Able to gain basic knowledge in green technology.</td></tr>
<tr><td colspan="2">Unit I</td><td colspan="2">CLASSIFICATION OF BUILDINGS, FOUNDATIONS AND TYPES OF MASONRY</td><td>9</td><td>0</td><td>0</td><td colspan="3">9</td></tr>
<tr><td colspan="10">Component parts of a building -Their functions. Classification of buildings according to National building code.
Site investigation for foundation as per N.B.C, Types of foundation and prevention of dampness at basement level,Classification of stone masonry</td></tr>
<tr><td colspan="2">Unit II</td><td colspan="2">DOORS, WINDOWS, LINTELS, SCAFFOLDING AND STAIRCASES</td><td>9</td><td>0</td><td>0</td><td colspan="3">9</td></tr>
<tr><td colspan="10">Doors and windows – parts of door and window – Types of Door and windows–Ventilators – fixed, swinging type and louvered. Lintels – Functions, Scaffolding – Purpose and types –Location of stairs.Types of stairs</td></tr>
<tr><td colspan="2">Unit III</td><td colspan="2">ROOFS, FLOORINGS, PROTECTIVE AND DECORATIVE FINISHES</td><td>9</td><td>0</td><td>0</td><td colspan="3">9</td></tr>
<tr><td colspan="10">Roof Beams and Roof Slabs – Types of Roofing Systems – Methods of Termite Proofing – Methods of Damp proofing.
Types of floors- Plastering (Interior and Exterior) – Pointing for Walls and Floors using Grouts – White Washing, Color Washing with different Color Shades available in the Markets – Painting – Types of Painting for Interior and Exterior application.</td></tr>
<tr><td colspan="2">Unit IV</td><td colspan="2">CONSTRUCTION EQUIPMENTS</td><td>9</td><td>0</td><td>0</td><td colspan="3">9</td></tr>
<tr><td colspan="10">Selection of equipment for earthwork excavation, drilling, blasting, tunnelling, erection and dewatering and pumping, concreting, material handling and erection of structures</td></tr>
<tr><td colspan="2">Unit V</td><td colspan="2">GREEN BUILDING TECHNOLOGY</td><td>9</td><td>0</td><td>0</td><td colspan="3">9</td></tr>
<tr><td colspan="10">Introduction to green technology – types and importance; zero waste and r concept, green materials – green concrete (purpose and limitations), green buildings, green engineering.</td></tr>
<tr><td colspan="10" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Building Construction by S.C.Rangawala
2	Construction Technology by Sarkar Oxford University Press
3	Building Material & Construction by S.P. Arora& S. P. Bindra
Reference Books:	
1	Hopkinson And Kay J.D., The Lighting of Building, Faber and Faber, London.
2	Koerner, R.M, Construction & Geotechnical Methods in Foundations Engineering, McGraw Hill, 1984
3	Varna M., Construction Equipment and Its Planning & Applications, Metropolitan Books Co, 1979

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Organize the construction technique to be followed in brick and stone masonry, concreting, flooring, roofing and plastering etc.	Create
CO2	Select safe practices in building construction activities	Evaluate
CO3	Clarify the different types of roofs, floor and productive materials of buildings	understand
CO4	Select the relevant equipment for building construction	Evaluate
CO5	Apply the Principles of green building technology.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	3	2	2	2	1	1	-	-	-	-	1
CO2	-	-	-	-	3	2	2	2	2	2	-	-	-	-	1
CO3	-	-	-	-	2	3	2	2	2	1	-	-	-	-	1
CO4	-	-	-	-	2	2	3	1	1	2	-	-	-	-	1
CO5	-	-	-	-	2	3	2	2	2	2	-	-	-	-	1
Avg	-	-	-	-	2.4	2.4	2.2	1.8	1.6	1.6	-	-	-	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

18CEM03	CONCRETE TECHNOLOGY					Semester		
PREREQUISITES			**Category**	**OE**		**Credit**		**3**
NIL			**Hours/Week**	**L**		**T**	**P**	**TH**
				3		**0**	**0**	**3**

Course Learning Objectives

1	To understand the properties of ingredients of concrete.
2	To study the behavior of concrete at its fresh and hardened state.
3	To study about the concrete design mix.
4	To know about the procedures in concrete at different stage.
5	To understand special concrete and their uses.

Unit I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Concrete materials, Cement: Field and laboratory tests on cement, Types of cement and their uses, different tests for aggregates. Methods for manufacturing of cement- Wet and dry process. Hydration of cement, Bogue's compound.

Unit II	**ADMIXTURES**	**9**	**0**	**0**	**9**

Accelerating admixtures, Retarding admixtures, water reducing admixtures, Air entraining admixtures, coloring agent, Plasticizers. Batching, Mixing, Transportation, placing of concrete, curing of Concrete

Unit III	**MIX DESIGN**	**9**	**0**	**0**	**9**

Factors influencing mix proportion, Mix design by ACI method and I.S. code method, Design of high strength concrete.

Unit IV	**BEHAVIOUR OF CONCRETE**	**9**	**0**	**0**	**9**

Strength of concrete, Shrinkage and temperature effects, creep of concrete, permeability of concrete, durability of concrete, Corrosion, Causes and effects, remedial measures, Thermal properties of concrete, Micro cracking of concrete.

Unit V	**SPECIAL CONCRETE**	**9**	**0**	**0**	**9**

Light-weight concrete, Fibre reinforced concrete, Polymer modified concrete, Ferro cement, Mass concrete, Ready-mix concrete, Self-compacting concrete, Quality control, Sampling and testing, Acceptance criteria.

Total= 45 Periods

Text Books:

1	Neville A.M Properties of Concrete, Pearson publication, 2012.
2	Shetty M.S Concrete technology, S.Chand and Company Ltd, New Delhi 2022.
3	Santha Kumar A.R Concrete Technology, Oxford university Press, NewDelhi, 2022.
4	Mehta K.P Concrete Technology, Chand & Co, NewDelhi, 2006.
5	Robert RatayForensic Structural Engineering Handbook, McGraw Hill LLC, 2009

Reference Books:	
1	Indian Standard Recommended Guide lines for Concrete Mix Design, IS:10262 – 2019, Bureau of Indian Standards, NewDelhi.
2	Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete IS:383-1970 R2011, Bureau of Indian Standards, NewDelhi.
3	Gambhir.M.L,Concrete Technology, Volume I & II, Tata McGraw-HillBookCompany,Third print, 2003
4	Krishna Raju N. Design of Concrete Mixes, CBS publishers. NewDelhi, 2002.
5	Stephen E. Petty,Forensic Engineering: Damage Assessments for Residential and Commercial Structures,CRCpress,Taylor& Francis,2013.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	To identify suitable materials to be used in the cement concrete by conducting various tests as per BIS code.	Evaluate
CO2	To know about the specific applications and uses of admixtures.	Understand
CO3	Design the concrete mix using ACI and BIS code methods.	Create
CO4	Determine the properties of fresh and hardened of concrete.	Evaluate
CO5	Design special concretes and to Ensure quality control while testing/ sampling and acceptance criteria for pre and post construction work.	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	3	-	1	1	1	2	1	1	1	-	1
CO2	-	-	-	-	3	-	3	-	1	1	-	-	2	-	1
CO3	-	-	-	-	3	-	3	-	-	1	-	-	1	-	1
CO4	-	-	-	-	3	2	1	-	-	-	-	-	-	-	1
CO5	-	-	-	-	3	3	3	1	1	3	1		3	-	1
Avg	-	-	-	-	3	2.5	2.2	1	1	1.75	1	1	1.75	-	1
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>18CEM04</td><td colspan="3">ENVIRONMENTAL ENGINEERING</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="3">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="3" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="8">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="7">To evaluate the sources of water and analyse its characteristics and processes in water treatment, express the analysis of distribution network</td></tr>
<tr><td>2</td><td colspan="7">To design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and its disposal</td></tr>
<tr><td>3</td><td colspan="7">To predict the sources, effects, dispersion of air pollutants air quality management and its control measures</td></tr>
<tr><td>4</td><td colspan="7">To identify the characteristics and sources of municipal solid wastes, its collection methods, off-site processing of municipal solid wastes and its recovery, disposal methods</td></tr>
<tr><td>5</td><td colspan="7">To assess the sources, effects and control measures of noise pollution</td></tr>
<tr><td>Unit I</td><td colspan="3">WATER TREATMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Water Quality and its Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.</td></tr>
<tr><td>Unit II</td><td colspan="3">WASTEWATER TREATMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Sewerage system design, quantity and quality of domestic wastewater, primary and secondary treatment. Effluent discharge standards; Sludge disposal; Reuse of treated sewage for different applications.</td></tr>
<tr><td>Unit III</td><td colspan="3">AIR POLLUTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality Index and limits.</td></tr>
<tr><td>Unit IV</td><td colspan="3">SOLID WASTE MANAGEMENT</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).</td></tr>
<tr><td>Unit V</td><td colspan="3">NOISE POLLUTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Noise pollution: Sources; Health effects; Standards; Measurement and control methods</td></tr>
<tr><td colspan="8" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Garg, S.K. Water supply Engineering, Khanna Publishers, New Delhi, 2010.
2	Garg, S.K. Sewage water disposal and Air pollution, Khanna Publishers, New Delhi, 2010.
3	George Tchobanoglous et.al., Integrated Solid Waste Management, McGraw-Hill, Publishers, 1993.
4	Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.

Reference Books:	
1	Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2	Peavy S.W., Rowe D.R. and Tchobanoglous G. Environmental Engineering, McGraw Hill, NewDelhi, 1985.
3	Metcalf and Eddy,M.C., Wastewater Engineering – Treatment &Reuse,TataMcGraw-Hill Publications, New Delhi,2003.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Identify the sources of water supply, analyze the characteristics of water with its standards and various unit operations and processes in water treatment, express the analysis of distribution network	Remember
CO2	Expertise design sewer system, basic design of the biological treatment processes, gain knowledge on sludge treatment and disposal and justify the methods for disposal of sewage	Analyze
CO3	Predict the sources, effects, dispersion of air pollutants air quality management and its control measures	Apply
CO4	Aware about the characteristics, types and sources of municipal solid wastes, Learn the collection methods, Know about off-site processing of municipal solid wastes and its recovery, disposal methods	Remember
CO5	Understand the sources, effects and control methods of noise pollution	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	3	2	1	1	2	1	1	3	-	2
CO2	2	1	3	1	1	3	1	-	1	2	2	1	3	-	2
CO3	2	1	3	1	1	3	1	-	1	2	2	1	3	-	2
CO4	2	1	3	1	1	3	1	-	-	2	2	1	3	-	2
CO5	2	-	3	-	-	3	-	-	-	2	1	1	3	-	2
Avg	2	1	3	1.3	1	3	1.3	1	1	2	1.6	1	3	-	2
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>18CEM05</td><td colspan="2">BASICS OF TRANSPORTATION ENGINEERING</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">The objective of the course is to educate the students on various components of highway engineering.</td></tr>
<tr><td>2</td><td colspan="6">To educate the geometric design concepts of highway engineering</td></tr>
<tr><td>3</td><td colspan="6">To develop skills on construction and maintenance of highway.</td></tr>
<tr><td>4</td><td colspan="6">Ability to plan various civil engineering aspects of railways and educate various components of railways</td></tr>
<tr><td>5</td><td colspan="6">The course enables the students to develop skill on evaluation and maintenance of railway track.</td></tr>
<tr><td>Unit I</td><td colspan="2">CROSS SECTIONAL ELEMENTS OF HIGHWAYS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Classification of Highways - Classification and Cross Section of Urban and Rural Roads (IRC), Highway Cross Sectional Elements- Right of Way, Carriage Way, Camber, Kerbs, Shoulders and Footpaths (IRC Standards), Sight Distances - Stopping Sight Distance (SSD), Overtaking Sight Distance (OSD), Sight Distance at Intersections, Intermediate Sight Distance and Illumination Sight Distance - Cross Sections of Different Class of Roads -</td></tr>
<tr><td>Unit II</td><td colspan="2">GEOMETRIC DESIGN OF HIGHWAYS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Horizontal Alignments – Superelevation, Widening of Pavements on Horizontal Curves, Vertical Alignments - Rolling. Limiting, Exceptional and Minimum Gradients, Summit and Valley Curves -Geometric Design of Hill Roads (IRC Standards Only)</td></tr>
<tr><td>Unit III</td><td colspan="2">CONSTRUCTION AND MAINTENANCE OF HIGHWAY</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Construction of Flexible and Rigid Pavements – Defects in Flexible and Rigid Pavements -Highway Drainage – Evaluation and Maintenance of Pavements.</td></tr>
<tr><td>Unit IV</td><td colspan="2">RAILWAY PLANNING AND DESIGN</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Permanent Way, its Components and Functions of Each Component: Rails - Types of Rails, Rail Fastenings, Concept of Gauges, Coning of Wheels, Creeps Sleepers - Functions, Materials, Density. Ballasts - Functions, Materials, Ballast less Tracks Geometric Design of Railway Tracks Gradients and Grade Compensation, Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves.</td></tr>
<tr><td>Unit V</td><td colspan="2">RAILWAY TRACK CONSTRUCTION MAINTENANCE AND OPERATION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Points and Crossings – Turnouts, Track circuiting, Signaling, Interlocking, Lay Outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance, Level Crossings.</td></tr>
<tr><td colspan="7" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Khanna K., Justo C.E.G., Highway Engineering Revised 10th Edition Khanna Publishers, Roorkee, 2014
2	Kadiyalil. R, Engineering Traffic and Transport Planning, Khanna Publishers, New Delhi, 2019.
3	Chandola S.P. Transportation Engineering-2019

Reference Books:	
1	Sharma S.K., Principles Practice and Design of Highway Engineering, S. Chand & Co Ltd. New Delhi, 2006
2	Guidelines Of Ministry of Road Transport and Highways, Government of India.
3	Agarwal M.M., Indian Railway Track, 14th Edition, Prabha and Co., New Delhi, 2002.
4	Saxena S.C. Highway & Traffic Engineering, 2014.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Classify roads as per Indian Road Congress and describe the principles of highway alignment	Understand
CO2	Determine the highway geometric elements	Analyse
CO3	Differentiate between types of pavements, their construction and design principles	Analyse
CO4	Explain the functions of components of Railways	Understand
CO5	Carry out the various methods for track alignment & procedure for construction of railway & maintenance of track	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	2	2	3	1	2	-	-	-	1	-	-
CO2	2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	2	2	3	1	3	-	-	-	1	-	-
CO4	-	-	-	-	2	2	3	1	2	-	-	-	-	-	-
CO5	-	-	-	-	2	2	3	1	2	-	-	-	1	-	-
Avg	2	3	2	2	2	2	3	1	2.25	-	-	-	1	-	-
3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**															

<table>
<tr><td>18CEM06</td><td colspan="5">REPAIR AND REHABILITATION OF STRUCTURES</td><td colspan="2">Semester</td><td></td></tr>
<tr><td colspan="4">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="4" rowspan="2">NIL</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="9">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="8">Study the various types and properties of repair materials</td></tr>
<tr><td>2</td><td colspan="8">Learn various distress and damages to concrete structures</td></tr>
<tr><td>3</td><td colspan="8">Understand the importance of maintenance of structures</td></tr>
<tr><td>4</td><td colspan="8">Assess the damage to structures using various tests</td></tr>
<tr><td>5</td><td colspan="8">Learn various repair techniques of damaged structures, corroded structures</td></tr>
<tr><td>Unit I</td><td colspan="4">MAINTENANCE AND REPAIR STRATEGIES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Maintenance, repair and rehabilitation, Facts of Maintenance, importance of Maintenance various aspects of inspection, assessment procedure for evaluating a damaged structure, causes of deterioration.</td></tr>
<tr><td>Unit II</td><td colspan="4">SERVICEABILITY AND DURABILITY OF CONCRETE</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Quality assurance for concrete construction, concrete properties- strength, permeability, thermal properties and cracking-effects due to climate, temperature, chemical, corrosion- Design and construction errors-effects of cover thickness and cracking.</td></tr>
<tr><td>Unit III</td><td colspan="4">MATERIALS AND TECHNIQUES FOR REPAIR</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Special concretes and mortar, concrete chemical, special elements for accelerated strength gain, expansive cement, polymer concrete, Sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, 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. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection.</td></tr>
<tr><td>Unit IV</td><td colspan="4">REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Strengthening of Structural elements, deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.</td></tr>
<tr><td>Unit V</td><td colspan="4">DEMOLITION TECHNIQUES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="9">Demolition methods by machines, explosives, Advanced techniques-Demolition sequences, dismantling techniques, safety precautions in dismantling and demolition, Engineered demolition techniques for dilapidated structures- case studies</td></tr>
<tr><td colspan="9" align="right">Total= 45 Periods</td></tr>
</table>

Text Books:	
1	Shetty, M.S, Concrete Technology- Theory and Practice, S. Chand and company, New Delhi,2019
2	Repair and protection of concrete structures by Noel P. Mailvaganam, CRC Press,1991.
3	CPWD: Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt. of India, 2002, updated reprint 2011

Reference Books:	
1	Santhakumar A.R, Training Course notes on Damage Assessment and Repair in Low-cost housing, "RHDC.NBO" Anna University, July 1992.
2	Raikar R.N.,Learning from failures- deficiencies in design, construction and services – R&D Centre (SDCPL), Raikar bhavan, Bombay,1987
3	Palaniyappan, N., Estate management, Anna Institute of Management, Chennai,1992.
4	Lakshmipathy, M. etal., Lecture notes of workshop on Repairs and Rehabilitation of structures, 29-30th October 1999.
5	https://nptel.ac.in/courses/114106035/38

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Demonstrate the condition of structures	Understand
CO2	Inspect and evaluate the damaged structure	Analyze
CO3	Implement the repairing techniques of a structure	Analyze
CO4	Identify and Use different materials for repairing works	Apply
CO5	Demonstrate the dismantling and demolishing structures	Apply

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-
CO2	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-
CO3	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-
CO4	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-
CO5	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-
Avg	1	-	2	2	2	2	3	2	-	-	-	1	2	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

18CEM07	GREEN BUILDING TECHNOLOGY			Semester			
PREREQUISITES		**Category**		**OE**	**Credit**		**3**
NIL		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Learning Objectives

1	To Know various aspects of green buildings
2	To Learn the principles of planning and orientation of buildings.
3	To Relate the construction of green building with prevailing energy conservation policy and regulations.
4	To Know and identify different green building construction materials.
5	To Learn different rating systems and their criteria

Unit I	**INTRODUCTION TO GREEN BUILDING**	**9**	**0**	**0**	**9**

Introduction, Necessity, Definition & concept of Green Building, Issues and strategies of Green Building, Principles and Benefits of Green Building, Components/ features of Green Building, Energy Efficiency, Water efficiency, Material Efficiency, Indoor Air Quality.

Unit II	**SITE SELECTION AND PLANNING**	**9**	**0**	**0**	**9**

Site selection, Site selection strategies, Landscaping, building form, orientation, building envelope and fenestration, material and construction techniques, roofs, walls, fenestration and shaded finishes, Environmental design (ED) strategies for building construction, Rainwater harvesting methods for roof & non-roof, reducing landscape water demand by proper irrigation systems, recycle and reuse systems, Waste Management.

Unit III	**ENERGY AND ENERGY CONSERVATION**	**9**	**0**	**0**	**9**

Introduction, Environmental impact of building constructions, present scenario, Need of energy conservation, Concepts of embodied energy,

operational energy and life cycle energy, Methods to reduce operational energy, Energy efficient building, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

Unit IV	**BUILDING MATERIALS**	**9**	**0**	**0**	**9**

Green building materials and products- Bamboo, Rice husk ash concrete, plastic bricks, Bagasse particle board, Insulated concrete forms. use of materials with recycled content such as blended cements, pozzolana cements, flyash bricks, vitrified tiles, materials from agro and industrial waste, reuse of waste material-Plastic, rubber, Newspaper wood, Nontoxic paint, green roofing.

Unit V	**RATING SYSTEM**	**9**	**0**	**0**	**9**

Introduction to Leadership in Energy and Environmental Design (LEED) criteria, Indian Green Building council (IGBC) Green rating, Green Rating for Integrated Habitat Assessment. (GRIHA) criteria, National Productivity council (NPC) Ministry of New and Renewable Energy (MNRE) Bureau of Energy efficiency (BEE) -BER (Building Energy Rating) – Certificates.

Total= 45 Periods

Text Books:

1	Kibert, C.J., Sustainable construction: Green Building design and Delivery, John Wiley Hobouken, NewJersey, 3rd Edition, 2012.
2	Chauhan, D S Sreevasthava, S K., Non-conventional Energy Resources, New Age International Publishers, NewDelhi, 4th Edition, 2021

Reference Books:	
1	O.P. Gupta, Energy Technology, Khanna Publishing House, NewDelhi
2	Jagadeesh, K S, Reddy Venkatta Rama &Nanjunda Rao, K S., Alternative Building Materials and Technologies, New Age International Publishers,Delhi.
3	Sam Kubba., Handbook of Green Building Design and Construction, Butterworth- Heinemann.
4	Means R S, Green Building - Project Planning and Cost Estimating, John Wiley &Sons
5	Sharma K V, Venkataseshaiah P., Energy Management and Conservation, IK International.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand the concepts of Green Building	Understand
CO2	Discuss the Planning of Green Building.	Understand
CO3	Explain the concept of Energy and Energy Conservation.	Understand
CO4	Select appropriate green building material and technique.	Understand
CO5	Summarize the Green Building Functions in various organizations.	Understand

COURSE ARTICULATION MATRIX

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	2	3	-	-	-	2	1	2	-	-
CO2	1	1	1	2	1	-	-	-	-	-	-	-	2	-	-
CO3	-	1	3	-	2	-	-	-	-	-	-	-	2	-	-
CO4	-	1	2	-	3	-	-	-	-	-	2	-	2	-	-
CO5	1	1	2	3	2	-	-	-	-	-	2	-	2	-	-
Avg	1	1	2	2	2	2	3	-	-	-	2	1	2	-	-

3/2/1 – indicates strength of **correlation (3- High, 2- Medium, 1- Low)**

B.E. – COMPUTER SCIENCE ENGINEERING - MINOR DEGREE

18CSM01	**PROGRAMMING IN C++**					
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Learning Objectives						
1	To understand and develop the object oriented programming concepts.					
2	To familiarize and design the template functions and classes					
3	To disseminate and apply exception handling mechanisms.					
4	To learn and exploit stream classes.					
Unit I	**INTRODUCTION**		**9**	**0**	**0**	**9**
Procedure oriented programming paradigm - Object oriented programming paradigm - Basic concepts of object oriented programming, benefits of OOP, application of OOP - C++ fundamentals –structure of C++ program, tokens, data types - Operators and expressions - Control structures - Functions.						
Unit II	**INHERITANCE AND VIRTUAL FUNCTIONS**		**9**	**0**	**0**	**9**
Classes and objects - friend functions- constructors and destructors- Operator overloading – binary and unary operator overloading using member function and friend function - Type conversions.						
Unit III	**INHERITANCE AND VIRTUAL FUNCTIONS**		**9**	**0**	**0**	**9**
Inheritance – defining derived classes, types, virtual base classes, abstract classes, constructor in derived classes - Pointers- pointers to objects, this pointer, pointer to derived classes - Virtual functions.						
Unit IV	**TEMPLATES AND EXCEPTION HANDLING**		**9**	**0**	**0**	**9**
Generic Classes – class template, class templates with multiple parameters - Generic Functions - function templates, function templates with multiple parameters, member function templates - Exception handling – basics, exception handling mechanism, rethrowing an exception – Exception handling options – understanding terminate() and unexpected() – the uncaught_exception() function – bad_exception().						
Unit V	**CONSOLE I/O AND FILE HANDLING**		**9**	**0**	**0**	**9**
C++ Stream Classes – unformatted I/O operations, formatted console I/O operations, manipulators - Files-classes for file operation, opening and closing a file, detecting end of file, files modes, sequential file operations, random file operations.						
						Total (45 L) =45 Periods

Text Books:	
1	E. Balagurusamy "Object –Oriented Programming with C++" Sixth Edition Tata McGraw-Hill
Reference Books:	
1	Herbert Schildt, "The Complete Reference C++", Fifth Edition, Tata McGraw Hill
2	Bjarne Stroustrup, "The C++ programming language", Fourth Edition Addison Wesley
3	K.R.Venugopal, Rajkumar Buyya, T.Ravishankar , Mastering in C++, Second Edition, Tata McGraw Hill

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Build the object oriented programming concepts.	Apply
CO2	Familiarize and build the template functions and classes	Understand
CO3	Disseminate and apply exception handling mechanisms.	Apply
CO4	Depict and exploit steam classes.	Understand

18CSM02	ADVANCED DATA STRUCTURES AND ALGORITHMS					
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To understand the concepts of ADTs
2	To Learn linear data structures – lists, stacks, and queues
3	To have knowledge about non-linear data structures like trees and graphs
4	To understand concepts about searching and sorting and hashing techniques

Unit I	**LINEAR DATA STRUCTURES – LIST**	**9**	**0**	**0**	**9**
Abstract Data Types (ADTs) – List ADT - Array based Implementation - Linked List Implementation – Singly Linked Lists - Circularly Linked Lists - Doubly-Linked Lists - Applications of Lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).					
Unit II	**LINEAR DATA STRUCTURES –STACKS AND QUEUES**	**9**	**0**	**0**	**9**
Stack ADT - Operations - Applications of Stacks - Evaluating Arithmetic Expression - Conversion of infix to postfix Expression - Queue ADT - Operations - Circular Queue - DeQueue - Applications of Queue					
Unit III	**NON LINEAR DATA STRUCTURES – TREES**	**9**	**0**	**0**	**9**
Tree ADT – Tree traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT – Threaded Binary Trees- AVL Trees – B-Tree – Heaps - Operations of Heaps - Priority Queues - Binary Heap - Max Heap - Min Heap - Applications of Heap.					
Unit IV	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**	**0**	**0**	**9**
Definition – Representation of Graphs –Types of Graphs - Graph Traversals - Breadth First Search - Depth First Search - Application of Graph Structures: Shortest Path Problem: Dijkstra's Algorithm - Minimum Spanning Trees: Prim's Algorithm - Kruskal's Algorithms					
Unit V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**	**0**	**0**	**9**
Searching: Linear Search - Binary Search - Sorting Algorithms - Insertion Sort - Selection Sort - Shell Sort - Bubble Sort - Quick Sort - Merge Sort - Radix Sort - Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.					
					Total (45 L) =45 Periods

Text Books:

1	Mark Allen Weiss, " Data Structures and Algorithm Analysis in C ", 4/E Pearson Education, 2013.

Reference Books:

1	Seymour Lipschutz, "Data Structures With C ",(Schaum`s Outline Series) Published by Tata McGraw-Hill Education Pvt. Ltd., 2015
2	Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structures In C", Second Edition, Silicon Press, 2008.
3	Richard F.Gilberg & Behrouz A.Forouzan, "Data Structures: A Pseudo code Approach With C", Second Edition, Cengage Learning Publishers,2005.
4	Classic Data Structures", Second Edition by Debasis Samanta, PHI Learning, 2009.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Implement various abstract data types to solve real time problems by using Linear Data Structures	Apply
CO2	Apply the different Non-Linear Data Structures to solve problems	Apply
CO3	Analyze and implement graph data structures to solve various computing problems.	Analyze
CO4	Critically analyze the various sorting and searching algorithms	Analyze

18CSM03	COMPUTER ORGANIZATION AND DESIGN					
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the basic structure and operations of digital computer
2	To learn the working of different arithmetic operations
3	To understand the different types of control and the concept of pipelining
4	To study the hierarchical memory system including cache memory and virtual memory
5	To understand the different ways of communication with I/O devices and standard I/O interfaces

UNIT I	INTRODUCTION	9	0	0	9

Functional units ,Basic Operational Concepts, Bus Structure ,Memory Locations and Addresses, MemoryOperations, Instruction and Instruction Sequencing, Addressing modes.

UNIT II	ARITHMETIC UNIT	9	0	0	9

Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, BoothAlgorithm, Fast Multiplication, Integer Division, Floating point number operations.

UNIT III	PROCESSOR UNIT AND PIPELINING	9	0	0	9

Fundamental Concepts, Execution of Instruction, Multi Bus Organization, Hardwired control, Micro programmed control, Basic Concepts of pipelining, Data Hazards, Instruction Hazards ,Data path & Control Considerations.

UNIT IV	MEMORY SYSTEMS	9	0	0	9

Basic Concepts, Semiconductor RAM, ROM, Cache memory, Improving Cache Performance, Virtual memory,Memory Management requirements, Secondary Storage Device.

UNIT V	INPUT AND OUTPUT ORGANIZATION	9	0	0	9

Accessing I/O devices, Programmed I/O, Interrupts, Direct Memory Access, Interface circuits, Standard I/O Interfaces (PCI, SCSI, USB).

Total (45 L) =45 Periods

Text Books:

1	Carl Hamacher V.,Zvonko G.Vranesic, Safwat G. Zaky, " Computer organization ", Tata McGraw Hill,5th Edition, 200

Reference Books:

1	Patterson and Hennessey, "Computer Organization and Design ". The Hardware/Software interface,Harcourt Asia Morgan Kaufmann, 3rd Edition, 2007
2	Hayes, "Computer Architecture and Organization ", 3rd edition,Tata McGraw Hill, 2006
3	Heuring V.P., Jordan H.F., " Computer System Design and Architecture ", 6th edition ,Addison Wesley,2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the working principles of computer componets	Understand
CO2	Design the arithmetic and processing units	Create
CO3	Analyze the various computer components	Analyze

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18CSM04	ADVANCED OPERATING SYSTEMS			Semester			
PREREQUISITES		**Category**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Learning Objectives

1	To understand the structure and functions of Operating systems
2	To understand the process concepts and scheduling algorithms
3	To understand the concept of process synchronization and deadlocks
4	To learn various memory management schemes
5	To illustrate various file systems and disk management strategies

UNIT I	**INTRODUCTION AND OPERATING SYSTEM STRUCTURES**	**9**	**0**	**0**	**9**

Main frame Systems, Desktop Systems, Multiprocessor Systems, Distributed Systems, Clustered Systems, Real Time systems, Hand held Systems; Operating Systems Structures - System Components, Operating System Services, System calls, System Programs, System Design and Implementation.

UNIT II	**PROCESS MANAGEMENT**	**9**	**0**	**0**	**9**

Processes-Process Concepts, Process Scheduling, Operation on Processes, Co-Operating Processes, InterProcess Communication; Threads- Multithreading Models, Threading Issues; CPU Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT III	**PROCESS SYNCHRONIZATION AND DEADLOCKS**	**9**	**0**	**0**	**9**

Process Synchronization- The Critical Section Problem, Synchronization Hardware, Semaphores, Classical Problem of Synchronization, Monitors; Deadlocks- Deadlock Characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance ,Deadlock Detection, Recovery from Deadlock.

UNIT IV	**MEMORY MANAGEMENT AND VIRTUAL MEMORY**	**9**	**0**	**0**	**9**

Memory Management- Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging; Virtual Memory - Demand paging, Page Replacement, Thrashing.

UNIT V	**FILE SYSTEM AND MASS-STORAGE STRUCTURE**	**9**	**0**	**0**	**9**

File System Interface - File Concepts, Access methods, Directory Structure, File Sharing, File Protection; File System Implementation- File System Structure and Implementation, Directory Implementation, Allocation Methods, Free Space Management; Mass-Storage Structure - Disk Structure, Disk scheduling, Disk Management, RAID Structure; Case study: Linux system.

Total (45 L) =45 Periods

Text Books:

1	Abraham Silberschatz, P.B.Galvin, G.Gagne —Operating System Concepts 6th edition, John Wiley & Sons, 2003.

Reference Books:

1	Andrew S. Tanenbaum, —Modern Operating Systems, PHI , 2nd edition, 2001
2	D.M.Dhamdhere, “Systems Programming and Operating Systems ", 2nd edition, Tata McGraw Hill Company, 1999.
3	Maurice J. Bach, —The Design of the Unix Operating System, 1st edition, PHI, 2004.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Identify the components and their functionalities in the operating system	Apply
CO2	Apply various CPU scheduling algorithms to solve problems	Apply
CO3	Analyze the needs and applications of process synchronization and deadlocks	Analyze
CO4	Apply the concepts of memory management including virtual memory and page replacement to the issues that occur in real time applications	Apply
CO5	Solve issues related to file system implementation and disk management	Apply

18CSM05	DATA COMMUNICATION AND COMPUTER NETWORKS		Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To study the concepts of data communications and functions of different ISO/OSI reference architecture
2	To understand the error detection and correction methods and also the types of LAN
3	To study the concepts of subnetting and routing mechanisms
4	To understand the different types of protocols and congestion control
5	To study the application protocols and network security

UNIT I	**DATA COMMUNICATIONS AND PHYSICAL LAYER**	**9**	**0**	**0**	**9**

Data Communication; Networks- Physical Structures (Types of Connections, Physical Topology),Categories of Networks, Interconnection of Networks: Internetwork; Protocols and Standards; Network Models-The OSI Model, Layers in the OSI Model, Addressing; Transmission media-Guided Media, Unguided Media.

UNIT II	**DATA LINK LAYER**	**9**	**0**	**0**	**9**

Introduction-Types of errors, Redundancy, Detection versus Correction, Modular Arithmetic; Block Coding-Error Detection and Correction (VRC,LRC,CRC, Checksum, Hamming Code);Data link Control- Flow Control (Stop- and-Wait, Sliding Window),Error Control (Automatic Repeat Request, Stop-and-wait ARQ, Sliding Window ARQ), HDLC; Local Area Networks-Ethernet, Token Bus, Token Ring, FDDI.

UNIT III	**NETWORK LAYER**	**9**	**0**	**0**	**9**

Network Layer services-Packet Switching-Network Layer Performance-IPv4 addresses-IPv6 addressing- Subnetting-Bridges-Gateways- Routers-Routing Algorithm-Distance Vector Routing, Link State Routing.

UNIT IV	**TRANSPORT LAYER**	**9**	**0**	**0**	**9**

Duties of the Transport layer-User Datagram Protocol-Transmission Control Protocol- Congestion Control and Quality of Service-Congestion, Congestion Control, Quality of Service, Techniques to improve QoS, Integrated Services.

UNIT V	**PRESENTATION LAYER AND APPLICATION LAYER**	**9**	**0**	**0**	**9**

Domain Name System - Domain Name Space, DNS in the Internet; Electronic Mail-FTP- HTTP- World Wide Web.

Total (45 L) =45 Periods

Text Books:

1	Behrouz A.Ferouzan, "Data Communications and Networking", 4th Edition, Tata McGraw-Hill, 2007.

Reference Books:

1	Andrew S. Tanenbaum, "Computer networks "PHI, 4th edition 2008
2	William Stallings," Data and computer communications", 10th edition,PHI, 2012
3	Douglas E. comer," Internetworking with TCP/IP-Volume-I", 6th edition,PHI, 2008

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Classify the fundamentals of data communications and functions of layered architecture	Understand
CO2	Apply the error detection and correction methods and also identify the different network technologies	Apply
CO3	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and routing technologies	Analyze
CO4	Illustrate the transport layer principles and reliable data transfer using protocols	Apply
CO5	Analyze the application layer protocols and also the use of network security	Analyze

18CSM06	PROGRAMMING ESSENTIALS IN PYTHON			Semester			
PREREQUISITES			**Category**	**OE**	**Credit**		**3**
			Hours/Week	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**
Course Learning Objectives							
1	To learn Python data structures, conditional and control structures and files						
2	To study Python Modules, packages, Functions and Exceptions.						
3	To describe Object oriented programming features and Regular Expressions.						
4	To learn about Web programming, GUI Programming and Database programming						
UNIT I	**INTRODUCTION**			**9**	**0**	**0**	**9**
Python: Features - The Basics-Python Objects-Numbers-Sequences-Mapping and set types- Conditionals and loops-if statement-else statement-elif-Conditional Expressions-while statement-for statement-break-continue.							
UNIT II	**FUNCTIONS, MODULES AND PACKAGES**			**9**	**0**	**0**	**9**
Functions-Calling functions-Creating functions-Passing Functions-Formal Arguments-Variable length arguments-variable scope-Recursion, Modules-Packages.							
UNIT III	**FILES AND EXCEPTIONS**			**9**	**0**	**0**	**9**
Files and Input/ Output –Errors and Exceptions-Introduction-Detecting and handling Exceptions-Context Management-Raising Exceptions-Assertions-Standard Exceptions.							
UNIT IV	**OBJECT ORIENTED PROGRAMMING AND REGULAR EXPRESSIONS**			**9**	**0**	**0**	**9**
Object Oriented Programming Introduction-Classes-class Attributes-Instances-Instances attributes-Building and Method Invocation-Static methods and class Methods-Inheritance-Operator overloading - Regular Expressions-Network Programming – Multithreaded Programming							
UNIT V	**ADVANCED TOPICS**			**9**	**0**	**0**	**9**
GUI Programming- Web Programming-Database Programming							
Total (45 L) =45 Periods							

Text Books:	
1	Wesley J.Chun-“Core Python Programming” –Prentice Hall, Second Edition, 2006.
Reference Books:	
1	Swaroop C N, “ A Byte of Python “, ebshelf Inc., 1st Edition, 2013
2	“A Practical Introduction to python programming”, Brian Heinold,Mount St.Mary’s University,2012
3	Learning to Program with Python,” Richard L. Halterman”., Southern Adventist University

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Level**
CO1	Develop programs using control structures and files.	Create
CO2	Create own Python Modules, packages, functions and Exceptions.	Create
CO3	Illustrate Object oriented Programming features and Regular Expressions.	Apply
CO4	Create own Web programs, GUI and database programs.	Create

22CSM07	ADVANCED DATABASE SYSTEM CONCEPTS			Semester		
PREREQUISITES		Category	OE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the fundamentals of data models ,SQL queries and relational databases
2	To make a study of database design using ER Diagram and normalize
3	To impart knowledge in transaction processing.
4	To make the students to understand the file operations and indexing
5	To familiarize the students with advanced databases

UNIT I	**RELATIONAL DATABASES**	**9**	**0**	**0**	**9**
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.					
UNIT II	**DATABASE DESIGN**	**9**	**0**	**0**	**9**
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.					
UNIT III	**TRANSACTION**	**9**	**0**	**0**	**9**
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.					
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9**	**0**	**0**	**9**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.					
UNIT V	**ADVANCED TOPICS**	**9**	**0**	**0**	**9**
Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL – XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Data Warehousing and Data Mining - information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.					
					Total (45 L) =45 Periods

Text Books:	
1	Abraham Silberschatz, Henry F.Korth and S.Sundarshan "Database System Concepts", Sixth Edition,Tata McGraw Hi 2011.
Reference Books:	
1	Ramez Elamassri and Shankant B-Navathe, "Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2011.
2	C.J. Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education Delhi, 2008.
3	Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill CollegePublications, 2015.
4	G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.
E-References:	
1.	Lecture Series on Database Management System by Dr.S.Srinath, IIIT Bangalore, nptl

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of the database and data models.	Understand
CO2	Design a database using ER diagrams and map ER into Relations and normalize the relations.	Create
CO3	Develop a simple database for applications	Create

<table>
<tr><td>18CSM08</td><td colspan="2">VIRTUALIZATION AND CLOUD COMPUTING</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To introduce the broad perceptive of Parallel Computing, Distributed Computing and Cloud Computing.</td></tr>
<tr><td>2</td><td colspan="6">To understand the concept of Virtualization</td></tr>
<tr><td>3</td><td colspan="6">To identify the approaches of SLA and programming model in Cloud</td></tr>
<tr><td>4</td><td colspan="6">To understand the Cloud Platforms in Industry and Software Environments.</td></tr>
<tr><td>5</td><td colspan="6">To learn to design the trusted Cloud Computing system</td></tr>
<tr><td>UNIT I</td><td colspan="2">INTRODUCTION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Principles of Parallel and Distributed Computing – Elements of Parallel and Distributed Computing, Technologies for Distributed Computing; Vision of Cloud, Defining a Cloud, characteristics and benefits; Cloud Computing Architecture- Cloud Reference Model, Types of Clouds, Open Challenges.</td></tr>
<tr><td>UNIT II</td><td colspan="2">VIRTUALIZATION</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Introduction, Characteristics of Virtualized environments, Virtualization techniques-Machine Reference Model, Hardware-Level Virtualization, Programming Language-Level Virtualization, Application-Level Virtualization ,Other types of Virtualization, Virtualization and Cloud computing, Pros and cons of Virtualization, Technology examples-Xen: Para virtualization, VMware: Full Virtualization.</td></tr>
<tr><td>UNIT III</td><td colspan="2">SLA MANAGEMENT IN CLOUD COMPUTING AND PROGRAMMING MODEL</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Traditional Approaches to SLA Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud; Data Intensive Computing - Technologies for Data Intensive Computing, MapReduce Programming Model.</td></tr>
<tr><td>UNIT IV</td><td colspan="2">CLOUD INDUSTRIAL PLATFORMS AND SOFTWARE ENVIRONMENTS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Cloud Platforms in Industry - Amazon Web Service, Google App Engine; Cloud Software Environments –Eucalyptus, OpenNebula; Aneka Cloud Application Platform-Aneka Framework Overview, Anatomy of Aneka Container.</td></tr>
<tr><td>UNIT V</td><td colspan="2">CLOUD SECURITY AND APPLICATIONS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">An Introduction to the Idea of Data Security, The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity; The Cloud, Digital Identity, and Data Security, Content Level Security, Pros and Cons; Cloud Scientific Applications.</td></tr>
<tr><td colspan="7" align="right">Total (45L) = 45 Periods</td></tr>
</table>

<table>
<tr><td colspan="2">Text Books:</td></tr>
<tr><td>1</td><td>Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, ‘Mastering Cloud Computing-Foundations and Applications Programming”, TMGH,2013.(Unit- I,II & IV)</td></tr>
<tr><td>2</td><td>RajKumar Buyya, James Broberg, Andrezei M.Goscinski, “Cloud Computing: Principles and paradigms”,2011(Unit-III & V)</td></tr>
<tr><td colspan="2">Reference Books:</td></tr>
<tr><td>1</td><td>Kai Hwang.GeoffreyC.Fox.JackJ.Dongarra, “ Distributed and Cloud Computing ,From Parallel Processing to The Internet of Things”, 2012 Elsevier</td></tr>
<tr><td>2</td><td>Barrie Sosinsky, “Cloud Computing Bible”, Wiley Publisher, 2011</td></tr>
</table>

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Level**
CO1	Explain the main concepts and architecture of Parallel computing, Distributed Computing and Cloud Computing.	Understand
CO2	Analyze the concept of Virtualization	Analyze
CO3	Identify the approaches of SLA and programming model in Cloud	Apply
CO4	Analyze the Cloud Platforms in Industry and Software Environments.	Analyze
CO5	Identify the security issues in scientific and real time applications.	Apply

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING - MINOR DEGREE

18ECM01	**ELECTRON DEVICES**					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:	
1.	To introduce components such as diodes, BJTs and FETs, their characteristics and applications
2.	To understand, analyse and design of simple diode and transistor circuits.
3.	To know the switching characteristics of components and the concept of rectifiers and power supplies

Unit I	**EXTRINSIC SEMICONDUCTOR AND PN JUCTIONS**	**9**	**0**	**0**	**9**
N and P type semiconductor and their energy band structures- Law of electrical neutrality-calculation of location of Fermi level and free electron and hole densities in extrinsic semiconductors-Mobility, drift current and conductivity-diffusion current-continuity equation- Hall effect and its applications. Band structure of PN junction – current component in a PN junction- derivation of diode equation-temperature dependence of diode characteristics and equivalent models.					
Unit II	**SWITCHING CHARACTERISTICS OF PN JUNTION AND SPECIAL DIODES**	**9**	**0**	**0**	**9**
Calculation of transition and diffusion capacitance- varactor diode-charge control description of diode-switching characteristics of diode- mechanism of avalanche and Zener breakdown-temperature dependence of breakdown voltages-backward diode-tunneling effect in thin barriers - tunnel diode-photo diode-light emitting diodes.					
Unit III	**BIPOLAR JUNCTION TRANSISTORS**	**9**	**0**	**0**	**9**
Construction of PNP and NPN transistors- BJT current components-emitter to collector and base to collector current gains-base width modulation CB, CE and CC characteristics- breakdown characteristics- Ebers-Moll model - transistor switching times- Photo translator.					
Unit IV	**FIELD EFFECT TRANSISTORS**	**9**	**0**	**0**	**9**
Construction and characteristics of JFET-relation between pinch off voltage and drain current derivation. MOSFETS - enhancement and depletion types. CMOS circuits. MOS capacitance, BICMOS, SOI CMOS.					
Unit V	**RECTIFIERS AND POWER SUPPLIES**	**9**	**0**	**0**	**9**
Half-wave, full-wave and bridge rectifiers with resistive load. Analysis for Vdc and ripple voltage with C, CL, L-C and C-L-C filters. Voltage multipliers Zener diode regulator. Electronically regulated d.c power supplies. Line regulation, output resistance and temperature coefficient.					
Total (45L)= 45 Periods					

Text Books:	
1.	JaconMillman& Christos C. Halkias, “ Electronic Devices and Circuits” Tata McGraw-Hill, 1991.

2.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory 8th edition.", PHI, 2002
Reference Books:	
1.	Donald A. Neaman. " Semiconductor Physics and Devices" 3rd Ed., Tata McGraw-Hill 2002
2.	S. Salivahanan, N. Suresh kumar and A. Vallavaraj, Electronic Devices and Circuits, TMH, 1998.
3.	Ben, G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education 2000
4.	Floyd, "Electronic Devices", Sixth edition, Pearson Education, 2003.
E-References:	
1.	https://archive.nptel.ac.in/courses/108/108/108108122/
2.	https://www.youtube.com/watch?v=qqQ8wO-lNmI
3.	https://slideplayer.com/slide/12438044/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Interpret various applications of diode.	Applying
CO2	Classify various configurations and biasing technique of BJT	Applying
CO3	Apply the knowledge of using special devices for various applications	Understanding
CO4	Discuss operation, biasing and applications of JFET.	Analysing
CO5	Design power supplies and rectifiers	Applying

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1
CO5	2	2	1	-	-	-	-	-	-	-	-	-	3	2	2
Avg	2	2	1	-	-	-	-	-	-	-	-	-	2.2	2	1.5

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

18ECM02	DIGITAL ELECTRONICS						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives

1	To introduce basic postulates of boolean algebra and show the correlation between expressions
2	To Introduce the methods for Simplifying Boolean expressions
3	To Outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4	To introduce the Concept of Memories and programmable logic devices
5	To illustrate the concept of synchronous and Asynchronous sequential circuits

Unit I	**NUMBER SYSTEMS AND LOGIC GATES**	**9**	**0**	**0**	**9**

Number Systems - signed Binary numbers - Binary Arithmetic - Binary codes -conversion from one code to another - Boolean Algebra and Minimization Techniques - Canonical forms – Conversion between canonical forms – Simplifications of Boolean expressions using Karnaugh map - LOGIC GATES - Implementations of Logic Functions using gates.

Unit II	**COMBINATIONAL CIRCUITS**	**9**	**0**	**0**	**9**

Design procedure – Adders/Subtractor – Serial adder/ Subtractor - Parallel adder/ Subtractor- BCD adder- Multiplexer/ Demultiplexer - encoder / decoder – code converters.

Unit III	**SEQUENTIAL CIRCUITS**	**9**	**0**	**0**	**9**

Design Procedure - Flip flops: SR, JK, T, D and JKMS – Triggering of Flip-flop - Realization of flip flops – Moore and Mealy – Counters: Asynchronous / Ripple counters – Synchronous counters – Modulo n counter. Register: shift registers- Universal shift register.

Unit IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**	**0**	**0**	**9**

Design of fundamental mode circuits – primitive state / flow table – Minimization of primitive state table –state assignment. Problems in Asynchronous Circuits: Cycles – Races – Hazards. Design of Hazard Free Circuits: Static, Dynamic Hazards elimination

Unit V	**PLD AND MEMORY DEVICES**	**9**	**0**	**0**	**9**

Classification of memories –RAM organization –ROM organization. Programmable Logic Devices: Programmable Logic Array (PLA) - Programmable Array Logic (PAL). Implementation of combinational logic using MUX, ROM, PAL and PLA.

Total (45 L) = 45 Periods

Text Books:

1	M. Morris Mano, Digital Design, 4.ed.,Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2008
2	R.P.Jain, Modern Digital Electronics, 4th edition, TMH, 2010.

Reference Books:

1	S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 2nd ed., Vikas Publishing House Pvt. Ltd, New Delhi, 2004
2	Charles H.Roth. "Fundamentals of Logic Design", Thomson Publication Company, 2003.
3	Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 5 ed., Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
4	John F.Wakerly, Digital Design: Principles and practices, PHI, 2006

E-Reference:

1	http://nptel.ac.in/noc/individual_course.php?id=noc15-ec01

2	https://nptel.ac.in/courses/117105080/6
3	https://nptel.ac.in/courses/117105080/12

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	Minimize Boolean expressions and implement using logic gates	Applying
CO2	Design and analyse combinational logic circuits.	Analysing
CO3	Design and analyse synchronous and asynchronous sequential logic circuits	Analysing
CO4	Understand the concepts of memories and PLDs	Understanding
CO5	Implement circuits using memory and PLDs.	Applying

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	2	3	2	-	-	-	-	2	1	-
CO2	3	3	2	2	3	3	2	1	1	-	-	-	3	2	-
CO3	2	2	3	3	2	1	2	1	1	-	-	-	2	2	-
CO4	2	1	2	1	2	2	3	1	-	-	-	-	2	1	-
CO5	2	1	2	1	3	2	1	2	-	-	-	-	3	2	-
Avg	2.4	1.8	2.2	1.8	2.6	2	2.2	1.4	1	-	-	-	2.4	1.6	-

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

18ECM03	ELECTRONIC CIRCUITS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Electron Devices		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives

1	To perform analysis on Small signal amplifiers and large signal amplifiers.
2	To give a comprehensive exposure to all types of discrete amplifiers and oscillators.
3	To understand the various linear and non-linear applications of op-amp

Unit I	**MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

BJT – Need for biasing - Fixed bias circuit - Load line and quiescent point. Different types of biasing circuits. Use of Self bias circuit as a constant current circuit. CE, CB and CC amplifiers. Method of drawing small-signal equivalent circuit. Mid-band analysis of various types of single stage amplifiers to obtain gain - input impedance and output impedance. Miller's theorem. Darlington connection using similar and Complementary transistors. Methods of increasing input impedance using Darlington connection and bootstrapping. CS, CG and CD (FET) amplifiers. Multistage amplifiers-Basic emitter coupled differential amplifier circuit. Differential gain - CMRR. Use of constant current circuit to improve CMRR.

Unit II	**LARGE SIGNAL AMPLIFIERS**	**9**	**0**	**0**	**9**

Low frequency & High frequency analysis of amplifiers -Hybrid – pi equivalent circuit of BJTs.-High frequency equivalent circuit of FETs. Gain-bandwidth product of FETs. General expression for frequency response of multistage amplifiers. Calculation of overall upper and lower cut off frequencies of multistage amplifiers. Amplifier rise time and sag time and their relation to cut off frequencies. Classification of amplifiers (Class A, B, AB, C&D), Efficiency of class A, RC coupled and transformer-coupled power amplifiers. Class B complementary-symmetry, push-pull power amplifiers. Calculation of power output, efficiency and power dissipation. Crossover distortion and methods of eliminating it. Calculation of actual power handling capacity of transistors with and without heat sink. Heat sink design.

Unit III	**OSCILLATORS**	**9**	**0**	**0**	**9**

Feedback Amplifier: Block diagram - Gain with feedback - Barkhausen Criterion - Mechanism for start of oscillation and stabilization of amplitude - Analysis of Oscillator using Cascade connection of RC and LC filters - RC phase shift Oscillator - Wien bridge Oscillator and Twin-T Oscillators - Analysis of LC Oscillators: Colpitts – Hartley – Clapp - Miller and Pierce oscillators - Frequency range of RC Oscillators - Electrical equivalent circuit of Crystal.

Unit IV	**TUNED AMPLIFIERS AND MULTIVIBRATORS**	**9**	**0**	**0**	**9**

Analysis of single tuned and synchronously tuned amplifiers - Class C tuned amplifiers and their applications - Efficiency of Class C tuned Amplifier- Collector coupled and Emitter coupled Astable Multi vibrator – Mono stable Multi vibrator – Bistable Multi vibrator - Triggering methods – Mono stable and Astable Blocking Oscillators using Emitter and base timing.

Unit V	**OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS**	**9**	**0**	**0**	**9**

Basic structure and principle of operation - Calculation of differential gain - Common Mode gain, CMRR - OP-AMP design - DC and AC characteristics of OP-AMP. Applications: Inverting and non-inverting amplifiers - Integrator and Differentiator - Summing amplifier - Precision rectifier - Schmitt trigger and its applications - Active filters: Low pass, high pass, band pass and band stop filters - Sine wave oscillators – Comparator – Multi vibrator.

Total (45 L) = 45 Periods

Text Books:

1	B.Visvesvara Rao, K.Raja Rajeswari, P.Chalam Raju Pantulu, K.Bhaskara Rama Murthy, "Electronic Circuits-II", Pearson Education,2012
2	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2011.

Reference Books:

1	Millman J. and Taub H., "Pulse Digital and Switching waveform", 3rd Edition, McGraw-Hill International , 2011.

2	Sedera& Smith, "Micro Electronic Circuits", 4 th Edition, Oxford University Press, Chennai.
3	Michael Jacob, 'Applications and Design with Analog Integrated Circuits', Prentice Hall of India, 1996.
4	K.R.Botkar, 'Integrated Circuits', 10th edition, Khanna Publishers, 2010.
e-Reference:	
1	http://nptel.ac.in/courses/117105080/40
2	http://nptel.ac.in/courses/117108038/1
3	https://freevideolectures.com/course/2915/linear-integrated-circuits

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom's Taxonomy Mapped
CO1	To analyze small signal amplifiers and Large signal Amplifiers.	Applying
CO2	Analyze the frequency response characteristics of amplifiers	Applying
CO3	Develop insight of on oscillator design.	Applying
CO4	Construct and analyse tuned amplifiers and multivibrators.	Applying
CO5	Develop competence in linear and nonlinear Op amp circuit analysis.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
CO5	1	2	1	2	-	-	-	-	-	-	-	-	1	2	1
Avg	2.4	2	1	2	-	-	-	-	-	-	-	-	1	2	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM04	SIGNAL PROCESSING						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**	
		Hours/Week	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	To understand and perform Fourier and Laplace analysis on signals and systems respectively.
2.	To analyse the Discrete Fourier Transform, Fast Fourier Transform algorithms.
3.	To design and realize IIR, FIR filters.

Unit I	INTRODUCTION TO SIGNALS AND SYSTEMS	9	0	0	9

Classification of Signals: Even and Odd Signal - Energy and power signals - Continuous time (CT) and Discrete time (DT) signals - Continuous and Discrete amplitude signal -. System properties and representation: linearity - Tme-invariance – Causality – Stability - Realizability. - Linear Time-Invariant (LTI) systems: Impulse response and step response – Convolution – Correlation - System representation through differential equations and difference equations.

Unit II	ANALYSIS OF SIGNAL AND SYSTEMS	9	0	0	9

Introduction to Fourier Transform, Fourier Series, Relating the Laplace Transform to Fourier Transform, Frequency response of continuous time systems. Introduction to z- Transform.

Unit III	DISCRETE FOURIER TRANSFORM	9	0	0	9

Introduction to DFT – Properties of DFT - Circular convolution - FFT algorithms – Radix-2 FFT algorithms – Decimation in Time and Decimation in Frequency algorithms.

Unit IV	INFINITE IMPULSE RESPONSE FILTER DESIGN	9	0	0	9

Characteristics of Analog Butterworth filter - Chebyshev filter - Low pass filter, High pass filter, Band pass filter and Band stop filter - Transformation of analog filters in to equivalent digital filters using bilinear transformation method - Realization structure for IIR filters-Direct form - Cascade form - Parallel form.

Unit V	FINITE IMPULSE RESPONSE FILTER DESIGN	9	0	0	9

Linear phase response of FIR filter - FIR design using window method: Rectangular, Hamming, Hanning and Blackmann Windows - Park-McClellan's method - Realization structures for FIR filters - Linear phase structures and Direct form structure - Comparison of FIR and IIR filters.

Total (45L)= 45 Periods

Text Books:

1.	A.Anand Kumar, “Signals and Systems” , 3rd Edition, PHI, 2013.
2.	John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, 4th Edition, Pearson Education, 2009.

Reference Books:	
1.	Alan V Oppenheim, Alan S Willsky and S Hamid Nawab, “Signals and Systems”, 2nd edition, PHI Learning Private Limited, New Delhi, 2010.
2.	B.P. Lathi, "Principles of Signal Processing and Linear Systems", Oxford University Press, 2009.
3.	Emmanuel C. Ifeacher, Barry W. Jervis, “Digital Signal Processing: A Practical Approach”, 2nd Edition, Pearson Education, 2004.
4.	S.K. Mitra, “Digital Signal Processing, A Computer Based approach”, 4th Edition, McGraw-Hill, 2010.
E-References:	
1.	http://nptel.ac.in/courses/117104074/
2.	https://www.coursera.org/learn/dsp
3.	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/

Course Outcomes: Upon completion of this course, the students will be able to:		Bloom’s Taxonomy Mapped
CO1	Analyse and understands different types of signals.	Analysing
CO2	Represent continuous signals and systems in time and frequency domain using different transforms.	Analysing
CO3	Analyse the need for Discrete Fourier Transform, Fast Fourier Transform algorithms in digital signals & systems.	Analysing
CO4	Design and realize IIR filters.	Applying
CO5	Design and realize FIR filters.	Applying

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	-	-	-	2	2	2
CO2	3	2	2	3	3	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO4	3	2	2	2	1	-	1	-	-	-	-	-	1	1	1
CO5	1	1	1	1	1	-	-	-	-	-	-	-	2	2	1
Avg	2.6	1.8	2	2.2	1.8	2	1						1.6	1.6	1.4

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

18ECM05	MICROPROCESSORS AND MICROCONTROLLERS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To familiarise with 8086 and 8051 architectures.
2.	To interface 8086 microprocessor and 8051 microcontrollers with peripherals by programming.
3.	To gain basic knowledge of PIC microcontrollers.

Unit I	**8086 MICROPROCESSOR ARCHITECTURE**	9	0	9
Overview of Microcomputer systems-8086 Architecture – Pin Assignments – Internal Architecture – Addressing modes- Instruction Formats- Directives and Operators-Assembly process.				
Unit II	**PROGRAMMING AND INTERFACING OF 8086**	9	0	9
Fundamental I/O considerations- Programmed I/O- Interrupt I/O- Basic 8086 Configurations- Minimum Mode-Maximum Mode-System Bus timing- I/O Interfaces-Peripheral Interfacing using 8255 PPI - 8279 Keyboard/Display controller - 8251 USART.				
Unit III	**8051 ARCHITECTURE**	9	0	9
8051 architecture - Registers in 8051 - Pin description - 8051 parallel I/O ports - memory organization - Instruction set –– Addressing modes				
Unit IV	**PROGRAMMING AND INTERFACING OF 8051**	9	0	9
Assembly language programming.8051Timers - Serial Port Programming - Interrupts Programming - LCD and Keyboard Interfacing - ADC, DAC and Sensor Interfacing - Motor Control.				
Unit V	**PIC MICROCONTROLLERS**	9	0	9
Main characteristics of PIC microcontrollers – PIC microcontroller families-Memory-Program Memory – RAM Data Memory - Instruction set and timers in PIC				
				Total (L+T) = 45 periods

Text Books:	
1.	Yu-Cheng Liu, Glenn A. Gibson," Microcomputer Systems, The 8086/8088 Family", Pearson, 2e, 2019.
2.	Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2e, 2022.
Reference Books:	
1.	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson education, 2011.
2.	Martin Bates,"PIC Microcontrollers-An Introduction to Microelectronics", 3e, Elsevier, 2011.
3.	Mathur Sunil,"Microprocessor 8086: Architecture, Programming and Interfacing" PHI Learning Pvt. Ltd. 2011.
4.	Salvador PinillosGimenez," 8051 Microcontrollers Fundamental Concepts, Hardware, Software and Applications in Electronics", Springer 2019.
E-References:	
1.	Ashraf Almadhoun,"A Detailed Look Into PIC Microcontroller and Its Architecture", Amazon 2020.
2.	https://nptel.ac.in/courses/108105102
3.	http://www.satishkashyap.com/2012/02/video-lectures-on-microprocessors-and.html

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe and analyse the architecture of 8086 microprocessor and 8051 architectures.	Remembering
CO2	Develop assembly language programs and Interface peripherals with 8086.	Applying
CO3	Develop assembly language programs and Interface peripherals with 8051.	Applying
CO4	Determine application specific circuit for real-time applications.	Understanding
CO5	Associate appropriate PIC microcontroller for a given application.	Understanding

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	2	2	-	-	-	-	-	-	-	-	2	-	1	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
Avg	2	2	2	2	-	-	-	-	-	-	2	-	1.8	2	2

18ECM06	ANALOG AND DIGITAL COMMUNICATION					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Understand analog and digital communication techniques.
2.	Learn data and pulse communication techniques.
3.	Be familiarized with source and Error control coding.

Unit I	**INFORMATION THEORY**	**9**	**0**	**0**	**9**

Uncertainty, information and entropy – Source coding theorem – Shannon Fano coding – Huffman coding – Discrete memoryless channels – Mutual information – Channel capacity – Channel coding theorem.

Unit II	**ANALOG COMMUNICATION**	**9**	**0**	**0**	**9**

Noise: Source of Noise – External Noise- Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types – Need for Modulation. Theory of Amplitude Modulation – Evolution and Description of SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

Unit III	**DIGITAL COMMUNICATION**	**9**	**0**	**0**	**9**

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

Unit IV	**PULSE COMMUNICATION AND MULTIPLE ACCESS TECHNIQUES**	**9**	**0**	**0**	**9**

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM). Multiple access techniques: FDMA, CDMA, TDMA, SDMA.

Unit V	**ERROR CONTROL CODING**	**9**	**0**	**0**	**9**

Linear block codes - Cyclic codes - Convolution codes – Maximum likelihood decoding of convolutional codes – Sequential decoding of convolutional codes – Trellis codes – Applications.

Total (45L)= 45 Periods

Text Books:

1.	Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2014.
2.	J.G.Proakis, M.Salehi, ―Fundamentals of Communication Systems‖, Pearson Education 2014.

Reference Books:

1.	B.P.Lathi, ―Modern Digital and Analog Communication Systems‖, 4th Edition, Oxford University Press, 2013.
2.	D.Roody, J.Coolen, ―Electronic Communications, 4th edition PHI 2015.
3.	B.Sklar, ―Digital Communications Fundamentals and Applications‖, 5th Edition Pearson Education 2017
4.	H P Hsu, Schaum Outline Series - ―Analog and Digital Communications‖ TMH, 5th edition 2006

E-References:

1.	https://onlinecourses.nptel.ac.in/noc21_ee74/preview
2.	https://nptel.ac.in/courses/117101051
3.	https://www.digimat.in/nptel/courses/video/117105143/L51.html

Course Outcomes: Upon completion of this course, the students will be able to:			Bloom's Taxonomy Mapped
CO	:	Apply the concepts of Random Process to the design of Communication	Applying
CO	:	Apply analog and digital communication techniques.	Applying
CO	:	Understand the use of data and pulse communication techniques.	Understanding
CO	:	Analyze Source and Error control coding.	Analysing
CO	:	Design AM communication systems and Angle modulated communication	Applying

COURSE ARTICULATION MATRIX															
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	2	1	1	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-	3	2	1
CO3	2	2	2	3	1	-	-	-	-	-	-	-	3	2	-
CO4	1	1	2	1	2	-	-	-	-	-	-	-	2	3	-
CO5	1	1	2	2	2	-	-	-	-	-	-	-	2	3	1
Avg	1.8	1.8	2	1.6	1.4	-	-	-	-	-	-	-	2.6	2.5	1
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM07	COMMUNICATION NETWORKS						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Objectives:

1.	Understand the division of network functionalities into layers.
2.	Be familiar with the components required to build different types of networks
3.	Be exposed to the required functionality at each layer
4.	Learn the flow control and congestion control algorithms

Unit I	**FUNDAMENTALS & LINK LAYER**	9	0	0	9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction

Unit II	**MEDIA ACCESS & INTERNETWORKING**	9	0	0	9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols (IP, ICMP, Mobile IP)

Unit III	**ROUTING**	9	0	0	9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6

Unit IV	**TRANSPORT LAYER**	9	0	0	9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmiision Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

Unit V	**APPLICATION LAYER**	9	0	0	9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need forCryptography and Network Security – Firewalls.

Total (45L)= 45 Periods

Text Books:

1.	Behrouz A Forouzan, Data Communications and Networking, 4th Edition, 2020

2.	James F. Kurose, Keith W. Ross, Computer Networking - A Top-Down Approach Featuring the Internet, Seventh Edition, Pearson Education, 2016.
Reference Books:	
1.	Nader. F. Mir,“ Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2nd Edition, 2014.
2.	Alberto Leon-Garcia, IndraWidjajaCommunication Networks 2nd Edition McGraw-Hill Education, 2003
3.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
E-References:	
1.	https://onlinecourses.nptel.ac.in/noc22_ee61/preview
2.	https://www.ee.iitb.ac.in/~sarva/courses/EE706/2012/EE706LecNotes.pdf
3.	http://www.cs.kent.edu/~farrell/net01/lectures/

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Explain the basic concept in modern data communication and different level of layers in the protocol	Understanding
CO2	Analyse the functions and services of data link layer	Analysing
CO3	Categorize the functions and services of network layer	Understanding
CO4	Examine the basic functions of transport layer and congestion in networks	Understanding
CO5	Analyse the concepts of various network applications and data security	Analysing

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	1	1	-	1	-	-	-	-	-	-	-	2	-	1
CO2	2	1	2	-	1	-	-	-	-	-	-	-	2	1	1
CO3	2	1	1	-	-	-	-	-	-	-	-	-	3	1	2
CO4	3	2	1	-	2	-	-	-	-	-	-	-	2	-	2
CO5	2	1	1	-	1	-	-	-	-	-	-	-	1	1	1
Avg	2.2	1.2	1.2	-	1.25	-	-	-	-	-	-	-	2	1	1.4
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM08	INTERNET OF THINGS						
PREREQUISITES		**CATEGORY**	**OE**	**Credit**			**3**
		Hours/Week	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Objectives

1	To understand Smart Objects and IoT Architectures
2	To learn about various IOT-related protocols
3	To build simple IoT Systems using Arduino and Raspberry Pi
4	To understand data analytics and cloud in the context of IoT
5	To develop IoT infrastructure for popular applications

Unit I	**FUNDAMENTALS OF IOT**	**9**	**0**	**0**	**9**
Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects					
Unit II	**IoT PROTOCOLS**	**9**	**0**	**0**	**9**
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT					
Unit III	**DESIGN AND DEVELOPMENT**	**9**	**0**	**0**	**9**
Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.					
Unit IV	**DATA ANALYTICS AND SUPPORTING SERVICES**	**9**	**0**	**0**	**9**
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG					
Unit V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**
Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control					
Total (45 L) = 45 Periods					

Text Books:

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2	ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

Reference Books:

1	Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).

2	Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
4	Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.
E-References:	
1	https://online.stanford.edu/courses/xee100-introduction-internet-things
2	https://www.udemy.com/topic/internet-of-things/
3	https://www.netacad.com/courses/iot

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the concept of IoT.	Understanding
CO2	Analyze various protocols for IoT.	Applying
CO3	Design a PoC of an IoT system using Rasperry Pi/Arduino	Applying
CO4	Apply data analytics and use cloud offerings related to IoT.	Applying
CO5	Analyze applications of IoT in real time scenario	Analysing

COURSE ARTICULATION MATRIX

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO2	2	1	2	1	1	-	-	-	-	-	1	-	2	2	2
CO3	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
CO4	2	2	2	1	1	-	-	-	-	-	1	-	2	2	2
CO5	2	2	3	2	1	-	-	-	-	-	2	-	2	2	2
Avg	2	1.6	2.4	1.4	1	-	-	-	-	-	1.4	-	2	2	2

3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)

18ECM09	WIRELESS SENSORS AND NETWORKING					
PREREQUISITE:		**CATEGORY**	**OE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	Learn fundamental of Ad hoc network and architecture
2.	Understand the MAC and routing protocols.
3.	Have an in-depth knowledge on QoS, security and sensor network platforms

Unit I	**ROUTING PROTOCOLS**	9	0	0	9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

Unit II	**ARCHITECTURES OF WSN**	9	0	0	9

WSN application examples, Types of applications, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Single-Node Architecture: Hardware Components, Energy Consumption of Sensor Nodes, Operating systems and execution environments

Network Architecture: Sensor Network Scenarios, Optimization goals and figures of merit, Design principles of WSN, Service interfaces of WSNs, gateway concepts.

Unit III	**MAC PROTOCOLS AND ROUTING PROTOCOLS**	9	0	0	9

Image compression: Predictive techniques – PCM – DPCM - DM - Transform coding - Introduction to JPEG - JPEG-2000 - JBIG standards - Study of EZW. Video compression: Video signal representation – ITU-T Recommendation H.261 – Model based coding – The MPEG-1 Video Standard - The MPEG-2 Video Standard: H.262 - ITU-T Recommendation H.263.

Unit IV	**QUALITY OF SERVICE AND ADVANCED APPLICATION SUPPORT**	9	0	0	9

Quality of Service: Coverage and deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control - Advanced application support: Advanced in-network processing, Security and Application-specific support.

Unit V	**SENSOR NETWORK PLATFORMS AND TOOLS**	9	0	0	9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

Total (45L) = 45 Periods

Text Books:	
1.	C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education – 2008
2.	Holger Karl and Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2007.
Reference Books:	
1.	Feng Zhao and LeonidesGuibas, "Wireless sensor networks ", Elsevier publication - 2004.
2.	Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
3.	William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004
4.	I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”, Computer Networks, Elsevier, 2002, 394 - 422.
E-References:	
1.	https://nptel.ac.in/courses/106105183
2.	https://nptel.ac.in/courses/106105183
3.	https://archive.nptel.ac.in/courses/106/105/106105160/

Course Outcomes: Upon completion of this course, the students will be able to		**Bloom’s Taxonomy Mapped**
CO1	Know the basics of Ad hoc networks and Wireless Sensor Networks	Understanding
CO2	Have a knowledge on architecture of Wireless Sensor Networks	Applying
CO3	Apply the knowledge to identify MAC and routing protocols	Applying
CO4	Understand the transport layer and security issues possible in Ad hoc and sensor networks	Understanding
CO5	Be familiar with the OS used in Wireless Sensor Networks and build basic modules	Remembering

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	3	1	3	3	3	2	-	-	-	3	3	3	-	2
CO2	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
CO3	3	3	3	3	3	3	2	-	-	-	3	3	3	-	2
CO4	3	3	2	3	3	3	2	-	-	-	2	3	3	-	2
CO5	3	3	2	3	3	3	2	-	-	-	3	3	3	-	2
Avg	3	3	2	3	3	3	2	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

18ECM10	BASICS OF EMBEDDED SYSTEMS					
PREREQUISITES		**CATEGORY**	**OE**	**Credit**		**3**
Microprocessors and Mmicrocontrollers		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives	
1	To impart knowledge on embedded system architecture and embedded development Strategies
2	To understand the bus Communication in processors and peripheral interfacing
3	To understand basics of Real Time Operating System

UNIT I	**BASICS OF EMBEDDED SYSTEMS**	9	0	0	9
Introduction - Fundamental Components of Embedded Systems - Challenges for Embedded Systems - Examples - Programming Languages - Recent Trends in Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Selection Process - Hardware Software Partitioning - Development Environment.					
UNIT II	**MEMORY MANAGEMENT AND INTERRUPTS**	9	0	0	9
Memory Access Procedure - Types of Memory - Memory Management Methods - DMA – Memory Interfacing - Polling Vs Interrupts - Types of Interrupts - Interrupt Latency - Interrupt Priority – Programmable Interrupt Controllers - Interrupt Service Routines					
UNIT III	**COMMUNICATION INTERFACES**	9	0	0	9
Interfacing Buses - Serial Interfaces - RS232/UART - RS422/RS485 - I2C Interface - SPI Interface - USB – CAN - IRDA - Ethernet - IEEE 802.11 – Bluetooth					
UNIT IV	**REAL TIME OPERATING SYSTEMS**	9	0	0	9
Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Inter Task Communication - Mutex - Semaphores - Message Queues - Timers - Commercial RTOS.					
UNIT V	**VALIDATION AND DEBUGGING**	9	0	0	9
Host and Target Machines - Validation Types and Methods - Host Testing - Host-Based Testing Setup - Target Testing - Remote Debuggers and Debug Kernels - ROM Emulator - Logical Analyzer – Background Debug Mode - InCircuit Emulator CASE STUDY: RFID Systems - GPS Navigation System – Development of Protocol Converter.					
Total (45 L) = 45 Periods					

Text Books:	
1	Sriram V Iyer and Pankaj Gupta, ―Embedded Real-time Systems Programming‖, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2	Arnold S Berger, ―Embedded Systems Design - An Introduction to Processes, Tools and Techniques, Elsevier, New Delhi, 2011.
Reference Books:	
1	Prasad K V K K, ―Embedded/Real-Time Systems: Concepts, Design and Programming – The Ultimate Reference, Himal Impressions, New Delhi, 2003
2	Heath, "Embedded Systems Design‖", Newnes an Imprint of Elsevier, Massachusetts, 2003.
3	Tammy Noergaard, "Embedded Systems Architecture‖, Newnes an Imprint of Elsevier, Massachusetts, 2006.
4	Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013
E-References:	
1	https://lecturenotes.in/subject/225/embedded-system-es
2	https://nptel.ac.in/courses/108102045/19

3	https://www.coursera.org/learn/introduction-embedded-systems.

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Course Outcomes: Upon completion of this course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Outline the concepts of embedded systems	Understanding
CO2	Understand the concept of memory management system and interrupts.	Understanding
CO3	Know the importance of interfaces.	Understanding
CO4	Understand real time operating system concepts.	Understanding
CO5	To realize the applications of validation and debugging.	Applying

COURSE ARTICULATION MATRIX															
COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	3	3	1	3	-	-	-	-	-	-	3	3	3	-	2
CO2	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
CO3	3	3	3	3	-	-	-	-	-	-	3	3	3	-	2
CO4	3	3	2	3	-	-	-	-	-	-	2	3	3	-	2
CO5	3	3	2	3	-	-	-	-	-	-	3	3	3	-	2
Avg	3	3	2	3	-	-	-	-	-	-	2.8	3	3	-	2
3/2/1 - indicates strength of correlation (3-High,2- Medium,1- Low)															

B.E. - ELECTRICAL AND ELECTRONICS ENGINEERING - MINOR DEGREE

18EEM01	**LINEAR AND DIGITAL ELECTRONICS CIRCUITS**		**SEMESTER**			
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Electron Devices and Circuits		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge on the characteristics& applications of Operation Amplifier, functional diagram and applications of linear ICs.
2.	To simplify the switching functions
3.	To design the combinational logic circuits and sequential logic circuits

Unit I	**OPERATIONAL AMPLIFIERS**	**9**	**0**	**0**	**9**

Operational amplifiers - Equivalent circuit, voltage transfer curve - Open loop Op-amp configurations –Voltage series, Voltage shunt feedback amplifiers configurations, closed loop differential amplifiers for single and differential outputs.
Output offset voltage, minimizing output offset voltage due to input bias current and input offset current, factors affecting off set parameters, CMRR - Open loop and closed loop frequency response of op-amps, circuit stability, slew rate and its effects in applications.

Unit II	**APPLICATION OF OPERATIONAL AMPLIFIER AND LINEAR ICS**	**9**	**0**	**0**	**9**

DC & AC amplifiers- Summing, Scaling and Averaging amplifiers-Instrumentation amplifier- Voltage to Current converter for floating and grounded loads - Current to voltage converter - Integrator, Differentiator. Voltage comparators - Zero Crossing Detector - Schmitt trigger with voltage limiter- Precision Rectifier Circuits-Peak Detector-Sample and Hold circuit, Active Filters - Frequency response characteristics of major active filters, first and higher order low pass and high pass filters, all pass filters.
Functional block diagram and Applications of Linear ICs: IC 555 Timer -IC 566 Voltage controlled oscillator- IC 565 Phase-locked loops - IC LM317 voltage regulators.

Unit III	**COMBINATIONAL LOGIC CIRCUITS**	**9**	**0**	**0**	**9**

Representation of logic functions: SOP and POS forms - Simplification of switching functions: K-maps method and QuineMcCluskey (Tabulation) method.
Design:Adders -Subtractors– 2 bit Magnitude Comparator-Multiplexer- Demultiplexer- Encoder - Priority Encoder - Decoder – Code Converters. Implementation of combinational logic circuits using multiplexers and Decoder.

Unit IV	**SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS**	**9**	**0**	**0**	**9**

Flip-flops: SR, D, JK and T- Conversion of flip-flops; Classification of sequential circuits: Moore and Mealy models - Analysis and design of synchronous sequential circuits - Design of synchronous counters- Universal shift register.

Unit V	**ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS**	**9**	**0**	**0**	**9**

Fundamental mode and pulse mode circuits , Analysis procedure of asynchronous circuits with /without using of SR latches-primitive state / flow table – Reduction of state and flow table - state assignment –Design Procedure of asynchronous circuits with /without using of SR latches-Problems in asynchronous sequential circuits: cycles -Races –Hazards.

Total (45L+0T) = 45 Periods

Text Books:

1.	Ramakant A Gayakward, “Op-Amps and Linear Integrated Circuits”, Fourth Edition, Pearson Education, 2003.
2.	Donald.E.Neaman, “Electronic Circuit, Analysis and Design”, Tata McGraw Hill Publishing Company Limited, Second Edition, 2002.
3.	D.Roy Chowdhury and Shail B. Jain, “Linear Integrated Circuits”, Fourth Edition, New Age International (P) Ltd Publishers, 2014.
4.	M. Morris Mano, “Digital Design” , Third Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2010 .
5.	S. Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Third Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 201

Reference Books:

1.	Jacob Millman, Christos C.Halkias, “Integrated Electronics - Analog and Digital circuits system”, Tata McGraw Hill 2003.
2.	R.P.Jain, “Modern Digital Electronics”, Third Edition, Tata McGraw–Hill Publishing company limited, New Delhi, 2011.
3.	Thomas L. Floyd, “Digital Fundamentals”, Pearson Education, Inc, New Delhi, 2015
4.	Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, Fifth Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the Op-amp characteristics	L2: Understanding
CO2	:	Understand the applications of Op-amp and other linear ICs.	L2: Understanding
CO3	:	Apply K-map and Tadulation methods to simplify the switching functions	L3: Applying
CO4	:	Design and implement of combinational logic circuits	L6: Creating
CO5	:	Analyse and design of synchronous & asynchronous sequential logic circuits	L4: Analyzing

COURSE ARTICULATION MATRIX

CO/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1											2		
CO2	3	2	1	1									3		
CO3	3	2		2	2								3	3	
CO4	3	2	3	1	2							2	3	3	1
CO5	3	2	3	1	2							2	3	3	1
Avg.	**2.8**	**1.8**	**2.3**	**1.25**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.8**	**3**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM02	MICROPROCESSOR AND MICROCONTROLLER		SEMESTER				
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**			**3**
C Programming		**Hours/Week**	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Objectives:					
1.	To study the architecture of µP8085 and µC 8051.				
2.	To study the Interrupt structure of 8085 and 8051.				
3.	To do simple applications development with programming 8085 and 8051.				
UNIT I	**8085 8 BIT MICROPROCESSOR**	**9**	**0**	**0**	**9**
Fundamentals of microprocessors – Architecture of 8085 – Groups of Instructions - Addressing modes – Basic timing diagram – Organization and addressing of Memory and I/O systems –Interrupt structure – Stack and sub-routines - Simple 8085 based system design and programming.					
UNIT II	**8051 8 BIT MICROCONTROLLER**	**9**	**0**	**0**	**9**
Fundamentals of microcontrollers – Architecture of 8051 – Groups of Instructions - Addressing modes – Organization of Memory systems – I/O Ports – Timers/Counters – Serial Port - Interrupt structure – Simple programming concepts using Assemblers and Compliers.					
UNIT III	**INTERFACING WITH 8051 MICROCONTROLLER**	**9**	**0**	**0**	**9**
Need and requirements of interfacing – Interfacing – LED, 7 segment and LCD Displays – Tactile switches, Matrix keyboard – Parallel ADC – DAC – Interfacing of Current, Voltage, RTD and Hall Sensors.					
UNIT IV	**EXTERNAL COMMUNICATION INTERFACE**	**9**	**0**	**0**	**9**
Synchronous and Asynchronous Communication. RS232, RS 485, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.					
UNIT V	**APPLICATIONS OF MICROCONTROLLERS**	**9**	**0**	**0**	**9**
Simple programming exercises- key board and display interface –Control of servo motor stepper motor control- Application to automation systems.					
					Total (45L+0T)= 45 Periods

Text Books:	
1.	R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2.	K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.
3.	Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
Reference Books:	
1.	R. Kamal, "Embedded System", McGraw Hill Education, 2009.
2.	D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.
E-References;	
1.	www.onlinecourses.nptel.ac.in/noc18_ee41
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand basics of microprocessor and microcontroller	L2: Understanding
CO2	:	Understand the architecture of Microprocessor and Microcontroller	L1: Remembering
CO3	:	Apply the digital concepts to measure and control simple electrical systems	L3: Applying
CO4	:	Design and interface communications between digital systems	L2: Understanding
CO5	:	Design a microcontroller based electrical control system.	L5: Evaluating

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	1	1								1	1	1	
CO2	2	1	1	1								1	1	1	
CO3	2	3	2	3	2							1	1	1	2
CO4	2	3	3	3	2							2	2	2	2
CO5	2	3	3	3	2							2	2	2	2
Avg.	**2**	**2.2**	**2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.4**	**1.4**	**1.4**	**2**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM03	CONTROL SYSTEMS		SEMESTER			
PREREQUISTIES		CATEGORY	PE	Credit		3
Electrical Machines and Electric circuit analysis		Hours/Week	L	T	P	TH
			1	1	0	3
Course Objectives:						
1.	To understand the methods of representation of physical systems and getting their transfer function models.					
2.	To provide adequate knowledge in the time response of systems and steady state error analysis.					
3.	To give basic knowledge in obtaining the open loop and closed loop frequency response of systems.					
4.	To understand the concept of stability of control system and methods of stability analysis.					
5.	To study the designing compensators for a feedback control system.					
UNIT I	**MODELLING OF LINEAR TIME INVARIANT SYSTEMS**		**6**	**9**	**0**	**9**
Basic elements in control systems – Open and closed loop systems – Feedback control system characteristics - Mathematical model and Electrical analogy of mechanical systems – Transfer function Representation– Synchro – AC and DC servo-motors – Block diagram reduction techniques – Signal flow graphs.						
UNIT II	**TIME RESPONSE ANALYSIS**		**6**	**3**	**0**	**9**
Standard test signals – Time response of first order and second order systems –time domain specifications - Steady-state errors and error constants – Type and order of control systems – Effect of adding poles and zeros to transfer functions – Response with P, PI, PD and PID controllers.						
UNIT III	**FREQUENCY RESPONSE ANALYSIS**		**6**	**3**	**0**	**9**
Correlation between time and frequency response: Second order systems – Frequency domain specifications - Polar plots – Bode plots – Computation of Gain Margin and Phase Margin — Constant M and N-circles – Nichols chart.						
UNIT IV	**STABILITY OF CONTROL SYSTEM**		**6**	**3**	**0**	**9**
BIBO stability – Necessary conditions for stability – Routh-Hurwitz stability criterion – Root locus concepts – Rules for the construction of Root loci – Nyquist stability criterion – Assessment of relative stability using Nyquist criterion.						
UNIT V	**COMPENSATOR AND CONTROLLER DESIGN**		**6**	**3**	**0**	**9**
Need for compensation – Types of compensators – Electric network realization and frequency characteristics of basic compensators: Lag, lead and lag-lead compensators – Design of compensators using root locus and Bode plot techniques- PID controller: Design using reaction curve and Ziegler - Nichols technique.						
Total (30L+15T) = 45 Periods						

Text Books:	
1.	A. Anand Kumar, “Control Systems”, PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2017.
2.	I.J. Nagrath, and M. Gopal, “Control Systems Engineering”, New Age International Publishers, Delhi, 7th Edition, 2021.
Reference Books:	
1.	K. Ogata, “Modern Control Engineering”, Pearson Education, New Delhi, 5th Edition, 2021.
2.	M. Gopal, “Control Systems: Principles and Design”, TMH, New Delhi, 4th Edition, 2018.
E-Reference	
1.	https://nptel.ac.in/courses/107106081
2.	https://nptel.ac.in/courses/108106098

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Develop the transfer function models of any electrical and electro-mechanical systems.	L2: Understanding
CO2	:	Obtain the time responses of the systems and construct root locus plot.	L3: Applying
CO3	:	Analyze the frequency response of the system	L3: Applying
CO4	:	Analyze the absolute / relative stability of a control system.	L4: Analyzing
CO5	:	Design the compensators and PID controller of a feedback control system.	L3: Applying

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	2	2	2							1	3	2	1
CO2	3	3	3	2	2							1	3	2	1
CO3	3	3	3	2	2							1	3	2	1
CO4	3	3	3	2	2							1	3	2	1
CO5	3	3	3	2	2							1	3	2	1
Avg	**3**	**3**	**2.8**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM04	MEASUREMENTS AND INSTRUMENTATION			SEMESTER			
PREREQUISTIES			**CATEGORY**	**PE**	**Credit**		**3**
Electric Circuit Analysis			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To educate the fundamental concepts and characteristics of measurement System
2.	To introduce the fundamentals of electrical and electronic instruments for measurement of Electrical and Non-electrical quantities
3.	To familiarize Oscilloscope and the bridge circuits for electrical parameters measurement

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement. Measurement of voltage and current - permanent magnet moving coil and moving iron type meters

UNIT II	**MEASUREMENT OF POWER , ENERGY AND FREQUENCY**	**9**	**0**	**0**	**9**

Measurement of power - single and three phase- electrodynamometer type watt meters – Construction, operation – torque equation for deflection – errors. Measurement of energy-Single phase induction type energy meters, Instrument transformers – Current and Potential transformers, Power factor meters- Single phase electrodynamometer type power factor meter, frequency meter-Electrical resonance type frequency meter

UNIT III	**DC AND AC BRIDGES**	**9**	**0**	**0**	**9**

Balance equations - Wheatstone bridge – Kelvin double Bridge –Maxwell's inductance capacitance bridge – Hay's bridge – Anderson's bridge – Schering bridge and De Sauty's bridge

UNIT IV	**POTENTIOMETERS, OSCILLOSCOPES AND DIGITAL INSTRUMENTS**	**9**	**0**	**0**	**9**

DC Potentiometer- Crompton's Potentiometer, AC potentiometer– Drysdale polar potentiometer- Gall Tinsley co-ordinate type potentiometer, Cathode Ray Oscilloscope and Digital storage Oscilloscope-Construction, operation and Applications, Digital multi-meters, Digital voltmeters.

UNIT V	**MEASUREMENT OF NON-ELECTRICAL QUANTITIES**	**9**	**0**	**0**	**9**

Classification of transducers –Position transducers, Piezo-electric transducers and Hall effect transducers. Measurement of pressure, temperature and displacement– Introduction to Smart Sensors

Total (45L+0T)= 45 Periods

Text Books:

1.	A.K. Sawhney, 'A Course in Electrical & Electronics Measurement & Instrumentation', Dhanpat Rai and Co, 2015
2.	E.O. Doebelin, 'Measurements Systems- Application and Design', Tata McGraw Hill publishing company, 2015.

Reference Books:

1.	D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt. Ltd, 2010.
2.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 2015.
3.	Martin Reissland, ' Electrical Measurements', New Age International(P) Ltd., Delhi, 2011.

E-Reference:

1	https://archive.nptel.ac.in/courses/108/105/108105153/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Recall the fundamentals of measurement system in electrical engineering.	L1: Remembering
CO2	:	Describe the working principle of different measuring instruments	L2: Understanding
CO3	:	Choose appropriate instrument for measuring the electrical parameters	L3: Applying
CO4	:	Employ the digital instruments in real time measurements.	L3: Applying
CO5	:	Select an appropriate transducer for measurement of non-electrical quantities	L4: Analysing

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	3				1		2		2	2	1	1
CO2	1	3			3					2		1	2	1	
CO3	1	1		2	1	1	2		1				1	2	1
CO4	1	1		1	1		2	2	1		2	2	1	3	1
CO5	2	2	3	1	2	2	1			1	3		1	2	
Avg	**1.4**	**1.8**	**2.5**	**1.75**	**1.75**	**1.5**	**1.67**	**1.5**	**1**	**1.67**	**2.5**	**1.67**	**1.4**	**1.8**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM05	ELECTRICAL MACHINES		SEMESTER			
PREREQUISTIES		CATEGORY	PE	Credit		3
		Hours/Week	L	T	P	TH
			3	0	0	3

Course Objectives:

1.	To impart knowledge on construction, working and performance of DC generators and motors.
2.	To deliberate the construction, working and performance of single phase and three phase transformers.
3.	To impart knowledge on construction, working and performance of synchronous generators and motors.
4.	To impart knowledge on construction, principle of operation and performance of single and three-phase induction motors.

UNIT I	DC GENERATORS	9	0	0	9

Principle of operation, constructional details, types - EMF equation, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, Open circuit and load characteristics of different types of DC Generators. Parallel operation of DC Generators, applications of DC Generators.

UNIT II	DC MOTORS	9	0	0	9

Principle of operation, significance of back emf, torque equation and power developed by armature, load characteristics of shunt, series and compound type motors, starting methods, speed control methods - losses and efficiency calculation, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Retardation test, Separation of core losses - applications of DC motors**.**

UNIT III	TRANSFORMER	9	0	0	9

Single phase transformer: Construction and principle of operation, working of practical transformer - equivalent circuit, voltage regulation, losses and efficiency- testing : polarity test, open circuit and short circuit tests, back-to back test, all day efficiency, parallel operation, applications.

Autotransformer: Construction and working, saving of copper - applications, **Three phase transformer**: construction, types of connections and their comparative features.

UNIT IV	SYNCHRONOUS GENERATOR AND MOTOR	9	0	0	9

Synchronous Generator: Constructional and working details – Types of rotors – EMF equation – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus - Synchronizing and parallel operation – Synchronizing torque - Voltage regulation – EMF, MMF and ZPF method – steady state power angle characteristics – Two reaction theory – slip test.

Synchronous Motor: Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power Developed -Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT V	THREE PHASE AND SINGLE PHASE INDUCTION MOTOR	9	0	0	9

Three phase induction motor: Constructional details – Types of rotors –- Principle of operation – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Starters: DOL, Autotransformer and Star delta starters – Speed control methods: Voltage control, Frequency control and pole changing – V/f control – Slip power recovery Scheme.

Single phase induction motor: Constructional details – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – split phase, Capacitor-start, capacitor start and capacitor run Induction motor.

Total (45L+0T)= 45 Periods

Text Books:

1.	I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2.	P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
3.	B.L.Theraja and A.K.Theraja," A text book of Electrical Technology - Volume-II", S.Chand & Company Ltd., New Delhi, 23rd Edition, 2009.

Reference Books:

1.	B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.

2.	Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition, 2010.
3.	A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education, 2017.
4.	Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 4th Edition 2017.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Explain the construction and working principle of DC machines, and Interpret various characteristics of DC machines.	L2: Understanding
CO2	:	Compute various performance parameters of the machine, by conducting suitable tests.	L5: Evaluating
CO3	:	Describe the working principle of transformer, auto transformer, three phase transformer connection, and determine the efficiency and regulation.	L3: Applying
CO4	:	Understand the construction and working principle of Synchronous Machines.	L3: Applying
CO5	:	Understand the construction and working principle, speed control of three phase and single phase induction motor.	L5: Evaluating

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	3	1	1	1			1				1	3	2	1
CO2	3	3	1	1	1			1				1	3	2	1
CO3	3	3	1	1	1			1				1	3	2	1
CO4	3	3	1	1	1			1				1	3	2	1
CO5	3	3	1	1	1			1				1	3	2	1
Avg.	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**3**	**2**	**1**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM06	ELECTRICAL DRIVES AND CONTROL		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
DC Machines and Transformers, Synchronous and Induction Machines, and Power Electronics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To know about the operation analyse of chopper fed DC drive, both qualitatively and quantitatively.
2.	To understand the operation and performance of AC motor drives.

UNIT I	**DC MOTOR CHARACTERISTICS & CHOPPER FED DC DRIVES**	**9**	**0**	**0**	**9**

Review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed. Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper.

UNIT II	**MULTI-QUADRANT & CLOSED-LOOP CONTROL OF DC DRIVE**	**9**	**0**	**0**	**9**

Review of Four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, current controller specification and design, speed controller specification and design.

UNIT III	**INDUCTION MOTOR CHARACTERISTICS**	**9**	**0**	**0**	**9**

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency. Review of three-phase voltage source inverter, generation of three-phase PWM signals, constant V/f control of induction motor

UNIT IV	**CONTROL OF SLIP RING INDUCTION MOTOR**	**9**	**0**	**0**	**9**

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery. .

UNIT V	**CONTROL OF SRM AND BLDC MOTOR DRIVES.**	**9**	**0**	**0**	**9**

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine - Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlledd Brushless dc motor drive

Total (45L+0T)= 45 Periods

Text Books:

1.	G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2.	R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall,2010
3.	Bose B K, "Modern Power Electronics and AC Drives", Pearson Education New Delhi, 2010.

Reference Books:

1.	G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2012.
2.	W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

E-Reference

1	https://www.iith.ac.in/~ketan/drives.htmL

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Understand the characteristics of dc motors and induction motors.	L2: Understanding
CO2	:	Summarize the operation of chopper fed DC drives.	L4: Analyzing
CO3	:	Understand the principles of speed-control of dc motors and induction motors.	L2: Understanding
CO4	:	Identify suitable power electronic converters used for dc motor and induction motor speed control.	L3: Applying

CO5	:	Analyze the SRM and BLDC motor drive control	L4: Analyzing

COURSE ARTICULATION MATRIX

COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1	3			1	1					1	3	2	
CO2	3	3	1	3		1	1					1	3	2	
CO3	3	3	3	3	1	1	1					1	3	2	
CO4	1	3	3	2	1	1	1					1	3	2	
CO5	3	3	3	3	1	1	1					1	3	2	
Avg.	**2.6**	**2.6**	**2.6**	**2.75**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**3**	**2**	**-**

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18EEM07	ELECTRIC VEHICLES AND CONTROL		SEMESTER			
PREREQUISTIES		**CATEGORY**	**PE**	**Credit**		**3**
Electrical drives and control		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To provide knowledge on electric vehicle architecture and its configurations
2.	To impart knowledge on vehicle control, use of energy storage systems and energy management in Electric Vehicle

UNIT I	**ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**
Configurations of Electric Vehicles (EV), Performance of Electric Vehicles, Tractive Effort in Normal Driving and Energy Consumption, Hybrid Electric Vehicles (HEV): Classification, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains					
UNIT II	**PLUG-IN HYBRID ELECTRICVEHICLES (PHEV) AND FUEL CELL ELECTRIC VEHICLES**	**9**	**0**	**0**	**9**
Functions and Benefits of PHEV, Components of PHEVs, Operating Principles of Plug-in Hybrid Vehicle, Control Strategy of PHEV, Fuel Cell: Operation and Types, Fuel Cell Electric Vehicle: Configuration and Control Strategy					
UNIT III	**ELECTRIC PROPULSION SYSTEMS**	**9**	**0**	**0**	**9**
Typical electric propulsion system, Classification of electric motor drives for EV and HEV, Multiquadrant Control of Chopper-Fed DC Motor Drives, Vector Control of Induction Motor drives, Permanent Magnetic Brush-Less DC Motor Drives, Switched Reluctance Motor Drives for Electric Vehicles					
UNIT IV	**ENERGY STORAGE SYSTEM**	**9**	**0**	**0**	**9**
Status of Battery Systems for Automotive Applications, Battery Technologies: Nickel–Metal Hydride (Ni–MH) Battery, Lithium–Polymer (Li–P) Battery, Lithium-Ion (Li-Ion) Battery, Ultracapacitors: Features, operation and performance, Ultrahigh-Speed Flywheels, Hybridization of Energy Storages					
UNIT V	**ENERGY MANAGEMENT SYSTEM**	**9**	**0**	**0**	**9**
Energy Management System(EMS) in Electric Vehicle, Rule-based control strategy: Deterministic rule-based control, Fuzzy logic-based control, and Neural network-based control. Optimization based control strategy: Dynamic Programming, Metaheuristic optimization methods and Model predictive control, Semi-active type Hybrid Energy Storage System-based EMS, Fully-active type Hybrid Energy Storage System-based EMS					
Total (45L+0T)= 45 Periods					

Text Books:

1.	Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, Taylor & Francis Group, Second Edition ,2011.
2.	Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, AliEmadi,, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles” CRC Press, 2016

Reference Books:

1.	Ali Emadi, Mehrdad Ehsani, John M.Miller ,“Vehicular Electric Power Systems”, Ali Emadi, Mehrdad Ehsani, John M.Miller, Special Indian Edition, Marcel dekker, Inc 2010

E-Reference:

1	https://archive.nptel.ac.in/courses/108/106/108106170/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Recall the fundamentals of electric vehicle and its mechanics	L1: Remembering
CO2	:	Explain the architecture of different forms of hybrid electric vehicles.	L2: Understanding
CO3	:	Illustrate the four-quadrant operation of DC drive, induction motor drive and SRM drive for Electric Vehicles.	L4: Analyzing
CO4	:	Select an appropriate energy storage system for Electric vehicle	L4: Analyzing
CO5	:	Use the suitable energy management control strategy for hybrid electric vehicle	L3: Applying

COURSE ARTICULATION MATRIX														
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1		1	3	1		1					1	1	2	1
CO2	1	2	3	1			2					2	1	2	
CO3	1	1			2		3						1	1	1
CO4	3	1	2	1	2		1					2	1	2	1
CO5	1	2	1	2	1							1	1	2	1
Avg	**1.4**	**1.5**	**1.75**	**1.75**	**1.5**	**-**	**1.75**	**-**	**-**	**-**	**-**	**1.5**	**1**	**1.8**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM08	ELECTRICAL ENERGY CONSERVATION AND AUDITING		SEMESTER				
PREREQUISITES		**CATEGORY**	**PE**	**Credit**			**3**
Power Generation, Transmission and Distribution System		**Hours/Week**	**L**	**T**		**P**	**TH**
			3	**0**		**0**	**3**

Course Objectives:

1.	To get knowledge about basics of energy and energy scenario of India.
2.	To familiarise the energy conservation methods.
3.	To acquire knowledge on energy auditing, energy efficiency and modern energy efficient devices.

UNIT I	**ENERGY SCENARIO**	**9**	**0**	**0**	**9**

Commercial and non-commercial energy -Primary energy resources - Commercial energy production - Final energy consumption - Energy needs of growing economy - Long term energy scenario - Energy pricing - Energy sector reforms - Energy and environment - Energy security - Energy conservation and its importance - Restructuring of the energy supply sector - Energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

UNIT II	**BASICS OF ENERGY**	**9**	**0**	**0**	**9**

Electricity tariff - Load management and maximum demand control - Thermal Basics-fuels - Thermal energy contents of fuel, temperature and pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT III	**ENERGY MANAGEMENT AND AUDIT**	**9**	**0**	**0**	**9**

Definition - Energy audit – Need and types of energy audit. Energy management (audit) approach understanding energy costs - Bench marking - Energy performance - Matching energy use to requirement - Maximizing system efficiencies - Optimizing the input energy requirements, fuel and energy substitution - Energy audit instruments. Material and energy balance: Facility as an energy system - Methods for preparing process flow, material and energy balance diagrams.

UNIT IV	**ENERGY EFFICIENCY**	**9**	**0**	**0**	**9**

Electrical system: Electricity billing - Electrical load management and maximum demand control -Power factor improvement and its benefit - Selection and location of capacitors - Performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types - Losses in induction motors - Motor efficiency - Factors affecting motor performance - Rewinding and motor replacement issues - Energy saving opportunities with energy efficient motors.

UNIT V	**ENERGY EFFICIENT TECHNOLOGIES**	**9**	**0**	**0**	**9**

Maximum demand controllers - Automatic power factor controllers - Energy efficient motors –Soft starters with energy saver - Variable speed drives - Energy efficient transformers - Electronic ballast - Occupancy sensors - Energy efficient lighting controls - Energy saving potential of each technology.

Total (45 L+ 0 T) = 45 Periods

Text Books:

1.	Sonal Desai, “Handbook of Energy Audit”, McGraw Hill, 2015.
2,	Tripathy, S. C, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
3.	Hossam A Gabbar, “Energy Conservation in Infrastructure Systems”, Wiley-IEEE Press, New Jersey, 2018

Reference Books:

1.	General Aspects of Energy Management and Energy Audit, Bureau of Energy Efficiency, New Delhi, 2015.
2,	Energy Efficiency in Electrical Utilities, Bureau of Energy Efficiency, New Delhi, 2015.

Course Outcomes: Upon completion of this course, the students will be able to:		**Bloom’s Taxonomy Mapped**
CO1	Identify the present energy scenario and future energy strategy.	L1: Understanding
CO2	Recognize the various forms of energy.	L1: Understanding
CO3	Interpret energy management methods and energy auditing.	L3: Applying
CO4	Familiar in energy efficiency of electrical systems.	L4: Analysing
CO5	Familiar with the advanced energy efficient technologies.	L4: Analysing

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	1	2	3	2	2		3					1	2	2	1
CO2	1	2	2	2	2		3					1	2	2	1
CO3	2	2	2	3	2		3					1	1	3	1
CO4	2	3	2	2	3		3					1	3	3	1
CO5	2	2	3	1	2		3					1	3	2	1
Avg	**1.6**	**2.2**	**2.4**	**2**	**2.2**	**-**	**3**	**-**	**-**	**-**	**-**	**1**	**2.2**	**2.4**	**1**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM09	SMPS AND UPS			SEMESTER			
PREREQUISITES		**CATEGORY**		**PE**	**Credit**		**3**
Power Electronics		**Hours/Week**		**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:

1.	To impart knowledge about modern power electronic converters and their applications in power utility.
2.	To impart knowledge about Resonant converters and UPS.

UNIT I	**DC-DC CONVERTERS**	**9**	**0**	**0**	**9**
Introduction to SMPS – Non-isolated DC-DC converters: Cuk, SEPIC topologies, Z-source converter – Zeta converter - Analysis and state space modeling –- Concept of volt-second and charge balance – High gain input-parallel output-series DC-DC converter.					
UNIT II	**SWITCHED MODE POWER CONVERTERS**	**9**	**0**	**0**	**9**
Isolated DC-DC converters: Analysis and state space modelling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques – Bidirectional DC-DC converters.					
UNIT III	**RESONANT CONVERTERS**	**9**	**0**	**0**	**9**
Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.					
UNIT IV	**DC-AC CONVERTERS**	**9**	**0**	**0**	**9**
Introduction – Multilevel concept – Types of multilevel inverters – Diode-clamped MLI – Flying capacitors MLI – Cascaded MLI – Cascaded MLI – Applications – Switching device currents – DC link capacitor voltage balancing – Features of MLI – Comparisons of MLI.					
UNIT V	**POWER CONDITIONERS, UPS, AND FILTERS**	**9**	**0**	**0**	**9**
Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for power electronic applications – Selection of capacitors.					
					Total (45L+0T)= 45 Periods

Text Books:

1.	Simon Ang, Alejandro Oliva,” Power-Switching Converters”, Third Edition, CRC Press, 2010.
2.	M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001.

Reference Books:

1.	Ned Mohan, Tore.M.Undeland, William.P.Robbins, “Power Electronics Converters, Applications and Design”, 3rd Edition, John Wiley and Sons, 2006.
2.	M.H. Rashid, “Power Electronics circuits, devices and applications”, 3rd Edition, PHI, New Delhi, 2007.

E-References:

1.	NPTEL Course: Power Electronics, IIT-B.
2.	www.cdeep.iitb.ac.in. (Electrical Engineering)

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Analyze the state space model for DC – DC converters.	L4: Analyzing
CO2	:	Acquire knowledge on switched mode power converters.	L2: Understanding
CO3	:	Outline the PWM techniques for DC-AC converters.	L1: Remembering
CO4	:	Discuss about modern power electronic converters and its applications in electric power utility.	L2: Understanding
CO5	:	Identify the filters and UPS.	L2: Understanding

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	1	2	2			1					2	2	2	1
CO2	1	1	3	2			1					2	3	3	2
CO3	2	2	2	3			1					1	2	2	1
CO4	2	1	1	2			1					2	2	3	2
CO5	1	1	2	1			1					1	2	2	1
Avg.	**1.6**	**1.2**	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1.6**	**2.2**	**2.4**	**1.4**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

18EEM10	UTILIZATION OF ELECTRICAL ENERGY			SEMESTER			
PREREQUISITES			**CATEGORY**	**PE**	**Credit**		**3**
Electrical Machines, Power System, and Power Electronics			**Hours/Week**	**L**	**T**	**P**	**TH**
				3	**0**	**0**	**3**

Course Objectives:	
1.	To understand the economics of power generation, tariff and energy conservation methods.
2.	To impart knowledge on principle and design of illumination systems.
3.	To analyze the performance and different methods of electric heating and electric welding.
4.	To impart knowledge on electric traction systems and their performance.
5.	To understand electric drives for various industrial applications.

UNIT I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Economics of generation – definitions – load duration curve – number and size of generator units – Cost of electrical energy – tariff — availability based Tariff- (ABT) – Battery Energy storage system (BESS)- Frequency based energy measurement - need for electrical energy conservation – methods.- Introduction to energy audit

UNIT II	**ILLUMINATION**	**9**	**0**	**0**	**9**

Introduction-nature of radiation – definition – laws of illumination – luminous efficacy-photometry – lighting calculations – design of illumination systems for residential, commercial, street lighting and sports ground– types of lamps –incandescent lamp- mercury vapour –fluorescent lamp-energy efficiency lamps – types of lighting schemes – requirements of good lighting

UNIT III	**HEATING AND WELDING**	**9**	**0**	**0**	**9**

Introduction- classification of methods of heating – requirements of a good heating material – design of heating element – temperature control of resistance furnace – electric arc furnace –induction heating – dielectric heating – electric welding – resistance welding – electric arc welding-electrical properties of arc-applications of electric arc welding.

UNIT IV	**ELECTRIC TRACTION**	**9**	**0**	**0**	**9**

Introduction – requirements of an ideal traction system – supply systems – train movement -mechanism of train movement – traction motors and control –speed control of three phase induction motor- multiple unit control – braking – recent trends in electric traction.

UNIT V	**DRIVES AND THEIR INDUSTRIAL APPLICATIONS**	**9**	**0**	**0**	**9**

Electric drive –advantages of electric drive-individual drive and group drive –factors affecting selection of motor – types of loads – steady state –transient characteristics –size of motor– load equalization – industrial applications – modern methods of speed control of D.C drives-dynamic braking using thyristors-regenerative braking using thyristors.

Total (45L+0T)= 45 Periods

Text Books:	
1.	C.L. Wadhwa, “Generation, Distribution and Utilization of Electrical Energy”, New Age International Pvt.Ltd, 2003.
2.	Eric Openshaw Taylor, “Utilisation of Electric Energy”, English Universities Press Limited, 1937
3.	J.B. Gupta, “Utilization of Electric Power and Electric Traction”, S.K.Kataria and Sons, 2002.
Reference Books:	
1.	G.C.Garg, S.K.Gridhar&S.M.Dhir, “A Course in Utilization of Electrical Energy”, Khanna Publishers, Delhi, 2003.
2.	H. Partab, “Art and Science of Utilization of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
E-References:	
1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Understand the economics of power generation, tariff and energy conservation methods.	L2: Understanding
CO2	:	Interpret the concept behind illumination and design a suitable illumination system for a specific application.	L3: Applying
CO3	:	Design and choose an appropriate heating method for specific application and gain knowledge about electric welding system.	L4: Analyzing
CO4	:	Explain the concepts and recent trends of traction system.	L4: Analyzing
CO5	:	Discuss the concepts of electric drives and their characteristics.	L2: Understanding

COURSE ARTICULATION MATRIX															
COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	3	1	1	1	1	2	1	2	2	1	1	1	2	2	3
CO2	2	3	2	3	1	1	2	1	1			1	3	3	2
CO3	3	3	1	3	1	1	2	1					2	2	3
CO4	1	2	2	3	3	1	2	1					2	3	2
CO5	3	1	1	2	1	1	2	1		1		1	2	2	3
CO6	1	3	3	3	3	1	2	2				1	3	3	2
Avg	**2.17**	**2.17**	**1.67**	**2.5**	**1.67**	**1.17**	**1.83**	**1.33**	**1.5**	**1**	**1**	**1**	**2.33**	**2.5**	**2.5**
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)															

B.E. – MECHANICAL ENGINEERING - MINOR DEGREE

18MEM01	**ENGINEERING THERMODYNAMICS** *(Use of standard thermodynamic tables, Mollier diagram are permitted)*					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
		Hours/Week	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To impart the knowledge on concepts of zeroth and first law of thermodynamics.
2.	To make the learners to understand the third law of thermodynamics and analyze the various work and heat interactions in closed and open systems.
3.	To teach properties of pure substance.
4.	To impart knowledge on the concepts of steam power cycle.
5.	To derive thermodynamic relations for ideal and real gases.

UNIT I	**BASIC CONCEPT AND FIRST LAW**	**9**	**0**	**0**	**9**

Role of Thermodynamics in Engineering and Science - Applications of Thermodynamics. Basic concepts - concept of continuum, macroscopic approach, thermodynamic systems, Property, state, path and processes, quasi-static process, Thermodynamic equilibrium, Displacement work, P-V diagram. Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow processes with reference to various thermal equipment.

UNIT II	**SECOND LAW AND ENTROPY**	**9**	**0**	**0**	**9**

Heat engine – Refrigerator – Heat Pump, Second law of thermodynamics – Kelvin's and Clausius statements- Equivalence of these statements their corollaries. Reversibility and irreversibility. Carnot cycle, reversed Carnot cycle. Clausius inequality, Concept of entropy, principle of increase of entropy, T-s diagram, T-ds equations, Entropy.

UNIT III	**PROPERTIES OF PURE SUBSTANCES**	**9**	**0**	**0**	**9**

Steam - formation and its thermodynamic properties - p-v, p-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

UNIT IV	**STEAM POWER CYCLE**	**9**	**0**	**0**	**9**

Basic Rankine cycle, T-s & h-s diagrams - Performance Improvement - Reheat cycle, regenerative cycle and their combination cycles.

UNIT V	**IDEAL AND REAL GASES AND THERMO DYNAMIC RELATIONS**	**9**	**0**	**0**	**9**

Properties of ideal and real gases, equation of state of ideal and real gases, Avogadro's law, Vander Waal's equation of states, Principle of corresponding states, reduced properties and compressibility chart. Exact differentials, Maxwell relations, Specific heat equations, Tds, relations, Clausius Clapeyron equations and Joule Thomson Coefficient.

Total (45L)= 45 Periods

Text Books:

1.	Nag. P.K, "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2017.
2.	Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., Fundamentals of Thermodynamics, 6th ed., John Wiley, 2003.
3.	Arora C.P, "Thermodynamics", Tata McGraw Hill, New Delhi, 2003.
4.	Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987.

Reference Books:	
1.	Cengel, "Thermodynamics- An Engineering Approach", 3rd Edition, Tata McGraw Hill, 2015.
2.	Merala C, Pother, Craig W and Somerton, "Thermodynamics for Engineers", Schaum Outline Series, Tata McGrawHill, New Delhi, 2004.

COURSE OUTCOMES: Upon completion of this course, the students will be able to:		Bloom Taxonomy Mapped
CO1	Understand the concepts of zeroth, first and second law of thermodynamics.	Remember
CO2	Analyze the various work and heat interactions for different types of processes for closed and open systems	Evaluate
CO3	Evaluate the different properties of pure substances using steam tables and Mollier chart	Evaluate
CO4	Analyze the performance of steam power cycle.	Analyze
CO5	Derive thermodynamic relations for ideal and real gases.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2			1					1	3	1	1
CO2	3	3	2	2			1					1	3	1	1
CO3	3	3	3	2		1	1					1	3	1	1
CO4	2	3	2	2		1	1					1	3	1	1
CO5	3	3	2	2		1						1	3	1	1
Avg	**2.8**	**3**	**2.2**	**2**		**1**	**1**					**1**	**3**	**1**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM02	FLUID MECHANICS AND MACHINERY					
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**
1.Engineering Physics 2.Engineering Chemistry 3.Engineering Mathematics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic concepts and properties of fluids.
2.	To analyze the kinematic and dynamic concepts of fluid flow.
3.	To understand the various incompressible fluid flow through pipes and between parallel plates.
4.	To apply the principles of fluid mechanics to design and operation of hydraulic turbines.
5.	To apply the principles of fluid mechanics to design and operation of hydraulic pumps.

UNIT I	**INTRODUCTION AND FLUID STATICS**	**9**	**0**	**0**	**9**

Basic concepts and units of measurement of physical quantities- Classification of fluids - Properties of fluids – density, relative density, vapour pressure, surface tension, Capillarity and viscosity. Fluid statics- hydrostatic pressure, buoyancy and Archimedes' principle.

UNIT II	**FLUID KINEMATICS AND DYNAMICS**	**9**	**0**	**0**	**9**

Classification of fluid flow - system and control volume - Lagrangian and Eulerian description for fluid flow - flow patterns-streamline, pathline, streakline and timeline. Velocity potential function and Stream function - continuity equation and its applications. Fluid dynamics - Bernoulli's equation and its applications. Dimensional analysis – Buckingham's theorem, dimensional homogeneity, similarity-laws and models.

UNIT III	**FLOW THROUGH PIPES AND PLATES**	**9**	**0**	**0**	**9**

Incompressible fluid flow-Laminar flow- Hagen-Poiseuille equation, shear stress, pressure gradient relationship - flow through pipes and flow between parallel plates. Turbulent flow – flow through pipes, friction factors in turbulent flow - total energy line, hydraulic gradient line, flow through pipes in series and parallel- Moody's friction factor chart. Power transmission-Boundary layer flows - Boundary layer thickness, momentum thickness, energy thickness-boundary layer separation.

UNIT IV	**HYDRAULIC TURBINES**	**9**	**0**	**0**	**9**

Hydraulic turbines classification-impulse and reaction turbines-Working Principle, work done-efficiency and performance curves for Pelton, Francis and Kaplan turbines (Only descriptive) - Comparison between impulse and reaction turbine-specific speed degree of reaction -draft tubes.

UNIT V	**HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Classification of hydraulic pumps- Centrifugal pumps - working principle, specific speed, performance curves and priming(Only descriptive) - Reciprocating pumps - classification, working principle, indicator diagram, air vessels and performance curves. Cavitation in pumps (Only descriptive) - Working principles of gear and vane pumps.

Total (45L)= 45 Periods

Text Books:

1.	Bansal, R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Ed", Laxmi Publication Pvt Ltd, 2010.
2.	Rajput, R.K., "A Textbook of Fluid Mechanics and Hydraulic Mechanics", S.Chand and Company Ltd, 2011.
3.	Subramanya. K., "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Company Ltd, 2011.

Reference Books:	
1.	White, “Fluid Mechanics, 8 Ed”, McGraw Hill India, 2017.
2.	Munson, Young and Okiishi, “Fundamentals of Fluid Mechanics 8 th Edition”, Wiley, 2016.
3.	Yunuscengel, John. M.cimbala, “Fluid Mechanics Fundamentals and Applications”, McGraw Hill, 2017.
4.	Som, S.K, Biswas.G and SumanChakraborty, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill India, 2011.
5.	Dr.P.N.Modi, Dr.S.M.Seth, “Hydraulics and Fluid Mechanics including Hydraulic Machines”, Standard book house, 2018.
E-References:	
1.	NPTEL courses: http://nptel.iitm.ac.in/courses.php - web and video sources on fluid mechanics.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Understand the basic concepts and properties of fluids.	Remember
CO2	Analyze the kinematic and dynamic concepts of fluid flow.	Analyze
CO3	Understand the various incompressible fluid flow through pipes and between parallel plates.	Understand
CO4	Apply the principles of fluid mechanics to design and operation of hydraulic turbines.	Apply
CO5	Apply the principles of fluid mechanics to design and operation of hydraulic pumps.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1				2				1		2	2	1
CO2	3	3	1		2								2	2	1
CO3	2	3	2	2	1								2	2	1
CO4	3	3	3	2	1	2	1						2	2	1
CO5	3	3	3	2	1	2	1						2	2	1
Avg	**2.8**	**2.6**	**2**	**2**	**1.25**	**2**	**1.3**				**1**		**2**	**2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM03	MANUFACTURING PROCESSES						
PRE-REQUISITE:		CATEGORY	PE	Credit		3	
1. Basic science, Engineering mathematics, Engineering Physics 2. Engineering Materials		Hours/Week	L	T	P	TH	
			3	0	0	3	

Course Objectives:	
1.	To make the students familiarize with various manufacturing processes and fabrication techniques of metals and design of casting.
2.	To develop design concepts of various manufacturing processes.
3.	Gain knowledge to select appropriate manufacturing processes for various parts.
4.	To develop an entrepreneur skill among the students.
5.	To evaluate and select plastic deformation processes for various parts.

UNIT I	CASTING	9	0	0	9
Concepts of Manufacturing Process -Sand casting -Patterns – Design of Pattern, mould and cores- gating and risering design, solidification time calculation - Moulding machines - Core making. Special moulding processes – CO2 moulding; shell moulding, investment moulding, pressure die casting, centrifugal casting, casting defects.					
UNIT II	**WELDING**	**9**	**0**	**0**	**9**
Classification of welding processes. Principles of Oxy-acetylene gas welding. Metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, electron beam welding, laser beam welding, defects in welding, Soldering and Brazing, Adhesive Bonding.					
UNIT III	**METAL FORMING**	**10**	**0**	**0**	**10**
Metallurgical aspects of metal forming, slip, twinning mechanics of plastic deformation, load estimation of bulk deformation processes, Hot working and cold working of metals, Forging processes – open, closed and impression die forging – forging operations. Rolling of metals– Types of Rolling mill – Flat strip rolling – shape rolling operations – Defects in rolled parts. Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types.					
UNIT IV	**SHAPING OF PLASTICS**	**8**	**0**	**0**	**8**
Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding.					
UNIT V	**SHEET METAL FORMING AND POWDER METALLURGY**	**9**	**0**	**0**	**9**
Formability of Sheet Metal, load estimation of sheet metal processes - Shearing, Deep drawing, Bending operations- types of presses used, Super Plastic forming; Introduction to Powder Metallurgy– Principal steps involved – sintering and compacting techniques, Advantages, limitations and applications of powder metallurgy.					
					Total (45L) = 45 Periods

Text Books:	
1.	HajraChoudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005.
2.	NagendraParashar B.S. and Mittal R.K., "Elements of Manufacturing Processes", Prentice-Hall of India Private Limited, 2007.
Reference Books:	

1.	Serope Kalpajian, Steven R.Schmid, "Manufacturing Processes for Engineering Materials", 4/e, Pearson Education, Inc. 2007.
2.	Jain. R.K., and S.C. Gupta, "Production Technology", 16th Edition, Khanna Publishers, 2001.
3.	"H.M.T. "Production Technology – Handbook", Tata McGraw-Hill, 2000.
4.	Roy. A. Linberg, "Process and Materials of Manufacture", PHI, 2000.
5.	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
E-References:	
1.	https://fdocuments.in/document/production-technology-55844cac00bfc.html?page=40

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Describe the operational features of various casting processes, design gate and riser and discover various defects in casting.	Understand
CO2	Explain various metal joining processes and compare them.	Understand
CO3	Summarize several types of metal forming processes and select suitable method for different applications.	Analyze
CO4	Analyze various manufacturing methods for plastics and their needs in industry.	Analyze
CO5	Describe various sheet metal forming processes, load estimation calculation and principles of powder metallurgy	Understand

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	1						1			1	2	1
CO2	2	1	2	1		1			1	1			1	2	1
CO3	1	1	1	1						1			1	1	1
CO4	1	1	1		1					1			1	1	1
CO5		1							1	1			1		1
Avg	**1.5**	**1**	**1.5**	**1**	**1**	**1**			**1**	**1**			**1**	**1.5**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM04	MATERIALS ENGINEERING						
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**		**3**	
1. Engineering Physics 2. Engineering Chemistry		**Hours/Week**	**L**	**T**	**P**	**TH**	
			3	**0**	**0**	**3**	

Course Objectives:

1.	To impart concept on reactions, treatment, microstructure and mechanical behavior of engineering materials at different temperature.
2.	To learn basic principles in metallurgy and materials engineering.
3.	To identity and select suitable engineering materials based on their applications.

UNIT I	**PHASE DIAGRAMS**	**9**	**0**	**0**	**9**

Crystal structures, Phases, solid solution types, compounds, Hume- Rothery rules; Gibb's phase rule; Binary isomorphous alloy systems – Eutectic, Eutectoid, Peritectic systems. Lever rule, Equilibrium and non-equilibrium cooling, Fe-C Equilibrium diagram - effects of alloying elements – Ferrite and Austenite Stabilizers, TTT and CCT diagrams.

UNIT II	**HEAT TREATMENT**	**9**	**0**	**0**	**9**

Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalizing, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbo-nitriding – Flame and Induction hardening. Heat treatment of non-ferrous alloys - precipitation hardening. Heat treatment of HSS tools, gears, springs and gauges.

UNIT III	**FERROUS AND NON FERROUS METALS**	**9**	**0**	**0**	**9**

Plain carbon steels – Tool steels - maraging steels – HSLA steels .Stainless steels- ferritic and Austenitic, martensitic, duplex and precipitation hardened stainless steels. Types of Cast Irons- Gray cast iron, white cast iron, malleable cast iron, S.G.Iron. Copper alloys – Brass, Bronze and Cupronickel, Aluminium alloys, Bearing alloys.

UNIT IV	**MECHANICAL PROPERTIES AND TESTING**	**9**	**0**	**0**	**9**

Mechanical properties of engineering materials - Mechanisms of plastic deformation, slip and twinning – Creep, Fatigue and Fracture - Types of fracture – Testing of materials - tension, compression and shear loads - fatigue and creep tests – hardness and its effects – testing for hardness (Brinell, Vickers and Rockwell) - Impact test - Izod and Charpy.

UNIT V	**NON DESTRUCTIVE TESTING AND SURFACE ENGINEERING**	**9**	**0**	**0**	**9**

Non Destructive Testing: Basic principles - Testing method - Radiographic testing, Ultrasonic testing, Magnetic Particle Inspection and Liquid Penetrant Inspections. Introduction to surface engineering - Definition, diffusion techniques, deposition methods, high and low energy beam methods, surface engineering charts, elastic contact mechanics.

Total (45L) = 45 Periods

Text Books:

1.	Kenneth G. Budinski and Michael K. Buinski, "Engineering Materials", Prentice Hall of India Ltd, 2002.
2.	Raghavan, V, "Materials Science and Engineering", Prentice Hall of India (P) Ltd., 1999.
3.	Aswani.K.G, "A Text Book of Material Science", S.Chand and Co. Ltd., New Delhi, 2001.
4.	Khanna O.P., "A Text Book of Materials Science and Metallurgy", DhanpatRai Sons, 2004.

Reference Books:

1.	William. D.Callsber, "Material Science and Engineering", John Wiley and Sons, 1997.
2.	Sydney.H.Avner, "Introduction to Physical Metallurgy" Mc Graw Hill Book Company, 1994.

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Understand the formation of materials and their classification based on atomic structure.	Understand
CO2	Understand the principles of various heat treatment processes in fabrication industry.	Understand
CO3	Describe properties, applications and types of various ferrous and non-ferrous metals used in fabrication industry	Understand
CO4	Describe various types of failure and select methods for destructive testing	Understand
CO5	Select methods for non destructive testing	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	2	1	1	1						2	3	1
CO2	1		2	1	1	2	1						2	3	1
CO3		1	1	1	1		1						3	2	1
CO4		2	2	1	1	1	1						2	3	1
CO5		2	2	2	1		1						2	2	1
Avg	**1**	**1.5**	**1.8**	**1.4**	**1.0**	**1.3**	**1**						**2.2**	**2.6**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM05	KINEMATICS OF MACHINERY				
PRE-REQUISITE:		**CATEGORY**	**PE**	**Credit**	**3**
1. Engineering graphics. 2.Engineering Mechanics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Objectives:

1.	To understand the basic components and layout of linkages in the assembly of a system/ machine.
2.	To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3.	To understand basics of cam profile and its displacement.
4.	To understand the basic concepts of toothed gearing and kinematics of gear trains.
5.	Illustrate the effects of friction drives in transmission system.

UNIT I	**BASICS OF MECHANISMS**	**9**	**0**	**0**	**9**

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider-crank chains Limit positions- Mechanical advantage - Transmission angle- Description of some common mechanisms- Quick return mechanism, straight-line generators.

UNIT II	**KINEMATIC ANALYSIS**	**9**	**0**	**0**	**9**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms- slider-crank mechanism dynamics Coincident points- Coriolis component of acceleration introduction to linkage synthesis three Position graphical synthesis for motion and path generation.

UNIT III	**KINEMATICS OF CAM**	**9**	**0**	**0**	**9**

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical method for cam profile design.

UNIT IV	**GEARS AND GEAR TRAINS**	**9**	**0**	**0**	**9**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference / undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V	**FRICTION IN MACHINE ELEMENTS**	**9**	**0**	**0**	**9**

Surface contacts- sliding and rolling friction- friction drives- friction in screw threads – bearings and lubrication- friction Clutches- belt and rope drives.

Total (45L) = 45 Periods

Text Books:

1.	Rattan S.S, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.
2.	Ghosh, A and Mallick, A.K, "Theory of Mechanisms and Machines", East-West Pvt. Ltd., New Delhi, 1988.

Reference Books:

1.	Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2.	Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.

3.	Erdman AG and Sandor G N, "Mechanism Design, Analysis and Synthesis", Vol.I, PHI Inc., 1997.
4.	Ambekar A.G, "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007.
5.	John Hannah and Stephens R C, "Mechanisms of Machines", Viva Low Price Student Edition, New Delhi, 1999.
E-References:	
1.	https://archive.nptel.ac.in/courses/112/104/112104121/
2.	https://nptel.ac.in/courses/112106270
3.	http://velhightech.com/Documents/ME8492 Kinematics of Machinery.pdf

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom's Taxonomy Mapped**
CO1	Demonstrate and understand the concepts of various mechanisms and pairs.	Apply
CO2	Analyze the velocity and acceleration of simple mechanisms.	Analyze
CO3	Construct the cam profile for various motion.	Create
CO4	Solve problems on gears and gear trains.	Evaluate
CO5	Evaluate the friction in transmission system	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1									3	1	
CO2	3	2	2	1									3	1	
CO3	3	2	2	1									3	1	
CO4	3	2	2	1									3	1	
CO5	3	2	2	1									3	1	
Avg	**3**	**2**	**2**	**1**									**3**	**1**	

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

<table>
<tr><td>18MEM06</td><td colspan="2">HYDRAULICS AND PNEUMATICS</td><td colspan="4"></td></tr>
<tr><td colspan="2">PRE-REQUISITE:</td><td>CATEGORY</td><td>PE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2"></td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
</table>

Course Objectives:

1.	To enable the students understand the basics of hydraulics and pneumatics
2.	Applying the working principles of hydraulic actuators and control components.
3.	Designing and develop hydraulic circuits and systems.
4.	Applying the working principles of pneumatic power system and its components.
5.	Solving problems and troubles in fluid power systems.

UNIT I	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS**	**9**	**0**	**0**	**9**

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque - Problems, Sources of Hydraulic power; Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of pumps – Fixed and Variable displacement pumps – Problems.

UNIT II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	**9**	**0**	**0**	**9**

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary actuators - Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories; Reservoirs, Pressure Switches – Filters – types and selection - Applications – Fluid Power ANSI Symbols – Problems.

UNIT III	**HYDRAULIC CIRCUITS AND SYSTEMS**	**9**	**0**	**0**	**9**

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double - Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail - Safe, Speed Control, Deceleration circuits, Sizing of hydraulic systems, Hydrostatic transmission, Electro hydraulic circuits – Servo and Proportional valves – Applications - Mechanical, hydraulic servo systems.

UNIT IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	**9**	**0**	**0**	**9**

Properties of air – Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – classification - single cylinder and multi cylinder circuits - Cascade method – Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V	**DESIGN OF FLUID POWER CIRCUITS AND TROUBLESHOOTING**	**9**	**0**	**0**	**9**

Servo systems, Hydro mechanical servo systems, electro hydraulic servo systems and proportional Valves, Introduction to electro hydraulic pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits, failure and troubleshooting. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low cost Automation – Hydraulic and Pneumatic power packs. Case studies: A simple sequence, synchronize circuits using hydraulic and pneumatics components.

Total (45L) = 45 Periods

Text Books:

1.	Manjumdar S.R, "Oil Hydraulics", Tata McGraw-Hill, December 2002.

2.	Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2013.
Reference Books:	
1.	Andrew Parr, “Hydraulic and Pneumatics”, Jaico Publications House, 2005.
2.	Bolton W. “Pneumatic and hydraulic system”, Butterworth-Heinemann 1997
3.	Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw Hill, 2010
4.	Shanmugasundaram.K, “Hydraulic and Pneumatic controls”, Chand & Co, 2006
5.	Srinivasan.R. “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 2008.
E-References:	
1.	http://www.fluidpowerjournal.com
2.	http://14.139.160.15/courses/112102011/2
3.	https://www.nfpa.com/home.htm

COURSE OUTCOMES: **Upon completion of the course, the students will be able to:**		**Bloom’s Taxonomy Mapped**
CO1	Select the components as per the application	Evaluate
CO2	Apply the working principles of hydraulic actuators and control components.	Apply
CO3	Design and develop hydraulic circuits and systems.	Create
CO4	Apply the working principles of pneumatic power system and its components.	Apply
CO5	Solve problems and troubles in fluid power systems.	Evaluate

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1										1	1	1
CO2		2	2	1									1	1	1
CO3	1	2	3			1							1	2	1
CO4	1	1	3	2	2								2	1	1
CO5	1	1	2										1	1	1
Avg	**1.25**	**1.4**	**2.2**	**1.5**	**2**	**1**							**1.2**	**1.2**	**1**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

<table>
<tr><td>18MEM07</td><td colspan="2">DESIGN OF MACHINE ELEMENTS</td><td colspan="5"></td></tr>
<tr><td colspan="2">PRE-REQUISITE:</td><td>CATEGORY</td><td>PE</td><td colspan="2">Credit</td><td colspan="2">3</td></tr>
<tr><td colspan="2" rowspan="2">1. Student should study engineering mechanics.
2. Student should study kinematic of machinery.</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td colspan="2">TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td colspan="2">3</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td>1.</td><td colspan="7">Understanding of background in mechanics of materials and design of machine components.</td></tr>
<tr><td>2.</td><td colspan="7">An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations</td></tr>
<tr><td>3.</td><td colspan="7">An understanding the design of shafts and couplings.</td></tr>
<tr><td>4.</td><td colspan="7">Familiarize the design of energy storing elements and engine components.</td></tr>
<tr><td>5.</td><td colspan="7">An appreciation of the relationships between component level design and overall machine system design and performance</td></tr>
<tr><td>UNIT I</td><td colspan="3">STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Introduction to the design process – Product development cycle- factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers– Direct, Bending and Torsional stress – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric loading – Factor of safety -theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations .</td></tr>
<tr><td>UNIT II</td><td colspan="3">DESIGN OF SHAFTS AND COUPLINGS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways - Design of rigid and flexible couplings.</td></tr>
<tr><td>UNIT III</td><td colspan="3">DESIGN OF THREADED FASTENERS, RIVETED AND WELDED JOINTS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Threaded fasteners - Design of bolted joints including eccentric loading – Design of riveted and welded joints for pressure vessels and structures- theory of bonded joints.</td></tr>
<tr><td>UNIT IV</td><td colspan="3">DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting rods and crank shafts.</td></tr>
<tr><td>UNIT V</td><td colspan="3">DESIGN OF BEARINGS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="8">Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number - Selection of Rolling Contact bearings.</td></tr>
<tr><td colspan="8" align="right">Total (45L) = 45 Periods</td></tr>
</table>

Text Books:	
1.	Bhandari V.B, “Design of Machine Elements”, Tata McGraw Hill Book Co, 2020
2.	Md.Jalaludeen.S, “A text book of Machine Design”, Anuradha Publications, 2006
Reference Books:	
1.	Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.
2.	Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

3.	Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4.	PSG Tech, "Design Data Handbook", M/s.DPV Printers, Coimbatore, 2009
E-References:	
1.	https://nptel.ac.in/courses/112105124
2.	Design of Machine Elements - V. B. Bhandari - Google Books
3.	A Textbook of Machine Design by R.S.Khurmi And J.K.Gupta [tortuka]_1490186411865.pdf | DocDroid

COURSE OUTCOMES: On completion of the course the student will be able to		**Bloom's Taxonomy Mapped**
CO1	Understand the influence of steady and variable stresses in machine component design.	Understand
CO2	Apply the concepts of design to shafts, keys and couplings.	Apply
CO3	Familiarize the design of temporary and permanent joints.	Understand
CO4	Design the various energy storing elements and engine components.	Analyse
CO5	Familiarize the design of various types of bearings.	Understand

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2		1	1				1		3	2	1
CO2	2	2	1	2		1	1				1		3	2	1
CO3	2	2	1	2		1	1				1		3	2	1
CO4	2	2	1	2		1	1				1		3	2	1
CO5	2	2	1	2		1	1				1		3	2	1
Avg	**2.0**	**2.0**	**1.0**	**2.0**		**1.0**	**1.0**				**1.0**		**3.0**	**2.0**	**1.0**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEM08	HEAT AND MASS TRANSFER					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
1.The laws and basic concepts of thermodynamics 2. The concept of energy transfers and their conversion principles		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES	
1.	Understanding the science behind conduction heat transfer and its applications.
2.	Differentiating the concepts of forced and natural convection heat transfer.
3.	Describing the laws and concepts of radiation heat transfer.
4.	Understanding phase change processes and analyzing heat exchangers.
5.	Studying the concept of mass transfer process and its modes.

UNIT-I	**CONDUCTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

General Differential equation – Cartesian(derivation of General Differential Equation), Cylindrical (derivation of General Differential Equation) and Spherical Coordinates – One DimensionalSteady State Heat-Concepts of electrical analogy, Conduction — plane and Composite Systems – Conduction with Internal HeatGeneration., Critical thickness of insulation.

Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infiniteand Infinite Solids –Use of Heisler's charts.

UNIT-II	**CONVECTION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Conservation equations, boundary layer concept – Forced convection: external flow – flow over plates, cylinders, spheres and bank of tubes. Internal flow – entrance effects.

Free convection –flow over vertical plate, horizontal plate, inclined plate, cylinders and spheres.

UNIT-III	**BOILING, CONDENSATION AND HEAT EXCHANGERS**	**9**	**0**	**0**	**9**

Regimes of Pool boiling and Flow boiling, Nusselt's theory of condensation- correlations in boiling and condensation. Heat Exchanger types - Overall Heat Transfer Co-efficient – Fouling Factors. LMTD and NTU methods.

UNIT-IV	**RADIATION HEAT TRANSFER**	**9**	**0**	**0**	**9**

Radiation laws - Black Body and Gray body Radiation - Shape Factor - Electrical Analogy -Radiation Shields.

UNIT-V	**MASS TRANSFER**	**9**	**0**	**0**	**9**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion - Equimolal counter diffusion. Basic Convective Mass Transfer Problems.

Total(45L) = 45 Periods

TEXT BOOKS:	
1	R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2017
2	Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 7th Edition, 2014.
REFERENCE BOOKS:	
1	Yunus A. Cengel, "Heat Transfer A Practical Approach" – Tata McGraw Hill, 5 th Edition - 2013
2	Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2017
3	Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2012
4	Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.

COURSE OUTCOMES: On completion of the course the student will be able to:		Bloom's Taxonomy Mapped
CO1	Analyze the mechanism of heat conduction under steady and transient conditions.	Apply
CO2	Develop solutions to problems involving convective heat transfer.	Create
CO3	Design a heat exchanger for any specific application.	Understand
CO4	Adopt the concept of radiation heat transfer in real time systems.	Understand
CO5	Develop solutions to problems involving combined heat and mass transfer.	Apply

COURSE ARTICULATION MATRIX															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2		1						3	3	1
CO2	3	3	3	3	2		1						3	3	1
CO3	3	3	3	3	2		1						3	3	1
CO4	3	3	3	3	2		1						3	2	1
CO5	2	2	2	2	1		1						3	1	
Avg	**2.8**	**2.8**	**2.8**	**2.8**	**1.8**		**1**						**3**	**2.4**	**1**
3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)															

18MEM09	METROLOGY AND QUALITY CONTROL					
PREREQUISITES		CATEGORY	PE	Credit		3
		Horus/Week	L	T	P	TH
			3	0	0	3

COURSE OBJECTIVES

1.	Explaining the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty
2.	Applying the applications of linear and angular measuring instruments
3.	Interpretation of various tolerance symbols.
4.	Applying the SQC methods in manufacturing.
5.	Applying the advances in measurements for quality control.

UNIT-I	BASICS OF MEASUREMENT SYSTEM AND DEVICES	9	0	0	9

Definition of metrology, accuracy, precision and sensitivity, Abbe‘s principle. Three stages of generalized measurement system - mechanical loading – static characteristics of instruments – factors considered in selection of instruments - commonly used terms, error analysis and classification - sources of error. Measurement uncertainty.

UNIT-II	CALIBRATION OF INSTRUMENTS AND QUALITY STANDARDS	9	0	0	9

Calibration of measuring instruments - principles of calibration, Calibration of Instruments - Vernier caliper, Micrometer, feeler gauges, dial indicator, surface plates, slip gauges, care of gauge blocks. General cares and rules in measurement, ISO 9000 quality standards. Comparators- mechanical, electrical, optical and pneumatic.

UNIT-III	GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS	9	0	0	9

Angular measurement - optical protractors, sine bar, roundness measurement, limit gauge, design of plug gauge, Taylor‘s principle, three basic types of limit gauges, Tomlinson surface meter, computer controlled CMM. ISO metric thread, measurement of major, minor and effective diameters. Gear terminology; spur gear measurement, checking of composite errors, base pitch measurement. Principle of interferometry, laser interferometer, Machine vision, Fundamental of GD&T. Inspection of straightness, flatness, roundness deviations.

UNIT-IV	STATISTICAL QUALITY CONTROL	9	0	0	9

Surface finish – terminology and measurements – Optical measuring instruments –Acceptance test for machines. Statistical Quality Control - Control charts - Sampling plans.

UNIT-V	SIX SIGMA	9	0	0	9

Six sigma: Define measure, analyse, improve and control phases. Analyze phase tools: CommonTools: Histogram, Box Plot, Control chart, Scatter chart, Cause and effect diagram, Pareto analysis, interrelations diagram. Special Tools: Regression Analysis, Hypothesis Testing, ANOVA Multi variate analysis.

Total(45L) = 45 Periods

TEXT BOOKS:

1	Gupta.I.C, ―A text book of Engineering Metrology, Dhanpat Rai publications, New Delhi, 2018
2	Beckwith.T.G, Roy D. Marangoni, John H. Lienhard, - Mechanical Measurements‖, Prentice Hall, 2006

REFERENCE BOOKS:

1	Jain.R.K, ―Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.
2	Holmen.J.P, ―Experimental Methods for Engineers‖, Tata McGraw Hill Publications Co Limited, 2017.

3	Grant, E.L., Statistical Quality Control, Mc Graw-Hill, 2004. 3. Doeblin E.O., Measurement Systems, Mc Graw-Hill, 2004.
4	Alan S Morris, ―Measurement and Instrumentation Principles, Butterworth, 2006.
5	De Feo J A and Barnard W W, ―Six Sigma: Break trough and BeyondG, Tata McGraw-Hill, New Delhi, 2005.
E-REFERENCES:	
1	https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_405_Book_2,_for_Unit_2B.pdf
2	https://www.nist.gov/system/files/documents/srm/NIST-SRM-RM-Articlefinal.pdf
3	https://www.researchgate.net/publication/319587859_Computer-Aided_Metrology-CAM

COURSE OUTCOMES: On completion of the course the student will be able to:		**Bloom's Taxonomy Mapped**
CO1	Explain the importance of measurements in engineering and the factors affecting measurements and to compute measurement uncertainty.	Understand
CO2	Apply the working principle and the applications of linear and angular measuring instruments.	Apply
CO3	Interpret of various tolerance symbols.	Apply
CO4	Apply the SQC methods in manufacturing.	Apply
CO5	Apply the advances in measurements for quality control in manufacturing industries.	Apply

COURSE ARTICULATION MATRIX

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1							2	1	2				2	1	
CO2							3	1	2				1	2	
CO3							2	1					2	1	
CO4				3			2		1				1	2	
CO5				2				3	1				2	1	
Avg				**2.5**			**2.25**	**1.5**	**1.5**				**1.6**	**1.4**	

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

18MEMI10	DYNAMICS OF MACHINERY					
PREREQUISITES		**CATEGORY**	**PE**	**Credit**		**3**
Engineering Mechanics, Kinematics of Machinery, Strength of Materials		**Hours\Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

COURSE OBJECTIVES:	
1.	To impart students with the knowledge about motion, masses and forces in machines and the Principle of Virtual Work.
2.	To facilitate the students, to understand the concept of balancing of rotating and reciprocating masses.
3.	To teach concepts of free vibration analyses of one and two degree-of-freedom rigid body systems
4.	To teach concepts of forced vibrations analyses of rigid body systems and to give awareness to students on the phenomenon of vibration and its effects.
5.	To learn about the concept of various types of governors.

UNIT I	**FORCE ANALYSIS**	**9**	**0**	**0**	**9**
Static Force Analysis, Free Body Diagrams, Conditions of Two, Three and Four Force Members. Inertia Forces and D‘Alembert‘s Principle – Inertia Force Analysis in Reciprocating Engines – Crank Shaft Torque. Flywheels – Turning Moment Diagrams and Fluctuation of Energy of reciprocating engine mechanisms, Coefficient of Fluctuation of Energy and Speed, Weight of Flywheel Required.					
UNIT II	**BALANCING**	**9**	**0**	**0**	**9**
Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines					
UNIT III	**FREE VIBRATION**	**9**	**0**	**0**	**9**
Basic Features of Vibratory Systems – Types – Single Degree of Freedom System – Transverse Vibration of Beams – Natural Frequency by Energy Method, Dunkerly‘s Method - Critical Speed - Damped Free Vibration of Single Degree Freedom System -Types of Damping – Free Vibration with Viscous Damping, Critically Damped System, Under Damped System. Torsional Systems: Natural Frequency of Two and Three Rotor Systems.					
UNIT IV	**FORCED VIBRATION**	**9**	**0**	**0**	**9**
Response to Periodic Force – Harmonic Force – Force caused by Unbalance – Support Motion - Logarithmic Decrement-Magnification Factor – Vibration Isolation and Transmissibility.					
UNIT V	**GOVERNORS**	**9**	**0**	**0**	**9**
Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force - other governor mechanisms.					
					Total (45L) = 45 Periods

TEXT BOOKS:	
1.	Design of Machinery, Fourth Edition, by R.L. Norton, McGraw Hill, 2007
2.	Mechanical Vibration, V.P.Singh, Dhanpatrai, Delhi
REFERENCE BOOKS:	
1.	Ballaney, P.L., “Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2002.
2.	Shigley, J.E. and Uicker, J.J., “Theory of Machines and Mechanisms”, TMH ND, 1998.
3.	Amithabha Ghosh, and Ashok Kumar Malik., “Theory of Mechanisms and Machines”, 2nd Ed., Affiliated East and West Press Limited, 1998.
4.	Prof.Nakara, IIT-Delhi Reference Books

E-REFERENCES:	
1.	www.university.youth4work.com/IIT_Kharagpur_Indian-Institute-of-Technology/study/1653-dynamics-of-Machinery-ebook
2.	http://nptel.ac.in/courses/112104114/

COURSE OUTCOMES: On completion of the course the student will be able to		Bloom's Taxonomy Mapped
CO1	Apply basic principles of mechanisms in mechanical system.	Apply
CO2	Familiarize the static and dynamic analysis of simple mechanisms.	Understand
CO3	Analyze the mechanical systems subjected to free vibration.	Analyze
CO4	Analyze mechanical systems subjected to forced vibration.	Analyze
CO5	Analyze the various types of governors and its speed control mechanism.	Analyze

COURSE ARTICULATION MATRIX

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	1					1		3	2	1	2
CO2	2	2	3	2	1					1		3	2	1	2
CO3	2	2	3	2						1		3	2	1	2
CO4	2	2	3	2	1					1		3	2	1	2
CO5	1	2	3	2						1		3	2	1	1
Avg	**1.8**	**2.0**	**3.0**	**2.2**	**1**					**1.0**		**3.0**	**2.0**	**1.0**	**1.8**

3/2/1 – indicates strength of correlation (3 – High, 2- Medium, 1- Low)

MINOR DEGREE: METALLURGICAL ENGINEEING

18MTM01	ADVANCED PHYSICAL METALLURGY		Semester			
PREREQUISITES		**Category**	**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To impart knowledge on the crystal structure, diffusion, phase diagrams for various engineering materials.

		L	T	P	TH
Unit I	**CRYSTAL STRUCTURES**	**9**	**0**	**0**	**9**

Review of atomic bonds, Lattice, unit cell, crystal systems and Bravais lattices; Principal crystal structures – BCC, FCC, HCP and its characteristics; Miller indices for crystallographic planes and directions, interplanar spacing; Volume, planar and linear atomic density; Polymorphism and allotropy; CsCl, NaCl, Diamond structures; single crystal and polycrystalline and amorphous materials; isotropy and anisotropy; Simple problems in the above topics

		L	T	P	TH
Unit II	**CRYSTALLINE IMPERFECTIONS**	**9**	**0**	**0**	**9**

Types of point defects, effect of temperature on vacancy concentration, interstitial sites-octahedral and tetrahedral sites; Line defects – dislocations – Edge, screw and mixed dislocations, Burger's vector, slip and twinning; Planar defects – grain boundaries, tilt boundaries, small angle grain boundaries; ASTM grain size number, grain size determinations; Volume defects; Simple problems in the above topics.

		L	T	P	TH
Unit III	**ATOMIC DIFFUSION IN SOLIDS AND SOLIDIFICATION OF METAL**	**9**	**0**	**0**	**9**

Diffusion mechanisms, steady state diffusion and non-steady state diffusion-Fick's first law and second law; Kirkendall effect and Darken's equation; Factors affecting diffusion; Industrial applications of diffusion processes; Simple problems in the above topics; Basic principles of solidification of metals and alloys; Growth of crystals– Planar growth, dendritic growth, Solidification time, dendrite size; Cooling curves; Cast or Ingot structure, Solidification defects – Control of casting structure; Directional solidification – single crystal growth; Simple problems in the above topics.

		L	T	P	TH
Unit IV	**PHASE DIAGRAMS**	**9**	**0**	**0**	**9**

Phases, solid solution types, compounds, Hume- Rothery rules; Gibb's phase rule; Phase diagram determination; Binary isomorphous alloy systems – composition and amount of phases, development of microstructure – equilibrium and non-equilibrium cooling- Coring and its effects, homogenization; Binary eutectic system - composition and amount of phases, development of microstructure; Eutectoid, Peritectic and monotectic reaction, Phase diagrams with intermediate phases and compounds; Ternary phase diagrams. Simple problems in the above topics.

		L	T	P	TH
Unit V	**IRON-CARBON PHASE DIAGRAM**	**9**	**0**	**0**	**9**

Iron-carbon diagram, Phases in Fe-C system, Invariant reactions, Microstructure of slowly cooled steels, composition and amount of phases, Effect of Alloying elements on Fe-C system, Type, structure, properties and applications of Plain Carbon Steels and different types of Cast iron; IS Specification for Steels and Cast Irons, Simple problems in above topics.

Total (45+0) = 45 Hours

Text Books:	
1	Donald R. Askeland,"The Science and Engineering of Materials", Thomson Learning, India Edition, 2007.
2	William D.Callister, "Materials Science and Engineering – An Introduction", 4th edition, JohnWiley & Sons, New York, USA, 1997.
Reference Books:	
1	Avner S H."An Introduction to Physical Metallurgy", McGraw Hill Book Co, New York, USA, 1997.
2	Donald R Askeland," Essentials of Material Science and Engineering ", Thomson Learning, India Edition, 2007
3	Raghavan V., "Physical Metallurgy – Principles and Practice", Prentice Hall of India Ltd., New Delhi, 199.
4	William F.Smith, "Foundations of Materials Science and Engineering", Second Edition, McGraw-Hill Inc, New York, 1993.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Describe the basic crystal structure, orientation and their influence on macroscopic properties.	L2: Understanding
CO2	:	Discuss the role of imperfections in strengthening the materials.	L2: Understanding
CO3	:	Diagonise the diffusion mechanism in solidification of materials under different conditions.	L4:Analysing
CO4	:	Apply the concept of phase diagrams in equilibrium transformation of materials phases.	L3:Applying
CO5	:	Construct the Fe-Fe_3C phase diagram and discuss various properties of steel and cast iron.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1		1	
CO2	1	1				1	1						1			1
CO3	1	1	1	1		1							1	1		
CO4	1	1		1	1								1			
CO5	1	1		1									1			1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

<table>
<tr><td>18MTM02</td><td colspan="2">THERMODYNAMICS AND KINETICS IN METALLURGY</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td>Category</td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">Engineering physics and Engineering chemistry</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To learn the basic principles and concepts of thermodynamics in the field of Metallurgy and materials; and to learn about equations and their applications.</td></tr>
<tr><td>Unit I</td><td colspan="2">FUNDAMENTAL CONCEPT AND INTERNAL ENERGY</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Introduction: System and surrounding, Classification of systems, Path and state properties, Thermodynamic processes, Thermodynamic equilibrium, Reversible and Irreversible processes. First law of thermodynamics: Heat and work, Internal energy, Heat capacity of materials, Cp-Cv relations, Nernst Equation, Enthalpy, Thermochemistry Hess's law, Kirchoff's law, Maximum flame temperature.</td></tr>
<tr><td>Unit II</td><td colspan="2">ENTROPY AND AUXILARY FUNCTIONS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Second law of thermodynamics: Carnot cycle, Entropy - Statistical interpretation of entropy, Free energy, Combined statement of first and second laws, Thermodynamic functions - Maxwell's relations, Gibbs Helmholtz equation. Third and Zeroth laws of thermodynamics : Definition, concept and applications</td></tr>
<tr><td>Unit III</td><td colspan="2">THERMODYNAMIC POTENTIALS AND PHASE EQUILIBRIA</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Thermodynamic potentials: Fugacity, Activity and Equilibrium constant. Clausius - Clayperon equation, Troutons rule. Le Chatelier's principle, Vant Hoff's equation. Equilibria in phase diagrams: Phase rule, Phase stability, Thermodynamics of surfaces, interfaces and defects, P-G-T diagrams, Application of free energy - composition diagrams to the study of alloy systems.</td></tr>
<tr><td>Unit IV</td><td colspan="2">THERMODYNAMICS OF SOLUTIONS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Gibbs - Duhem equation, Partial and integral molar quantities, chemical potential, Ideal solutions - Raoult's law, Real solutions, Activity coefficient, Henry's law, Alternative standard states, Sievert's law, Mixing functions and excess functions, Regular solutions, Applications of Gibbs - Duhem equation.</td></tr>
<tr><td>Unit V</td><td colspan="2">THERMODYNAMICS OF REACTIONS AND KINETICS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Electro chemical process: Cells, Interconversion of free energy and electrical work, Determination of thermodynamic quantities using reversible cells, Solid electrolytic cells. Kinetics: First, Second and third order reactions, Arrhenius equation - activation energy, Determination of order of the reaction.</td></tr>
<tr><td colspan="7" align="right">Total (45+0) = 45 Hours</td></tr>
</table>

Text Books:	
1	Upadhyaya G S andDube R K., "Problems in Metallurgical Thermodynamics & Kinetics",Pergamon, 1977.
2	Ahindra Ghosh, Text book of Materials & MetallurgicalThermodynamics, Prentice Hall India, 2002
3	. David R Gaskell, "Introduction to the Thermodynamics of Materials", Fifth Edition, Taylor & Francis, 2008
Reference Books:	
1	David V Ragone, "Thermodynamics of Materials - Volume-1", John Wiley & Sons, Inc. 1995.
2	Dr S.K Dutta,Prof A.B.Lele – Metallurgical thermodynamics kinetics and numericals,S.Chand& co Ltd.,New Delhi 2011
3	Darken LS and Gurry R W,"Physical Chemistry of Metals", CBS publications and distributors, 2002.
4	Parker R H, "An introduction to chemical metallurgy", Pergamon press, New York, second edition, 1978.
5	Kapoor M.L., "Chemical and Metallurgical Thermodynamics Vol. I and II", Nem Chand, 1st Ed., 1981

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the fundamental concepts of thermodynamics and internal energy	L2: Understanding
CO2	:	State the thermodynamics entropy and auxilary functions.	L2: Understanding
CO3	:	Identify the basic laws, chemical potential and phase equilibria.	L4:Analysing
CO4	:	Describe the thermodynamics of the solution and various important equations.	L2: Understanding
CO5	:	Apply to solve problems related to electrochemical processes and kinetics.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1	1										1		1	
CO3	1	1		1	1								1			
CO4	1			1	1								1		1	1
CO5	1	1				1	1						1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

18MTM03	MECHANICAL BEHAVIOUR OF MATERIALS		Semester			
PREREQUISITES			**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**
Course Learning Objectives						
1	To know the fundamental concepts of deformation behaviour for structural engineering applications.					
Unit I	**DISLOCATIONS AND PLASTIC DEFORMATION**		**9**	**0**	**0**	**9**
Strength of perfect crystal and need for dislocations; Characteristics of dislocations – Edge dislocation, Screw dislocation, Burger's vector, mixed dislocation, dislocation loops; Movement of dislocation – Pierls stress, Cross slip, Climb; Dislocations in FCC, HCP and BCC lattice; Stress fields and energies of dislocations, forces on and between dislocations; Dislocation density; Intersections of dislocations – Jogs and kinks; Dislocation multiplication; Dislocation pile-ups; Deformation by slip and twinning; Critical resolved shear stress; Deformation bands and kink bands.						
Unit II	**STRENGTHENING MECHANISMS**		**9**	**0**	**0**	**9**
Strain hardening; Grain boundary strengthening; Solid solution strengthening - yield-point phenomenon, strain ageing; Precipitation hardening - Conditions for precipitation hardening, Ageing, Formation of precipitates, coarsening of precipitates, Mechanism of strengthening; Dispersion strengthening; Fiber strengthening; Martensite strengthening - examples for above strengthening mechanisms from ferrous and non-ferrous systems, Bauschinger effect; Preferred orientation; Sever plastic deformation.						
Unit III	**FRACTURE AND FRACTURE MECHANICS**		**9**	**0**	**0**	**9**
Types of fracture – ductile and brittle fracture, Ductile to Brittle Transition Temperature (DBTT), Metallurgical factors affecting DBTT, determination of DBTT, Hydrogen embrittlement and other embrittlement, Theoretical cohesive strength of metals, Griffith's theory of brittle fracture, Orowan's modification. Fracture mechanics - introduction, modes of fracture, stress intensity factor, strain energy release rate, fracture toughness and determination of KIC, introduction to COD, J integral.						
Unit IV	**FATIGUE BEHAVIOUR AND TESTS**		**9**	**0**	**0**	**9**
Fatigue: Stress cycles, S-N curves, effect of mean stress, factors affecting fatigue, structural changes accompanying fatigue, cumulative damage, HCF / LCF, thermo-mechanical fatigue, application of fracture mechanics to fatigue crack propagation, fatigue testing machines.						
Unit V	**CREEP BEHAVIOUR AND TESTS**		**9**	**0**	**0**	**9**
Creep curve, stages in creep curve and explanation, structural changes during creep, creep mechanisms, metallurgical factors affecting creep, high temperature alloys, stress rupture testing, creep testing machines, parametetric methods of extrapolation. Deformation Mechanism Maps						
						Total (45+0) = 45 Hours

Text Books:	
1	George. E. Dieter, “Mechanical Metallurgy”, 3rd Edition, McGraw-Hill Publications, New York, SI Edition, 2004
2	Marc Andr’e Meyers, Krishan Kumar Chawla, “Mechanical Behavior of Materials”, Cambridge University Press, UK, 2009.
Reference Books:	
1	Reed Hill, R.E., "Physical Metallurgy Principles", Affiliated East West Press, New Delhi, 1992.
2	Davis.H.E. Troxell G.E., Hauck.G.E.W. “The Testing of Engineering Materials”, McGraw-Hill, 1982.
3	Wulff et al Vol. III “Mechanical Behavior of Materials”, John Wiley and Sons, New York, USA, 1983.
4	Honeycombe R.W.K., “Plastic Deformation of Materials”, Edward Arnold Publishers, 1984

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom’s Taxonomy Mapped**
CO1	:	Discuss the mechanical behaviour of materials.	L2: Understanding
CO2	:	Discuss the strengthening mechanisms of materials.	L2: Understanding
CO3	:	List the various types of fractures and their mechanisms, fracture mechanics and various theories describing fracture mechanics.	L2: Understanding
CO4	:	Discuss the fatigue behaviour and the mechanism of fatigue, SN curve and fatigue testing machines.	L2: Understanding
CO5	:	Describe the creep behaviour and mechanism, factors affecting creep and creep testing machines.	L2: Understanding

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1		1	1								1	1		
CO3	1	1	1		1										1	1
CO4	1	1				1	1								1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM04	RATE PROCESSES IN METALLURGY		Semester			
PREREQUISITES			**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1	To learn the basic principles and concepts of kinetics in the domain of metallurgy and materials; to learn about equations and their applications; And to appreciate that metallurgical kinetics as a Knowledge base with abundant applications.

Unit	Title	L	T	P	TH
Unit I	**INTRODUCTION**	**9**	**0**	**0**	**9**

Introduction: Role of kinetics, heterogeneous and homogeneous kinetics, Role of heat and mass transfer in metallurgical kinetics, rate expression, Effect of Temperature and concentration on reaction kinetics: effect of temperature (Arrhenius Equation), Effect of concentration (order of a reaction), significance and determination of activation energy.

Unit	Title	L	T	P	TH
Unit II	**KINETICS OF SOLID-FLUID REACTION**	**9**	**0**	**0**	**9**

Kinetics of solid-fluid reaction: kinetic steps, rate controlling step, definition of various resistances in series, shrinking core model, chemical reaction as rate controlling step, Product layer diffusion as rate controlling step, Mass transfer through external fluid film as rate controlling step, heat transfer as the rate controlling step, Concentration boundary layer, definition and significance of heat and mass transfer coefficient, Theoretical models for mass transfer coefficients, Correlations for heat and mass transfer coefficients

Unit	Title	L	T	P	TH
Unit III	**LIQUID-SOLID PHASE TRANSFORMATION**	**9**	**0**	**0**	**9**

Principles of Solidification in metals and alloys: thermodynamics involved, eutectic and peritectic Solidification, Homogeneous and heterogeneous nucleation, Mechanisms of growth. Rapid Solidification Processing.

Unit	Title	L	T	P	TH
Unit IV	**SOLID STATE PHASE TRANSFORMATIONS**	**9**	**0**	**0**	**9**

Nucleation and growth Kinetics, homogeneous and heterogeneous transformation, Precipitation: Coherency, age hardening, particle Coarsening. Ostwald ripening, Order-disorder transformation, spinodal decomposition, massive transformations

Unit	Title	L	T	P	TH
Unit V	**SOLID STATE PHASE TRANSFORMATIONS IN STEEL**	**9**	**0**	**0**	**9**

Reconstructive and displacive transformations; Pearlitic transformation: mechanism and kinetics: Johnson-Mehl equation, morphology of pearlite; Bainitic transformation: mechanism and kinetics; morphology of upper bainite and lower bainite; Martensitic transformation: Mechanism- diffusionless displacive nature; morphology of high carbon and low carbon martensite.

Total (45+0) = 45 Hours

Text Books:

1.	Ahindra Ghosh and Sudipto Ghosh, A Text book of Metallurgical Kinetics, PHI learning Pvt. Ltd., New Delhi, 2014
2.	H.S. Ray, Kinetics of Metallurgical Reactions, International Science publisher, 1993.
3.	F. Habashi, Kinetics of Metallurgical Processes, Metallurgy Extractive Québec, 1999.
4.	Upadhyaya G S and Dube R K., "Problems in Metallurgical Thermodynamics & Kinetics", Pergamon, 1977.

Reference Books:

1.	Phase transformations in metals and alloys- D.A. Potter and K.E. Easterling, CRC Press, 1992. 2. Transformations in Metals, P.G. Shewmon, Mc-Graw Hill, 1969.
2.	Introduction to Physical Metallurgy – S. N. Avner, Tata McGraw Hill, 1997.
3.	Physical Metallurgy Principles, R. E. Reed-Hill and R. Abbaschian, 3rd ed, PWS-Kent Publishing, 1992.
4.	Modern Physical Metallurgy, R. E. Smallman, Butterworths, 1963

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the thermodynamic aspects of phase changes.	L2: Understanding
CO2	:	Discuss the fundamentals of solid –fluid reactions.	L2: Understanding
CO3	:	Explain the eutectic and peritectic solidifications and rapid solidification processes.	L2: Understanding
CO4	:	Describe the fundamentals of solidification.	L1: Remembering
CO5	:	Apply the solid state phase transformations in steel.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1			1
CO2	1	1			1	1									1	1
CO3	1	1		1	1								1	1		
CO4	1	1		1	1									1		1
CO5	1		1			1	1								1	1
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM05	CORROSION AND SURFACE ENGINEERING		Semester			
PREREQUISITES			OE	Credit		3
Engineering chemistry		Hours/Week	L	T	P	TH
			3	0	0	3

Course Learning Objectives

1	To understand the corrosion and surface engineering, with its application in engineering field.

Unit	Title	L	T	P	TH
Unit I	**MECHANISMS AND TYPES OF CORROSION**	9	0	0	9

Principles of direct and Electro chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice Fretting, Erosion and Stress Corrosion, corrosion fatigue, hydrogen damage –Factors influencing corrosion

Unit	Title	L	T	P	TH
Unit II	**TESTING AND PREVENTION OF CORROSION**	9	0	0	9

Corrosion testing techniques and procedures- Corrosion Testing ASTM Standards, Pitting Corrosion Test, Hydrogen Induced Cracking Test, Sulphide Stress Corrosion Cracking Test- Prevention of Corrosion-Design against corrosion –Modifications of corrosive environment –Inhibitors – Cathodic Protection –Special surfacing processes.

Unit	Title	L	T	P	TH
Unit III	**CORROSION OF INDUSTRIAL COMPONENTS**	9	0	0	9

Corrosion in fossil fuel power plants, Automotive industry, Chemical processing industries, corrosion in petroleum production operations and refining, Corrosion of pipelines- wear of industrial components.

Unit	Title	L	T	P	TH
Unit IV	**SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE**	9	0	0	9

Diffusion coatings –Electro and Electroless Plating –Hot dip coating –Hard facing-Metal spraying, Flame and Arc processes- Conversion coating –Selection of coating for wear and Corrosion resistance.

Unit	Title	L	T	P	TH
Unit V	**THIN LAYER ENGINEERING PROCESSES**	9	0	0	9

Laser and Electron Beam hardening –Effect of process variables such as power and scan speed - Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating - Chemical vapor deposition – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating-Properties and applications of thin coatings.

Total (45+0) = 45 Hours

Reference Books:

1.	Fontana. G., Corrosion Engineering, McGraw Hill,1985.
2.	Kenneth G. Budinski, Surface Engineering for Wear Resistance, Prenticehall,1992.
3.	ASM Metals Hand Book –Vol. 5, Surface Engineering,1996.
4.	Denny A Jones, “Principles and prevention of corrosion”, 2ndedition, Prentice Hall, New Jersey,1995.
5.	ASM International, Surface Engineering for Corrosion and Wear Resistance,2005.
6.	Schweitzer. P.A., Corrosion Engineering Hand Book, 3rd Edition, Marcel Decker, 1996.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Name the different types of corrosion and their mechanism.	L2: Understanding
CO2	:	Estimate corrosion resistance by different tests.	L4:Analysing
CO3	:	Explain the corrosion behavior of different metals in different industries.	L2: Understanding
CO4	:	Classify the different forms of processing techniques of surface engineering materials.	L1: Remembering
CO5	:	Select the type of deposition and spraying technique.	L3:Applying

COURSE ARTICULATION MATRIX

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1		1	1								1	1		
CO2	1	1		1		1							1	1		
CO3	1	1	1	1			1								1	1
CO4	1	1		1	1										1	1
CO5	1	1		1	1								1	1		
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0						1.0	1.0	1.0	1.0

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)

18MTM06	MATERIALS CHARACTERIZATION			Semester		
PREREQUISITES			**OE**	**Credit**		**3**
Engineering physics		**Hours/Week**	**L**	**T**	**P**	**TH**
			3	**0**	**0**	**3**

Course Learning Objectives

1. To acquire knowledge on various characterizations, chemical and thermal analysis of metallurgical components using its analysis tools.

Unit	Title	L	T	P	TH
Unit I	**OPTICAL MICROSCOPY**	**9**	**0**	**0**	**9**

Metallographic specimen preparation. Macro-examination -applications. Metallurgical microscope - principle, construction and working, , Optic properties - magnification, numerical aperture, resolving power, depth of focus, depth of field, different light sources, lens aberrations and their remedial measures, Various illumination techniques-bright field , dark field, phase-contrast, polarized light illuminations, interference microscopy, high temperature microscopy; Quantitative metallography – Image analysis.

Unit	Title	L	T	P	TH
Unit II	**X-RAY DIFFRACTION**	**9**	**0**	**0**	**9**

Characteristic X-ray spectrum, Bragg's Law, Diffraction methods - Laue method, rotating crystal method and powder method. Diffraction intensity – structure factor calculation. X-ray diffractometer -general features, filters and counters. Applications of X-ray diffraction in materials characterisation – Determination of crystallite size, crystal structure, precise lattice parameter, measurement of stress.

Unit	Title	L	T	P	TH
Unit III	**ELECTRON MICROSCOPY**	**9**	**0**	**0**	**9**

Electron beam - specimen interactions. Construction and operation of Transmission Electron Microscopy – Diffraction effects and image formation, various imaging modes, selected area diffraction, applications, specimen preparation techniques. Scanning electron microscopy – principle, equipment, various operating modes and applications, Electron probe microanalyser (EPMA)- principle, instrumentation, qualitative and quantitative analysis. Introduction to HRTEM, FESEM, EBSD.

Unit	Title	L	T	P	TH
Unit IV	**SPECTROSCOPIC TECHNIQUES**	**9**	**0**	**0**	**9**

X-ray spectroscopy – EDS and WDS. Principle, instrumentation, working and applications of Auger Electron spectroscopy, X-ray photoelectron spectroscopy and Secondary ion mass spectroscopy / ion microprobe. Optical emission spectroscopy, Atomic Absorption spectroscopy and X-ray fluorescence spectroscopy - principle, construction, working and applications. UV-Vis, FTIR and Raman spectroscopy.

Unit	Title	L	T	P	TH
Unit V	**THERMAL ANALYSIS AND ADVANCED CHARACTERIZATION TECHNIQUES**	**9**	**0**	**0**	**9**

Thermal Analysis: Principles of differential thermal analysis, differential scanning calorimetry and thermo-graviometric analysis – Instrumentation and applications. Advanced characterization techniques: Scanning probe microscopy - STM and AFM - principle, instrumentation and applications. Field ion microscopy including atom probe - principles, instrumentation and applications.

Total (45+0) = 45 Hours

Text Books:

1. Cullity, B.D., Elements of X Ray Diffraction, Addison-Wesley Publishing Company Inc, Philippines, 1978
2. Brandon, D. and W.D. Kaplan, Microstructural Characterization of Materials, John Wiley & Sons Ltd, England, 2013.
3. Leng, Y., Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd, Singapore, 2008

Reference Books:	
1.	ASM Handbook, Volume 10, Materials Characterization, ASM international, USA, 1986.
2.	Vander Voort, G.F., Metallography: Principle and practice, ASM International, 1999.
3.	Phillips V A, Modern Metallographic Techniques and their Applications, Wiley Eastern, 1971.
4.	Angelo, P. C., Materials Characterization, Reed Elsevier India Pvt Ltd, Haryana, 2013.

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Discuss the principles of metallurgical microscope, optical properties and various illumination techniques.	L2: Understanding
CO2	:	Analyze the various diffraction methods, X-ray diffractometer and determination of crystal parameter.	L4:Analysing
CO3	:	Discuss the principles of TEM, SEM, EPMA.	L2: Understanding
CO4	:	Explain various spectroscopic techniques,	L2: Understanding
CO5	:	Discuss the chemical and thermal analysis using advanced methods.	L2: Understanding

<u>COURSE ARTICULATION MATRIX</u>

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	`1		1	1								1		1	
CO2	1	1	1	1		1							1			1
CO3	1		1			1	1					1	1			1
CO4	1	1		1	1							1	1			1
CO5	1	1		1	1								1		1	
Avg.	1.0	1.0	1.0	1.0	1.0	1.0	1.0					1.0	1.0		1.0	1.0
3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)																

<table>
<tr><td>18MTM07</td><td colspan="2">AUTOMOTIVE, AEROSPACE AND DEFENCE MATERIALS</td><td colspan="3">Semester</td><td></td></tr>
<tr><td colspan="2">PREREQUISITES</td><td></td><td>OE</td><td colspan="2">Credit</td><td>3</td></tr>
<tr><td colspan="2" rowspan="2">Engineering physics</td><td rowspan="2">Hours/Week</td><td>L</td><td>T</td><td>P</td><td>TH</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">Course Learning Objectives</td></tr>
<tr><td>1</td><td colspan="6">To understand the properties and applications various materials suitable for automobile, aircraft and defnce industries and its components.</td></tr>
<tr><td>Unit I</td><td colspan="2">MATERIALS FOR ENGINES AND TRANSMISSION SYSTEMS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Materials selection for IC engines: Piston, piston rings, cylinder, Engine block, Connecting rod, Crank shaft, Fly wheels, Gear box, Gears, Splines, Clutches.</td></tr>
<tr><td>Unit II</td><td colspan="2">MATERIALS FOR AUTOMOTIVE STRUCTURES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Materials selection for bearings, leaf springs, chasis & frames, Bumper, shock absorbers, wind screens, panels, brake shoes, Disc, wheels, differentials , damping and antifriction fluids, Tyres and tubes. Materials for electronic devices meant for engine control, ABS, Steering, Suspension, Sensors, anti-collision, Anti-fog, Head lamps.</td></tr>
<tr><td>Unit III</td><td colspan="2">AEROSPACE METALS AND ALLOYS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Types of corrosion – Effect of corrosion on mechanical properties – Stress corrosion cracking – Corrosion resistance materials used for space vehicles. Heat treatment of carbon steels – aluminium alloys, magnesium alloys and titanium alloys – Effect of alloying treatment, heat resistance alloys – tool and die steels, magnetic alloys, powder metallurgy- application of materials in Thermal protection systems of Aerospace vehicles – super alloys</td></tr>
<tr><td>Unit IV</td><td colspan="2">CERAMICS AND COMPOSITES</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Introduction – physical metallurgy – modern ceramic materials – cermet - cutting tools – glass ceramic –production of semi-fabricated forms - Plastics and rubber – Carbon/Carbon composites, Fabrication processes involved in metal matrix composites - shape memory alloys – applications in aerospace vehicle design.</td></tr>
<tr><td>Unit V</td><td colspan="2">NUCLEAR WASTE AND RADIATION PROTECTION, IRRADIATION EFEFCTS</td><td>9</td><td>0</td><td>0</td><td>9</td></tr>
<tr><td colspan="7">Introduction-unit of nuclear radiation-Types of waste –disposal –ICRP recommendations-radiation hazards and prevention –radiation dose units - Irradiation Examination of Fuels, Irradiation behaviour of metallic uranium – irradiation growth, thermal cycling, swelling, adjusted uranium, blistering in uranium rods. Irradiation effects in ceramic oxide and mixed oxide fuels, definition and units of burn up, main causes of fuel element failure in power reactors and remedies to avoid failures.</td></tr>
<tr><td colspan="7" align="right">Total (45+0) = 45 Hours</td></tr>
</table>

<table>
<tr><td colspan="2">Reference Books:</td></tr>
<tr><td>1.</td><td>ASM Handbook, “Selection of Materials Vol. 1 and 2”, ASM Metals Park, Ohio. USA, 1991.</td></tr>
<tr><td>2.</td><td>Materials Science and Engineering, Willium D. Callister, Jr. John Wiley & Sons publications
Or Callister’s Materials Science and Engineering Adapted By R. Balasubramaniam, Wiley India, Edition -2010.</td></tr>
<tr><td>3.</td><td>Material Science and Engineering, V. Raghavan, Prentice Hall of India, 4th Edition.</td></tr>
<tr><td>4.</td><td>Engineering Metallurgy Applied Physical Metallurgy, R. A. Higgins, 6th Edition</td></tr>
</table>

5.	Gladius Lewis, "Selection of Engineering Materials", Prentice Hall Inc. New Jersey USA, 1995.
6.	Charles J A and Crane. F A. A., "Selection and Use of Engineering Materials", 3rd Edition, Butterworths, London UK, 1996
7.	ASM Handbook. "Materials Selection and Design", Vol. 20- ASM Metals Park Ohio.USA, 1997
8.	Cantor," Automotive Engineering: Lightweight, Functional, and Novel Materials", Taylor & Francis Group, London, 2006

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Describe the materials selection criteria for engine and transmission systems.	L2: Understanding
CO2	:	Analyze the different materials used for automotive structures and Different electronic materials for automotive applications.	L4:Analysing
CO3	:	Explain various topics such as elements of aerospace materials and mechanical behaviour of materials,	L2: Understanding
CO4	:	Compare the ceramics and composites of aerospace materials	L4:Analysing
CO5	:	Examine the fuels for nuclear materials.	L3:Applying

<u>COURSE ARTICULATION MATRIX</u>

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
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