Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune

DEPARTMENT OF CIVIL ENGINEERING

Curriculum Structure and Syllabus
of
T.Y. B.Tech Civil Engineering
(Course 2020)

Effective from Academic Year 2023-24
(Updated with minor changes)

Institute Vision

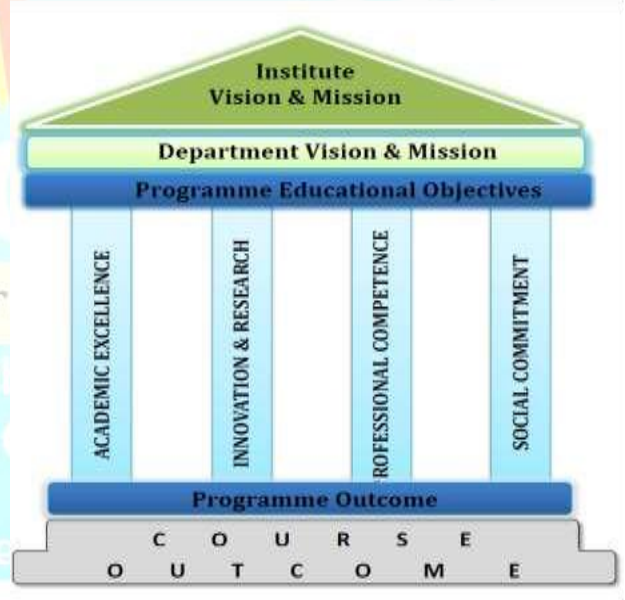
To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with ability to think and act independently in demanding situations

Quality Policy

We at PCCOE are committed to impart Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders. We shall strive for academic excellence, professional competence and social commitment in fine blend with innovation and research. We shall achieve this by establishing and strengthening state-of- the-art Engineering and Management Institute through continual improvement in effective implementation of Quality Management System.



INDEX

LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

SR. NO.	ABBREVIATION	TYPE OF COURSES
1.	BSC	Basic Science Course
2	ECC	Engineering Core Course
3	HSMC	Humanities, Social Sciences and Management Course
4	PCC	Professional Core Course
5	PEC	Professional Elective Course
6	OEC	Open Elective Course
7	PROJ	Project
8	INTR	Internship
9	Audit	Audit Course
10	MC	Mandatory Course
11	LS	Life Skill
12	PFC	Proficiency Course
13	MOOC	Massive Open Online Course
14	L	Lecture
15	P	Practical
16	T	Tutorial
17	H	Hours
18	CR	Credits
19	IE	Internal Evaluation
20	MTE	Mid Term Evaluation
21	ETE	End Term Evaluation
22	TW	Term Work
23	OR	Oral
24	PR	Practical

CURRICULUM FRAMEWORK

(2020-2021; 2021-2022; 2022-2023; 2023-2024)

Course and Credit Distribution

SR NO.	TYPE OF COURSE	NO. OF COURSES	TOTAL CREDITS	
			NO.	%
1.	Basic Science Course (BSC)	8	23	14
2.	Engineering Core Course (ECC)	14	22	14
3.	Humanities, Social Science and Management Course (HSMC)	6	13	8
4.	Professional Core Course(PCC)	24	48	30
5.	Professional Elective Course(PEC)	6	18	11
6.	Open Elective Course(OEC)	6	18	11
7.	Project(PROJ)	2	16	10
8.	Internship(INTR)	1	3	2
9.	Audit Course (AUDIT)	3	0	-
10.	Mandatory course (MC)	2	0	-
11.	Life Skill (LS)	4	0	-
12.	Proficiency course (PFC)	3	0	-
13.	Massive Open Online Courses (MOOC)	1	0	-
TOTAL		**80**	**161**	**100**

Semester wise Course Distribution

Sr. No.	TYPE OF COURSE	NO. OF COURSES/ SEMESTER								TOTAL
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	3	3	2	-	-	-	-	-	8
2.	Engineering Core Course (ECC)	6	5	2	1	-	-	-	-	14
3.	Humanities, Social Science and Management Course (HSMC)	1	1	1	1	1	1	-	-	6
4.	Professional Core Course(PCC)	-	-	6	6	4	4	4	-	24
5.	Professional Elective Course(PEC)	-	-	-	-	2	2	2	-	6
6.	Open Elective Course(OEC)	-	-	-	1	1	2	2	-	6
7.	Project(PROJ)	-	1	-	-	-	-	-	1	2
8.	Internship(INTR)	-	-	-	-	-	-	-	1	1
9.	Audit Course (AUDIT)	-	-	-	1	1	1	-	-	3
10.	Mandatory course (MC)	-	-	-	-	1	1	-	-	2
11.	Life Skill (LS)	1	1	1	1	-	-	-	-	4
12.	Proficiency course (PFC)	-	-	-	1	1	1	-	-	3
13.	Massive Open Online Courses (MOOC)	-	-	-	-	-	-	1	-	1
	TOTAL	**11**	**11**	**12**	**12**	**12**	**13**	**9**	**2**	**80**

Semester wise Credit Distribution

1 Lecture hour = 1 Credit 2 Lab Hours = 1 Credit 1 Tutorial Hour = 1 Credit

Sr. No.	TYPE OF COURSE	NO. OF COURSES/ SEMESTER								TOTAL
		1	2	3	4	5	6	7	8	
1.	Basic Science Course (BSC)	9	9	5	-	-	-	-	-	23
2.	Engineering Core Course (ECC)	9	7	3	3	-	-	-	-	22
3.	Humanities, Social Science and Management Course (HSMC)	2	2	3	2	2	2	-	-	13
4.	Professional Core Course(PCC)	-	-	12	12	8	8	8	-	48
5.	Professional Elective Course(PEC)	-	-	-	-	6	6	6	-	18
6.	Open Elective Course(OEC)	-	-	-	3	3	6	6	-	18
7.	Project(PROJ)	-	2	-	-	-	-	-	14	16
8.	Internship(INTR)	-	-	-	-	-	-	-	3	3
9.	Audit Course (AUDIT)	-	-	-	-	-	-	-	-	0
10.	Mandatory course (MC)	-	-	-	-	-	-	-	-	0
11.	Life Skill (LS)	-	-	-	-	-	-	-	-	0
12.	Proficiency course (PFC)	-	-	-	-	-	-	-	-	0
13.	Massive Open Online Courses (MOOC)	-	-	-	-	-	-	-	-	0
	Total	**20**	**20**	**23**	**20**	**19**	**22**	**20**	**17**	**161**

Curriculum structure

TY B Tech

Civil Engineering

CURRICULUM STRUCTURE

For Third Year B. Tech. (Civil Engineering) Semester-V

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme						
			L	P	T	H	CR	IE	MTE	ETE	TW	PR	OR	Total
BCI5413	PCC	**Hydrology & Water Resources Engineering**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI5414	PCC	**Transportation Engineering**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI5501 A/B/C/D	PEC	**Professional Elective Course – I**	2	-	-	2	2	20	30	50	-	-	-	**100**
BCI5502 A/B/C/D	PEC	**Professional Elective Course – II**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI5415	PCC	**Hydrology & Water Resources Engineering Lab**	-	2	-	2	1	-	-	-	25	-	50	**75**
BCI5416	PCC	**Transportation Engineering Lab**	-	2	-	2	1	-	-	-	50	-	25	**75**
BCI5503 A/B/C/D	PEC	**Professional Elective Course – I Lab**	-	2	-	2	1	-	-	-	50	-	-	**50**
	OEC	**Open Elective-II**	3	-	-	3	3	20	30	50	-	-	-	**100**
BHM5113	HSMC	**HSMC – 5 Principles of Management**	2	-	-	2	2	30	-	20	-	-	-	**50**
BCI5912 A/B/C/D	PFC	**Proficiency Course - 2**	-	2	-	2	-	-	-	-	-	-	-	**GR**
BHM5917	MC	**Professional Development Training - 1**	3	-	-	3	-	-	-	-	-	-	-	**GR**
BHM9961	AUDIT	**AUDIT –2 Environmental Science**	1	-	-	1	-	-	-	-	-	-	-	**GR**
Total			**20**	**8**	**-**	**28**	**19**							**750**

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, CIE-Continuous Internal Evaluation, IE – Internal Evaluation, MTE – Mid Term Examination, ETE – End Term Examination, TW – Term Work, PR- Practical Exam, OR – Oral Exam

Semester – V

List of courses – Professional Elective Course – I

Course Code	Course Name	
BCI5501A	Solid Waste Management	Choose any one
BCI5503A	Solid Waste Management Lab	
BCI5501B	Architecture & Town Planning	
BCI5503B	Architecture & Town Planning Lab	
BCI5501C	Elements of Earthquake Engineering	
BCI5503C	Elements of Earthquake Engineering Lab	
BCI5501D	Foundation Engineering	
BCI5503D	Foundation Engineering Lab	

List of courses – Professional Elective Course – II

Course Code	Course Name	
BCI5502A	Hydropower Engineering	Choose any one
BCI5502B	TQ and HR Management in Construction	
BCI5502C	Advanced Mechanics of Structures	
BCI5502D	Railways, Tunnel & Harbor	

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List of courses – Open Elective Course – 2

Course Code	Department	Course Name	
BAS5607	AS&H	Statistical Data Analysis Using R	Choose any one
BCE5601	COMPUTER	Data Structures Using Python	
BCE5602		Programming with C++	
BET5601	E&TC	Smart City: An Electronic Perspectives	
BET5602		Modeling and Simulation with MATLAB	
BIT5601	IT	Object Oriented Programming	
BME5602A	MECH	Industry 4.0	
BME5602B		Safety, Health and Environment	

Semester – V

List of courses – Humanities, Social Sciences and Management Course – 5

Course Code	Course Name
BHM5113	Principles Management

List of courses – Proficiency Course – 2

Course Code	Course Name	
BCI5912A	Analysis of RCC and steel structures by STAAD Pro software	Choose any one
BCI5912B	Material Management using ERP	
BCI5912C	Introduction and application of QGIS software	
BCI5912D	PLAXIS: bearing capacity and settlement analysis module	

List of courses – Audit Courses – 2

Course Code	Course Name
BHM9961	Environmental Science

Open Elective Course – 2 Offered by Civil Department to other department

OEC	Semester	Course Code	Course Name
Open Elective Course- 2	Semester V	BCI5602A	Total Quality Management
		BCI5602B	Intelligent Transport System

CURRICULUM STRUCTURE

For Third Year B. Tech. (Civil Engineering) Semester-VI

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme						
			L	P	T	H	CR	IE	MTE	ETE	TW	PR	OR	Total
BCI6417	PCC	**Water and Waste Water Engineering**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI6418	PCC	**Design of Reinforced Concrete Structures**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI6503 A/B/C/D	PEC	**Professional Elective Course – III**	2	-	-	2	2	20	30	50	-	-	-	**100**
BCI6504 A/B/C/D	PEC	**Professional Elective Course – IV**	3	-	-	3	3	20	30	50	-	-	-	**100**
BCI6419	PCC	**Environmental Engineering Lab**	-	2	-	2	1	-	-	-	-	25	-	**25**
BCI6420	PCC	**Design of Reinforced Concrete Structures Lab**	-	2	-	2	1	-	-	-	25	-	25	**50**
BCI6505 A/B/C/D	PEC	**Professional Elective Course – III Lab**	-	2	-	2	1	-	-	-	25	-	-	**25**
-	OEC	**Open Elective-III**	3	-	-	3	3	20	30	50	-	-	-	**100**
-	OEC	**Open Elective-IV**	3	-	-	3	3	20	30	50	-	-	-	**100**
BHM6114 /15/16	HSMC	**HSMC -6**	2	-	-	2	2	30	-	20	-	-	-	**50**
BCI6913 A/B/C/D	PFC	**Proficiency Course - 3**	-	2	-	2	-	-	-	-	-	-	-	**GR**
BHM6918	MC	**Professional Development Training - 2**	3	-	-	3	-	-	-	-	-	-	-	**GR**
BHM9962	AUDIT	**AUDIT – 3 Constitution of India**	1	-	-	1	-	-	-	-	-	-	-	**GR**
		Total	**23**	**8**	**-**	**31**	**22**							**750**

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, CIE-Continuous Internal Evaluation, IE – Internal Evaluation, MTE – Mid Term Examination, ETE – End Term Examination, TW – Term Work, PR- Practical Exam, OR – Oral Exam

Semester – VI

List of courses – Professional Elective Course – III

Course Code	Course Name	
BCI6503A BCI6505A	Design of Hydraulic Structures Design of Hydraulic Structures Lab	Choose any one
BCI6503B BCI6505B	Construction Equipment and Material Management Construction Equipment and Material Management Lab	
BCI6503C BCI6505C	Finite Element Methods Finite Element Methods Lab	
BCI6503D BCI6505D	Advanced Transportation Engineering Advanced Transportation Engineering Lab	

List of courses – Professional Elective Course – IV

Course Code	Course Name	
BCI6504A	Sustainable Engineering	Choose any one
BCI6504B	Project Management and Economics	
BCI6504C	Prestressed concrete structures	
BCI6504D	Advanced Geotechnical Engineering	

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List of courses – Open Elective Course – 3

Course Code	Department	Course Name	
BAS6608	AS&H	Multivariate Data Analysis Using R	Choose any one
BCE6603	COMPUTER	Information Security	
BCE6604		Principles of Software Engineering	
BET6601	E&TC	Designing with Raspberry Pi	
BET6602		Basics of Automotive Electronics	
BIT6601	IT	Web Technology	
BME6603A	MECH	3D Printing and Modeling	
BME6603B		Material Informatics	

List of courses – Open Elective Course – 4

Course Code	Department	Course Name	
BCE6605	COMPUTER	Fundamentals of Machine Learning	Choose any one
BCE6606		JAVA Programming	
BET6603	E&TC	Designing with Arduino platform	
BET6604		Communication Protocols for e-Vehicle	
BIT6602	IT	Mobile Application Development	
BME6604A	MECH	Model Based System Engineering	
BME6604B		Electronics Cooling	

List of courses – Humanities, Social Sciences and Management Course – 6

Course Code	Course Name	
BHM6114	Project Management	Choose any one
BHM6115	Financial Management	
BHM6116	Entrepreneurship Development	

List of courses – Proficiency Course – 3

Course Code	Course Name	
BCI6913A	Analysis and design of RCC and steel structures by STAAD Pro software	Choose any one
BCI6913B	Project management using MSP	
BCI6913C	Analysis and design of sewer network	
BCI6913D	Open Road	

List of courses – Audit Course – 3

Course Code	Course Name
BHM9962	Constitution of India

Open Elective Course – 3&4 Offered by Civil Department to other department

OEC	Semester	Course Code	Course Name
Open Elective Course- 3	Semester VI	BCI6603A	Remote Sensing and GIS
		BCI6603B	Building Services and Maintenance
Open Elective Course- 4	Semester VI	BCI6604A	Smart Cities & Building Automations
		BCI6604B	Mechanical Electrical Plumbing (MEP) Systems

Course Syllabus

TY B Tech

Semester-V

Program:	B. Tech. (Civil Engineering)			Semester :	V		
Course:	Hydrology and Water Resources Engineering			Code:	BC15413		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge:

1. Knowledge of fundamentals of fluid mechanics and geology
2. Knowledge of fundamentals of statistics is essential.

Course Objectives:

1. To impart knowledge of government organizations in water resources, precipitation, runoff and application of Q-GIS in hydrology.
2. To build the concept of groundwater hydrology.
3. To make aware of reservoir planning, capacity and irrigation concepts.
4. To get acquainted with hydraulic structures

Course Outcomes:

After learning the course, the students should be able to:

1. Explain government organizations in water resources and analyze precipitation and its abstraction
2. Evaluate Yield through Aquifer
3. Analyze runoff and understand the application of Q- GIS software in hydrology
4. Estimate reservoir capacity using concepts of mass flow curve and sedimentation
5. Apply irrigation concepts and evaluate water requirement of crops
6. Explain different types of dams, Spillway, energy dissipater and Weir.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Hydrology** Introduction: Hydrological cycle, brief introduction of government organizations, precipitation: types of precipitation, measurement, analysis of precipitation data, evaporation, evapotranspiration, infiltration, climate change, stream gauging.	07
2	**Ground Water Hydrology** Occurrence and distribution of ground water, specific yield of aquifers, Darcy's law, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well, tube wells, open wells and their construction, Groundwater recharge methods.	08
3	**Run Off** Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff, Runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, unit hydrograph theory, S-curve hydrograph, uses and limitations of unit hydrograph, synthetic hydrograph (no numerical on synthetic hydrograph) Floods: Estimation of peak flow, rational formula and other methods, flood frequency analysis, Introduction to flood routing.	08
4	**Reservoir Planning** Introduction, investigation for reservoir planning, applications of mass curve and demand curves, fixation of reservoir capacity from annual inflow and outflow, reservoir sedimentation-phenomenon, measures to control reservoir sedimentation, density currents, significance of trap efficiency, useful life of reservoir.	08
5	**Irrigation and Canal structures** Methods of irrigation, water requirements of crops, calculations of canal and reservoir capacities, Piped distribution network for irrigation (PDN) : Introduction, advantages and disadvantages of PDN over conventional, canal distribution network and its application, canal and canal structures, canal lining, canal revenue assessment methods, introduction to cross drainage works	08
6	**Introduction to Hydraulic Structures** Gravity dam, various components of dam, forces acting on gravity dam, low and high gravity dam. Earth dam : Introduction, causes of failure of earthen dam. Spillways and energy dissipaters (Introduction), Diversion head works – Weir and barrages.	06
	Total	45

Text Books:

1. Engineering Hydrology by K. Subramanyam, 3rd Edition, Tata McGraw Hill, 2017.
2. Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, 21st Edition, Khanna Publishers, New Delhi, 2016.
3. Irrigation Engineering and Hydraulic Structures, Vol.II, S.K.Garg, 32nd Edition, Khanna Publishers, New Delhi, 2016.

Reference Books:

1. Irrigation, Water Resources and Water Power Engineering, P. N. Modi, 8th Edition, Standard Book House, 2012.
2. Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, 16th Edition, Standard Publisher, 2016.
3. Groundwater Hydrology, Todd, 3th Edition, John Wiley & Sons, 2011.
4.Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke-Locate Press
5. Irrigation Engineering, H.M.Raghunath,1st Edition, Wiley India Pvt. Ltd.,2016.

E-Resources

1. https://www.imdpune.gov.in/
2. https://old.amu.ac.in/emp/studym/99994128.pdf
3. https://pubs.usgs.gov/wsp/2220/report.pdf
4. https://indiawris.gov.in/wris/
5. http://www.cwc.gov.in/water-resources-information-system-wris
6. http://cgwb.gov.in/

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Program:	B. Tech. (Civil Engineering)			Semester :		V	
Course:	Transportation Engineering			Code:		BC15414	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Basic Civil & Environmental Engineering
2. Geotechnical Engineering for characteristics of soil
3. Engineering Geology & Rock Mechanics for design of road geometry
4. Concrete Technology for designing of rigid pavement

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. Surveys needed for collecting different kinds of data related to highways
2. Geometric design and pavement design of highways
3. Modern trends in highway materials, construction, maintenance and repair

Course Outcomes:

After learning the course, the students should be able to:

1. Understand the importance of different types of surveys for executing road project
2. Plan and Design the geometrics of a highway
3. Apply the principles of traffic engineering for road project
4. Elaborate use of different materials in pavement construction and bituminous mix design
5. Design a pavement as per IRC codal provisions
6. Explain the construction process of different layers & bituminous mixes used in pavements

Detailed Syllabus

Unit	Description	Duration (H)
1	**Highway Development & Planning:** History; Road development plans & classification of roads; Road Patterns; Road development in India - Vision 2030 & Rural Road Development Vision 2030; Current road projects in India; Highway alignment and highway project report preparation (Planning surveys & Master Plans based on saturation system).	07
2	**Geometric Design of Highways:** Introduction; highway cross section elements, typical cross section (TCS) for different types of roads; Sight distances, Design of horizontal alignment: horizontal curve, superelevation & its attainment, transition curves, widening on curves; Design of vertical alignment: gradients, grade compensation, design of summit curves & valley curves; Highway drainage: importance of highway drainage, subsurface and surface drainage systems.	08
3	**Traffic Engineering & Control:** Introduction to basic traffic stream parameters: flow, speed & density & their relationships; Traffic characteristics; Traffic engineering studies; Traffic regulation and control devices (signs, signals, islands, road markings); Accident and Parking studies: Types, Reasons, Contributing factors, ASI etc..; Types of road intersections.	07
4	**Pavement Materials:** Materials used in highway construction and related tests: Soil subgrade and CBR Test, stone aggregates; Bituminous binders; Bituminous paving mixes; Viscosity based gradation of bitumen; Modified Bitumen (Cutbacks, Emulsions, Crumbed Rubber Modified Bitumen – CRMB, Polymer Modified Bitumen-PMB, Foamed Bitumen); Marshall Stability Mix Design and Test (All 5 test parameters).	08
5	**Pavement Design:** Introduction; Flexible pavements: computation of design traffic (Vehicle Damage Factor VDF, Lane distribution factor LDF, Traffic growth rate); Stresses in flexible pavements; Design guidelines for flexible pavements as per IRC 37-2012 (steps only); Rigid pavements: components and functions, factors affecting design; Stresses in rigid pavements (ESWL); Design guidelines for concrete pavements as per IRC 58-2015 (steps only); Joints in CC pavements and problems related to it.	08

6	**Modern Trends in Highway Materials, Construction & Maintenance** Construction process of GSB, WBM, WMM; Cemented base; Introduction to bituminous works such as prime coat, tack coat, seal coat, Built-up Spray Grout (BSG), Asphaltic Concrete (AC) or Bituminous Concrete (BC), Bituminous Macadam (BM), Dense Bituminous Macadam (DBM) and premix carpet; Dry lean Concrete (DLC), Pavement Quality Concrete (PQC). Mastic Asphalt, Cold Mix Asphalt Technology, Warm Mix Asphalt Technology, Recycled/Reclaimed Asphalt Pavement (RAP) (Manual Series - 2), Introduction to Non-Destructive Testing for pavements.	**07**
	Total	**45**

Text Books:

1. Highway engineering – S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Brothers, Roorkee, 10th Edition,(2018)
2. Traffic Engineering, Roger P. Roess, Elena S. Prassas, and William R. McShane, Pearson, Fifth Edition, (2019)
3. Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna Publishers Delhi, 9th Edition,(2017)

Reference Books:

1. A Course in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi, (2003)
2. Principles of Transportation Engineering – G.V. Rao Tata McGraw Hill Publication (2007)
3. Highway Engineering – Rangwala, Charotar publishing House, Anand 388001(2017)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Highway and Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

Codes:

1. I.S. 1201 to 1220-1978: Methods for Testing Tar and Bitumen
2. I.S. 73 (2013): Paving Bitumen (Specification)
3. I.S. 2386 Part I to V: Methods of Tests for Aggregates
4. I.S. 2720 Part 16-1987 (Reaffirmed 1997): Methods of test for soil
5. I.R.C. 58- 2015: Tentative Guidelines for the Design of Rigid Pavements
6. IRC 37-2012: Tentative Guidelines for the Design of Flexible Pavements
7. Specifications for Road and Bridge Works (MoRTH) 5th Revision, New Delhi

E-Resources

1. https://ocw.mit.edu/collections/transportation (MIT- Open courseware)
2. https://www.icevirtuallibrary.com

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Program:	B. Tech. (Civil Engineering)			Semester :	V		
Course:	Solid Waste Management (PEC-I)			Code:	BC15501A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Environmental Studies,
2. Engineering Chemistry

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. To understand problems of solid waste, estimate and characterize the solid waste and apply the knowledge of laws for municipal solid waste (MSW) management for handling of MSW.
2. To understand government initiatives for management of solid waste, to apply the knowledge of mathematics, science, and engineering for effective solid waste collection systems, for waste collection route optimization and its economics.
3. To understand processing of solid waste, material recovery facility and to design composting & bio-methnation systems, maintain and operate waste process for effective organic waste treatment.
4. To design & manage construction and operations of landfill facilities and management of legacy solid waste.

Course Outcomes:

After learning the course, the students will be able to:

1. Outline solid waste management systems with respect to its generation rate (quantity), sampling, characteristics and regulatory/legal requirements.
2. Explain and suggest relevant method of storage, collection and transportation of solid waste for the given site condition with justification.
3. Develop understanding of technological applications for processing and material recovery from solid waste with its economics and design composting and bio-methnation system for organic waste.
4. Outline the design, operation, and maintenance of sanitary landfill and management of legacy waste.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Solid Waste Management** Definition, objectives of SWM, impacts of improper SWM, functional outlines of SWM, sources and types of solid waste. MSW: sampling, refuse analysis, composition, characteristics: physical, chemical, biological and generation rate, factors affecting generation rate, estimation of quantity of solid waste. Sustainable solid waste management for smart cities, role of urban local bodies in waste management, objectives and importance of MSW Rules 2016.	08
2	**Government Initiatives, Collection & Transportation of Solid Waste** Swachh survekshan and its impact on the SWM scenario in India, national urban livelihood missions (NULM) and its role in SWM, social entrepreneurship, swachhta & rural engagement cell (SESREC): government of India initiatives, success stories of SWM in India. Integrated solid waste management, storage, different methods of collection, collection systems, transfer and transportation of solid waste, uses of radio frequency identification (RFI)/global positioning system (GPS) for tracking vehicles location, optimization of route, measurement and methods of measuring solid waste, economics of solid waste collection and transport.	07
3	**Separation, Processing and Transformation of Solid Waste** Decentralized system Vs. centralized system, source reduction, segregation and salvage, material recovery facility centers, recycling and reuse of solid waste, use of solid waste as raw materials in industry, economics of solid waste processing, and circular economy in waste management. Theory of composting, types of composting, Indore method, Bangalore method, mechanical composting plant, factors governing composting and design of composting system. Waste to Energy: bio-methnation: theory of anaerobic digestion, factors affecting anaerobic digestion, applications/use of biogas, design of anaerobic digester, advances in solid waste treatment.	08

4	**Disposal of Solid Waste** Landfill: Introduction, components of land filling, types of land filling, site selection, construction techniques, maintenance and precautions, leachate and landfill gas: estimation, management, treatment and disposal/reuse, control of contamination of ground water, operation monitoring, closure and end-use, design of sanitary landfill, slope stability analysis, concept of bioreactor landfill: principle, types, applications. Legacy waste management or biomining: concept, methods, applications, economics and time duration. Construction and demolition waste management.	**07**
	Total	**30**

Text Books:

1. Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI (2013).
2. Solid waste management, A.D. Bhide, B.B. Sundaresan, New Delhi: Indian National Scientific Documentation Centre, (1983).

Reference Books:

1. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi (2000).
2. Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated (India) Edition 2014, Fifth reprint (2017).
3. Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore, 1st Edition, (2004).

e-Resources:

1. https://swachhbharat.mygov.in/
2. https://cpcb.nic.in/
3. https://mpcb.gov.in/node
4. https://www.nswai.org/
5. https://swachcoop.com/
6. https://www.iswa.org/
7. https://nulm.gov.in/

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Architecture & Town Planning (PEC-1)			Code:	BCI5501B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge:

1. Basic Civil Engineering- Principles of Building & Architectural Planning
2. Building Planning, Construction and Materials- Concept of Zoning, Legal aspects and Sanctioning of Plan.

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. To study the history of various architectural designs.
2. To use architectural planning principles and understand the futuristic need of users.
3. To discuss and demonstrate the concept of landscaping and settlement planning.
4. To appraise the planning strategies with respect to various laws, norms, policies and guidelines.

Course Outcomes:

After learning the course, the students should be able to:

1. Explain the history of civilization and various forms of architectural designs.
2. Explain the significance of architectural planning principles for improving quality of life.
3. Explain the significance of Landscaping principles, urbanization, and sustainability in town planning for improving quality of life.
4. Evaluate and defend planning strategies to develop the area under guidelines and govt. norms

Detailed Syllabus

Unit	Description	Duration (H)
1.	**History of Architecture:** Western Architecture: Egyptian, Greek, Roman Architectures- Orders. Indian Architecture: Vedic age, Indus Valley civilization– Buddhist period: Stambas, Stupa, Toranas, Chaityas, Viharas – Hindu temples: Dravidian and Indo-Aryan (Nagara) Styles. Indo-Saracenic (Islamic) Architecture: Mosque – Palace – Fort – Tomb.	06
2.	**Principles of Architectural design.** Elements of Designing - form, surface texture, mass, line, color, tone Principles of Composition: –Unity, contrast, proportion, scale, balance, circulation, rhythm, character, expression and relevant case studies. Qualities of Architecture: user-friendly, contextual, eco-friendly, utility of spaces, future growth with the case study. Role of Architect in Planning and Designing.	08
3.	**Landscaping and Town Planning:** Landscaping: objectives, principles, elements, material (soft and hard), styles of landscaping, green roofs and vertical gardens: need, means, outcome. Need for town planning, urbanization and sustainability, the difference between urban and rural planning. Urban renewal process and its impact on quality of life and livability, urban conservation with case study. Horizontal and vertical expansion of towns- garden cities, satellite towns- floating towns- sky scrapers-pyramidal cities.	08
4.	**Legal provisions in Acts & Smart City requirement** The administrative level of planning (neighborhood, local, district, state and national) Land acquisition Rehabilitation and resettlement act, 2013, real estate (regulation and development) act 2016 and MAHA-RERA, URDPFI Guidelines (for land use, infrastructure, etc.), AMRUT Guidelines (water/sewerage, transport etc.) Special purpose plan -Smart cities. Special townships: SEZ, application of GIS, GPS, remote sensing in Town planning.	08
	Total	30

Textbooks:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. The great ages of World Architecture' by G.K. Hiraskar.
4. Planning and Design of Buildings by Section of Architecture' by Y. S. Sane.
5. Professional Practice' by G.K.Krishnamurthy, S.V.Ravindra, PHI Learning, New Delhi.
6. Indian Architecture – Vol. I & II' by Percy Brown, Taraporevala Publications, Bombay.
7. Fundamentals of Town Planning' by G.K. Haraskar

Reference Books:

1. MRTP Act : The director, government printing, stationery and publications, Maharashtra state, Mumbai
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India
3. LARR Act 2013: Ministry of law and justice, Government of India
4. An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company
5. Drafting and Design for Architecture by Hepler, Cengage Learning
6. Architect's Portable Handbook by John Patten Guthrie – McGraw Hill International Publications.
7. Town and Country Planning By A.J.Brown and H.M.Sherrard.

E-Resources:

https://archive.nptel.ac.in/courses/124/107/124107158/ Introduction to Urban Planning by Prof. Harshit Lakra , IIT Roorkee.
http://www.digimat.in/nptel/courses/video/124107001/L16.html NPTEL Video Course: NOC: Housing Policy and Planning by Dr. Uttam K. Roy, IIT Roorkee.
https://mohua.gov.in/upload/uploadfiles/files/URDPFI%20Guidelines%20Vol%20I(2).pdf
http://amrut.gov.in/upload/uploadfiles/files/designandStandards_AMRUT(3).pdf
https://mmrda.maharashtra.gov.in/home
https://www.pmrda.gov.in/index
https://maharera.mahaonline.gov.in/

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Elements of Earthquake Engineering (PEC-I)			Code:	BCI5501C		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	MTE	IE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of: Engineering Geology, Structural Analysis.

Course Objectives:

1. Understand fundamentals of earthquake engineering and seismic conditions of the country and world.
2. Identify and calculate the different types of earthquake intensity.
3. Interpret earthquake characteristics and associated effects on structures.
4. Examine concepts of dynamic analysis for civil engineering applications.

Course Outcomes:

After learning the course, the students should be able to:

1. Understand the fundamentals of earthquake engineering and seismicity conditions of the country and world.
2. Analyze site specific deterministic seismic hazard.
3. Analyze earthquake characteristics and associated effects on structures, including linear responses.
4. Apply the concepts of dynamic equations of motion and perform analysis for dynamic systems in civil engineering applications.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Origin of Earthquakes**: Engineering geology, Indian Seismic Map, Seismicity of the world, Faults, Propagation of earthquake waves.	06
2	**Quantification of Earthquake:** (magnitude, energy, intensity of earthquake), Measurements of earthquake (accelerograph, accelogram recording), Determination of magnitude, Epicentral distance, focal depth, etc. Ground motion and their characteristics, Factors affecting ground motions. Idealization of the building model and its dynamic properties.	08
3	**Earthquake Resistant Design**: design philosophy, Four virtues of EQRD: Stiffness, Strength, ductility and Configurations.	08
4	**Methods of Earthquake Analysis**: Introduction to Capacity design concepts, Introduction to IS:1893, Load combinations, concept of strong column weak beam design. Codal Coefficient and Response Spectrum Method. Equivalent linear static analysis (with numerical), modal spectrum analysis (with numerical).	08
	Total	30

Textbooks:

1. Earthquake resistant design of structures by Agrawal, P. and Shrikhande, M. Prentice Hall of India, Inc. (2011).
2. Dynamics of structures: Theory and application to earthquake engineering by Chopra, A.K, Prentice Hall of India, 5th edition (2017).
3. Dynamics of structure and foundation – A unified approach: 2 Applications by Chowdhary, I. and Dasgupta, S.P. CRC Press, Balkema. (2009).
4. Seismic analysis of structures by Datta, T. K. John Wiley & Sons (Asia) Pte Ltd. Singapore. (2010).
5. Geotechnical earthquake engineering Kramer, S. L. Prentice Hall, (2007).

Reference Books:

1. Earthquake Resistance Design for Engineers and Architects by Dowrick, D. L. John Willey & Sons, 2nd Edition, (1987).
2. Housner, G. W. & Jenning, P.C. "Earthquake Design Criteria", Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
3. Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
4. Design of Earthquake Resistance Buildings Wakabayashi, M. McGraw Hill Books Company, (1986).
   Introduction to Earthquake Engineering by Okamoto, S. University of Tokyo press, 2nd Edition, (1984).

IS Codes;

1. IS 1893 (Part I), 2016: Indian Standard Criteria for Earthquake Resistant Design of Structures.
2. IS 13920, 2016 Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.
3. IS 4326, 1993: Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings.
4. IS 13827, 1993: Indian Standard Guidelines for improving Earthquake Resistance of Earthen Buildings
5. IS 13828, 1993: Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings
6. IS 13935, 2009: Seismic Evaluation, Repair and Strengthening of Masonry Buildings - Guidelines.

e-Resources:

1. https://nptel.ac.in/courses/105101004
2. https://onlinecourses.nptel.ac.in/noc22_ce64/preview
3. https://library.iitd.ac.in/node/75670
4. https://www.eeri.org/
5. https://eq.iitr.ac.in/e-learning/index.html
6. https://www.nicee.org/EQTips.php

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Foundation Engineering (PEC-I)			Code:	BCI5501D		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge:

1. Engineering Geology
2. Geotechnical Engineering

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. To learn about types and purposes of different foundations.
2. To learn how to utilize their knowledge in soil mechanics to perform various types of engineering calculations, this includes bearing capacity analysis, consolidation analysis for foundations, and settlement analysis and load carrying capacity in pile foundation.

Course Outcomes:

After learning the course, the students should be able to:

1. Explain the methods of subsurface investigation and apply the knowledge of field tests on site.
2. Calculate bearing capacity of different types of soil.
3. Determine the settlement below footing and consolidation settlement.
4. Compute the load carrying capacity of single pile and pile group.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Subsurface Investigations for Foundations** Purpose and planning of subsurface exploration, Methods of Investigation: Trial pits, borings, depth & number of exploration holes, core recovery, Rock Quality Designation (RQD), Geophysical methods – Seismic refraction, Electrical resistivity method, Disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler, Field tests – Standard Penetration Test (SPT), N value correction and significance, Dynamic Cone Penetration Test (DCPT), Static Cone Penetration Test (SCPT).	**07**
2.	**Bearing capacity and Shallow Foundation** Basic definitions, Modes of shear failure, Bearing capacity analysis - Terzaghi's, Meyerhof's, Skempton's, and IS code method -Rectangular and Circular footings, Bearing Capacity evaluation: -Plate Load Test and SPT, Housel's perimeter shear concept, Effect of water table on bearing capacity, Effect of eccentricity, Shallow foundation -Types and Applications.	**08**
3.	**Settlement & consolidation** Settlement -Introduction, Causes of settlement, Pressure bulb, Contact pressure, Significant Depth of foundation, Allowable settlement, Differential settlement - I.S. criteria, Types -Elastic settlement, Consolidation settlement. Use of Plate Load test and SPT in settlement analysis. Consolidation - Introduction, spring analogy, Terzaghi's consolidation theory, Laboratory consolidation test, Determination of coefficient of consolidation - Square root of time fitting method and logarithm of time fitting method, Introduction of Normal consolidation, over consolidation and Preconsolidation pressure.	**07**
4.	**Deep Foundations and Geosynthetic Materials** Introduction, Pile classification, Pile installation - Cast in-situ, driven and bored pile, Load carrying capacity of pile by static method, Dynamic methods - Engineering news formula (ENR) and Modified ENR formula, Settlement of pile, Pile load test , Group action - Feld rule, Negative skin friction, Piers and Caissons - Definition, Types and uses, Well foundation: components, sand Island method. Geosynthetics: type's, functional properties and requirements, Geosynthetic Applications in Civil Engineering.	**08**
	Total	**30**

Text Books:

1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan, Pune.
2. Foundation Design Manual by N V Nayak, Dhanpat Rai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
3. Soil Mechanics - T. William Lambe - Wiley
4. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
5. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
6. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
7. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:

1. IS 1892 1979 Code of practice for subsurface investigation for foundations
2. IS 2131 1981 Methodf or standard penetration test for soils
3. IS 1888 1982 Method of load test on soils
4. IS 1080 1985 Code of Practice For Design And Construction Of Shallow Foundations in Soils

e –Resources:

https://nptel.ac.in/courses/105105176

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Hydropower Engineering (PEC-II)			Code:	BCI5502A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge:
Fluid Mechanics

Course Objectives:
1. To make students aware of the planning of hydropower plan
2. To impart knowledge of resources , load calculations and analyze required factors to design the plant
3. To make students aware of design of turbine and calculate the economics of hydroelectric power based on demand

Course Outcomes:
After learning the course, the students should be able to:
1. understand various energy resources and hydropower potential
2. classify hydropower plants and analyze hydrological parameters
3. calculate total load on the turbine
4. study water conductor system and powerhouse details
5. design impulse and reaction turbine
6. analyze economics of hydroelectric power

Detailed Syllabus

Unit	Description	Duration (H)
1	**Energy resources** : Planning and Potential: Power resources – Conventional and nonconventional, need and advantages, overview of World Energy Scenario, energy and development linkage, environmental impacts of energy use, green house effect, trends in energy use patterns in India, hydropower development in India, hydropower potential	07
2	**Hydropower plants:** Hydrological analysis, classification of hydropower plants based on hydraulic characteristics - run of river plants, storage or valley dam plants, Pumped storage plants, classification based on head, classification based on operating functions, classification based on plant capacity, classification based on nature of topography, Introduction to micro hydro, base load and peak load plants, advantages and disadvantages, components of hydropower plants.	07
3	**Load assessment:** Calculation of electrical load on turbines. Load factor, Plant factor, peak demand and utilization factor, installed capacity, diversity factor, firm power, secondary power load curve, load duration curve, Prediction of load, Hydro-Thermal Mix, Combined Efficiency of Hydro-Thermal-Nuclear Power Plants.	08
4	**Water conductor system and powerhouse:** Water Conductor System – alignment, intake structures- location and types, trash rack, headrace tunnel/canal, penstock and pressure shaft, types of powerhouses, typical layout of powerhouse, components, power plant equipments, instrumentation and control.	08
5	**Turbines :** Components of turbines, Classification based on : A) type of flow B) specific speed C) head, principles and design of impulse and reaction turbines, selection of turbine, specific speed, governing of turbines, water hammer, hydraulic transients and surge tanks, draft tubes, cavitation.	08
6	**Economics of Hydroelectric Power:** Hydropower - Economic Value and Cost and Total Annual Cost. Economic considerations – pricing of electricity, laws and regulatory aspects, Policies, Electricity act – 2003, Investment in the power sector, Carbon credits, Participation of private sector.	07
	Total	45

Text Books:

1. Water Power Engineering, Dandekar, M.M., and Sharma, K.H., Vikas Publishing House Pvt. Ltd. Second Edition, 2013.
2. Water Power Engineering, Barrows, H.K., Tata McGraw Hill Publishing Company Ltd. (1943),3rd edition.
3. Hydro Power Structures, Varshney, R.S., Nem Chand & Bros. 2001.

Reference Books:

1. Water Power Engineering – R. K. Sharma and T. K. Sharma, S. Chand and Co. Ltd. , 2003
2. Handbook of Hydroelectric Engineering – P.S. Nigam , second edition reprint, 2008
3. Modern Power System Planning – Wang, McGraw Hill-1994
4. Hydropower Resources in India – CBIP
5. Hydro Power Structures – R. S. Varshney , Nem Chand Publications, fifth edition, 2014
6. Water Power Development – E. Mosonvi, Vol. I & II,.
7. Hydro-electric Engineering Practice – G. Brown, Vol. I, II & III.
8. Hydro – Electric Hand Book – Creager and Justin.
9. Water Power Engineering – P. K. Bhattacharya, Khanna Pub., Delhi
10. Water Power Engineering – M. M. Deshmukh, Dhanpat Rai Pub
11. Manual of "Energy Group" of 'PRAYAS', an NGO

e –Resources:

1. https://www.energy.gov/eere/water/hydropower-basics
2. https://www.worldcat.org/title/hydropower-engineering-handbook/oclc/1153189415?referer=di&ht=edition

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Program:	B. Tech. (Civil Engineering)	Semester:	V
Course:	Total Quality and Human Resource management in Construction (PEC-II)	Code:	BCI5502B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge:
Basic knowledge of Basic Civil Engineering, Building Construction and Technology, Concrete Technology, Construction Management, Quality aspects.

Course Objectives: After Completing this course, student will be able to:
1. Interpret quality aspects of various quality gurus.
2. Use various tools for Quality improvement to identify defects in construction and suggest remedial measures.
3. Apply ISO principles and prepare quality documentation for various processes.
4. Optimize resources in the challenging environment of the construction industry.

Course Outcomes: After learning the course, the students should be able to:
1. Justify the importance of quality in construction with the quality philosophy of the quality gurus.
2. Analyze the improvements in quality construction using various tools and cost incurred for the same.
3. Identify the factors affecting the quality of construction and take measures to prevent them.
4. Apply the resource management principles for quality improvement in construction processes.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Concept of Quality** a) Quality – Various definitions and interpretation by various Quality gurus. Importance of quality on a project in the context of global challenges. b) Factors affecting quality of construction, reasons for poor quality & measures to overcome.	07
2	**TQM & Defects in Construction** a) TQM – Necessity, advantages, Six sigma as a tool in TQM. b) Difference between, quality control, quality assurance, total quality control and total quality management (TQM). c) Defects in construction & it's classification. Measures to prevent and rectify defects.	08
3	**ISO & Quality Manual** a) Process based approach for achieving TQM. Study of ISO 9001 principles. b) Quality manual – Importance, contents, documentation. Importance of check-lists in achieving quality. Typical checklist for concreting activity, form work activity, steel reinforcement activity.	07
4	**TQM tools, Cost of Quality & Certification** a) Supply chain management as a tool in TQM, Benchmarking in TQM, Kaizen in TQM, 5-S concept b) Categories of cost of Quality, *Cost of conformance and Non-Conformance.* c) CONQAS, CIDC-CQRA certification.	08
5	**Introduction to HRM-** a) Meaning, Definition, Features, Scope, Objectives, Importance, Principles of HRM, Evolution of HRM, Functions of HRM, Challenges of HRM, b) Role of HR Manager, Difference between HRM & Personnel Management, Challenges before HRM	08
6	**HRM in Changing Environment & Trends in HRM** a) HRM, *competencies needed in project managers*, Work force Diversity, Technological Changes & HRM, International HRM, b) E- Human Resource Management, Human Resource Information System (HRIS), HRM in Virtual Organizations, Work from Home, Out-Sourcing, Changing Role of HRM.	07
	Total	45

Text Books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.Company
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd

Reference Books:

1. Juran's Quality Handbook – Juran Publication. (2016 Edition)
2. Management –Principal, process and practices by Bhat – Oxford University Press.(2008)
3. Financial management by Shrivastava- Oxford University Press (6th Edition 2022)
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co. (2022)
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd. (1993, with latest Edition)

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Advanced Mechanics of Structures (PEC-II)			Code:	BCI5502C		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Engineering Mechanics: Equilibrium conditions, types of supports and analysis of beams.
2. Strength of Materials: Basics of slope and deflection of beams.
3. Mechanics of structures: Knowledge of static and kinematic indeterminacy of the structures, various methods of finding slopes and deflection of beams and frames, basics of influence line diagram.

Course Objectives:

1. To impart the knowledge about the basic concepts required for analysis of structures.
2. To develop the ability of analyzing structures.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze indeterminate beams structures and frames by strain energy methods.
2. Analyze determinate and indeterminate trusses by Castigliano's first and second theorem.
3. Analyze two and three hinged arches and its application.
4. Analyze beams and frames by rotation contribution method.
5. Analyze determinate beams and trusses using an influence line diagram (ILD).
6. Understand the theories of failure under static load

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Analysis of Indeterminate Beams and Frames** **a)** Propped cantilever and fixed beams by strain energy method, analysis of continuous beams by three moment theorem (Clapeyron theorem) up to three unknowns. **b)** Castigliano's second theorem, analysis of beams and rectangular portal frames with indeterminacy up to second degrees.	**08**
2.	**Analysis of Pin jointed Plane Trusses** a) Joint displacement of determinate trusses by Castigliano's first theorem. b) Analysis of redundant trusses by Castigliano's second theorem, lack of fit, sinking of support, temperature changes (indeterminacy up to second degrees).	**07**
3.	**Analysis of Arches** a) Three hinged arches: Concepts, types of arches, analysis of parabolic arch with supports at same and different levels, semicircular arches with supports at same level, determination of horizontal thrust, radial shear and normal thrust for parabolic and circular arch. b) Two hinged arches: Analysis of parabolic and semicircular arches with supports at same level, determination of horizontal thrust, radial, shear and normal thrust.	**07**
4.	**Rotation Contribution Method** a) Basic concepts- The rotation contribution, rotation factor, applications to continuous beams. b) Applications to Portal frames and multistoried frames.	**08**
5.	**Applications of Influence Line Method** a) Application of Influence line Diagram to moving loads on girders to calculate maximum and minimum shear force and bending moment. b) Influence line diagram for axial force in trusses, application of influence line diagram to determine the axial forces in the members of plane determinate trusses under dead load and live load.	**07**

6	**Theories of failure Under Static Load:** a) Maximum principal or (normal) stress theory (also known as Rankine's theory). Maximum shear stress theory (also known as Guest's theory or Tresca's theory). b) Maximum principal or (normal) strain theory, also known as Saint Venant theory), Maximum strain theory (also known as Haigh's Theory), Maximum distortion energy theory (also known as Hencky and Von Mises theory).	**08**
	Total	**45**

Text Books:

1. Theory of Structures by S. Ramamrutham and R. Narayan, Dhanpat Rai Publishing Company (P) Ltd, 10th Edition, (2014)
2. Structural Analysis-I & II by S. S. Bhavikatti, Vikas Publishing House Pvt. Ltd, 4th Edition, (2014)
3. Structural Analysis: A Matrix Approach by G.S. Pandit and S. P. Gupta, Tata McGraw Hill Education Pvt. Limited, 2nd Edition, (2016)

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, Tata McGraw Hill Education Pvt. Ltd. 7th Edition, (2013)
2. Mechanics of Structures Vol. II (Theory and Analysis of Structures) by Dr. H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd, 23rd Edition, (2013)
3. Basic Structural Analysis by C. S. Reddy, Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, (2010).
4. Structural Analysis by R. C. Hibbler, Pearson Education. 3rd Edition, (2013).

e-Resources:

1. https://nptel.ac.in/courses/105/101/105101086/
2. https://nptel.ac.in/courses/105/106/105106050/.

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Railways, Tunnel & Harbor (PEC-II)			Code:	BCI5502D		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Geotechnical Engineering (Soil Properties, Bearing Capacity, Structure-Soil Interaction)
2. Engineering Geology (Types of Rocks and Foundation)

Course Objectives:

After Completing this course, student will have adequate background:

1. To introduce the students about terminologies, geometric design, signaling and maintenance related to railway.
2. To impart knowledge of construction and maintenance of Tunnel, Tunnel Lighting and Ventilation.
3. To make aware of operational features of Docks and Harbors

Course Outcomes:

After learning the course, the students should be able to:

1. Classify components of railway track and understand the concepts of tilting-coning.
2. Apply the knowledge of geometrics in track design.
3. Classify signals used in railway network and understand the concept of interlocking.
4. Explain the methods of track laying, maintenance of tracks and understand the modern developments in railways.
5. Explain the basic aspects of a tunnel and the various tunneling techniques
6. Classify harbors and describe various components of harbors.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to Railways:** Administration of Indian Railways; Permanent way & its components: rails, sleepers, ballast, subgrade & embankments; Track structure of BG, Functions of rail & standard rail; Tilting of rail & coning of wheels; Rail joints, types, evil effects, remedial measures, bearing plates, anti-creep devices, check and guard rails, welding of rails, short and long welded rails; Survey for track alignment and surveys required.	07
2.	**Geometric Design of Track:** Types of gradients, Curves, Grade compensation on curves, Alignment, Super elevation, Equilibrium cant, Equilibrium speed, Maximum permissible limits for cant, Cant deficiency, Cant excess, Speed on curves, Safe speed on curves using Indian railways formula only for fully transition curves, Concept of negative cant, Points, crossings and turnouts- functions, Components, elements of points, Types of crossings and turnouts, Track maintenance: Regular and Periodic.	08
3.	**Signaling & Control Systems:** Objectives; Principles of signaling; Classification and types of signals; Control of movement of trains and monitoring; Track circuiting; Interlocking of signals & points: necessity and functions, methods of interlocking, devices for interlocking (names & figures)	08
4.	**Construction, Renewal and Drainage of Track** Stages of construction; Methods of laying track: Tramline method, Telescopic method, American method; Relaying of railway track: Important considerations and standard methods,Drainage of track: Surface and subsurface drainage. **Modern developments in Railways** Metro rail, mono rail, bullet trains, hyper loop; Development of high and super high speeds: speed developing techniques	08
5.	**Tunnels:** Functions & types of tunnel, Criteria for selection of size & shape of tunnels. Pilot tunnel, shaft, addit and portal, Needle beam, NATM, TBM & earth pressure balance method of tunneling in soft soil, Drilling & blasting method of tunneling including various operations like mucking, Drainage in tunneling- Pre drainage and permanent drainage, Tunnel lining, Ventilation in tunneling temporary and permanent.	07

6.	**Docks and Harbors:** Introduction, Requirements of harbors and ports, Classification of harbors with examples, Selection of site for harbor, Various components of ports, Break waters- types, comparison, design criteria, methods of construction, Tetra pod, Tri bar, Hexapod, Quay wall, Wet & dry dock, Floating dock, Wharves, Jetties, Types of fenders, Dolphins, Marine railway.	**07**
	Total	**45**

Textbooks:

1. Railway Engineering- Satish Chandra, M.M. Agarwal , Oxford Publishing House, Second Edition (2013)
2. S.C.Saxena And S.P. Arora, A Text Book of Railway Engineering, Dhanpat Rai Sons, New Delhi (2015)
3. S.C. Saxena, Tunnel Engineering, Dhanpat Rai & Sons, New Delhi
4. S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, Charotar Publishing House, Anand, 27th Edition (2017)
5. Harbor, Dock and Tunnel Engineering- R Srinivasan, Charotar publishing House, Anand 388001(2022)

Reference Books:

1. Railway Bridge and Tunnel Engineering- Ketki Dalal- Charotar publishing House, Anand 388001, 3rd Edition(2021)
2. Railway Track Engineering: J.S. Mundrey, Tata McGraw Hill
3. Dock & Harbour Engineering: Hasmukh P. Oza & Gautam H. Oza - Charoter Book Stall
4. Tunnel Engineering Handbook- John Bickel, THomas Kuesel, CBS Publishers and Distributors.

e-Resources:

1. https://ocw.mit.edu/courses/1-221j-transportation-systems-fall-2004 (MIT- Opencourseware)
2. https://www.icevirtuallibrary.com

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Hydrology and Water Resources Engineering Lab			Code:	BCI5415		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	50	-	75

Course Objectives :
1. To impart knowledge of rainfall data, measurement of infiltration and evaporation
2. To provide knowledge of catchment area and application of Q-GIS software in hydrology.
3. To impart knowledge of runoff and storage capacity of reservoir.

Course Outcomes:
After learning the course, the students should be able to:
1. Demonstrate measurement of evaporation and infiltration and get awareness of hydraulic structures
2. Apply the principle of delineating catchment area on toposheet and using Q-GIS software
3. Analyze rainfall data, runoff and determine reservoir capacity.

Detailed Syllabus

Term work consists of a journal containing details of assignments and visit report (Any 8,site visit and assignment 4 & 12 is compulsory).

1. Analysis of rainfall data (double mass curve technique/missing rainfall data)
2. Measurement of / video demonstration of evaporation by pan evaporimeter
3. Measurement of / video demonstration of infiltration by infiltrometer
4. Marking catchment area on a topo-sheet and working out average annual precipitation and determining yield by various methods - Application of open-source Q-GIS software for delineation of catchment/watershed .
5. Application of Q-GIS software in groundwater assessment
6. Experiment on determination of groundwater flow
7. Determination of peak flood discharge in a basin using unit hydrograph technique
8. Frequency analysis (return period, hydrologic event)
9. Determination of storage capacity of a reservoir using mass curve of inflow and outflow
10. Site visit to meteorological station.
11. Application of HEC-RAS for Hydrologic routing.
12. Literature collection of types of dams (minimum 5 dams) or case study of failure of any hydraulic structure.

Text Books:
1. Engineering Hydrology by K. Subramanyam, 3rd Edition, Tata McGraw Hill, 2017.
2. Hydrology and Water Resources Engineering, Vol-1, S. K. Garg, 21st Edition, Khanna Publishers, New Delhi, 2016.
3. Irrigation Engineering and Hydraulic Structures, Vol.II, S.K.Garg, 32nd Edition, Khanna Publishers, New Delhi,2016.

Reference Books:
1. Irrigation, Water Resources and Water Power Engineering, P. N. Modi, 8th Edition, Standard Book House, 2012.
2. Irrigation and Water power Engineering, Dr. Punmia and Dr. Pande, 16th Edition, Standard Publisher, 2016.
3. Groundwater Hydrology, Todd,3th Edition, John Wiley & Sons,2011.
4. Q-GIS for Hydrological Applications: Recipes for Catchment Hydrology and Water Management, Hans Van Der Kwast, Kurt Menke-Locate Press
5. Irrigation Engineering, H.M.Raghunath,1st Edition,Wiley India Pvt. Ltd., 2016.

E-Resources
1. https://www.imdpune.gov.in/
2. https://old.amu.ac.in/emp/studym/99994128.pdf
3. https://pubs.usgs.gov/wsp/2220/report.pdf
4. https://indiawris.gov.in/wris/
5. http://www.cwc.gov.in/water-resources-information-system-wris
6. http://cgwb.gov.in/

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Transportation Engineering Lab			Code:	BCI5416		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	50	25	-	75

Course Objectives :

1. To impart the knowledge related to standard methods of testing of aggregate Bitumen and Soil.
2. To Make students aware about the codal provisions and test method for the designing of bituminous mix

Course Outcomes: After learning the course, the students will be able to:

1. Identify the quality of aggregates by performing standard tests as per IS codes
2. Evaluate the strength characteristics of bitumen by performing tests as per IS codes
3. Determine the strength of bituminous mix as per standard test procedure
4. Calculate the bearing capacity of soil required for designing a pavement.

Detailed Syllabus:

A. Lab Experiments:

I. Tests on Aggregate (Any Five):

1. Aggregate Impact Value Test
2. Aggregate Crushing Strength Test
3. Los Angeles Abrasion Test
4. Shape Test (Flakiness Index and Elongation Index)
5. Specific Gravity and Water Absorption Test by basket method
6. Stripping Value Test
7. Soundness Test

II.Tests on Bitumen (Any Five):

1. Penetration Test
2. Ductility Test
3. Softening Point Test
4. Flash Point & Fire Point Test
5. Specific Gravity Test
6. Bitumen Extraction Test

III. Tests on Aggregate Bitumen Combined:

1.Marshall Stability Test

IV. Tests on Soil Subgrade: (Not Mandatory):

1.California Bearing Ratio Test (CBR Test)

B. Technical site visits to (Any One)

1. Road Construction and/or RAP Site
2. Hot mix Plant with detailed report

Text Books:

1. Highway engineering – S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Brothers, Roorkee, 10th Edition,(2018)
2. Traffic Engineering, Roger P. Roess, Elena S. Prassas, and William R. McShane, Pearson, Fifth Edition, (2019)
3. Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna Publishers Delhi, 9th Edition,(2017)

Reference Books:

1. ACourse in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi, (2003)
2. Principles of Transportation Engineering – G.V. Rao Tata McGraw Hill Publication (2007)
3. Highway Engineering – Rangwala, Charotar publishing House, Anand 388001(2017)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Highway and Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

e-Resources:

1. https://ocw.mit.edu/collections/transportation (MIT- Opencourseware)
2. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Solid Waste Management Lab (PEC-I)			Code:		BCI5503A	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	50	-	-	50

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. Present an overview of the steps of SWM from waste generation to final use/disposal
2. Conceptually design solid waste conversion/treatment processes

Course Outcomes:

After learning the course, the students will be able to:

1. Characterize solid waste quantity and composition for the design of suitable treatment facility.
2. Plan and design appropriate treatment and disposal facility for the solid waste.

Detailed Syllabus:

List of Laboratory Experiments:

Term work consists of following experiments/site visit/Assignments. Any 10 out 14 practical. Term work marks will be based on continuous assessment.

1. Report of site visit to municipal solid waste management: housing society / village /town /city/ metropolitan.
2. Practical/theoretical (from case study) sampling methods and characterization study of municipal solid waste, determination of density: present and future trend, estimation of quantity of refuse.
3. Determine moisture content and volatile solids for organic faction of municipal solid waste by using oven and muffle furnace.
4. Determine carbon/ nitrogen/ phosphorous content of manure produced from composting process or organic faction of municipal solid waste.
5. Determine calorific value of municipal solid waste by using bomb calorimeter.
6. Practical/theoretical (from case study) optimization of route network for municipal solid waste collection.
7. Design a composting system for organic waste generated from housing society or city.
8. Design an anaerobic digester for organic waste generated from housing society or city.
9. Design of a sanitary landfill system for any city.
10. Estimation of quantity of leachate and landfill gas emission by using free software such as, bio-transform, HELP, GAISM, LANDGEMs etc.
11. Identify any construction demolition waste problem and suggest appropriate solution.
12. Prepare a report for management of e-waste/ biomedical waste/ hazardous waste based on case study or field visit.
13. Prepare a report based on filed visit or case study. Use of Smart Technologies in solid waste management sector-sensors for segregation of waste, using of VTS /GPS/ RFID system and reverse vending machine installed at bus station, railway station.
14. Prepare a report based on filed visit or case study for pay as you pollute or extended producer responsibility (EPR) behavioral analysis in solid waste management.

Text Books:

1. Solid Waste Management, Sasikumar K and Sanoop Gopi Krishna, PHI (2013).
2. Solid waste management, A.D. Bhide, B.B. Sundaresan, New Delhi: Indian National Scientific Documentation Centre, (1983).

Reference Books:

1. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi (2000).
2. Integrated Solid Waste Management: Engineering Principles and Management Issues, George Tchobanoglous, Hilary Theisen, Samuel Vigil, Tchobanoglous George, Vigil Samuel, McGraw-Hill Companies, Incorporated (India) Edition 2014, Fifth reprint (2017).
3. Solid waste Engineering, Vesilind P. A., Worrell W and Reinhart, Thomson Learning Inc., Singapore, 1st Edition, (2004).

e-Resources:

1. https://swachhbharat.mygov.in/
2. https://cpcb.nic.in/
3. https://mpcb.gov.in/node
4. https://www.nswai.org/
5. https://swachcoop.com/
6. https://www.iswa.org/
7. https://nulm.gov.in/

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Architecture & Town Planning Lab (PEC-1)			Code:	BCI5503B		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	50	-	-	50

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. To use principles of architectural planning and understand the futuristic needs of users.
2. To discuss and demonstrate the concepts of landscaping, urban renewal and sustainable architecture
3. To distinguish and relate planning levels and understand use of act and to develop neighborhood plan
4. To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning

Course Outcomes:

After learning the course, the students should be able to:

1. Explain the concepts of role and responsibility of engineers, planners and architects for Town planning
2. Apply the principles of town planning, urban conservation, and urban renewal to improve quality of life with sustainability.
3. Explain the working principles of various town planning authorities under guidelines and Govt. norms.

Detailed Syllabus:

Lab Assignments (Any Nine out of following)

1. Study and analysis of the development plan with respect to land use, services, infrastructure, street furniture, housing etc.
2. Neighborhood planning with respect to a case study.
3. Report on the contribution of engineers, planners and architects in post-independence India.
4. Report on any satellite towns like new Mumbai, Gandhinagar etc. (in relation to TP aspects inclusive of infrastructure, disaster management, etc),
5. Study of salient features of urban renewal schemes with a case study.
6. Study of any existing town planning scheme.
7. Study of URDPFI OR AMRUT guidelines with a case study
8. Study of special townships or SEZ or rural planning strategies.
9. Study of urban conservation or sustainable architecture.
10. E-learning: referring to websites of various town planning Authorities with its report
11. Case study of any Smart city planning and design.

Textbooks:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books:

1. MRTP Act 1966 : The director, government printing, stationery and publications, Maharashtra state, Mumbai
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India
3. LARR Act 2013: Ministry of law and justice, Government of India
4. An Introduction to Landscape Architecture, Michael Laurie, American Elsevier Publishing Company

Program:	B. Tech. (Civil Engineering)			Semester:		V	
Course:	Elements of Earthquake Engineering Lab (PEC-1)			Code:		BCI5503C	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	50	-	-	50

Course Objectives:

1. Interpret and demonstrate the measurement of earthquakes.
2. Analyze the calculations involved in design earthquake forces.

Course Outcomes:

After learning the course, the students will be able to:

1. Illustrate the quantification of earthquake potential.
2. Analyze the dynamic properties of building model.

Detailed Syllabus:

A) List of Laboratory Experiments: (Any *six* out of the following)

1. Study of earthquake ground motion of worldwide earthquakes.
2. Introduction to seismic analysis software.
3. Mathematical model of a two storied building.
4. Determining Dynamic properties of Building.
5. Identifying mode shapes of the building model
6. Analysis of Centre of mass and Centre of rigidity of the given floor plan.
7. Assigning rigid diaphragm in the given model.
8. Defining Response spectrum function in seismic analysis software.
9. Study of Shake Table.

B) Assignments: (Any *four* out of the following)

1. Estimation of epicenter of earthquake using circle method.
2. Estimation of origin time and focal depth of an earthquake.
3. Estimation of intensity of an earthquake.
4. Calculation of Design Seismic Force by Static Analysis Method.
5. Calculation of Design Seismic Force by Dynamic Analysis Method.

Textbooks:

1. Earthquake resistant design of structures by Agrawal, P. and Shrikhande, M. Prentice Hall of India, Inc. (2011).
2. Dynamics of structures: Theory and application to earthquake engineering by Chopra, A.K, Prentice Hall of India, 5th edition (2017).
3. Dynamics of structure and foundation – A unified approach: 2 Applications by Chowdhary, I. and Dasgupta, S.P. CRC Press, Balkema. (2009).
4. Seismic analysis of structures by Datta, T. K. John Wiley & Sons (Asia) Pte Ltd. Singapore. (2010).
5. Geotechnical earthquake engineering Kramer, S. L. Prentice Hall, (2007).

Reference Books:

1. Earthquake Resistance Design for Engineers and Architects by Dowrick, D. L. John Willey & Sons, 2nd Edition, (1987).
2. Housner, G. W. & Jenning, P.C. “Earthquake Design Criteria”, Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
3. Earthquake Engineering Research Institute, Oakland, California, USA, (1982).
4. Design of Earthquake Resistance Buildings Wakabayashi, M. McGraw Hill Books Company, (1986).
5. Introduction to Earthquake Engineering by Okamoto, S. University of Tokyo press, 2nd Edition, (1984).

IS Codes;

1. IS 1893 (Part I), 2016: Indian Standard Criteria for Earthquake Resistant Design of Structures.
2. IS 13920, 2016 Indian Standard Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.
3. IS 4326, 1993: Indian Standard Code of Practice for Earthquake Resistant Design & Construction of Buildings.
4. IS 13827, 1993: Indian Standard Guidelines for improving Earthquake Resistance of Earthen Buildings
5. IS 13828, 1993: Indian Standard Guidelines for Improving Earthquake Resistance of Low Strength Masonry Buildings
6. IS 13935, 2009: Seismic Evaluation, Repair and Strengthening of Masonry Buildings - Guidelines.

e-Resources:

1. https://nptel.ac.in/courses/105101004
2. https://onlinecourses.nptel.ac.in/noc22_ce64/preview
3. https://library.iitd.ac.in/node/75670
4. https://www.eeri.org/
5. https://eq.iitr.ac.in/e-learning/index.html
6. https://www.nicee.org/EQTips.php

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Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Foundation Engineering Lab (PEC-1)			Code:	BCI5503D		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	50	-	-	50

Course Objectives:

To impart knowledge of methods of analysis and design of various foundations.

Course Outcomes:

After learning the course, the students will be able to:

1. Calculate the bearing capacity of soil using different methods.
2. Design different types of foundations.
3. Interpret existing soil investigation report.

Detailed Syllabus:

Lab Assignments: The term work shall consist of a journal giving following Assignments. (All Compulsory)

1. Study of soil investigation report and preparation of detailed bore log analysis.
2. Calculate bearing capacity by Terzaghi's method
3. Calculate bearing capacity by IS code method
4. Detailed description and calculation of bearing capacity and settlement using plate load test data with critical comment on load settlement curve
5. Consolidation Test
6. Problems on Consolidation and Settlements
7. Problems on pile foundation – individual and group action
8. Case Study report on Application of Geosynthetic Materials (Minimum 2 Case Study)
9. Visit to foundation construction sites and preparation of the report.

Text Books:

1. Foundation Engineering by Dr. B. J. Kasmalkar, Pune Vidyarthi Griha Prakashan, Pune.
2. Foundation Design Manual by N V Nayak, Dhanpat Rai Publications, 7th Edition (2018)
3. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
4. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

Reference Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
3. Soil Mechanics- T. William Lambe - Wiley
4. Foundation Engineering by P.C.Varghese - PHI Learning Pvt. Ltd (2013)
5. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers (2018)
6. Soil Mechanics & Foundation Engineering by M. Bandhu, Wiley Publications, 3rd Edition (2010)
7. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)

IS Codes:

1. IS 1892 1979 Code of practice for subsurface investigation for foundations
2. IS 2131 1981 Method for standard penetration test for soils
3. IS 1888 1982 Method of load test on soils
4. IS 1080 1985 Code of Practice For Design And Construction Of Shallow Foundations in Soils

e-Resources:

https://nptel.ac.in/courses/105105176

Program:	B. Tech. (Civil Engineering)						Semester: V
Course:	Statistical Data Analysis Using R (OEC-2)						Code: BAS5607
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of:

1. Descriptive Statistics
2. Inferential Statistics
3. Probability

Course Objectives:

1. This course aims at enabling the students to learn data collection, visualization, and preprocessing techniques for data science.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the data properties and identify the R packages related to data science.
2. Make use of data preprocessing methods and generate quality data for analysis.
3. Apply different data visualization techniques to understand the data.
4. Analyze the data using analytical methods for regression for numerical data using the R.
5. Develop a model for Prediction and Decision Making for a data set along with some of their characteristics, strengths, limitations, and applications.
6. Construct the hypothesis for the data and test it for data set in R.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to data analysis and R Software fundamentals** Understanding the Data, R Packages for Data Science, Importing and Exporting Data in R Software, Getting Started: Analyzing Data in R Software, Accessing Databases with R Software.	07
2	**Data Wrangling** Pre-processing Data in R Software, Dealing with Missing Values in R Software, Data Formatting in R Software, Data Normalization in R Software, Binning in R Software, Turning categorical variables into quantitative variables in R Software.	08
3	**Data Visualization in R Software** Histogram, Bar/ Line Chart, Box Plot (including group-by option), Scatter Plot (including 3D and other features), Mosaic Plot, Heat Map, Correlogram (GUIs)	08
4	**Data Analysis** Statistical Data Analysis: Probability, Sampling & Sampling Distributions Exploratory Data Analysis: Central & Descriptive Statistics, Hypothesis Testing.	07
5	**Model Development** Linear regression and multiple linear regression, model evaluation using visualization, prediction and decision making	08
6	**Data Analysis Using R:** use a dataset from kaggle (Link is given below). Identify the problem statement for the given data and by applying data analysis techniques analyze the data. Draw inferences from the data. https://www.kaggle.com/code/cvaisnor/heart-2020/data https://www.kaggle.com/code/kailash068/crop-recommendation/data https://www.kaggle.com/datasets/debajyotipodder/co2-emission-by-vehicles https://www.kaggle.com/datasets/csafrit2/higher-education-students-performance-evaluation	07
	Total	45

Reference Books:

1. Montgomery and Runger, “Applied Statistics and Probability for Engineers”, Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, “Probability and Statistics for Engineers”, Prentice India Ltd, 8 Edition, ISBN 13:978-8120342132.
3. S.P.Gupta, “Statistical Methods”, Papperbook publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Victor A. Bloomfield, “Using R for Numerical Analysis in Science and Engineering”, CRC Press, First Edition, ISBN: 9781315360492

e-sources:

NPTEL Course lectures links:

1. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB (Probability)
2. https://nptel.ac.in/courses/111104100 (Introduction to R software)
3. https://www.youtube.com/watch?v=WbKiJe5OkUU&list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz (Descriptive statistics using R software)

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Program:	B. Tech. (Civil Engineering)						Semester: V
Course:	Data Structures Using Python (OEC-2)						Code: BCE5601
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of: Python Programming

Course Objectives:

1. To understand Python Specific Data Structures.
2. To illustrate and demonstrate Stacks, Queues.
3. To understand how searching and sorting is performed in Python.
4. To understand how linear and non-linear data structures work.
5. To learn the fundamentals of writing Python scripts.
6. To learn the operations on tree and graph data structure.

Course Outcomes:

After learning the course, students will be able to:

1. Elaborate the basic concepts of data structure and python programming
2. Comprehend the searching & sorting algorithms.
3. Explore the data structures using Python Programming.
4. Apply concepts of linear and non-linear data structures .
5. Use effective data structures for solving real-time problems

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Data Structures** Introduction to Python programming, Data Structures – Definition, Linear Data Structures, on-Linear Data Structures, Python Specific Data Structures - List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, slicing.Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs. List.	8
2	**Searching and Sorting Techniques** Searching - Linear Search and Binary Search Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort and QuickSort.	7
3	**Linked List** Linked Lists – Introduction, Implementation of Singly Linked Lists, DoublyLinked Lists, Circular Linked Lists	8
4	**Stack & Queue** Stacks - Overview of Stack, Implementation of Stack, Applications of Stack, Queues-Overview of Queue, Implementation of Queue, Applications of Queues, Priority Queues.	8
5	**Tree** Trees - Overview of Trees, Tree Terminology, Binary Trees - Introduction, Implementation. Tree Traversals, Binary Search Trees - Introduction	7
6	**Graph** Introduction, directed vs. Undirected Graphs, Weighted vs. Unweighted Graphs, Representations - Adjacency Matrix, Adjacency list, Graph Traversals - Breadth First Search, Depth First Search.	7
	Total	**45**

Text Books:

1. Data structures and algorithms in python by Michael T. Goodrich, ISBN-13: 978-1118290279, ISBN-10: 1118290275, Publisher: Wiley; 1st edition (March 18, 2013).
2. Problem Solving with Algorithms and Data Structures Using Python by Bradley N Miller and David L. Ranum. ISBN-13: 978-1590282571, ISBN-10: 1590282574, Publisher: Franklin, Beedle & Associates; 2nd edition (August 22, 2011).

Reference Books:

1. Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7, 2nd Edition by Dr. Basant Agarwal, Benjamin Baka. ISBN: 9781788991933, 2018.
2. Core Python Programming -R. Nageswara Rao, ISBN-10: 9789351199427, ISBN-13: 978-9351199427, Willy; 1st edition (January 1, 2016).

Program:	B. Tech. (Civil Engineering)					Semester: V	
Course:	Programming with C++ (OEC-2)					Code: BCE5602	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
03	-	03	03	20	30	50	100

Prior knowledge of: Python Programming

Course Objectives:

1. To explore the principles of Object-Oriented Programming (OOP).
2. To use the concept of inheritance and polymorphism.
3. To understand the use of exception handling in C++ programs.
4. To provide a foundation for advanced programming using File handling and STL.
5. To provide lifelong learning attitude towards problem solving.

Course Outcomes:

After learning the course, students will be able to:

1. Identify the need of object-oriented programming to solve computational problems.
2. Demonstrate the use of inheritance in object-oriented programming.
3. Apply the concept of overloading and virtualization.
4. Illustrate exception handling in object-oriented programming.
5. Discuss the use of input and output stream in C++.
6. Analyze the usage of template classes and the STL library in C++.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction of OOPs Concepts** Overview of procedural programming and object-oriented programming, Syntax of variables declaration, Classes and objects, Member functions, memory management. **Case Study:** Write a program in c++ to create an employee class with appropriate features.	8
2	**Inheritance** Introduction, benefits, Access specifiers, Types of inheritance - single, multiple, multilevel, hybrid and hierarchical. **Case Study:** Write a program in c++ to derive class bicycle from class vehiclewith appropriate syntax.	7
3	**Polymorphism** Introduction, Types of polymorphism: function and operator, Virtual functions, Pure virtual functions, Virtual base class, Overloading and overriding.**Case study:** Write a program in c++ to overload '+' and '-' operator.	8
4	**Exception Handling** Introduction to exception, Benefits of exception handling, try, throw and catch blocks, pre-defined exceptions in c++, Re-throw.**Case Study:** Write a program in c++ to create a class student with name, age,roll no and telephone number as parameters. Program should throw anexception if telephone_number >10.	7
5	**File Handling** Classes for file stream operation, Opening and closing a file, File pointers and their manipulation, File operations on binary files – variables, class objects, sequential file organization, Direct access files.**Case Study:** Write a program in c++ to create a database for airline reservationsystem using file handling.	8
6	**Templates** Introduction, Function templates, Class template with multiple parameters. **Introduction to STL: Introduction** of STL components, Sequential container, Algorithms, Iterators.**Case Study:** Write a program in c++ to create vector template using STLcontainer.	7
	Total	45

Text Books:

1. E. Balagurusamy, “Object -Oriented Programming with C++”, McGraw Hill Education, Eighth Edition, Sept. 2020, ISBN-13: 978-9389949186.
2. Ivor Horton, Peter Van Weert, “Beginning C++20”, Novice Professional, Sixth Edition, 2020, ISBN-13: 978-1484258835 (ISBN-10: 1484258835)
3. Robert Lafore, “OOP in C++”, Pearson Publishing, 4th Edition, 2001, ISBN:0672323087 (ISBN 13: 9780672323089).

Reference Books:

1. Bjarne Stroustrup, The C++ Programming language, Third edition, 2008, Pearson Education. ISBN 9780201889543.
2. Deitel, C++ How to Program, 4 th Edition, Pearson Education,2002, ISBN:81-297-0276-2.
3. Herbert Schildt, C++ the complete reference, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805.

MOOC Courses:

An Introduction to Programming Through C++, NPTEL, 12 weeks

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Program:	B. Tech. (Civil Engineering)	Semester: V
Course:	Smart City: An Electronic Perspective(OEC-2)	Code: BET5601

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Basic Electronics
2. Basics of electronic communications.

Objectives:

1. To explore need and basics of smart city and fundamental concepts of IoT.
2. To comprehend the roles of sensors and protocols in IoT
3. To explain different IoT framework and networking protocols.

Outcomes:

After learning the course, the students will be able to:

1. Understand the conceptual basis of a smart city.
2. Analyze physical and logical designs for IoT systems with communication protocols.
3. Analyze the different wireless communication protocols used in sensor networks.
4. Compare the features, addressing, packet fragmentation, operation, and security of the different wireless protocols.
5. Describe distributed intelligence and central planning in a smart city.
6. Interpret the role of ICTs in the development of smart cities using IoT applications.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Necessity of SMART CITY**: The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework.	7
2	**Fundamentals of IOT:** History of IoT, Introduction,definition and characteristics of IoT, architecture of IoT, Physical & logical design of IoT, Enabling technologies in IoT, Identifiers in IoT, M2M communication verses IoT.	8
3	**Sensor Networks:** Definition, types of sensors & actuators, examples & working, RFID Principles and components, Wi-Fi, Bluetooth, etc. wireless sensor network: History, sensor node, networking nodes, WSN versus IoT.	7
4	**Wireless Protocols for Smart Cities:** IPv6overLow-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking Basics, Wireless Networking Assumptions, Bluetooth Low Energy, IoT data protocols: MQTT Protocol. COAP Protocol, AMQ Protocol.	8
5	**Distributed Intelligence and Central Planning:** On the Interplay between Humans and Smart Devices, Intelligence-artificial Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamic and Algometry in Smart Cities.	7
6	**Applications of IoT in smart city: The Role of ICTs,** Applications in smart city & their distinctive advantages -smart environment, smart street light and smart water & waste management. Smart transportation and hospitality, Role and scope of IOT in present and the future marketplace, Industrial IoT. IOT in present and the future marketplace, Industrial IoT.	8
	Total	45

Text Books:

1. Surjeet Dalal ,Vivek Jaglan "Green Internet of Things for Smart Cities: Concepts, Implications, and Challenges", CRC Press; 1st edition.
2. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT" Cambridge University Press.
3. HakimaChaouchi,"TheInternetofThingsConnectingObjectstotheWeb"ISBN:978-1-84821-140-7, Wiley Publications
4. OlivierHersent,DavidBoswarthick,andOmarElloumi,"TheInternetofThings:KeyApplications and Protocols", Wiley Publications

Reference Books:

1. Vincenzo Piuri, Rabindra Nath Shaw, “AI and IoT for Smart City Applications”, Springer; 1st ed. 2022 edition.
2. Alfredo Barton, Raymond Manning, “Smart Cities:Technologies, Challenges and Future Prospects” Nova Science Pub Inc 2017.
3. Ibrahim El Dimeery, Moustafa Baraka, Syed M. Ahmed, “Design and Construction of Smart Cities” Amin Akhnoukh, Springer; 1st ed. 2021 edition
4. Ricardo Armentano, Robin Singh Bhadoria , Parag Chatterjee , “The Internet of Things: Foundation for Smart Cities”, eHealth, and Ubiquitous Computing” Chapman and Hall/CRC; 1st edition 2017
5. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN:978-1-118-47347-4,Willy Publications 2013.
6. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press 2017.

Online Link/Courses:

1. NPTELcourse on Fundamentals of Electric vehicles: Technology & Economics, IIT Madras, Prof. Ashok Jhunjhunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannan https://nptel.ac.in/courses/108106170
2. NPTEL course on Electric Vehicles - Part 1, IIT Delhi, Prof. Amit Jain https://nptel.ac.in/courses/108102121
3. NPTEL Archives on Electric vehicles and renewable energy, IIT Madras https://archive.nptel.ac.in/courses/108/106/108106182/
4. Electric Vehicles Comprehensive Course, Udemy.com https://www.udemy.com/course/electric-vehicles-comprehensive-course/

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Program:	B. Tech. (Civil Engineering)					Semester: V	
Course:	Modeling and Simulation with MATLAB (OEC-2)					Code: BET5602	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Engineering Mathematics
2. Basics of OOPs is essential

Course Objectives:

1. To apply basic modeling techniques and tools to develop Simulink block diagrams.
2. To Model and simulate continues and discrete systems in Simulink.
3. To get acquainted with neural networks and its modeling.
4. To get acquainted with fuzzy set and its modeling.

Course Outcomes: After learning the course, the students should be able to:

1. Understand the basic tools used in Matlab programming
2. Understand the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems.
3. Understand different types of simulation techniques.
4. Understand different optimization methods.
5. Simulate the models for the purpose of optimum control by using software.
6. Design and simulate the Fuzzy controllers to solve engineering problems.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Introduction to Matlab:** Programming environment, input and output variables, State variables, basic syntax; Deterministic linear model, Array mathematics in Matlab, Plotting, Static and Dynamic systems; Hierarchy of knowledge about a system and Modeling Strategy.	06
2	**Physical Modeling:** Dimensions analysis, Dimensionless grouping of input and output variables of find empirical relations, similarity criteria and their application to physical models. Stochastic modeling	07
3	**Modeling of System with Known Structure:** Review of conservation laws and the governing equation for heat, mass and momentum transfer, Deterministic model: distributed parameter models in terms of partial identification and their solutions and lumped parameter models in terms of differential and difference equations, state space model, transfer functions block diagram and sub systems, stability of transfer functions, modeling for control.	08
4	**Optimizations and Design of Systems:** Summary of gradient based techniques : Nontraditional Optimizations techniques, genetic Algorithm (GA)- coding, GA operations, elitism, Application using MATLAB: Simulated Annealing, Introduction to GUI,GUI Programming.	07
5	**Introduction to Neural Network Modeling**: Basics of Neural Network, Neural Network Modeling of Systems only with Input-output Database: Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multilayer feed forward network and its back propagation learning algorithm, Application to complex engineering systems and strategy for optimum output.	09
6	**Modeling Based on Expert Knowledge**: Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers, Simulation of Engineering Systems: Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems.	08
	Total	45

Text Books:

1. Zeigler B.P. Praehofer. H. and Kim I.G. "Theory of modeling and simulation", 2 nd Edition. Academic press 2000
2. Ogata K "Modern control Engineering" 3 rd edition. Prentice hall of India 2001
3. Jang J.S.R. sun C.T and Mizutani E,, "Neuro-Fuzzy and soft Computing ", 3 rd edition, Prentice hall of India 2002
4. Shannon, R. E., "System Simulation: the Art and Science", Prentice Hall Inc. 1990
5. Pratab.R " Getting started with MATLAB" Oxford university Press 2009

Reference Books:

1. Steven I Gordon. Brian Guilfoos."Introduction to modeling and simulation using MATLAB & Python" CRC press.
2. Dr.Shailendra Jain." Modeling and simulation using MATLAB-Simulink ",2 nd Edition,Wiley

Online course link: https://in.mathworks.com/learn/training/simulink-fundamentals.html

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Program:	B. Tech. (Civil Engineering)	Semester: V
Course :	Object Oriented Programming (OEC-2)	Code : BIT5601

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. C Programming

Course Objectives:

1. To learn the fundamentals of object-oriented concepts and programming
2. To develop problem-solving skills using object oriented programming concepts
3. To apply the concepts of object-oriented paradigm
4. To develop programming skills using object oriented programming concept

Course Outcomes:

After learning the course, the students will be able to:

1. Demonstrate the key object oriented concepts.
2. Apply functions for given real life data
3. Apply operator overloading to develop programs
4. Design hierarchy of classes using inheritance.
5. Make use of polymorphism using virtual functions for solving real life problems.
6. Develop application which handles different types of exceptions

Detailed Syllabus

Unit	Description	Duration (H)
1.	**FUNDAMENTALS OF OBJECT ORIENTED PROGRAMMING** Object Oriented Paradigm, Features of Object-Oriented Programming: Objects and Classes, Data Abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Communication. Visibility/Access Control, Constructors and Destructors, Operators, Static data members and member functions, Arrays and reference variables.	6
2.	**FUNCTIONS** Function prototypes, Default and Const arguments, Object as a function argument and returning object, Passing argument by reference, Returning a reference, Inline functions, Function overloading, Friend function.	7
3.	**OPERATOR OVERLOADING** Rules of operator overloading, overloading the unary and binary operators using member and friend function, overloading relational and assignment operator.	8
4.	**INHERITANCE** Need of inheritance, base and derived classes, member accessibility, types of inheritance, derived class constructor, constructors in multiple inheritance, overriding member functions, virtual base class.	8
5.	**VIRTUAL FUNCTIONS** Pointers, Pointers to objects, 'this' pointer, Pointers to derived classes, virtual functions, Pure virtual functions, abstract class, virtual destructors.	7
6.	**EXCEPTION HANDLING** Introduction, Exception handling mechanism: try, catch and throw, Multiple Exceptions, Exceptions with arguments	9
	Total	**45**

Text Books:

1. E. Balaguruswamy, "Object-oriented Programming with C++", Tata McGraw Hill, 7th edition.
2. Robert Lafore, "Object-Oriented Programming in C++", SAMS Techmedia

Reference Books:

1. Herbert Schildt, "C++: The Complete Reference", McGraw-Hill.
2. Kogent, "Object-Oriented Programming Methodology", Wiley, ISBN-9789351191841

Online References:

1. Coursera Course on C++ Basics:Selection and iteration offered by C- Codio, available online at https://www.coursera.org/learn/codio-cpp-basics
2. NPTEL Course Lecture Links on "Programming in C++" offered by IIT, Karagpur, available online at https://nptel.ac.in/courses/106105151

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Program:	B. Tech. (Civil Engineering)					Semester: V	
Course:	Industry 4.0 (OEC-2)					Code: BME5602A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of:

1. Basic programming skills
2. Mathematical skills

Course Objectives:

1. The concept of smart factories for future, especially the various technical pillars of the smart manufacturing.
2. The role and importance of each technical pillar involved within smart manufacturing.
3. The applications and scope for technological pillars involved in smart manufacturing.

Course Outcomes: After learning this course, the students will be able to:

1. Apply the knowledge of PLC language for designing a PLC system for relevant application
2. Understand the key concepts and describe the technological pillars of Industry 4.0
3. Understand the role of cloud computing and how cloud computing is applied to protect cyber-physical systems in Industry 4.0
4. Apply the knowledge of sensors and robots for designing a system
5. Understand the role of simulation techniques and how these software tools used for advanced simulations in Industry 4.0
6. Understand the importance of hardware and software technologies used in AR and VR

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Industrial Revolutions** History of industrial revolution, Industry 3.0: Automation and Mechanization, Types of automation, features of hard and soft automation, classification of production system, adaptive control, overview of terminologies like CAD, CAM, CAE, CAPP etc., Introduction to PLC, framework, and design of PLC system.	9
2.	**Introduction to Industry 4.0:** Introduction to industry 4.0, need for Industry 4.0, Framework for Industry 4.0, technological pillars of industrial 4.0, applications, challenges and scope for industry 4.0	6
3.	**Technological developments in Industry 4.0:** Introduction to Smart Manufacturing, overview of big data and analytic techniques, cyber security, Internet of things (IoT), Industrial Internet of things (IIoT), Cloud computing, artificial intelligence.	8
4.	**Robotics and Sensors:** Introduction to technological components of Robot, classification of sensors and its applications in Manufacturing industry, Role of robots in Industry 4.0, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics	8
5.	**Simulation, Augmented Reality and Virtual Reality in Industry 4.0:** Introduction to simulation, methods for simulation of physical processes, interconnectivity using simulation softwares, Introduction to Augmented reality and Virtual reality, classification of AR and VR, Difference between AR and VR, Hardware and Software Technology for AR and VR, Applications of AR and VR	8
6.	**Ecosystem for Industry 4.0:** Economic aspects, opportunities and skills required for industry 4.0, Effects of 4-M Man, Machine, Material and Method in Industry 4.0, current state of industry 4.0 in India	6
	Total	45

Text Books:

1. M. P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Pearson Publication, 2005
2. Lamb, Frank. Industrial Automation: Hands On, McGraw-Hill Professional, 2013.
3. W. Leong, Nine pillars of technologies for Industry 4.0, IET publishers, 2020
4. A. Gilchrist, Industry 4.0, Apress Publication, 2016

Reference Books:

1. C. Schröder, The Challenges of Industry 4.0 for Small and Medium-sized Enterprises, 2021.
2. Chua C. K., Leong K. F., Lim C. S., Rapid Prototyping, World Scientific, 2012.
3. A. Nayyar and A. Kumar, A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development-Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-14544-6
4. K. Kumar, D. Zindani, J. P. Davim, Industry 4.0: Developments towards the Fourth Industrial Revolution, Springer Singapore, 2019.

E-sources: **https://nptel.ac.in/courses/108105063**

Program:	B. Tech. (Civil Engineering)	Semester: V
Course:	Safety, Health and Environment (OEC-2)	Code: BME5602B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Course Objectives:

1. To provide exposure to the students about safety and health provisions.
2. To create awareness on safety standards in residential, commercial and agricultural applications.
3. To help students to learn about Factory act 1948, Environment act 1986 and rules framed under the act.
4. To describe the chemistry of fire & explosion and select & use appropriate fire-fighting and explosion proof equipment,
5. To teach about various safety education and training.
6. Identify ergonomic hazards and recommend appropriate controls.

Course Outcomes: Upon successful completion of the course, the student will be able to

1. Demonstrate the safety and ethical issues that may arise from industrial processes
2. Identify the safety standards in residential, commercial and agricultural applications
3. List out important legislations related to Health, Safety and Environment
4. Select a suitable method for prevention of fire and explosion.
5. Develop appropriate safety education and training program.
6. Analyze and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and select appropriate work systems.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Concepts and Techniques:** History of safety movement – Evolution of modern safety concept, safety survey, safety inspection, safety sampling. Safety Audits- Non-Conformity Reporting (NCR), audit checklist- identification of unsafe acts of workers and unsafe conditions in the industry.	7
2	**Safety in residential, commercial, agricultural, installation & Protective equipment:** Electricity, its Usefulness and Hazards, statutory Provisions, Indian Standards, Effects of Electrical parameters on human body, Safety measures for electric shock, portable electrical apparatus, Electric work in hazardous atmosphere.	8
3	**Factories Act – 1948 & Environment Act – 1986:** **Factories Act – 1948:** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Maharashtra Factories Rules 1963. **Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001. Air Act 1981 and Water Act 1974 -audit, penalties and procedures.	8
4	**Fires and Explosions and concepts to prevent fires and explosions:** Fire triangle, Distinction between fires and explosions, Flammability characteristics of liquids and vapors, limiting oxygen concentration and inerting, Controlling static electricity, Explosion-proof equipment and instruments, Ventilation.	8
5	**Safety Education and Training:** Importance of training-identification of training needs, methods – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – domestic Safety and Training.	7
6	**Ergonomics at Work Place:** Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs.	7
	Total	**45**

Reference books:

1. Philip E. Hagan, John F. Montgomery, James T. O'reilly "Accident Prevention Manual for Business and Industry: Administration and Programs", 14th Edition, National Safety Council, Illinois, Chicago, 2015.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
3. Krishnan N.V. "Safety Management in Industry" Jaico Publishing House, Bombay, 1997.

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course :	Principles of Management (HSMC-5)			Code:	BHM5113		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	30	-	20	50

Course Objectives:

1. To help the students gain understanding of the functions and responsibilities of managers and common frameworks used in business organizations.
2. To enable the students to analyze and understand the environment of the organization.
3. To provide them tools and techniques to be used in the performance of the managerial job.

Course Outcomes:

After learning the course, the students will be able to :

1. Understand the concept of Management and Strategic Management with their implications.
2. Identify the importance of human resource in every organization.
3. Apply necessary skills to incorporate innovative management in various business sectors.
4. Analyze organizational ecology in various business domains.

Detailed Syllabus:

Unit	Description	Duration (Hrs)
1	**Introduction to Management & Strategic Management** Concepts of Management, Definition of Management; Evolution of Management Thought: - Introduction to Scientific Management and Administrative Management, Is Management an Art, Science or Profession, Functions of Management, Levels of Management and Corresponding Skills, Four Roles of Manager, Concept of Strategic Management, Strategic Management Process, Vision and Mission, Contemporary Challenges faced by Management.	7
2	**Organizational Ecology** : Concept & Definition of Organization, Organization and its Characteristics, Types of Business Organizations, Concept of Business Environment, Internal Factors of Business Environment, SWOT Analysis and PESTLE Analysis, Adapting to the Change in Environment, Assessing Success in Organization and Managing Change, Competitive Dynamics with examples. Case studies based on Business Environment	7
3	**Organizational Design and Leadership**: Concept of Organization Design, Process of Organizational Design, Types of Organizational Design : Traditional and Contemporary Organizational Designs, Concept of Organizational Development, Process of Organizational Development, Concept of Organizational Culture, 4 Types of Organizational Cultures & their influences, Concept and definition of Leadership, Leader and Manager, Types of Leadership Styles.(Each concept to be explained with Case study / Examples)	8
4	**Innovative Management** : Concept of Innovation, Creativity & Invention and its need. Concept and Definition of Innovative Management. Definition of Design Thinking, Stages in the Design Thinking Process, The Design Thinking Multi-Stage Model, What is the Difference between Project-Based Learning (PBL), Understanding by Design (UbD), and Design Thinking (DT). (Class Activity : Brain Storming on Innovative Management)	8
	Total	30

Text Books:

1. George R. Terry, Stephen G. Franklin; Principles of Management, A.I.T.B.S. Publishers

Reference Books:

1. Stephen Robbins, Organizational Behaviour, New Delhi: Prentice- Hall, 2005
2. Veerabhadrappa and Havinal; Management and Entrepreneurship, New Age International Publishers, 2011
3. Chaudhary Omvir, Singh Prakash; Principles of Management, New Age International Publishers, 2011

e-sources:

1. https://nptel.ac.in/courses/122106031
2. https://www.coursera.org/learn/principles-of-management

Program:	B. Tech. (Civil Engineering)	Semester:	V
Course:	Proficiency Course 2: Analysis of RCC and Steel Structures by STAAD-PRO Software.	Code:	BCI5912A

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	-	2	-	-	-	Grade

Course Objectives:

1. To impart knowledge of structural load analysis for RCC framed and steel structures.
2. To develop the ability to analyze structures using STAAD – PRO software.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the different types of loads that act on structures and its calculation.
2. Analyze the RCC and steel structures using STAAD-Pro software.

Detailed Syllabus:

Unit	Description	Duration (H)
1	Load types and calculations for RCC framed and steel truss structures.	5
2	STAAD Model: Structural Modeling, Material Constants, Section Properties, Member Specifications, and Support conditions.	5
3	Analysis of Structures: Analysis of G + 1 RCC framed structure, truss or steel tower.	5
4	Post Processing & Report Creation: Load Lists, Joint Displacement, Member Forces, Support Reactions, Analysis Results, Member Stresses.	5
	Total	**20**

Reference Books:

1. STAAD Pro V8i for Beginners by T. S. Sarma, 1st Edition, 2014.
2. Principles of Structural Analysis – Static and Dynamic Loads, by Krishnan Sathia, 2nd Edition, 2021.
3. Analysis and Design of Structures - A Practical Guide to Modeling, by D.Trevor Jones, 1st Edition, 2012.
4. STAAD Pro: Reference Guide by C S Changeriya, 1st Edition, 2010.

IS Code:

1. IS 1893- 2016 Criteria for earthquake resistance design of structures
2. IS 800 – 2007 General Construction in steel
3. IS 456- 2000 Design of Reinforced concrete structures.

e- Resources:

https://www.bentley.com/en/products

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Proficiency Course 2: Material Management using ERP			Code:	BCI5912B		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	-	2	-	-	-	Grade

Course Objectives:

1. To Plan the project and determine its Visibility
2. To create partial or full invoice
3. To generate various reports of the project

Course Outcomes:

After learning the course, the students will be able to:

1. To determine the visibility of the project during the planning stage.
2. To generate invoices.
3. To generate material consumption reports.
4. To generate the quotations for the project.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Planning Module:** Create detailed timeliness of your projects; Draw up employee work schedules and track work hours on each project; View the resources required to deliver the projects; Track project progress; Assign and track equipment resources; Create a Gantt-chart; Organize all teams; Organize interventions by location, technician, date, time; Order by qualifications, locations.	5
2	**Quotation Module:** Quote management; Calculation of own works; Subcontractor management, price request, comparison, selection; Management of the quantity survey (formula or LLH); Individualization of prices for a resource, an item or for the entire estimate; Calculation of transport costs.	5
3	**Project Module:** Management of progress reports, revision formula, bad weather calendar, debt declaration, calculation of deadlines; Activity and consumption reports; Consumption analysis; Integration with the Personnel and Purchasing modules; Management of additional work; Real-time monitoring of the project margin.	5
4	**Purchase Module:** Send out price requests/ RFQs; Place orders; Generate a purchase order from a quote or a project resource requirement list; Cross-check the delivery notes or supplier invoices; Access purchase history and backorder data; Delivery tracking; Invoice verification; Possibility to import a supplier catalog.	5
	Total	**20**

References:

1. http://www.erpexpertstraining.com/product/hit-officefulltimecourse.

Program:	B. Tech. (Civil Engineering)			Semester:			V
Course:	Proficiency Course 2: Introduction and application of QGIS software			Code:			BCI5912C
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	-	2	-	-	-	Grade

Course Objectives:

1. To familiarize the students with the Quantum GIS (QGIS) interface and GIS features and its applications in water resources and hydrology studies.
2. To promote the Life long learning courses for open-source QGIS software tools to enhance the research, development tools and technologies.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand spatial analysis, the limitations and the problems encountered in establishing GIS
2. Apply the procedures involved in integrated data analysis, spatial interpolations, and extrapolation for watershed management.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Geo referencing of the image and digitizing of image** Open QGIS map,open QGIS reference,open scanned image,locate ground control points ,start QGIS georeferencer.	5
2	**Digital Elevation Model (DEM) download and DEM analysis , Delineation of watershed** Find DEM data,fill sinks,generate stream network,project outlet point,extract co-ordinates of outlet points,generate watershed of the stream network.	5
3	**Generation of contours and Cartography** Create contour from points,create contours from DEM,contouring smoothing,study area map,preparation using print composer,adding North,legend and grid to study area map.	5
4	**Creating datasets using Google Earth** Open Google Earth Pro.,Import GIS shape file,Import Geo TIFF or other raster dataset.	5
	Total	**20**

Reference Books:

1. Netler M., and Mitasova, H. Open source GIS. A GRASS GIS approach, 2008

e- Resources:

1. http://www.qgis.org/wiki/Installation_Guide
2. Geospatial data abstraction library. https://gdal.org, 2013
3. Geographic resource analysis support system. https://grass.osgeo.org,2013
4. Web map service (1.3.0) implementation specification. https://portal.opengeospatial.org,2004
5. Spatial support for postgresql. http://postgis.refractions.net/, 2013

Program:	B. Tech. (Civil Engineering)	Semester:	V
Course:	Proficiency Course 2 Plaxis – Bearing Capacity and Settlement Analysis Module	Code:	BCI5912D

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	H	TW	OR	PR	Total
2	-	-	2	-	-	-	Grade

Course Objectives:
1. To provide the knowledge of Bearing Capacity and Settlement analysis using Plaxis Software.
2. To bridge the skill gaps and make students industry ready.

Course Outcomes:
After learning the course, the students will be able to:
1. Explain the main features of the Bearing Capacity and Settlement analysis software.
2. Determine the Bearing Capacity of shallow and deep foundations using PLAXIS.
3. Estimate the Settlement of shallow and deep foundations using PLAXIS.

Detailed Syllabus:

Unit	Description	Duration (H)
1	Introduction Plaxis software and its different modules	04
2	Bearing capacity analysis of circular footing, strip footing, rectangular footing	08
3	Settlement analysis – Loading conditions, boundary conditions	08
	Total	20

Text Books/ Reference Books :
1. PLAXIS 2D-Reference Manual., CONNECT Edition V21.01.(2021)
2. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)
3. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)

IS Codes:
1. IS 1892 1979 Code of practice for subsurface investigation for foundations
2. IS 2131 1981 Methodfor standard penetration test for soils
3. IS 1888 1982 Methodof load test on soils
4. IS 1080 1985 Codeof Practice For Design And Construction Of Shallow Foundations in Soils

Program:	B. Tech. (Civil Engineering)			Semester :	V		
Course :	Professional Development Training-I (PDT-1)			Code :	BHM5917		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	TW	OR	PR	Total
3	-	-	3	-	-	-	Grade

Course Objectives:
This course aims at enabling the students
1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes: Students will be able to
After learning the course, the students will be:
1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Modern Maths** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	06
2.	**Algebra** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	06
3.	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics.**	06
4.	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	06
5	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	06
6	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	06
	Total	36

Reference Books:

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
3. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
4. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance.

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Environmental Sciences (AUDIT-2)			Code:	BHM9961		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
01	-	-	01	-	-	-	Grade

Course Objectives:

1. To gain an understanding on the concepts and strategies related to sustainable development and identify and analyse various conservation methods for renewable and non-renewable resources.
2. To examine biotic and abiotic factors within an ecosystem and to identify energy flow in ecosystem.
3. To understand the value of biodiversity and identify current efforts for it‘s conservation at national and local level.
4. To provide comprehensive overview of environmental pollution and technology associated with monitoring and control.

Course Outcomes:

After learning the course, the students will be able to:

1. Demonstrate an integrative approach to environmental issues with a focus on sustainability and identify the role of organism in energy transfer in different ecosystem.
2. Distinguish between renewable and non-renewable resources and analyse consumption of resources
3. Identify key threats to biodiversity and develop appropriate policy options for it‘s conservation.
4. Analyse the impact of environmental pollution and the science behind those problems and potential solutions.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Multidisciplinary nature of environmental studies:** Definition, scope and importance, Need for Public awareness, **Natural Resources**: Renewable and non- renewable resources: Natural resources and associated problems a) Forest b)Water c) Mineral d)Food e) Land f) Energy, Role of an individual in conservation of natural resources, Use of resources for sustainable lifestyle.	3
2	**Ecosystems**: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposer, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Characteristic features, Case study on Forest ecosystem, Aquatic ecosystem.	3
3	**Biodiversity and its conservation:** Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values, Biodiversity at global, national and local levels, India as a mega-diversity nation, Hotspots of biodiversity, Threats to biodiversity, Conservation of biodiversity, Case study on any one Hotspot of biodiversity.	3
4	**Environmental Pollution:** Definition, Cause, effects and control measures of different pollution: a. Air b. Water c. Soil d. Noise e. Thermal f. Nuclear hazards, Solid waste management, Relevance of environmental ethics for environmental protection, **Social Issues and the Environment :**From Unsustainable to Sustainable development ,Urban problems related to energy ,Water conservation, Impact of Climate change, Innovative ideas for creating public environmental awareness.	3
	Total	12

Text Books:

1. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., ―Environmental Encyclopedia‖, Jaico Publications House, 1st edition, 2000, ISBN-13: 978-8172247867

2. Agarwal, K.C, ―Environmental Biology‖, Nidhi Publishers, 2nd edition ,2008, ISBN-13978-8189153021

Reference Books:

1.BharuchaErach, ―The Biodiversity of India‖, Mapin Publishing Pvt. Ltd., 1st edition, 20021, ISBN- 108188204064

Course Syllabus

TY B Tech

Semester-VI

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Water and Wastewater Engineering			Code:	BCI 6417		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Surveying, Building Planning and Fluid Mechanics
2. Basic Concepts of Engineering Sciences and Mathematics

Course Objectives:

After completing this course, student will have adequate background to understand and solve the problem involving :

1. To make students understand importance of water infrastructure with respect to needs of various users.
2. To discuss and demonstrate the principles of water treatment plant and layout.
3. To inculcate and impart design principles and working of WTP components
4. To introduce students about the need of sanitation infrastructure, wastewater treatment, sludge management system and to identify potential of wastewater for recycle and reuse.
5. To inculcate an ability to learn the working principle, operation and design of various units of wastewater treatment plant.

Course Outcomes:

After learning the course, the students will be able to:

1. Define identify, describe reliability of water sources, estimate water requirement for various sectors and Understand the requirement of water treatment plant for infrastructure and Government scheme.
2. Design components of water treatment plant – aeration, sedimentation and estimating coagulant dose.
3. Design components of water treatment plant – flocculator, filtration, elevated service reservoir capacity.
4. Recall sanitation infrastructure, quantification and characterization of wastewater, natural purification of streams and explain the potential of recycle and reuse of wastewater treatment.
5. Design preliminary and primary unit operations in waste water treatment plant.
6. Design suspended and attached growth wastewater treatment systems.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Basics of Water Supply Engineering:** Introduction to water supply scheme: importance of water infra-structure in India, data collection required for implementing water supply schemes, components and layouts. Design periods, factors affecting design periods. Quantity: rate of water consumption for various purposes, fire demand, factors affecting rate of demand, population forecasting. Government of India initiatives - SMART city, AMRUT, Jal Jeevan Mission and its implication in rural India.	8
2.	**Principles of Water Treatment:** principles of water treatment unit operations and processes, water treatment flow sheets, criteria for site selection for WTP. Aeration: principle and concept, necessity, methods, design of aeration fountain. Sedimentation: plain and chemical assisted, principle, efficiency of an ideal settling basin, types of sedimentation, settling velocity, types of sedimentation tanks, design of plain sedimentation tank, design of tube settlers. Coagulation and flocculation: principle of coagulation, common coagulants, natural coagulants.	7
3.	**Design of Water Treatment Plant**: Concept of mean velocity gradient and power consumption, design of flocculation chamber, design of clari-flocculator. Filtration: theory of filtration, mechanism of filtration, filter materials, types of filter and design of rapid sand gravity filters. Disinfection: mechanism, factors affecting disinfection, types of disinfectants, types and methods of chlorination, bleaching powder estimation. Water distribution system: system of water supply: continuous and intermittent system, design of elevated storage reservoir capacity.	8
4.	**Sanitation Infrastructure System** : wastewater sources and types, importance of sanitation infrastructure, collection and conveyance, quantitative estimation of wastewater, self-cleansing velocity, hydraulic design of circular sanitary sewer, necessity and location of pumping station. Self-purification of natural streams: oxygen sag curve, Streeter - Phelps equation- application and limitations. Wastewater recycle and reuse: driving factors for recycle and reuse, recycling of grey water, municipal sewage, storm water and industrial effluent, reuse opportunities in municipal, industrial, agricultural sector.	7

5.	**Preliminary and Primary Wastewater Treatment** - sewage/effluent treatment plant - flow diagram, unit operation and process, preliminary and primary treatment, emerging contaminants & its treatment issues, screens: types, hydraulics, velocity and head loss, design of screens, disposal of screenings. Grit chamber: sources of grit, types, proportional flow weir, Parshall flume, design of grit chamber, disposal of grit, skimming tanks: sources of oil and grease, methods of oil and grease removal. Equalization and neutralization tanks - application and benefits. Primary sedimentation tank: types of settling, types of sedimentation tanks, factors affecting efficiency, design of primary sedimentation tank.	**7**
6.	**Secondary and tertiary Treatment**: Aerobic secondary treatment: unit operations and processes, principle of biological treatment, Activated sludge process (ASP): design of ASP, modifications in ASP. Oxidation pond: bacteria – algae symbiosis, design of oxidation pond, Constructed wetlands, phytoremediation: principle, advantages, disadvantages, trickling filter: principle, different TF media & their characteristics, design TF using NRC formula, operational problems, and control measures. Sludge management system. Tertiary treatment – principle and methods, concept of Zero Liquid Discharge (ZLD).	**8**
	Total	**45**

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).
2. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).
3. Environmental Engineering-1: Water Supply Engineering, B. C. Punmia, Ashok Jain and Arun Jain. Laxmi Publications (P) Ltd, 2nd Edition, Reprint (2016).
4. Sewage Disposal & Air Pollution Engineering, S. K. Garg, Khanna Publication, 41st Edition, (2018).

Reference Books:

1. Environmental Engineering, Peavy and Rowe, McGraw Hill Publications, (2017).
2. Waste Water Treatment & Disposal, Metcalf & Eddy, McGraw Hill Education (India) Private Limited, 4th Edition, (2017).
3. Manual on Sewerage & Sewage Treatment published by Ministry of Urban Development, New Delhi, Third Edition, (1993).
4. Wastewater Treatment for Pollution Control and Reuse, Arceivala and Asolekar, McGraw Hill Education (India) Private Limited, 3rd Edition, (2017).
5. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association IS Codes 01
6. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.

e-Resources:

1. http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php
2. http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php
3. http://cpheeo.gov.in/cms/manual-on-storm-water-drainage-systems---2019.php
4. http://cpheeo.gov.in/cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php

Program:	B. Tech. (Civil Engineering)			Semester :			VI
Course :	Design of Reinforced Concrete Structures			Code :			BCI6418
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Engineering Mechanics
2. Strength of Materials
3. Mechanics of Structures

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. Basic concepts of various design philosophies.
2. IS code based design method of RCC structures.
3. Design of columns & footing.
4. Ductile detailing as per IS:13920:2016

Course Outcomes:

After learning the course, the students should be able to:

1. Explain concepts of various design philosophies and determine moment capacity of beam elements using the Limit State Method.
2. Analyze & design beams for different support conditions
3. Analyze & design one-way slabs for different support conditions.
4. Analyze and design two-way slabs & staircase.
5. Analyze design column & Isolated footing for different loading condition
6. Apply ductile detailing knowledge as per IS:13920:2016

Detailed Syllabus:

Unit	Description	Duration(H)
1.	**Introduction to Design Philosophies:** Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.	**07**
2.	**Design of Beam:** design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced and flanged), shear, bond and torsion.	**08**
3.	**Design of one way Slab:** Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients	**07**
4.	**Design of two way slab:** simply supported, continuous and restrained. **Design of staircase:** dog legged.	**08**
5.	**Design of Column with footing:** Assumptions, minimum eccentricity, design of short column with footing for axial load, design of short column with footing subjected to combined axial load and uniaxial.	**07**
6.	**Ductile Detailing:** Ductile Detailing of reinforced concrete structures using IS 13920. Design of rectangular and flanged cross section continuous beam by using IS code coefficients & ductile detailing using IS 13920 Design of short column & footing subjected to combined axial load & biaxial bending using interaction curves & ductile detailing using IS 13920.	**08**
	Total	**45**

Reference Books

1. Illustrated Reinforced Concrete Design by Dr. V.L.Shah and Dr. S.R. Karve, Structures Publications ,Pune 411009
2. Illustrated Design of Reinforced Concrete Buildings (G+3) by Dr. V.L. Shah and Dr. S.R. Karve, Structures Publications, Pune 411009.
3. Design of Reinforced Concrete Structures by Subramanian, Oxford University Press.
4. Comprehensive Design of R.C. Structures by Punmia, Jain and Jain, Standard Book House', New Delhi.
5. RCC Analysis and Design by Sinha, S, Chand and Co. New Delhi.
6. Reinforced Concrete Design by Varghese, PHI, New Delhi. Design of Prestressed concrete structures- T. Y. Lin.
7. Reinforced Concrete Design by Pillai Menon, Tata McGraw Hill', New Delhi.
8. Design of Concrete Structure by J N Bandyopadhyay, PHI, New Delhi.
9. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co

IS Codes

1. IS 456-2000: Plain and reinforced concrete-code of practice, Bureau of Indian Standards, New Delhi
2. IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice, Bureau of Indian Standards, New Delhi
3. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials, Bureau of Indian Standards, New Delhi
4. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads, Bureau of Indian Standards, New Delhi

e- Resources

1. https://www.classcentral.com/course/swayam-design-of-reinforced-concrete-structures-13995
2. https://www.udemy.com/course/reinforced-concrete-beam-design/
3. https://nptel.ac.in/courses/105105105
4. https://www.academia.edu/5041739/DESIGN_OF_REINFORCED_CONCRETE_STRUCTURES

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Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Design of Hydraulic Structures (PEC-III)			Code:		BCI6503A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of: Fluid Mechanics, Hydrology and Water Resources Engineering, , Engineering Geology (Geological investigations for suitable site selection)

Course Objectives:

1. To make students aware of various classification of dams and stability analysis of gravity dam
2. To make students aware of stability analysis of earthen dam and the concept of diversion head works
3. To impart knowledge of design of suitable hydraulic structures
4. To impart knowledge for appropriate cross drainage works and river training works

Course Outcomes:

After learning the course, the students will be able to:

1. classify dams and analyze stability of concrete gravity dam
2. analyze Stability of earthen dam and the diversion head works
3. design lined canal and related canal structures
4. relate cross drainage works and river training works

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to dams :** Introduction, historical development of dams, different terms related to dams, selection of site for dam, factors governing selection of type of dam, classification of dams, dams and social issues, large dams verses small dams **Gravity Dams :** Components of gravity dam, conditions favoring gravity dams, Forces acting on gravity dam, combinations of loading for design, seismic analysis of dam, middle third rule, modes of failure of gravity dam, elementary profile of gravity dam, economic height of dam, concept of low and high gravity dams, various design methods of gravity dam	7
2.	**Earth Dam:** Introduction, Classification of earth dam, selection of type of earth dam, components of an earth dam, requirements for safe design of earth dam, hydraulic (seepage) analysis, plotting of seepage line, forces acting on earth dam, stability analysis of an earth dam, analysis by Swedish slip circle method, failure of earth dam, seepage control in earth dams, causes of seepage, seepage control measures **Diversion head works:** Typical layout and components of diversion head works, site selection, criteria for safe deign of weir floor, brief introduction to Bligh and Lane's theory, Khosla's theory	8
3.	**Spillway :** Concept, classification of spillway, design of ogee spillway, energy dissipation below spillway, classification of energy dissipation devices, spillway gates, classification of spillway crest gates, maintenance of gates, inspection of gates **Canal and canal structures :** Introduction, classification of canals, design of stable canal in alluvial beds, Kennedy's theory, design of canal by Kennedy's theory, Limitations of Kennedy's theory, Lacey's regime theory, canal Lining design of lined canal, canal falls introduction, necessity, types of falls, canal outlets- introduction of canal outlet or module, canal escapes.	8
4.	**Cross drainage (C.D.) Works:** Necessity of cross drainage works, site selection classification drain over canal-siphon, super passage, canal over drain - aqueduct, siphon aqueduct, canal and drain water mixed in each other--level crossing, inlet and outlet, design considerations for cross drainage works **River training works :** Introduction, classification of rivers, classification based on topography, regime, alignment, source, behavior of rivers, river training, objectives classification, purpose, river training structures	7
	Total	**30**

Text Books:

1. Engineering hydrology, K. Subramanya,Tata McGraw-Hill, New Delhi, (4th Edition), 2013
2. Irrigation, water resources and water power Engineering, P. N. Modi, Standard book House 11th edition (2020)
3. Punmia, B.C. and Pande, B.B.L. "Irrigation and water power engineering", Laxmi Publications Pvt. Ltd, New Delhi 17th edition , 2016

Reference Books:

1. Design of Small Dams- United States Department of the Interior, Bureau of Reclamation revised Third edition 1987, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, 2008.
3. Engineering for Dams- Creager W.P, Justin J.D, Hinds J -Wiley Eastern Pvt. Ltd., New Delhi, 1968
4. Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers New Delhi, 34th revised 2017edition,

IS Codes:

1. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
2. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
3. I.S. 10135 – 1985(Reaffirmed 2002), Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi
4. I.S. 14591 – 1999 (R2015), Temperature control mass concrete for dams – guidelines, B.I.S. New Delhi.
5. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
6. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi .
7. I.S. 11155- 2019 (Reaffirmed 2020), Second Revision, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi

e-Resources:

1. https://www.worldcat.org/title/hydraulic-structures/ edition
2. https://www./Hydrodynamic-Forces-Hydraulic-Structures-Manual ebook/dp/B077DRQVP8

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Program:	B. Tech. (Civil Engineering)			Semester :	VI
Course :	Construction Equipment and Material Management (PEC-III)			Code :	BCI6503B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior knowledge:
Basic Civil, Building Technology and Architectural planning, Concrete Technology, Transportation engineering, Railway, tunnel and harbor

Objectives:
After Completing this course, student will have adequate background :

1. To make aware of the effective utilization, maintenance and cost control of construction equipments
2. To get familiar with working of various equipments for different construction process
3. To introduce with effective material procurement system
4. To know inventory techniques and store management of materials.

Outcomes:
After learning the course, the students will be able to:

1. Explain the selection criteria, cost associated with equipment and work cycle time
2. Classify different construction equipment's based on its application and working
3. Explain effective procurement process for management of materials
4. Analyze problems related to inventory management and store management

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Construction Equipment Management:** Introduction to equipment management in construction projects, Selection criteria for construction equipment, Sources of construction equipment: purchase of old or new, rent and lease of equipment, economics of construction equipment, preventive maintenance, merits and demerits of maintenance, depreciation analysis, work cycle time of any equipment with corrective factors. Equipment's safety management	7
2.	**Construction Equipment's:** Earthmoving equipment, compaction equipment, Drilling and Blasting equipment, tunneling equipment's, equipment for dewatering and Grouting, Pile Driving Equipment, Material handling equipment.	8
3.	**Materials Management importance and procurement:** Importance, scope, objectives and functions of material management, Role of materials manager, Material research, Identification of sources of procurement, Planning and creative Purchase, Procurement Organization, vendor analysis, Concept of supply chain management , Insurance of materials, concept of international purchase.	7
4.	**Inventory and store management:** Introduction to Inventory Control and its techniques, Economical Order Quantity (EOQ), ABC analysis, JIT - Just in time management, Use of (MMS) – Materials Management Systems. **Stores Management**: location, site layout, different types of stores, methods of storing, codification of materials, store accounts, stock verification, care, safety and security of materials, losses on storage. Obsolete, surplus and scrap materials management.	8
	Total	**30**

Text Books:

1. Construction planning, equipment and methods by Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C, Tata McGraw Hill, Singapore, 2006.
2. Construction equipment management for engineers, estimators, and owners by Gransberg, D. D., Popescu, C. M., & Ryan, R. C. (2nd ed.). CRC Pres, 2006
3. Construction Equipment and Management by Sharma S.C., Khanna Publishers, New Delhi, 5th edition, 2015
4. Construction Equipment Planning and Applications by Dr. Mahesh Varma,Metropolitan Book Company, New Delhi. 1988.
5. Materials Management An Integrated Approach , by P. Gopalakrishnan and Sundaresan, Prentice Hall of India,23rd reprint, 2011
6. Materials of Construction' by Ghose, Tata- McGraw Hill Publication,1989

Reference Books:

1. Construction Planning, Equipment and methods – Peurifoy-McGraw Hill Publication,9th edition,2011
2. Journals such as CE & CR. Construction world, International Construction.
3. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
4. P. Gopalkrishnan, Handbook of Materials management, Prentice Hall Publication.
5. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
6. Arnold, "Introduction to Materials Management", Pearson Education India,2009

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Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Finite Element Methods (PCE-III)			Code:	BCI6503C		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Engineering Mathematics: Basics of matrix.
2. Strength of Materials: Basics of stress, strain and their relationship.

Course Objectives:

1. To impart the knowledge about the theory and characteristics of finite elements that represent engineering structures.
2. To develop ability of applying finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand fundamentals of finite element method.
2. Formulate the stiffness matrix using member approach for portal frame.
3. Understand displacement function for 2D triangular (CST and LST) and rectangular elements.
4. Develop element characteristic equation procedure and generation of global stiffness equation will be applied.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Theory of elasticity:** Strain-displacement relations, compatibility conditions in terms of strain, plane stress and plane strain problems. Applications and advantages of FEM, concept of finite element for continuum problems, discretization of continuum, use of polynomial displacement function, Pascal's triangle, and convergence criteria.	8
2.	**Formulation of stiffness matrix**: Analysis of spring assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, applications to truss and beam not involving unknowns more than three.	7
3.	**Element Shapes and Coordinate System:** Principle of minimum potential energy, formulation of stiffness matrix for truss element using variation principles. Displacement function for 2D triangular (CST and LST) and rectangular elements, Introduction to 3D elements such as tetrahedron and hexahedron.	8
4.	**Shape Functions:** Use of shape functions, Area co-ordinates for CST element, Shape functions in cartesian and natural coordinate systems, shape functions for one dimensional element such as truss and beam, shape functions of 2D Lagrange and serendipity elements.	7
	Total	**30**

Text Books:

1. Introduction to Finite Elements in Engineering / Chandraputla, Ashok and Belegundu Hall. 2nd Edition, (2011).
2. The Finite Element Methods in Engineering / SS Rao / Pergamon, 5th Edition (2010)
3. An Introduction to the finite element method – J.N. Reddy – Tata McGraw Hill Publishing Co. Ltd, 5th Edition, (2010).
4. Finite Element Analysis – Theory & Programming - C.S. Krishnamurthy – Tata McGraw Hill Publishing Co.LTd, 3rd Edition (2015)
5. The Finite Element Method, Zienkiewicz & Taylor - 4th Edition – Vol – I & II – McGraw Hill International Edition, 2nd Edition, (2011)
6. Finite Element Analysis Schaum's outlines - G.R. Buchanan – Tata McGraw Hill Publishing Co. Ltd, 3rd Edition, (2011).

Reference Books:

1. Finite Element Analysis – S.S. Bhavikatti - New Age International Publishers, Delhi, 5th Edition, (2015)
2. The Finite Element Method in Engineering - ELSEVIER Publication, S.S. Rao - 4th Edition, (2013)
3. Concepts & Applications of Finite Element Analysis – Robert D. Cook, D.S. Malkus, M.E. Plesha – John Wiley & Sons. 4th Edition, (2001)
4. Applied Finite Element Analysis - Segerlind L.J. – John Wiley & Sons, 2nd Edition, (2005)

Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Advanced Transportation Engineering(PEC-III)			Code:		BCI6503D	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Transportation Engineering
2. Design concept of flexible and rigid pavement
3. Principles of traffic engineering and system planning

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving:

1. To learn all the aspects related to design of traffic signals and pavement
2. To use to concept of transport economics in evaluating the financial and economic feasibility of a road project
3. To train the students to develop their career in transportation industry

Course Outcomes:

After learning the course, the students should be able to:

1. Plan a transport network and analyze it w.r.t. trip generation, distribution, assignment, and modal split
2. Apply the knowledge of traffic engineering for road projects. Apply the knowledge of transport economics to evaluate the financial and economic viability of road projects
3. Analyze and design a flexible pavement
4. Analyze and design a rigid pavement and overlays

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Transport System Planning:** Transportation planning process and types of surveys. Travel demand forecasting - trip generation, modal split analysis, trip distribution and route assignment analysis, Transportation System Management (TSM), application in Comprehensive Mobility Plan (CMP) and DPR.	6
2.	**A. Traffic Engineering and Transport Economics** Level of service, signal design- IRC method and Webster's method, parking study and analysis, bicycle and pedestrian facility design. Road user cost - Vehicle operations cost, running cost, value of travel time, accident cost. Economic evaluation – Benefit cost method, Net present value method, First year rate of return method, Internal rate of return method & comparison of various methods	8
3.	**Flexible Pavement:** Philosophy of design and design criteria, design of flexible pavement using IRC 37-2012, Distresses in flexible pavement, evaluation of pavement – Benkelman beam, Falling Weight Deflectometer (FWD), Pavement Management Systems (PMS).	8
4.	**Rigid pavement and Overlays :** Philosophy of rigid pavement, comparison of rigid pavement over flexible pavement, types of rigid pavements, design of rigid pavement using IRC 58-2015 including design of joints, distresses in rigid pavement. Types of overlays, design of overlay using IRC 81-1997.	8
	Total	**30**

Textbooks:

1. Traffic Engineering and Transport Planning - L R Kadiyali, Khanna Publishers.(2017)
2. Principles of Transportation Engineering – P. Chakraborty, A. Das, PHI Learning Pvt. Ltd, Second Edition
3. Pavement Design- R Srinivasa Kumar, Universities press, Orient Blackswan.

Reference Books:

1. Highway Engineering - Laurence I Hewes & Clarkson H Oglesby
2. Pavement analysis and design- Yang Huang, Pearson Education India, Second Edition
3. Principles of Urban Transport Systems Planning - B. G. Hutchinson.
4. Introduction to transport planning - M. J. Bruton.
5. Transportation Engineering An Introduction – C. Khisty, B. Kent Lall, Pearson Publication.
6. Traffic analysis (New technologies new solutions)-Taylor M P, Hargreen Pub.Co., New Delhi.

Codes:

1. I.R.C. 58- 2015: Tentative Guidelines for the Design of Rigid Pavements
2. IRC 37-2012: Tentative Guidelines for the Design of Flexible Pavements
3. Specifications for Road and Bridge Works (MoRTH) 5th Revision, New Delhi
4. IRC 81-1997: Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Banklemen Beam
5. IRC 82-2015: Code of practice for maintenance of bituminous surface roads
6. IRC 115-2014: Structural Evaluation of Pavement using FWD

e-Resources:

1. https://ocw.mit.edu/courses/1-221j-transportation-systems-fall-2004 (MIT- Opencourseware)
2. https://ocw.mak.ac.ug/courses/civil-and-environmental-engineering/1-201j-transportation-systems-analysis-demand-and-economics-fall-2008 (Open Courseware)

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Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Sustainable Engineering (PEC-IV)			Code:	BCI6504A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Fundamentals of Environmental Studies.
2. Introduction to the basic concept of sustainability.
3. Engineering Chemistry

Course Objectives:

1. To provide the fundamental concepts of sustainable engineering and the roles and responsibilities of engineers in developing a sustainable society.
2. To build conceptual knowledge of the circular economy and sustainable material management.
3. To provide conceptual knowledge of ISO framework of Life Cycle Assessment and LCA tools.
4. To impart knowledge on energy conservation, carbon footprints, and carbon credits.
5. To be aware of policies and clean development mechanisms for green energy.
6. To provide conceptual knowledge on risk assessment and environmental impact assessment.

Course Outcomes:

After learning the course, the students will be able to:

1. Explain the various aspects of sustainability and their roles and responsibilities as engineers in developing sustainable solutions.
2. Design a circular economy model.
3. Assess the criteria for life cycle assessment and associated tools.
4. Explain the methods and policies for energy conservation.
5. Identify the rules and regulations for clean energy production and its mechanism.
6. Evaluate the risk assessment and EIA tools, laws, and protection acts.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to Sustainable Engineering:** Introduction to sustainability -definitions, principles, and indicators of sustainability, quantification of sustainability. Links between industrial activities and sustainability issues, Sustainable Development Goals, roles and responsibilities of engineers in developing a sustainable society.	7
2.	**Design for Circular Economy:** Environmental design for sustainability, economics, environmental and social performance indicators, sustainable engineering design principles, environmental cost analysis, sustainable material management.	8
3.	**Life Cycle Assessment:** Life cycle analysis, methodology, ISO 14040:2006 for Life Cycle Assessment**,** benefits and drawbacks**,** life cycle inventory analysis (LCI) and impact assessment (LCIA), LCA tools (Open LCA and The LCA Calculator), Case study on LCA	8
4.	**Energy Conservation and Environment:** Significance of energy conservation and environment, an overview of global and Indian Energy scenario; environmental impact of energy conversion its functions, policies, methods of energy conservation, energy and material flow analysis. Carbon footprint & carbon credits: introduction, carbon emission, calculation, carbon trading.	8
5.	**Green solutions:** Importance, principles of cleaner production and its benefits, the role of industry, pollution prevention, and cleaner production awareness plan, waste audit, Government and institutes policies in cleaner production, clean development mechanisms, 5R: waste to wealth concept with a case study.	7
6.	**Risk assessment and Environmental Impact Assessment:** Risk and Life cycle framework for sustainability, introduction to environmental risk assessment. **EIA:** introduction, methodologies, characteristics of environmental issues, health hazards, environmental data collection, Environmental laws and protection acts.	7
	Total	**45**

Text Books:

1. Sustainable Engineering: Principles and Practice, Bhavik R. Bakshi, Cambridge University press (2019)
2. Sustainable Engineering, Dr. Srinivas Vasam, Dr. K. Jagannadha Rao, S.K. Kataria & Sons, S.K. Kataria & Sons, 1st Edition (2021)
3. Introduction To Sustainable Engineering, Rag R. L. Remesh Lekshmi Dinachandran, PHI, (2016)
4. Sustainable Engineering, Roy K Varghese, Pentex Book Publishers & Distributors, (2015)

Reference Books:

1. Engineering for Sustainability, Jonker Gerald, Elsevier Science & Technology 1st Edition (2012)
2. Cradle to Cradle: Remaking the Way We Make Things, William McDonough, North Point Press, (2002)
3. Circular Economy and Sustainability, Volume 1: Management and Policy, Alexandros Stefanakis, Ioannis Nikolaou, Elsevier, (2021)
4. Environmental Management, Ajith Sankar, Oxford University Press, (2015)

e-Resources:

1. https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
2. https://www.rit.edu/sustainabilityinstitute/blog/what-life-cycle-assessment-lca
3. https://link.springer.com/book/10.1007/978-3-319-56475-3#toc
4. https://archive.nptel.ac.in/courses/105/105/105105157/
5. https://www.coursera.org/learn/global-sustainable-development

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Program:	B. Tech. (Civil Engineering)			Semester :		VI	
Course :	Project Management and Economics (PEC-IV)			Code :		BCI6504B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Pre-requisite:
Basic of management and economics

Objectives: After Completing this course, student will have adequate background :

1. To make aware of concepts in project management and organization structure.
2. To build the ability of student to do project planning, scheduling and resource planning.
3. To provide knowledge of project economics for construction projects.
4. To impart knowledge of project selection and recommend the best project.

Outcomes:
After learning the course, the students will be able to:

1. Explain Project life cycle and basic aspects of project management
2. Solve the problems on project network planning and scheduling using CPM and PERT.
3. Apply the knowledge of resource allocation, monitoring and site planning for resource optimization.
4. Explain the concepts of economics and sources of finance for construction projects.
5. Evaluate the project feasibility using project appraisal and selection techniques.

Detailed Syllabus:

Unit	Description	Duration(H)
1.	**Project Management Introduction:** Need, objectives & functions of Project Management, principles of project management, Categories of Project, Project Life Cycle (PLC) Concept, Types of project organization structure, Project Management Book of Knowledge {PMBOK} and domain areas, Role of project manager in client and contractor, project management institute, Project failure due to delays in project.	07
2.	**Project planning and scheduling using CPM:** Work Breakdown Structure (WBS), Bar chart, Gantt and its Limitations, types of precedence relationships, Activity on Arrow (AOA.), Activity on Node (AON), development of critical path method (CPM) network, network analysis, time estimation, types and computation of float values, critical path.	08
3.	**Project planning and scheduling using PERT:** Program Evaluation and Review Technique (PERT): three time estimates, slack, expected duration, calculation of probability of completion. Project risk classification and management concept.	07
4.	**Project organizing, monitoring and site planning:** Resource Allocation, Resource smoothening and leveling, network crashing- time and cost, Network updating, Introduction to use of project management software's – MS Project / Primavera. Introduction to BIM (Building Information Modeling) in project management. Project site layout planning, Importance of safety at project site, accidents, their causes, effects and preventive measures, safety precautions and program	08
5.	**Project Economics:** Importance, concept of cost, types of interest, law of demand and supply, , equivalence, time value of money, concept of cash flow and sinking fund, Break even analysis, Budget provisions, sources of project finance, Concepts of debt capital and equity capital	08
6.	**Project Appraisal:** Project pre-feasibility study, Feasibility report, types of appraisals- social, political, environmental, techno-legal, financial and economical, study of detailed Project Report (DPR), Role of Project Management Consultants (PMC) in Pre-tender and Post-tender. Criteria for Project Selection – Net Present Value (NPV),Internal Rate of Return(IRR), Pay-Back Period, benefit cost ratio.	07
	Total	45

Text Books:

1. Project planning and control with PERT and CPM by DR. B.C. Punmia and K. Khadelwal, Laxmi publication, New Delhi, 4th edition,2016.
2. Construction Engineering and Management by S. Seetharaman, 5th edition, 2015.
3. Project management Principles and Techniques by B.B. Goel, Deep and Deep publisher

Reference Books:

1. Construction project management by K. K. Chitkara, 4th edition, McGraw Hill Education, 2019
2. Construction Project management, Theory & Practice, by Jha, Kumar Neeraj., Pearson Education India, 2015.
3. construction management and planning by B. Sengupta and H. Guha Published by Mc Graw Hill India (2015)
4. Engineering Economics By R. Panneerselvam, PHI Learning pvt.ltd,13th print 2012.
5. Engineering Economy by William G. Sullivan, Elin M. Wicks and C. Patrick Koelling - Publisher: Prentice Hall, Inc.17th edition, 2019

e-resources: NPTEL project management courses

https://nptel.ac.in/courses/105104161

https://onlinecourses.nptel.ac.in/noc23_ce62

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Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Prestressed Concrete Structures (PEC-IV)			Code :	BCI6504C		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of: Strength of Materials

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. Concept of prestressed concrete structures
2. Design of post tensioned flexural elements.
3. Design of post tensioned flat slab.
4. Maintenance and rehabilitation of prestressed concrete structures

Course Outcomes:

After learning the course, the students should be able to:

1. Calculate losses in pre-stressed concrete sections.
2. Apply the principles of pre-stressed concrete for calculating extreme fiber stresses in pre-stressed concrete sections.
3. Apply the design methodology given in IS 1343 for designing prestressed concrete sections and end blocks.
4. Calculate the prestressing force and the number of PT cables required in one-way and two-way post-tensioned slabs.
5. Calculate the moment distribution for interior and exterior panel of post-tensioned flat slab
6. Describe the methodology of carrying out maintenance and rehabilitation of prestressed concrete structures.

Detailed Syllabus:

Unit	Description	Duration(H)
1.	**Introduction to pre-stressed concrete**: The basic concept and general principles, materials used and their properties, methods, and techniques of pre-stressing, pre-stressing systems, loss of pre-stress, Introduction to IS 1343.	7
2.	**Analysis of Flexural Members**: Basic concepts, stresses at transfer and service loads, critical sections under working load for pre-tensioned and post-tensioned members, stress concept, strength concept and load balancing method of analysis of pre-stressed concrete beams, the concept of cable profile	8
3.	**Design of post-tensioned beam**: The design of prestressed concrete simply supported rectangular beams and the Design of flanged sections for flexure. Anchorage zone stresses for post-tensioned members. Design of end block for busting force	9
4.	**Design of post-tensioned slab**: Design one-way post-tensioned slab and two-way post-tensioned slab (Single panel only).	7
5.	**Design of post-tensioned flat slab**: Introduction to flat slab, IS 456 codal provisions for the flat slab. Design of prestressed two-way flat slab by direct design method	8
6.	**Maintenance and rehabilitation of prestressed concrete structures:** Maintenance methodology, Inspection of Structures, Cracks in prestressed concrete members remedy and repairs, Repairs of girders damaged by collision. Case studies of repair and rehabilitation of structures.	6
	Total	**45**

Text Books:

1. Pre-stressed Concrete, N. Krishna Raju, Tata McGraw Hill Publishing Co. (2018)
2. Prestressed concrete, G.S.Pandit and S.P.Gupta, CBS Publishers and Distributers Pvt. Ltd, second edition (2014)

Reference Books:

1. Design of Pre-stressed Concrete Structures, T.Y. Lin, John Wiley and Sons Inc. (2010)
2. Modern Pre-stressed Concrete, J. Libby, Springer Science & Business Media (2012)
3. Pre-stressed Concrete Analysis and Design, A. E. Naaman, McGraw-Hill College (2014)

IS Code:

1. IS 1343- 2012 Prestressed Concrete- Code of practice (Second Revision)
2. IS 456-2000 Plain and Reinforced Concrete - Code of Practice (Fourth Revision)

e- Resources: https://nptel.ac.in/courses/105106117

Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Advanced Geotechnical Engineering (PEC-IV)			Code:	BCI6504D		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Engineering Geology
2. Geotechnical Engineering
3. Foundation Engineering

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. To make aware of different soil classification systems and provide the knowledge of clay mineralogy and soil structures.
2. To provide the knowledge of stress distribution, earth pressure analysis.
3. To impart knowledge of application of geosynthetics on field.

Course Outcomes:

After learning the course, the students will be able to:

1. Identify the type of soil using different soil classification systems.
2. Explain the clay minerals and its structures.
3. Determine the vertical stress for different loading conditions.
4. Determine the earth pressure behind retaining wall and design the retaining wall.
5. Apply the knowledge of geosynthetics on field.
6. Explain the elements of rheology and its application in geotechnical engineering.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Standard Soil classification Systems** Particle size classification, Textural classification, AASHTO classification system, Unified classification system, Indian standard classification system, Boundary classification, Field identification of soils, General characteristics of soils of different groups.	7
2.	**Soil Structure and Clay Minerals** Introduction, gravitational and surface forces, primary valence bonds, hydrogen bond, secondary valence bonds , basic structural units of clay minerals, kaolinite mineral, montmorillonite, Illite mineral, electrical charges on clay minerals ,base exchange capacity, DDL theory.	8
3.	**Stresses due to applied loads :** Introduction, Stress - strain parameters, vertical stresses under a strip load, vertical stresses under circular area, rectangular area, Triangular load, Trapezoidal load, Stresses due to inclined loads, Contact pressure distribution, Newmarks Influence charts.	7
4.	**Earth pressure and Design of earth retaining structures** Earth pressure theory Earth pressure theories for calculation of active and passive pressure, Rankines and Coulombs earth pressure theories, analytical and graphical methods. Design of earth retaining structures Design of gravity and cantilever retaining walls, design -cantilever sheet pile walls, anchored sheet pile walls.	8
5.	**Geosynthetics and Reinforced soil** Application of geosynthetics in geoenviroment, Reinforced soil Mechanism, reinforcement soil – interaction. Applications –reinforcement soil structures with vertical faces, reinforced soil embankments. Reinforcement soil beneath unpaved roads, reinforcement of soil beneath foundations. Open excavation and slope stabilization using soil nails.	8
6.	**Rheology** Rheological elements, basic and composite rheological models. Examples of compound models used to explain different soil phenomena; such as secondary consolidation, creep etc.	7
	Total	**45**

Text Books:

1. Soil Mechanics and Foundation Engineering by K. R. Arora, Standard Publisher, 7th Edition (2019)
2. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publications, 16th Edition (2017)

Reference Books

1. Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. R. Rao, Newage International, 3rd Edition (2016)
2. Soil Mechanics- T.William Lambe--Wiley
3. Principles of Soil Mechanics and Foundation Engineering by V.N.S. Murthy, UBS Publishers(2018)
4. Soil Mechanics & Foundation Engineering by M. Bandhu, WileyPublications, 3rd Edition (2010)
5. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education, 2nd Edition (2017)
6. Foundation Analysis and Design by J.E. Bowels, McGraw-Hill book company, 5th Edition (2001)
7. Principles of Geotechnical Engineering by Braja M. Das, Cengage Learning, 8th Edition (2020)
8. Geotechnical Engineering by Shashi K. Gulhati & Manoj Datta, Tata McGraw Hill (2017)

I.S .Codes

1. IS: 1892-1979 – Code of Practice for Subsurface Investigation for Foundation‖.
2. IS: 2131-1981 (Reaffirmed 1997) - Method for Standard penetration Test for Soils.

e -Resources

https://www.digimat.in/nptel/courses/video/105101001/L01.html

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Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Environmental Engineering Lab			Code:			BCI6419
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	-	-	25	25

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. To introduce students to how the experiments relating to water and wastewater quality are performed.
2. To help students to know which tests are appropriate for given environmental problems, statistically interpret laboratorial results and write technical reports, and basic environmental design and technical solutions.

Course Outcomes:

After learning the course, the students will be able to:

1. Learn how to characterize drinking water for physical & chemical treatment and design of water treatment plant.
2. Learn how to characterize wastewater for physical, chemical & microbiological treatment and design of wastewater treatment plant.

A) List of Laboratory Experiments:

Any five experiments from Sr. No 1 to 6, any five experiments from Sr. No. 7 to 12 and Sr. No. 13 are compulsory.

Part A: (Any four experiment from 1 to 5 and any four experiment from 6 to 11)

1. Total hardness and its components in raw water.
2. Determination of chlorides in water
3. Determination of chlorine demand and residual chlorine.
4. Determination of turbidity and optimum dose of alum.
5. Determination of Most Probable Number (MPN)
6. Determination of dissolved oxygen in a given water and wastewater sample
7. Determination of Bio-Chemical Oxygen Demand in a given wastewater sample
8. Determination of Chemical Oxygen Demand in a given wastewater sample
9. Determination of solids -Total solids, suspended solids, volatile solids, settleable solids and non-settleable solids in a given wastewater sample
10. Determination of Sludge Volume Index in a given wastewater sample
11. Determination of Phosphates by spectrophotometer in a given wastewater sample.
12. Determination of total nitrogen in a given wastewater sample.

Part B: (Any one experiment)

1. Exercise on design of water distribution network using any suitable software such as EPANET / tools (total pipe length @ 10 km and minimum 10-12 nodes).
2. Design of Water Treatment Plant (WTP)/ Sewage Treatment Plant (STP) through software.

Part C:

1. Visit to water treatment plant and domestic / Industrial wastewater treatment plant & its detailed report.

Text Books:

1. Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, 35th Edition (2015).

Reference Books:

1. Standard Methods for examination of water and wastewater, Mary Franson, American Public Health Association.
2. IS 10500:2012 Drinking water specifications.
3. IS 3025: 2013, Methods of Sampling and Test (Physical, Chemical and Biological) for Water and Waste Water, Bureau of Indian Standards, New Delhi.
4. Water Supply and Sanitary Engineering, G. S. Birdie and J. S. Birdie, Dhanpat Rai Publishing Company, New Delhi, 9th Edition, (2010).

e-Resources:

8. http://cpheeo.gov.in/cms/manual-on-water-supply-and-treatment.php
9. http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php
10. http://cpheeo.gov.in/cms/manual-on-storm-water-drainage-systems---2019.php
11. http://cpheeo.gov.in/cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php

Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Design of Reinforced Concrete Structures Lab			Code:			BCI6420
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	25	-	50

Course Objectives:

After Completing this course, student will have adequate background to understand and solve the problem involving :

1. Design the reinforced concrete residential building
2. Structural drawings
3. Ductile detailing as per IS:13920-2016

Course Outcomes:

After learning the course, the students should be able to:

1. Design the different structural components of reinforced concrete residential buildings.
2. Prepare Structural drawings showing reinforcement details of different elements of the buildings.
3. Apply ductile detailing knowledge for structural reinforcement detailing as per IS:13920-2016.

List of Experiments:

01. Design Project: Design of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings and staircase (first and intermediate flight) with following details.

i. Minimum plan area of each floor shall be more than 150 m2
ii. Design of plinth and ground beams: for each type two simply supported and two continuous.
iii. Design of all slabs and beams of typical floor (first or second floor)
iv. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending, (c) axial load with biaxial bending, from terrace level to footing along with detailed load calculations.
v. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending.
vi. Design any one element by using spreadsheet or use of analysis and design by suitable software.
vii. Four full imperial drawing sheets. Out of which only structural plan drawing sheets shall be drawn by using any drafting software. Schedule of slabs, beams, columns and footing can be prepared by using any drafting software.
viii. Detailing of reinforcement should be as per SP-34 & IS-13920.

02. Reports of two site visits on
Reinforced cement concrete building construction site.

Note: For term work, the group size should not be more than four students and each group should have different design data.

Reference Books:

1. Varghese P.C.; Limit state design of Reinforced Concrete Structures Prentice Hall of India (1999)
2. Karve S.R. and Shah V.L, Limit State Theory and Design of Reinforced Concrete, Structures Publications, Pune. (2007)
3. S.U.Pillai ,D.Menon: Reinforced Concrete Design, Tata Mcgraw-Hill Publishing Company New Delhi (2003)
4. Ramchandra. Limit state Design Standard Book House 1990. Bureau of Indian Standards, I.S.456-2000: Plain and reinforced concrete, Code of Practice, Bureau of Indian Standards (2000)
5. S.P. (16): Design Aids for Reinforced Concrete. (Interaction Charts Only) Bureau of Indian Standards (1980)
6. Prestressed Concrete- N. Krishna Raju – Tata Mc Graw Hill Publication Co.

e-Resources:

1. IS 456-2000: Plain and reinforced concrete-code of practice.
2. IS 13920-2016: Ductile design and detailing of reinforced concrete structures subjected to seismic forces - code of practice.
3. IS 875-Part 1-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (I) dead loads-unit weights of building materials and stored materials.
4. IS 875-Part 2-1987: Code of practice for design loads (other than earthquake) for buildings and structures: Part (II) imposed loads.

Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Design of Hydraulic Structures Lab (PEC-III)			Code:		BCI6505A	
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	-	-	25

Course Objectives:

1. To impart knowledge of stability analysis of gravity and earthen dam
2. To provide Knowledge of Design of spillway with energy dissipater and lined canal
3. To impart knowledge of safety of weir on permeable foundation

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze the stability of gravity and earthen dam.
2. Design suitable hydraulic structure
3. Apply knowledge of causes of failure of hydraulic structure from the reference case study

Term Work:

A) Analysis /Design Assignments

1) Stability analysis of gravity dam
2) Design of profile of Ogee spillway and stilling basin
3) Stability analysis of earthen dam
4) Analysis of weirs on permeable foundations.
5) Design of lined canal
6) Design of any one type of river training work

B) A report based on visit to any irrigation project during the academic term.

C) Presentation on review of any one case study of failure of hydraulic structure from published literature or patent related to hydraulic structures. (In a group of five students)

Text Books:

. 1. Engineering hydrology, K. Subramanya,Tata McGraw-Hill, New Delhi, (4th Edition), 2013
2. Irrigation, water resources and water power Engineering, P. N. Modi, Standard book House 11th edition (2020)
3. Punmia, B.C. and Pande, B.B.L. "Irrigation and water power engineering", Laxmi Publications Pvt. Ltd, New Delhi 17th edition , 2016

Reference Books:

1. Design of Small Dams- United States Department of the Interior, Bureau of Reclamation revised Third edition 1987, Oxford and IBH Publishing Co.
2. Irrigation and Water Resources Engineering- Asawa G.L- New Age International (P) Ltd. Publishers, 2008.
3. Engineering for Dams- Creager W.P, Justin J.D, Hinds J -Wiley Eastern Pvt. Ltd., New Delhi, 1968
4. Irrigation Engineering and Hydraulic Structures- Garg S.K- Khanna Publishers New Delhi, 34th revised 2017edition,

IS Codes:

1. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
4. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
5. I.S. 10135 – 1985(Reaffirmed 2002), Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi
4. I.S. 14591 – 1999 (R2015), Temperature control mass concrete for dams – guidelines, B.I.S. New Delhi.
5. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
6. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi .
7. I.S. 11155- 2019 (Reaffirmed 2020), Second Revision, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi

e-Resources:

1. https://www.worldcat.org/title/hydraulic-structures/ edition
2. https://www. Hydrodynamic-Forces-Hydraulic-Structures-Manual ebook/dp/B077DRQVP8

Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Construction Equipment and Material Management Lab (PEC-III)			Code:			BCI6505B
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	-	-	25

Course Objectives:

1. To provide the knowledge of management of construction equipment's and material management

Course Outcomes:

After learning the course, the students will be able to:

1. Decide the criteria for selection of construction equipment
2. Prepare and present case studies related to construction equipments
3. Solve the problems related to inventory management
4. Explain the process involve in material and store management

Lab Experiments / Assignments : Any 8 assignments

1. Assignment on planning and selection of construction equipment for project
2. Numerical on outcome of construction equipment
3. Case studies on loss and time due to improper selection of equipment.
4. Case studies on modern trends/technology in equipment.
5. Assignment on depreciation and cycle time
6. Assignment on procurement process of material
7. Numerical on inventory control technique
8. Assignment on store management
9. Assignment on any software used for material management.

Text Books:

1. Construction planning, equipment and methods by Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C,Tata McGraw Hill, Singapore, 2006.
2. Construction equipment management for engineers, estimators, and owners by Gransberg, D. D., Popescu, C. M., & Ryan, R. C. (2nd ed.). CRC Pres, 2006
3. Construction Equipment and Management by Sharma S.C., Khanna Publishers, New Delhi, 6th edition, 2015
4. Construction Equipment Planning and Applications by Dr. Mahesh Varma,Metropolitan Book Company, New Delhi. 1988.
5. Materials Management An Integrated Approach , by P. Gopalakrishnan and Sundaresan, Prentice Hall of India,23rd reprint, 2011
6. Materials of Construction' by Ghose, Tata- McGraw Hill Publication

Reference Books:

1. Construction Planning, Equipment and methods – Peurifoy-McGraw Hill Publication,9th edition,2011
2. Journals such as CE & CR. Construction world, International Construction.
3. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
4. P. Gopalkrishnan, Handbook of Materials management, Prentice Hall Publication.
5. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
6. Arnold, "Introduction to Materials Management", Pearson Education India,2009

Program:	B. Tech. (Civil Engineering)			Semester:			VI
Course:	Finite Element Methods Lab (PEC-III)			Code:			BCI6505C
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	-	-	25

Prior Knowledge of:

1. Engineering Mathematics: Basics of matrix.
2. Strength of Materials: Basics of stress, strain and their relationship.

Course Objectives:

1. To impart knowledge and develop the ability to apply finite element solutions to structural, thermal, and dynamic problems.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the fundamentals of the finite element method and formulate the stiffness matrix using.
2. Develop element characteristic equation procedure, and generation of global stiffness equation will be applied.

LAB Assignments

All Assignments are compulsory.

1. Plane stress and plane strain problems. Applications of finite elements for continuum problems.
2. Applications of polynomial displacement function, Pascal's triangle, and convergence criteria.
3. Formulation of stiffness matrix for any 1-D element.
4. Formulation of stiffness matrix for any 2-D element.
5. Formulation of stiffness matrix for any 1-D element by using a coding tool.
6. Formulation of stiffness matrix for any 1-D element by using a coding tool.
7. Numerical on the Principle of minimum potential energy.
8. Numerical based on displacement function.
9. Applications of finite element method to 3D elements such as tetrahedron and hexahedron.
10. Use of shape functions for 2D Lagrange and serendipity elements.
11. Software applications of any one of the following cases using any available standard software. (Trusses / Grid Problem)
12. Software applications of any one of the following cases using any available standard software. (Plane stress/plane strain problem)

Text Books:

1. Introduction to Finite Elements in Engineering / Chandraputla, Ashok and Belegundu Hall. 2nd Edition, (2011).
2. The Finite Element Methods in Engineering / SS Rao / Pergamon, 5th Edition (2010)
3. An Introduction to the finite element method – J.N. Reddy – Tata McGraw Hill Publishing Co. Ltd, 5th Edition, (2010).
4. Finite Element Analysis – Theory & Programming - C.S. Krishnamurthy – Tata McGraw Hill Publishing Co.LTd, 3rd Edition (2015)
5. The Finite Element Method, Zienkiewicz & Taylor - 4th Edition – Vol – I & II – McGraw Hill International Edition, 2nd Edition, (2011)
6. Finite Element Analysis Schaum's outlines - G.R. Buchanan – Tata McGraw Hill Publishing Co. Ltd, 3rd Edition, (2011).

Reference Books:

1. Finite Element Analysis – S.S. Bhavikatti - New Age International Publishers, Delhi, 5th Edition, (2015)
2. The Finite Element Method in Engineering - ELSEVIER Publication, S.S. Rao - 4th Edition, (2013)
3. Concepts & Applications of Finite Element Analysis – Robert D. Cook, D.S. Malkus, M.E. Plesha – John Wiley & Sons. 4th Edition, (2001)
4. Applied Finite Element Analysis - Segerlind L.J. – John Wiley & Sons, 2nd Edition, (2005)

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Advanced Transportation Engineering Lab (PEC-III)			Code:	BCI6505D		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	TW	OR	PR	Total
2	-	1	2	25	-	-	25

Course Objectives:

1. To Impart the knowledge related to advanced survey methods and software in the domain of transportation system planning
2. To check the performance index and deflection characteristics of a pavement..

Course Outcomes:

After learning the course, the students will be able to:

1. Perform the surveys required to collect the data for advanced stage of transport planning
2. Measure the deflection and performance of paved surface area
3. Understand the use of soft tools to design the geometrical parameters of a road

Lab assignments (Any Six):

1. Study and conduct of household survey and recording sample measurements.
2. Study and conduct of Traffic volume count and spot speed survey
3. Conduct distress surveys on a flexible pavement or a rigid pavement and determine its condition index (PCI)
4. Design of a flexible pavement using IRC: 37-2012 using IITPAVE.
5. Design of rigid pavement using IRC: 58-2015.
6. Road deflections measurement using Benkelman Beam method..
7. Design of an overlay using IRC: 81-1997.
8. Study of any two softwares related to transportation engineering.

Text Books:

1. Highway engineering – S.K. Khanna, C.E.G. Justo & A. Veeraragavan, Nem Chand and Brothers, Roorkee, 10th Edition,(2018)
2. Traffic Engineering, Roger P. Roess, Elena S. Prassas, and William R. McShane, Pearson, Fifth Edition, (2019)
3. Principles and practices of Highway engineering –Dr. L.R. Kadiyali, Khanna Publishers Delhi, 9th Edition,(2017)

Reference Books:

1. ACourse in Highway Engineering – S.P. Bindra, Dhanpat Rai and Sons, Delhi, (2003)
2. Principles of Transportation Engineering – G.V. Rao Tata McGraw Hill Publication (2007)
3. Highway Engineering – Rangwala, Charotar publishing House, Anand 388001(2017)
4. Principles of Transportation Engineering – Partha Chakraborty, Animesh Das, Prentice Hall of India Pvt. Ltd., New Delhi.
5. Highway and Bridge Engineering – B.L. Gupta, Amit Gupta Standard publishers Distributors, Delhi.

e-Resources:

1. https://ocw.mit.edu/collections/transportation (MIT- Opencourseware)
2. https://www.icevirtuallibrary.com

Program:	B. Tech. (Civil Engineering)				Semester :		VI
Course :	Multivariate Data Analysis Using R(OEC-3)				Code :		BAS6608
Teaching Scheme					Evaluation Scheme		
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of

Descriptive Statistics
Inferential Statistics
Probability

Course Objectives:

This course aims at enabling the students to learn multivariate data collection, visualization, and preprocessing techniques for data science.

Course Outcomes:

After learning the course, the students will be able to:

1. **Apply** data preprocessing methods in R and generate quality data for analysis.
2. **Implement** R packages and related functions to data science to analyze multivariate data.
3. **Apply** different data visualization techniques to understand the multivariate data.
4. **Analyze** the multivariate data using dependent analysis methods using the R.
5. **Analyze** the multivariate data using independent analysis methods using the R.
6. **Develop** a model for Prediction and Decision Making for a data set.

Detailed Syllabus:

Unit	Description	Duration [H]
1	**Data Wrangling** Understanding the multivariate data, Standardizing Variables, Accessing Databases with R Software, Merging multiple data sources into a single dataset for analysis, Dealing with Missing values, dealing with extreme outliers in data, discrepancies or removing.	7
2	**Multivariate Data and Multivariate Analysis** Calculating Summary Statistics for Multivariate Data: Means and Variances Per Group, Between-groups Variance and Within-groups Variance for a Variable, Between-groups Covariance and Within-groups Covariance for Two Variables, Calculating Correlations for Multivariate Data, The multivariate normal density function.	8
3	**Multivariate Data Visualization in R Software** Geometric projection techniques: Scatter plot matrix, Hyper box, Trellis display, Parallel coordinates, Icon-based techniques: Chernoff faces, Stick figures, Star plots, Color icons, Pixel-oriented techniques: Query-independent techniques: visualize the entire dataset, Query-dependent techniques: visualize a subset of data that are relevant to the context of a specific user query, Hierarchical techniques, Hybrid techniques	8
4	**Dependent Analysis** Multiple linear regression, Conjoint Analysis, Multiple Discriminant Analysis, Linear Probability Analysis, Multivariate analysis of variance (MANOVA), Canonical Correlation Analysis, Structural Equation Modeling	7
5	**Independent Analysis** Factor Analysis: Factor analysis model, the k-factor analysis model, Estimating the parameters in the k-factor analysis model. Cluster Analysis: Cluster analysis, K-means clustering, Displaying clustering solutions graphically, multidimensional Scaling, Correspondence Analysis	7
6	**Multidimensional Scaling** Models for proximity data, Spatial models for proximities: Multidimensional scaling, Classical multidimensional scaling, non-metric multidimensional scaling. **Linear Discriminant Analysis :** Loadings for the Discriminant Functions, Separation Achieved by the Discriminant Functions, A Stacked Histogram of the LDA Values, Scatter plots of the Discriminant Functions, Allocation Rules and Misclassification Rate.	8
	Total	**45**

Reference Books:

1. Montgomery and Runger, "Applied Statistics and Probability for Engineers", Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, "Probability and Statistics for Engineers", Prentice India Ltd, 8 Edition, ISBN 13:978-8120342132.
3. S.P.Gupta, "Statistical Methods", Papperbook publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Everitt and Hothorn , "Use R!" series on using R for multivariate analyses, An Introduction to Applied Multivariate Analysis with R.
5. Barbara G. Tabachnick, Using Multivariate Statistics (4th Edition), Allyn & Bacon; 4th edition (August 9, 2000), ISBN-10:0321056779.
6. Yasunori Fujikoshi, Vladimir V. Ulyanov, Ryoichi Shimizu, Multivariate Statistics: High-Dimensional and Large-Sample Approximations, John Wiley & Sons, 15-Aug-201, ISBN:0470539860

e-sources:

NPTEL Course lectures links:

https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-ma53 (Introduction to R software)
https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-ma37 (Descriptive statistics using R software)

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Program:	B. Tech. (Civil Engineering)			Semester: VI			
Course:	Information Security (OEC-3)			Code: BCE6603			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Course Objectives:

1. To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
2. To make students aware about the basics and different algorithms of Cryptography.
3. To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.

Course Outcomes:

After learning the course, the students should be able to:

1. Identify computer and network security threats, classify the threats and develop a security model to prevent, detect and recover from the attacks.
2. Propose the security Services and Mechanisms for preventing the different security attacks.
3. Use Symmetric key Cryptographic Techniques to encrypt and decrypt the massages.
4. Use Asymmetric key Cryptographic Techniques to encrypt and decrypt the massages.
5. Use different Hash Techniques to provide the Authentication and to check the Integrity of messages in transit.
6. Use Message Authentication Code to provide Authentication.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Security Basics** **Computer Security Concepts** - Need, Security Vs Privacy, Confidentiality, Integrity & Availability (CIA), additional Security considerations, The challenges of Security, Threats, Attacks and Assets, Operational Model of Security; **Case Study: Study of Campus Network and identification of possible Threats, Attacks and Assets**	7
2	**Encryption Techniques** **Basics:** Symmetric & Asymmetric Cipher Model; Cryptography; Cryptanalysis and Brute-Force Attack **Classical Encryption Techniques** - Substitution Techniques: Caesar Cipher, Mono-alphabetic Ciphers, Poly-alphabetic Ciphers, Playfair Cipher; Transposition Techniques: Rail Fense Technique	8
3	**Symmetric Cipher** **Traditional Cipher Structure:** Stream ciphers and Block Ciphers; Feistel Cipher Structure **Data Encryption Standard (DES):** DES Encryption; DES Decryption; DES Example; Strength of DES; **Block Cipher Modes of Operations:** Electronic Code Book (ECB), Cipher Block Chaining Mode(CBC), Cipher Feedback Mode (CFB), Output Feedback Mode (OFB), Counter Mode (CTR)	8
4	**Asymmetric Cipher** **Public-Key Cryptosystems:** Secrecy, authentication, secrecy & authentication; applications, requirements; **The RSA Algorithm:** Algorithm, Example, The security of RSA; **Diffie-Hellman Key Exchange:** The Algorithm, Key Exchange Protocol, Man-in-the-middle attack;	8
5	**Key Management and Distribution** Symmetric Key Distribution using Symmetric key Encryption, Symmetric Key Distribution using asymmetric key Encryption, Distribution of Public Keys. **Case Study: Introduction to X.509**	7
6	**Cryptographic Hash Functions & Massage Authentication Codes** **Cryptographic Hash Functions:** Applications, Secure Hash Algorithm (SHA)-512, MD5 **Message Authentication Codes (MAC):** Requirements, Functions, Security of MACs	7
	Total	**45**

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Text Books:

1. William Stallings, “Cryptography and network security principles and practices”, Pearson, 6th Edition, ISBN: 978-93-325-1877-3
2. Atul Kahate, “Cryptography and Network Security”, Mc Graw Hill Publication, 2nd Edition, 2008, ISBN: 978-0-07-064823-4

Reference Books:

1. Eoghan Casey, “Digital Evidence and Computer Crime Forensic Science, Computers and the Internet”, ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Bernard Menezes, “Network Security and Cryptography”, Cengage Learning India, 2014, ISBN No.: 8131513491
3. Forouzan, “Cryptography and Network Security (SIE)”, Mc Graw Hill, ISBN, 007070208X, 9780070702080
4. Nina Godbole, SunitBelapure, “Cyber Security”, Wiley India, 2014, ISBN No.: 978-81-345-2179-1

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Program:	B. Tech. (Civil Engineering)				Semester: VI		
Course:	Principles of Software Engineering (OEC-3)				Code: BCE6604		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Course Objectives: The course is aiming to impart conceptual clarity among students about.

1. The fundamental phases of the Software Development Life-cycle (SDLC).
2. Selection of an appropriate process model for specific software project development.
3. Comprehension of methods for capturing, specifying, and analyzing software requirements.
4. Applying Design principles to software project development.
5. Comprehension of UML Diagrams for software project development.
6. The fundamental understanding of agile process model.

Course Outcomes: After learning the course, the students should be able to:

1. Comprehend the fundamental phases of the Software Development Life-cycle (SDLC).
2. Compare and select an appropriate process model for specific software project development.
3. Comprehend methods for capturing, specifying, and analyzing software requirements.
4. Apply Design principles to software project development.
5. Comprehend UML Diagrams for software project development.
6. Relate the basics of agile process model for the development of software projects.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction To Software Engineering** Definition of Software, Software Application Domains, Software engineering layers, Software engineering practice, The Essence of Practice, General Principles, Software development myths, Management myths, Customer myths, Practitioner's myths, Software Development Life-cycle.	7
2	**The Software Process** A Generic Process Model, Defining a Framework Activity, Perspective Process Model, Waterfall Model, V Model, Incremental Process Model, Evolutionary Process Models-Prototyping, The Spiral Model, Unified Process, Phases of the Unified Process	8
3	**Requirements Analysis** Requirement Engineering, Requirements engineering tasks, Establishing the Groundwork-Eliciting Requirements, Collaborative Requirements Gathering, Quality Function Deployment, Usage Scenarios, Elicitation Work Products, Developing use cases.	8
4	**Design Concepts** The design Process, Abstraction, Architecture, Separation of Concerns, Modularity, Information Hiding, Refinement, The design Model, Data Design Elements, Architectural Design Elements, Interface Design Elements.	8
5	**Modeling with UML** Modeling Concepts and Diagrams, Introduction to UML, Use Case Diagrams, Class Diagrams, State chart Diagrams, Activity Diagrams, Package Diagram, Component Diagrams, Deployment Diagrams.	7
6	**Agile development Process** Agile Process- Extreme Programming in agile development, Agile software development process Models, SCRUM – process flow, scrum roles, scrum cycle description, product backlog, sprint planning meeting, sprint backlog, sprint execution, daily scrum meeting.	7
	Total	**45**

Text Books:

1. Roger S Pressman, "Software Engineering – A Practitioner's Approach", Pearson Education, 7th Edition, ISBN 0073655783, 2010.
2. Ian sommerville, "Software Engineering", 9th edition, ISBN-13: 978-0-13-703515-1, 2010.
3. Unified Modeling Language User Guide, The (2nd Edition) (Addison-Wesley Object Technology Series), ISBN:978-0-321-26797-9, May 2005.

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 10: 0133056996, 2002.
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 13: 978-8120348981, 2014.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715, 2010.

Program:	B. Tech. (Civil Engineering)				Semester: VI		
Course:	Designing with Raspberry Pi (OEC-3)				Code: BET6601		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of
Basics of Programming

Objectives:
1. To explain fundamentals of Raspberry pi (Rpi) and installation of OS in Rpi
2. To demonstrate the Python programming and interfacing of sensors and actuators with Rpi
3. To describe the Node-RED tool used in Rpi and its applications.

Outcomes: After completion of this course, students should be able to:
1. Describe the basic specifications and operating systems of Raspberry Pi.
2. Illustrate the usage of Node-RED tool for Raspberry Pi programming.
3. Understand the Python programming concepts.
4. Apply the concepts of programming for sensor interfacing with RPi.
5. Apply the concepts of programming for actuator interfacing with RPi.
6. Design IoT based applications with Python programming and Raspberry Pi.

Detailed Syllabus:

Unit	Description	Duration(H)
1	**Getting started with Raspberry Pi** Basic functionality of Raspberry Pi board, Physical design and specifications, GPIO Pin description of Rpi, Reading the datasheet of RPi, comparison of various Rpi models, Rpi as mini- computer. Introduction of various operating systems of Rpi, Installation of Raspbian/Noobs/OSMC operating system on Rpi, first boot and basic configuration of Rpi, Introduction to Linux commands required to configure Rpi, Overview of Graphic User Interface (GUI).	8
2	**Getting started with Node-RED tool on Rpi** Prerequisite for Node-RED, Installing and upgrading Node-RED, Running Node-RED app locally and as a service on network, auto-start on boot, opening the editor, installation of various libraries for Node-RED, adding node, add debug node, wire the nodes, deploy the flow.	6
3	**Programming the Raspberry Pi** Introduction to Python programming language: Python Programming Environment, Python Expressions, Strings, Functions, Data types in python, importing libraries, flow control, conditional statement, Loops.	10
4	**Sensor interfacing with Rpi** Basics of sensors: What are sensors? Types of sensors Sensor interfacing: Temperature and Humidity sensor (DHT11), PIR Motion sensor, obstacle detection using Ultrasonic sensor, soil moisture sensor	6
5	**Actuator interfacing with Rpi** Basics of actuators: What are actuators?, Their need in making a closed loop system Actuator interfacing: Electronic Relays, LED's, Buzzers/Fan, DC Motor, Stepper motor, LCD.	7
6	**Case Study based following topics** Home Automation, Smart City, Smart Farming, Smart Transportation, Health and Lifestyle, Pollution Monitoring system	8
	Total	45

Text Books:

1. Gary Mitnick,"Raspberry Pi 3: An Introduction to using Python Scratch, javascript and more", Createspace Independent publishing Platform 2017.
2. Tim Cox, "Raspberry Pi for python program cookbook" Packet Publishing Limited, 2 nd edition, 2016
3. John C. Shovic,"Raspberry Pi IoT Projects", Apress Berkeley CA, 2016

Reference Books:

1. Sean McManus, Mike Cook, “Raspberry Pi for Dummies”,
2. Maik Schmidt, “Raspberry Pi: A Quick-Start Guide”, The pragmatic programmers, LLC, 2012
3. Simon Monk,”Programming the Raspberry Pi”, 2nd Edition, McGraw Hill publications, 2012
4. Matt Richardson,”Getting started with Raspberry pi”, 3rd Edition, Make community, LLC 2016
5. Derek Molloy,”Exploring Raspberry pi”, 1st Edition, Wiley, 2016

MOOCs Courses:

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs74/preview

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Program:	B. Tech. (Civil Engineering)						Semester: VI
Course:	Basics of Automotive Electronics (OEC-3)						Code: BET6602
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Electrical and Electronics

Objectives:

1. To introduce Electronics Control Unit(ECU) used in Automotive applications.
2. To explain processing principle of sensors and actuators used in automotive
3. To explore role of electronic systems in Active and passive safety systems.

Outcomes:

After learning the course, the students should be ableto:

1. To apply the concept of electronics systems in automotive applications.
2. To explore different sensors and actuators.
3. Illustrate vehicle motion control systems.
4. Understand algorithms used in Engine Control System.
5. Describe the role of electronics in Active and passive safety systems.
6. Make use of automotive components, subsystems, and basics of Electronic Engine Control in the automotive industry.

Detailed Syllabus:

Unit	Description	Duration(H)
1	**Automotive Systems Overview:** Automotive vehicle technology, Present trends in automobiles with emphasis on increasing role of electronics and software, Overview of typical automotive subsystems and components, Body, Chassis, and Powertrain Electronics	07
2	**Sensors :** Basic sensor arrangement, Types of sensors such as oxygen sensors, Crankshaft angle position sensors, Fuel metering/ vehicle speed sensors, Flow sensor, Temperature, Exhaust Gas Oxygen (O2/EGO), Air mass flow sensors, Throttle position sensor, Strain Gauge MAP sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Engine Coolant Temperature (ECT) Sensor, Piezoelectric Knock Sensor. **Actuators :** Solenoids, Stepper Motors, Relays, Fuel Injector, EGR Actuator, Ignition System	09
3	**Vehicle Motion Control:** Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)	07
4	**Engine Control System:** Algorithms for engine control including open loop and closed loop control system, Electronic ignition, EGR for exhaust emission control.	07
5	**Active and passive safety systems:** Body electronics including lighting control, Remote keyless entry, Immobilizers, Electronic instrument clusters and dashboard electronics, Antilock braking system, Computer vision based ADAS	07
6	**Future Automotive Electronic Systems:** Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tire pressure warning system, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control	08
	Total	45

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics- An Engineering Perspective", 7th edition, Butterworth-Heinemann Publications, 2017.
2. Ronald K. Jurgen, "Automotive Electronics Handbook", Mc-Graw Hill, 1999
3. Oliver scheid , "Autosar Compendium, Part 1: Application & RTE", Create Space Independent Publishing Platform, 2015

Reference Books:

1. Robert Bosch, "Automotive Hand Book", 10th edition, Wiley Publications, 2018
2. Kiencke, Uwe, Nielsen & Lars, "Automotive Control Systems for Engine, Driveline and Vehicle", Second edition, Springer Publication, 2005.
3. John F. Kershaw, James D. Halderman, "Automotive Electrical and Electronic Systems", 5th Edition, Pearson Prentice Hall, 2007
4. https://autosartutorials.com/
5. https://www.udemy.com/course/learn-autosar-from-scratch/

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Program:	B. Tech. (Civil Engineering)	Semester:	VI
Course :	Web Technology(OEC-3)	Code:	BIT6601

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Computer Fundamentals
2. Any one computer Language

Course Objectives:

1. To write a valid standards-conformant HTML document involving a variety of element types, including hyperlinks, images, lists, tables, and forms
2. To use CSS to implement a variety of presentation effects in HTML and XML documents, including explicit positioning of elements
3. To demonstrate techniques for improving the accessibility of an HTML document
4. To learn the concepts commonly used in dynamic language programming, such as introspection, higher-order functions, and closures.

Course Outcomes:

After learning the course, the students will be able to:

1. Illustrate static website development using HTML and CSS.
2. Demonstrate static and dynamic website development using Bootstrap.
3. Discuss the basics of JavaScript in Web Development.
4. Make use of AJAX and JQuery in mobile website development
5. Describe MVC architecture as Front end framework.
6. Build responsive web application using ReactJS

Detailed Syllabus

Unit	Description	Duration(H)
1.	**HTML:** Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links, Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements. CSS: Types of CSS, How to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.	6
2.	**BOOTSTRAP:** CSS over Bootstrap, How to Use Bootstrap, Bootstrap Grid System, Bootstrap Responsive, Bootstrap Classes, Bootstrap Components (i.e., Button, Table, List, etc.),Bootstrap as a Cross Platform. W3C: What is W3C , How W3C handles/Supports Web Technologies.	6
3.	**JavaScript:** Introduction to Scripting languages, Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events. Advanced JavaScript: JSON - JSON Create, Key-Value Pair, JSON Access, JSON Array, JS Arrow Functions, JS Callback Functions, JS Promises, JS Async-Await Functions, JS Error Handling	7
4.	**AJAX:** Why AJAX, Call HTTP Methods Using AJAX, Data Sending, Data Receiving, AJAX Error Handling. JQUERY :Why JQuery, How to Use, DOM Manipulation with JQuery, Dynamic Content Change with JQuery, UI Design Using JQuery.	10
5.	**Front-End Frameworks:** Web Framework Types. MVC: What is MVC, MVC Architecture, MVC in Practical, MVC in Web Frameworks. TypeScript: Introduction to TypeScript (TS), Variables and Constants, Modules in TS.	6

6.	**ReactJS** Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux- Architecture, Hooks- Basic hooks, useState() hook, useEffect() hook, useContext() hook	10
	Total	**45**

Text Books:

1. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13: 978812653867
2. Jeremy McPeak& Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937

Reference Books:

1. Steven Holzner,"HTML Black Book", Dremtech press.
2. Web Technologies, Black Book, Dreamtech Press
3. Web Applications: Concepts and Real World Design, Knuckles, Wiley-India
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson.

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Program:	B. Tech. (Civil Engineering)	Semester : VI
Course :	3D Printing and Modeling (OEC-3)	Code: BME6603A

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of basics of

a. Materials Engineering is essential
b. CAD/CAM

Objectives:

1. To understand the importance of 3D Printing process of various applications.
2. To be familiar with the different 3D printing process.
3. Learn to create CAD model that satisfy product development/prototyping requirements.

Outcomes:

The Students will be able to,

1. Understand the meaning and generic steps of the 3D printing process.
2. Identify the effects of critical parameters in the Stereo lithography and Solid ground curing process.
3. Identify the effects critical parameters in the Laminated object manufacturing and Fused Deposition Modeling Process.
4. Identify the effects critical parameters in the Selective laser sintering process and Direct Energy deposition.
5. Develop the .STL file and create sliced model by using open source software
6. Understand the various application of 3D printing process.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to 3D Printing**: Meaning of 3D Printing, The Generic/steps in 3D printing Process, Materials used in 3D Printing, Types of 3D Printing process and Benefits of 3D printing, Design for Additive manufacturing (DFAM).	8
2.	**Liquid based systems:** Stereo lithography apparatus (SLA): Specifications, parameters, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages. Solid ground curing (SGC): Specifications, parameters, process, working, principle, applications, advantages and disadvantages.	7
3.	**Solid based systems:** Laminated object manufacturing (LOM): Specifications, parameters, Process, Working principle, Applications, Advantages and disadvantages. Fused Deposition Modeling (FDM): Specifications, Process, parameters, Working principle, Applications, Advantages and disadvantages.	7
4.	**Powder Based Systems:** Selective laser sintering (SLS): Specifications, process, parameters, working principle, applications, advantages and disadvantages. Direct Energy deposition (DED): Specification, parameters, process, working principle, applications, advantages and disadvantages.	8
5.	**Modelling in 3D printing:** Meaning of STL file, Special rules for the STL format, Meaning of Slicing, Components of Slicing software, Preparation of CAD models, Converting into STL file, slicing by using open source software.	8
6.	**Applications of 3D Printing**: Prototyping and manufacturing, Medical applications, Automotive applications, Aerospace & Defence applications, Constructions applications. Art and Jewellery applications.	7
	Total	45

Text Books:

1. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies, Second Edition, Springer Publications, ISBN 978-1-4939-2112-6.
2. Vannessa Goodship , Bethany Middleton, Ruth Cherrington, Design and Manufacture of Plastic Components for Multi functionality, Elsevier Publications, ISBN: 978-0-323-34061-8.

Reference books:

Henrique Amorim Almeida and Paulo Jorge da Silva Bártolo, Mathematical Modeling of 3D Tissue Engineering Constructs, Springer International Publishing AG 2017.

Program:	B. Tech. (Civil Engineering)			Semester : VI			
Course :	Material Informatics (OEC-3)			Code: BME6603B			
Teaching Scheme/week				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	--	3	3	20	30	50	100

Prior knowledge of :

a. Data Science
b. Machine Learning
c. Pyton/R programming

are essential

Objectives:

1. To Aquitaine students about materials, their properties, structure property relationship.
2. To create awareness about the importance of statistics in materials data analysis.
3. To imbibe significance of data science, machine learning in use, selection and analysis of materials.

Outcomes:

The Students will be able to,

1. Compare different materials based on their structures.
2. Interpret material property data and draw conclusions.
3. Apply statistical methods for materials data analysis.
4. Use programming languages like python/R programming for materials data analysis.
5. Apply machine learning algorithm for interpretation of materials data.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to materials:** Classification of materials, structure of materials **:**Atomic structure, crystal structure and microstructure, material properties: Physical, Mechanical, Electrical, Magnetic etc.	7
2.	**Materials Information:** Structure property relationship**,** Applications and selection of materials, Analysis and synthesis of materials.	7
3.	**Statistics and Materials:** Basic probability and statistics, basic R/ Python , Inaccurcacies and error and its propagation, Descriptive data analysis, Probability distributions, Probability distributions using R/Python, Fitting functions to data: regression, testing significance of fit.	8
4.	**Experimental data**: Processing of experimental data using R/Python, R/Python for graphical handling of data and fitting.	7
5.	**Feature extraction:** Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in materials Engineering.	8
6.	Classification: Decision tree, Random forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in materials Engineering.	8
	Total	45

Text Books:

1. Material Science and engineering an introduction, William D.Callister, Wiley Publication
2. Machine Learning and Artificial Intelligence, B Joshi, Springer, 2020.
3. R for Beginners, Emmanuel Paradis, Open source online
4. Databases: MaterialsProject.org, MaterialsWeb.org
5. Pymatgen, MPInterfaces software for materials analysis.

Reference books:

1. Materials Informatics: Methods, Tools, and Applications, Wiley VCH
2. Informatics for Materials Science and Engineering, Elsevier
3. Emerging Trends and Applications of Machine Learning, Solanki, Kumar, Nayyar, IGI Global, 2018.

Program:	B. Tech. (Civil Engineering)			Semester: VI			
Course:	Fundamentals of Machine Learning (OEC-4)			Code: BCE6605			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of
Engineering Mathematics

Course Objectives:

1. To introduce different machine learning primitives.
2. To introduce different preprocessing techniques to prepare training and testing data set
3. To solve regression problems using regression techniques.
4. To develop skills to understand nature of the problem and apply machine learning algorithm
5. To use classification algorithms to solve classification problems.
6. To introduce metrics and methods for Evaluating Classifier Performance

Course Outcomes:

After learning the course, the students should be able to:

1. Distinguish different machine learning primitives.
2. Use different data preprocessing techniques to prepare training and testing data set.
3. Apply data similarity and dissimilarity measures for statistical analysis.
4. Apply Association Rule Mining algorithms for market basket analysis.
5. Solve real world problems using regression techniques.
6. Apply classification algorithms to solve real world problems.

Detailed Syllabus

Note: Case studies mentioned in Unit IV, Unit V and VI are just to get understanding to students, and will not be considered for evaluation.

Unit	Description	Duration(H)
1	**Introduction to Machine learning** Introduction to Machine learning, Machine Learning Approaches-Supervised Learning, Unsupervised Learning and Reinforcement Learning, Important Elements of Machine Learning-Data formats, Underfitting and Overfitting, Error measures, Creating training and testing datasets	**7**
2	**Data Pre-Processing** Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes; Data Pre-processing: Data Cleaning, Data integration, Data transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction, Data Discretization, Binning techniques for smoothing noise.	**8**
3	**Measuring Data Similarity and Dissimilarity** Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, Dissimilarity of Numeric Data: Euclidean distance and Manhattan distance; Cosine Similarity	**7**
4	**Unsupervised Learning** **Association Rules Mining-** Market Basket Analysis, Frequent item set, Association Rules, Apriori Algorithm, Generating Association Rules from Frequent Item sets; **Clustering-** K-means: Finding optimal number of clusters **Case study of ML application:** Shopping mall application for Market Basket Analysis.	**7**
5	**Supervised Learning- Regression** **Linear Regression-** Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Regularization-Ridge, Lasso **Logistic regression-**Linear classification, Logistic regression **Case study of ML applications:** Applications for house price prediction, Share Market	**7**
6	**Supervised Learning- Classification** Naïve Bayes Classifier, Decision Tree Classification, K-Nearest Neighbor Classifier, Metrics for Evaluating Classifier Performance, Confusion Matrix, Evaluating the Accuracy of a Classifier: Holdout Method and Cross-Validation, ROC Curve **Case study of ML applications:** Applications in Agriculture sector, Health care domain using analytical tools such as WEKA/KNIME/R/SK-Learn	**9**
	Total	**45**

Text Books:

1. Jiawei Han, Micheline Kamber, “Data mining: concepts and techniques", Morgan Kaufmann Publisher 2012, third edition, ISBN 978-0-12-381479-1.
2. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt Publishing Limited 2017, ISBN-10: 1785889621, ISBN-13: 978-1785889622.

Reference Books:

1. EthemAlpaydin, “Introduction to Machine Learning”, PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, Cambridge University Press, Edition 2012, ISBN-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell “Machine Learning” McGraw Hill Publication 1997, ISBN: 0070428077 9780070428072
4. AurélienGéron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, O'Reilly Media, Inc. publisher 2017, ISBN: 9781491962299.
5. Ian H. Witten and Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Second Edition, Morgan Kaufmann Publishers 2005, ISBN: 0-12-088407-0.

Web references:

1. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf
2. https://balasahebtarle.files.wordpress.com/2020/01/machine-learning-algorithms_text-book.pdf
3. http://www.academia.dk/BiologiskAntropologi/Epidemiologi/DataMining/Witten_and_Frank_DataMining_Weka_2nd_Ed_2005.pdf
4. http://scikit-learn.org/stable/datasets/
5. https://scikit-learn.org/stable/modules/model_evaluation.html
6. https://www.kaggle.com/datasets

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Program:	B. Tech. (Civil Engineering)					Semester: VI	
Course:	JAVA Programming (OEC-4)					Code: BCE6606	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

Decision control structures, loop control structures, arrays, Functions, pointers, structure and union, searching and sorting techniques**.**

Course Objectives:

1. To understand various data types, conditional and looping constructs in Java.
2. To understand concepts of Java classes, various types of constructors in Java.
3. To use inheritance and polymorphism to solve real life problems.
4. To apply multi-threading concepts and collection framework.
5. Exemplify the usage of packages and implement the concepts of Applets and JavaFX.

Course Outcomes:

After learning the course, the students should be able to:

1. Comprehend basic Java concepts and JVM.
2. Use object-oriented programming concepts to solve real time problems.
3. Use inheritance and polymorphism in OOP application.
4. Apply exception handling for problem solving in Java .
5. Use multithreading for synchronization in Java.
6. Illustrate UI components for designing windows-based applications.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to Java :** Introduction to JAVA, history of JAVA, Java virtual machine, difference betweenJDK, JRE ,variables and data types, control structure, looping structures. Case study: Implement the C++ program to demonstrate class,variables, memberfunction & control structure.	9
2	**JAVA programming concepts** Features of JAVA, classes, methods, constructor, types of constructor, use of staticand this, aggregation. Case study: Implement the student class in JAVA using member functions, constructor, static & this keyword.	8
3	**Polymorphism and Inheritance :** **Polymorphism**-Introduction, types of polymorphism with syntax, method overloading. **Inheritance**-Introduction, syntax, types of inheritance, extends keyword, methodoverriding, use of super keyword, use of final keyword, abstract class. **Interface**-Introduction, syntax, extend one interface from another, implement classesthrough interface. Case study: Implement class employee using polymorphism, inheritance and interface.	9
4	**Exception Handling**: Introduction,syntax,types of exception,components of exception handling, use of throws keyword,flow control in try catch,exception class, inbuilt exception classes, user defined exception classes, use of finally block.	7
5	**Java Multithreading:** Introduction to multithreading, life cycle of thread, thread scheduler techniques, synchronization, enumerations fundamentals and example, wrappers class.	6
6	**Applet**: Introduction to applet, applet architecture, life cycle and components of applet. **JavaFX**: Introduction to JAVAFX, JavaFX architecture, components of JAVAFX, scene graph	6
	Total	**45**

Text Books:

1. Herbert Schildt,"Java - The Complete Reference", The McGraw-Hill Education,11th Edition,2018, 978-1260440232.
2. E. Balagurusamy, "Programming with Java" McGraw Hill Education India, 6th Edition, 2019, 9789353162344

Reference Books:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press India Pvt. Ltd., Paperback, 2015, 9789351197584.
2. Ken Arnold, James Gosling and David Holmes, "The Java Programming Language", Addison-Wesley, 4th Edition, 2005, 0321349806

Web references:

1. https://www.w3schools.com/java
2. https://www.javatpoint.com/java-tutorial
3. www.spoken-tutorial.com : Free Online course of JAVA

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Program:	B. Tech. (Civil Engineering)					Semester: VI	
Course:	Designing with Arduino platform (OEC-4)					Code: BET6603	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Basic Programming Fundamentals

Course Objectives:

1. To make the students aware of the Arduino platform in terms of the physical board, Arduino IDE and libraries.
2. To make the students aware of circuit prototyping, and interfacing of peripherals with Arduino.

Course Outcomes: After completion of the course, students will be able to:

1. Summarize the features of the Arduino board.
2. Apply the programming concepts to the Arduino board.
3. Make use of analog and digital pins of Arduino.
4. Develop a system to monitor the real-time parameters using Arduino.
5. Illustrate the Object detection using Arduino.
6. Realize the Sound sensing and distance measurement using Arduino.

Detailed Syllabus:

Unit	Description	Duration(H)
1	**Knowing Your Arduino:** Introduction of Arduino Uno, Atmega328P,Arduino Shields, getting to know the Arduino Uno Pins, power, clock, Using the digital input and output pins, analog input and output pins, Introduction to Serial (UART) communications, I²C (TWI) communications, SPI communications	7
2	**Arduino Ide And Programming Concepts.** An introduction to the Arduino IDE: Getting and installing the Arduino IDE and uploading a sketch to your Arduino. An introduction to Arduino programming, Understand the basic parts of an Arduino sketch, custom functions Creating custom functions and the return keyword, Using variables, constants, Introduction to control structures: The "if”,” while", "For”,” Switch" statement	8
3	**Arduino Programming Hands On** Digital input/output - how to read the state of a button control an LED, Analog input/ output - how to read the state of a potentiometer and create a fading LED, Introduction to the RGB (color) LED, Wiring the RGB LED, RGB LED: creating colors, using a library to control an RGB LED with PWM.	8
4	**Monitoring Real Time Parameters Using Arduino** Interfacing of Ultra -violet light sensor, RGB color sensor, DHT22 sensor, LM 35 to Arduino for monitoring the parameters like temperature, humidity, etc.	7
5	**Interfacing With Arduino - I.** Introduction to detecting acceleration with the ADXL335, Plugging the ADXL335 directly in the Arduino, and detect its orientation, A demonstration of using the IR and PIR sensor with the Arduino	7
6	**Interfacing With Arduino - II.** Introduction to the ultrasonic distance sensor, Wiring and understanding Trigger and Echo, and calculating distance. Introduction to the analog sound sensor, A demonstration and sketch of the analog sound sensor and the digital sound sensor. Case study elaborating the use of Arduino in various applications.	8
	Total	45

Text Books:

1. Arduino-Based Embedded Systems: By Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury, CRC Press, Taylor & Francis Group, 1st edition 2017.
2. Arduino Made Simple by Ashwin Pajankar, BPB Publication, 1st edition 2018.

Reference Books:

1. Exploring Arduino: Tools and Techniques for Engineering Wizardry 1st Edition,by Jeremy Blum , SBN-13: 978-1118549360,ISBN-10: 1118549368

Online Links :

https ://www.arduino.cc/en/Tutorial/HomePage

https://spoken-tutorial.org/tutorial-search/?search_foss=Arduino&search_language=English

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Program:	B. Tech. (Civil Engineering)					Semester: VI	
Course:	Communication Protocols for e-Vehicle (OEC-4)					Code: BET6604	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of

1. Fundamentals of computer networks
2. Electric machines

Objectives:

1. To make student understand basics of EVs, including EV Components, architecture, and energy management.
2. To make student able to compare various topologies of EV communication systems.
3. To introduce student about connectors and chargers in EV's
4. To make student to evaluate the impact of EVs in Connected Mobility and Autonomous Mobility

Outcomes: After completion of this course, students will be able to:

1. Understand the basics of e-vehicles
2. Illustrate the EV Components and controlling units.
3. Compare various EV Communication protocols & their need in the e-Mobility business
4. Understand the fundamentals of EVSE Communication
5. Analyse connectors and chargers in EVs
6. Apply the Knowledge of e-Mobility through Indian Roadmap Perspective

Detailed Syllabus:

Unit	Description	Duration(H)
1	**EV Basics** Overview of EVs and challenges, the architecture of EVs, EV market and promotion, infrastructure needs, energy sources used in EVs & HEVs, medium of power transfer (conductive and wireless), and wireless power transfer.	7
2	**EV Components** Battery Management System (BMS), BLDC Motors, Inverter Unit, Powertrain Unit and Couplers with Chassis, PDU (Power Distribution Unit), BCM (Body Control Module, ECU, and Tuning Parameters.	7
3	**EV Communication protocols** Communication Systems in EV (CAN and LIN), V2V, V2G and its applications in power systems, power saving & coordinated charging, the layout of power converters, electrification challenges	8
4	**Electric vehicle supply equipment (EVSE)** Basics of EVSE, EVSE Power Module selection and technical specification, Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module), Communication gateway	8
5	**Connectors and Chargers** Types of EV charging connectors, EV Plug Standards, Selection and Sizing of Common Types of Connectors and Applications, Selection of AC and DC charger types.	7
6	**Charging communication & e-Mobility** Communication Interface between the charger and CMS, CCS (Combined Charging System), CHAdeMO, Tesla, Specification of open charge point protocol, Connected Mobility and Autonomous Mobility, e-Mobility: Indian Roadmap Perspective, EV integration in smart grid, social dimensions of EVs.	8
	Total	45

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics", Elseiver,2012
2. Jack Erjavec, Jeff Arias, "Alternate Fuel Technology-Electric, Hybrid & Fuel Cell Vehicles", Cengage, 2012
3. Tom Denton, Electric and Hybrid Vehicles, 2nd Edition, 2016.

Reference Books:

1. Wireless Communications Principles and Practice; by Theodore S Rappaport, Pearson Education, 2nd edition 2018
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.
3. Wei Liu (General Motors, USA), Hybrid Electric Vehicle System Modelling and Control, John Wiley & Sons, Inc., 2nd edition, 2017.
4. Teresa Donateo, Hybrid Electric Vehicles, , Published by ExLi4EvA,1st edition , 2017

NPTEL Online Courses / MOOCs

1. NPTELcourse on Fundamentals of Electric vehicles: Technology & Economics, IIT Madras, Prof. Ashok Jhunjhunwala Prof. Prabhjot Kaur Prof. Kaushal Kumar Jha Prof. L Kannan

   https://nptel.ac.in/courses/108106170
2. NPTEL course onElectric Vehicles - Part 1, IIT Delhi, Prof. Amit Jain

   https://nptel.ac.in/courses/108102121
3. NPTEL Archives on Electricvehicles and renewable energy, IIT Madras

   https://archive.nptel.ac.in/courses/108/106/108106182/
4. Electric Vehicles Comprehensive Course, Udemy.com

   https://www.udemy.com/course/electric-vehicles-comprehensive-course/

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Program:	B. Tech. (Civil Engineering)			Semester: VI			
Course :	Mobile Application Development (OEC-4)			Code : BIT6602			
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of Java programming language

Course Objectives:

1. To learn a new mobile application development environment.
2. To develop problem solving skills with mobile applications.
3. To develop competency for the design, coding and debugging for mobile app development.
4. To build the programming skills using 'Android Programming Language.

Course Outcomes:

After learning the course, the students will be able to:

1. Explore the android environment for mobile application development.
2. Design android user interface for Mobile application.
3. Explore different notification interfaces to facilitate communication between components.
4. Apply different persistent storage techniques used to store and retrieve data in android applications.
5. Make use of SQLite in android application development,
6. Explore android services in android application development.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to Android Operating System** Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools. Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application, Activities, Activity lifecycle,	8
2.	**Android User Interface** Measurements – Device and pixel density independent measuring units, Layouts – Linear, Relative, Grid and Table Layouts etc. User Interface (UI) Components – Editable and non-editable TextViews, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers etc Event Handling – Handling clicks or changes of various UI components.Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities.	8
3.	**Intents and Broadcasts** Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity Notifications – Creating and Displaying notifications, Displaying Toasts	8
4.	**Persistent Storage** Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference	5
5.	**Database** Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)	8

6.	**Android Services** Introduction of android services and its lifecycle. Location Services,Types of Services, Best practices- Performance, Testing,Privacy, Security etc. Deployment of Application.	8
	Total	**45**

Text Books:

1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013

Reference Books:

1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013
2. Android Application Development Black Book Pradeep Kothari, KLSI,Dreamtech Press

Reference URL:
https://www.javatpoint.com/android-service-tutorial
https://developer.android.com/guide/components/services

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Program:	B. Tech. (Civil Engineering)					Semester VI	
Course :	Model Based System Engineering (OEC-4)					Code : BME6604A	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge of : – Not Required

Course Objectives:

Students are expected to:

1. Acquire Fundamentals of systems and subsystems which should include different processes, properties.
2. Develop structural and behavioural aspects of general diagramming.
3. Perform a functional analysis.
4. Construct systems engineering requirements.

Course Outcomes:

The Students will be able to,

1. DESCRIBE the methods, Processes and practices of systems engineering.
2. UNDERSTAND Fundamentals of systems and subsystems.
3. DIFFERENTIATE between traditional document-based and model based systems engineering.
4. ANALYZE three pillars of MBSE: languages, methods, and tools.
5. CREATE models and diagrams using modelling language.
6. APPLY Model Based Systems Engineering (MBSE) approach to Engineering problems.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to Systems Engineering** History / Background, Industrial revolution, Discover Systems Engineering, Systems Engineering definition INCOSE, V-Cycle. Cyber physical systems – Advantages, Necessity and its challenges: a) Security: Control of interfaces, emergent vulnerabilities. b) Data: Privacy, data capture, analysis, access issues, data adequacy and accuracy. c) Regulations and Standards: Policy, Standards. d) Life cycle Sustainment.	8
2.	**Fundamentals of MBSE :** Introduction, Systems, subsystems and levels, Concrete and abstract objects, Properties, States, event, process, behavior and fact, Systems of interest.	8
3.	**Three Pillars of MBSE :** Modelling methods, Modelling tools and Modelling language	7
4.	**Overview of System Modeling Language** SysML Diagram overview, General diagram concepts**,** the structural aspect and the behavioural aspect, The relationships between behavioural diagrams and structural diagrams	8
5.	**Process Modelling with MBSE** Approach, The Process Modelling Framework, Using the process modelling framework	7
6.	**Requirements Modelling with MBSE** Introduction, The Requirements modelling Framework, Using the Requirements modelling Framework (ACRE Process)	7
	Total	**45**

Text Books:

1. **SysML for Systems Engineering, A model-based approach**, Jon Holt and Simon Perry, 3rd Edition, The Institution of Engineering and Technology, 2019

Reference books:

1. **Practical Model-Based Systems Engineering**, Jose L. Fernandez and Carlos Hernandez, Artech House, 2019
2. **System Requirements Analysis**, Jeffrey O. Grady, Elsevier, 2nd Edition, 2016.
3. **Systems Engineering Fundamentals and Applications,** Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.
4. **NASA Systems Engineering Handbook**, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.
5. **Systems Engineering: Design Principle and Models, Dahai Liu,** CRC Press Taylor & Francis Group, 2016.
6. **Systems Engineering Guidebook-A process for developing systems and Products,** James N Martin, CRC Press, 2000.
7. **INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities**, Wiley, 2015.

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Program:	B. Tech. (Civil Engineering)				Semester : VI		
Course :	Electronics Cooling (OEC- 4)				Code : BME6604B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior knowledge:

a) Engineering Physics
b) Electronics Components and its mountings
c) Electronics Packaging

Course Objectives:

1. To describe the need for thermal management of electronic components.
2. To introduce the fundamental heat transfer mechanisms of conduction, convection and radiation.
3. To introduce the concept of thermal resistance and illustrate its applications.
4. To provide simple equations and tabulate commonly used thermal properties to enable the learner to perform a first order analysis of heat transfer from an electronic package.
5. To describe various cooling methods typically used or considered.

Course Outcomes:

After learning the course, students should be able to

1. Realize the need of thermal management of electronics.
2. Summarize sources of heat generation and modes of heat dissipation.
3. Apply the concept of electrical analogy to determine thermal resistance.
4. Examine the appropriate cooling methods as per the application.
5. Evaluate the cooling requirement of electronic packages.
6. Compare the methods of cooling employed in diverse electronics applications.

Detailed Syllabus

Unit	Description	Duration (H)
1.	**Introduction to Thermal Management:** Electronics Component Packaging Trends, Sources of heat generation, Electronic component failure analysis, Need of Thermal Management, modes of heat dissipation	7
2.	**Heat Transfer Principals in Electronics Cooling:** Conduction Heat Transfer, Steady and Transient Conduction, Natural Convection in Electronic Devices, Forced Convection Heat Transfer, Radiation Heat Transfer	7
3.	**Thermal Resistance:** Concept of Electrical Analogy, Thermal Resistance of conduction, convection and radiation, Thermal Contact Resistance, Thermal resistance network, thermal interface material applications, thermal adhesives	8
4.	**Electronics Cooling Methods in Industry:** Thermal interface and phase change materials, Passive and novel air cooling approaches, micro channel, jet impingement, Thermoelectric Cooling, Immersion Cooling, Vapor Chambers, Cooling Techniques for High Density Electronics.	8
5.	**Evaluating Cooling Requirement:** Conduction cooling for chassis and circuit boards, Concentrated heat sources, distributed heat sources, Circuit boards with Aluminum Heat Sink, heat transfer across interfaces by conduction and convection	8
6.	**Electronics Cooling Applications:** Avionics, Data Centers, Mobile, High-Performance Computing, Automotive	7
	Total	45

Text Books:

1. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, a Wiley-Interscience Publication, John Wiley & Sons, Inc, 1991
2. S M Sohel Murshed, Electronics Cooling, ExLi4EvA Publication, 2016.

Reference Books:

1. Y.A. Cengel and A. J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited, 2019
2. F.P. Incropera, D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, 2009
3. J. P. Holman, Heat Transfer, McGraw – Hill publications, 2008

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course :	Project Management (HSMC-6)			Code:	BHM6114		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	30	-	20	50

Course Objectives:

1. To help the students gain understanding regarding the concept of projects and Project Management
2. To enable the students to know the key components of project management including project time,cost & Risk management.
3. Recognize issues in a realistic project scenario.

Course Outcomes:

After learning the course, the students will be able to

1. Understand how to initiate, define and organize a project.
2. Optimize results while managing the triple constraints.
3. Apply appropriate approaches to plan a new project and develop project schedule
4. Analyze the risk associated with various project

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Introduction to Project Management** Concept and Definition of Project, Characteristics of Project, Concept and definition of Project Management, Functions of Project Management, Importance of Project Management, Who is a Project Manager, Roles & Responsibilities of Project Manager. Understanding the Phases in the Lifecycle of Projects and their Significance, Different types of Projects: Industrial, Telecommunication, Research and more, Project Selection Methods : Agile method & Waterfall methods	7
2	**The Triple Constraint in Project Management :** The concept of the Triple Constraint in Project Management : Scope, Cost and Time, Project Cost Management : Concept, Consideration, Five types of Costs involved in a project, Cost Management process, Project Time Management and methods of Time estimation, Communications Management in Project , Work Breakdown Structure (WBS). Case studies based on Mega Projects of the World.	7
3	**Planning and Execution of Project**: Developing a Mission, Vision, Goals of the project. Concept and definition of Project Planning. Importance of Project Planning. Concept and definition of Network Scheduling ,Critical Path Method, Concept of Project Execution, Phases of Project Execution, Project Evaluation; The Review Technique – Planning and Scheduling of Activity Networks - Concept of PERT/CPM, Assumptions in PERT Modeling – Time-cost, Trade-offs, HRM issues in Project Management & How they can be tackled, Quality Circle, Reasons for Failures of Project , Case Study with respect to different Domains	8
4	**Project Monitoring and Risk Management** : Concept of Project Monitoring , How to Building a Suitable Monitoring; Control System, Concept of Conflict Management, Concept & Definition of Risk and Risk Management, Concept of Risk Matrix Analysis, Strategies to Manage Risks, An Overview of Useful Techniques and Tools Used in Project Management. Case Studies	8
	Total	30

Text Books:

1. Joseph Heagney, Fundamentals of Project Management, American Management Association, 2012

Reference Books:

1. Erik W Larson, Clifford Gray, Rohit Joshi; Project Management-The managerial process, MacGraw Hill Publication, 2021
2. Punmia, Project Management with CPM /PERT, Laxmi Publications, 2001
3. Robert L Kimmons, Project Management Basics, Taylor & Francis Ltd, 2018
4. N. D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

e-sources:

1. https://www.youtube.com/watch?v=RjOA7AxOVj8&list=PLLy_2iUCG87AUusGVo2wsXvRZ4zlbbKUu
2. https://www.youtube.com/watch?v=W2EdffbwgcM&list=PL3MO67NH2XxIRneBXA3yA1RacZQIuX7Yl
3. https://www.youtube.com/watch?v=RQNZWCl6eXI&list=PLBd76GK9sWTwVXm9FlVHOTXXbGY2vZR8z

Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Financial Management (HSMC-6)			Code:		BHM6115	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	2	2	30	-	20	50

Prior knowledge of

1. Basic Financial Literacy

Course Objectives:

This course aims at enabling students

1. To develop an understanding of day-to-day working capital decisions; and also longer-term dealing, involving major capital investment decisions and raising long-term finance.
2. To improve students' understanding of the time value of money concept and the role of finance in the current competitive business scenario.

Course Outcomes:

After learning the course, the students will be able to

1. Understand the basics of financial management and its terms and concepts
2. Understand financial markets and the role of financial institutions
3. Apply knowledge of capital budgeting; its allocation, management and funding.
4. Analyse financial statements and read documents and books of accounts.

Detailed Syllabus:

Unit	Description	Duration (H)
1	**Introduction to Financial Management**- Concept of Business Finance, Objective function in Finance, Traditional and Modern Approaches to Financial Management, Financial Planning - Principles and Steps in Financial Planning and its practical approach.	7
2	**Financial Markets, Institutions and instruments:** Introductions to Financial Markets – Nature – Functions and Types of Financial markets, Different Financial Instruments, Sources of financing - Shares, Debentures, Term Loans, Lease & Hire Purchase, Retained Earnings, Public Deposits, Bonds, Trade Credit, Introduction to Bank Finance.	7
3	**Time Value of Money and capital budgeting:** Timelines for cash flow, Annuities, Perpetuities, Need and Importance of Capital Budgeting, Different Techniques of Evaluating the Project on the Basis of Payback Period, ARR, NPV, IRR, PPP	8
4	**Financial Statement Analysis:** Concept of Financial Statements: Balance Sheet, Profit and Loss Statement, Cash Flow Statement, Tools of Analysis of Financial Statements: Comparative Statements, and Ratio analysis.	8
	Total	**30**

Text Books:

1. Prasanna Chandra, Financial Management, Tata McGraw Hill, 2011

Reference Books:

1. Agrawal M R, Financial Management, Garima Publications, Jaipur, 2021
2. Khan and Jain, Financial Management, Tata McGraw Hill, 2008
3. Paramasivan C, Subramanian T, Financial Management, New Age International (L) Publishers, 2017
4. R. M.Srivastava, Financial Management, Himalaya Publishers, 2005
5. Vanhorne J, Financial Management & Policy, Pearson Education, Delh,2015
6. Gupta Pratik, Arora Amit, Financial Management, Vayu Education of India, 2020

e-sources:

1. https://www.youtube.com/watch?v=TgF2XvjquUU&list=PLLy_2iUCG87CXY2B6fPex1SOIqxzzD5Wj
2. https://www.youtube.com/watch?v=CCQwz_Gwo6o
3. https://www.youtube.com/watch?v=OT5RdoJAkhY&list=PLPjSqITyvDeUTeAOGhip_ubjN3y8oqT13

Program:	B. Tech. (Civil Engineering)	Semester:	VI
Course:	Entrepreneurship Development(HSMC-6)	Code:	BHM6116

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	H	IE	MTE	ETE	Total
2	-	2	2	30	-	20	50

Course Objectives:

This course aims at enabling students,

1. To understand the role and importance of entrepreneurship for economic development
2. To seek necessary knowledge and develop skills required for organizing and carrying out entrepreneurial activities.
3. To develop the ability to analyse and understand business situations in which entrepreneurs act.

Course Outcomes:

After learning the course, the students will be able to

1. Understand the entrepreneurship as an opportunity
2. Optimize the business opportunities that suit aspirant entrepreneurs
3. Appraise the financial schemes and support systems for Entrepreneurship Development.
4. Design a comprehensive business plans.

Detailed Syllabus:

Unit	Description	Duration(H)
1	**Introduction to the Entrepreneurship Development** : Concept and definition of Entrepreneurship, The concept of Opportunity Window, Challenges and Misconceptions Related to Entrepreneurship with Indian Context, McClelland's Need Achievement Theory, Concept of Entrepreneur, Entrepreneurship as a Career, Traits of Successful Entrepreneur, Types of Entrepreneur (proprietary, partnership, collaboration etc), Entrepreneur v/s Intrapreneur, Woman Entrepreneur – A Paradigm Shift , Factors Affecting Entrepreneurship, Types of Enterprises and their Features: Manufacturing, Service and Trading Case Study: Indian Entrepreneurs Pre and Post Covid World, Success stories for few Entrepreneurs.	7
2	**Entrepreneurial Opportunities and Process Selection:** Concept of Business Opportunity, How to Generate Business Ideas? Identification of Ideal and Viable Business Opportunities, Elements of a good business idea. the entrepreneurial process, Challenges in the Selection of Business Opportunities, Business Opportunities Identification Process, Required Licenses, Approvals and Expertise, Business Value Chain, Different Sections of the Business Value Chain for Potential Opportunities, Understanding Product Costs and Operations Costs; Legal Aspects.	7
3	**Finance and Support Systems**: Raising Capital, Venture Capital, Angel Investors, Seed Funding, Role of Government in Promoting Entrepreneurship in India, Start-up India, Atmanirbhar Bharat, Make in India, Assistance to an Entrepreneur, Industrial park, Special Economic Zone, MSME Act, MSME Policy in India, Financial Assistance to MSME, Various Government Schemes - PMEGP, CGTMSE, PMKVY, Mudra Loan, Incubation, Role of Incubation Centers, Support from Incubation Centers	8
4	**Business Plan:** Concept and definition of Business Plan, Contents of Business Plan: Executive Summary, Business Concept, Business Strategy, Management Summary, Marketing Plan, Operations Plan, Financial Plan, Presenting Business Plan, Procedure for setting up an Enterprise, Why Do Some Business Plans Fail?	8
	Total	**30**

Text Books:

1. C. B. Gupta and N. P. Srinivasan, Entrepreneurial Development, Sultan Chand & Sons, New Delhi, 2008

Reference Books:

1. Dr. Radha, Entrepreneurial Development, Prasana Publishers, Chennai, 2007.
2. S.S.Khanka, Entrepreneurial Development, Sultan Chand & Co., Ltd., New Delhi 2005
3. Stevenson, H. Perspective on entrepreneurship. Boston: Harvard Business Press, 2007

e-sources:

1. https://www.entrepreneur.com/
2. http://dst.gov.in/scientific-programme/t-d-tdb.htm
3. https://www.youtube.com/

Program:	B. Tech. (Civil)	Semester:	VI
Course:	Proficiency Course 3: Analysis and design of RCC and Steel Structures by STAAD-PRO Software.	Code:	BCI6913A

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	H	IE	MTE	ETE	Total
2	-	-	2	-	-	-	Grade

Course Objectives:

1. To impart knowledge of structural analysis and design.
2. To develop the ability to analyze and design structures using STAAD – PRO software.

Course Outcomes:

After learning the course, the students will be able to:

1. Analyze the seismic load acting on the structure and understand concrete and steel design parameters.
2. Analyze and design the RCC and Steel structures using STAAD-Pro software.

Detailed Syllabus:

Unit	Description	Duration (H)
1	Introduction to Seismic analysis, use of Finite Element Analysis in Structural Analysis.	4
2	General overview of Concrete Design As per IS 456:2000, RCC Design Parameters in STAAD.Pro.	4
3	Analysis and Design of G+3 RCC Framed Building using STAAD.Pro.	6
4	Analysis and Design of Structural Steel Framed Building using STAAD.Pro.	6
	Total	**20**

Reference Books:

1. STAAD Pro V8i for Beginners by T. S. Sarma, 1st Edition, 2014.
2. Principles of Structural Analysis – Static and Dynamic Loads, by Krishnan Sathia, 2nd Edition, 2021.
3. Analysis and Design of Structures - A Practical Guide to Modeling, by D.Trevor Jones, 1st Edition, 2012.
4. STAAD Pro: Reference Guide by C S Changeriya, 1st Edition, 2010.

IS Code:

1. IS 1893- 2016 Criteria for earthquake resistance design of structures
2. IS 800 – 2007 General Construction in steel
3. IS 456- 2000 Design of Reinforced concrete structures.

e- Resources:

https://www.bentley.com/en/products

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Proficiency Course 3: Project Management using MSP			Code:	BCI6913B		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	-	2	-	-	-	Grade

Course Objective:
To introduce the students with various features of Microsoft Project.

Course Outcomes:
After learning the course, the students will be able to:
Create a schedule for construction projects and carry out required analysis.

Detailed Syllabus:

Unit	Description	Duration
1.	**Introduction to Microsoft project:** Activity, calendars – definition, sequencing & estimation duration, development of a schedule plan and Network analysis.	5
2.	**Development of WBS:** Preparation of work breakdown structure (WBS), updation of WBS & Constraints management of cost in a project.	5
3.	**Allocation of Resources:** Define resources and cost estimation, resource pool and allocate resources filters and grouping, material resources, and their allocation.	5
4.	**Project monitoring:** Analysis of resources by leveling the resource using crashing, stretching & splitting, Earned value analysis, developing different types of reports according to industrial needs, Scheduling in multiple projects, Customization of Project	5
		20

Reference Books:

1. Project planning and control with PERT and CPM by DR. B.C. Punmia and K.K.Khadelwal, Laxmi publication, New Delhi, 4th edition,2016
2. Project management Principles and Techniques by B.B. Goel, Deep and Deep publisher
3. Construction Engineering and Management by S. Seetharaman, 5th edition, 2015.
4. Construction project management by K. K. Chitkara, 4th edition, McGraw Hill Education, 2019
5. Construction Project management, Theory & Practice, by Jha, Kumar Neeraj., Pearson Education India, 2015.
6. Construction management and planning by B. Sengupta and H. Guha Published by Mc Graw Hill India,2015

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Proficiency Course 3: Analysis and design of sewer network			Code:	BCI6913C		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	-	2	-	-	-	Grade

Course Objectives:

1. To impart knowledge of discharge through sewers.
2. To provide conceptual knowledge on analysis and designing of sewers using SewerGEMS.

Course Outcomes:

After learning the course, the students will be able to:

1. Apply the fundamental principles of Sewer system design (hydraulics of sewer), sewer modeling.
2. Apply SewerGEMS models for analysis and design networks, operations and troubleshooting.

Detailed Syllabus:

Unit	Description	Duration
1	Introduction to Open flow Sewer network, modeling fundamentals and hydraulics review.	05
2	Analysis and design of sewer network.	05
3	The design approach includes velocities considerations and pumps	05
4	Model builder, Hydraulic model, scenarios and alternatives, Case Study, Region: Urban India.	05
	Total	20

Reference Books:

1. Manual on Sewerage and Sewage Treatment System, CPHEEO, (2013)
2. Wastewater Treatment: Concepts and Design Approach, Karia G. L., PHI Learning.

e-Resources:

1. https://docs.bentley.com/LiveContent/web/Bentley%20SewerGEMS%20SS5-v2/en/GUID-F362F8D1-2D66-4DF5-B109-DCEA50A5CE98.html
2. https://www.google.com/search?client=avast-a-1&q=sewergems+tutorial&oq=sewergems+&aqs=avast.4.69i57j69i59l2j0l5.6058j0j15&ie=UTF-8

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Proficiency Course 3 : Bentley Open Roads			Code:	BCI6913D		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Credit	Hours	IE	MTE	ETE	Total
2	-	-	2	-	-	-	Grade

Course Objective:
To introduce the students with various features of Bentleys Open roads Designer

Course Outcomes:
After learning the course, the students will be able to:
To Introduce the soft tools for the design of various geometrical features of a road.

Detailed Syllabus:

Unit	Description	Duration
1	**Introduction to Open Roads Designer:** Introduction to the software, Exploring feature definitions and symbologies, Alignment feature definition and symbology, Terrain-Corridor feature definition, Linear template feature and symbology properties, Referencing files	05
2	**Terrain :** Introduction to terrain display, Laying out of a network, Referencing of a map, Introduction to terrain display, Referencing a 3d terrain model into a 2d file, Label and analyze terrain points	05
3	**Geometry Design:** Create Horizontal Tangent Elements, Define stationing and annotation, Existing terrain model and defining 2d and 3d views, Create, Edit and Review vertical geometry	05
4	**Beyond Centreline Geometry:** Features of Open Roads, Obedient vs. Oblivious graphics, Heads up display and properties, Representing Edges of pavement, curb returns, creating cul-de-sac, Driveway design, Design of vertical profile.	05
	Total	20

Reference Books:

1. OpenRoads Designer on boarding guide version 1 by Bentley.

Program:	B. Tech. (Civil Engineering)			Semester :	VI		
Course :	Professional Development Training-I I(PDT-II)			Code :	BHM6918		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	TW	OR	PR	Total
3	-	-	3	-	-	-	Grade

Course Objectives:
This course aims at enabling the students
1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes: Students will be able to
After learning the course, the students will be:
1. Having adaptive thinking and adaptability through various Quantitative ability concepts.
2. Having critical thinking and innovative skills
3. Having interest in lifelong learning & developing verbal competencies in the students.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Modern Maths** Profit loss, Ratio & Proportion, LCM & HCF, Time speed and Distance, Average, Mean, mode, median, permutation & combination, Probability, Pipe & systems, Mixture validation, Allegations and Mixtures, Simple Interest and Compound Interest.	06
2.	**Algebra** Linear equations, Quadratic equations, Triplets. **Geometry** Triangles, Polygons (questions on Area Perimeter).	06
3.	**Mensuration** Cube cuboids cone cylinder sphere (questions on volume surface Area) **Trigonometry** **Number System** **Statistics.**	06
4.	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	06
5	**Data Interpretation** Data charts, Data tables, Bar, Pie, Line graphs, Venn diagram.	06
6	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Para Jumbles.	06
	Total	36

Reference Books:

5. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
6. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.
7. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
8. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Lt.

** Students should get a passing grade if they will clear at least two online aptitude tests and achieve minimum criteria of attendance.

Program:	B. Tech. (Civil Engineering)	Semester :	VI
Course :	Constitution of India (Audit-3)	Code :	BHM9962

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
1	-	-	1	-	-	-	Grade

Course Objective:

1. To enable the student to understand the importance of constitution
2. To identify individual role and ethical responsibility towards nation.
3. To understand human rights and its implications
4. To know about central and state government functionalities in India.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the functions of the Indian government and get acquainted with knowledge of Constitutional Amendments.
2. Identify and explore the basic features, modalities about Indian constitution and assessment of the Parliamentary System in India.
3. Differentiate and relate the functioning of Indian Political system at the Central and State level.
4. Comprehend the fundamental rights and abide the rules of the Indian constitution.

Detailed Syllabus:

Unit	Description	Duration
1	**Introduction to Constitution:** Meaning of the constitution law and constitutionalism, making of constitution, Salient features and characteristics of the Constitution of India, Preamble, Fundamental Rights, Directive Principles of State Policy, Fundamental Duties and it‘s legal status, Citizenship.	3
2	**System of Government- Center & State level and local level** Structure and Function of Central Government, President, Vice President, Prime Minister, Cabinet, Parliament, Supreme Court of India, Judicial Review, Federal structure and distribution of legislative and financial powers between the Union and the States, local self-government	3
3	**Judiciary:** Governor, Chief Minister, Cabinet, State Legislature Judicial System in States, High Courts and other Subordinate Courts, Parliamentary Form of Government in India.	3
4	**Constitution Functions:** Indian Federal System and it‘s characteristics, Center& State Relations, President‘s Rule, Constitutional Amendments and powers, Constitutional Functionaries, Emergency Provisions, Assessment of working of the Parliamentary System in India	3
		12

Text Books:

1. Durga Das Basu, ―Introduction to the Constitution of India ―, Prentice Hall of India, New Delhi,24th edition, 2020, ISBN-109388548868
2. Clarendon Press, Subhash C, Kashyap, ―Our Constitution: An Introduction to India‘s Constitution and constitutional Law‖, NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1. Maciver and Page, ―Society: An Introduction Analysis ―, Laxmi Publications, 4th edition, 2007, ISBN-100333916166
2. PM Bhakshi, ―The constitution of India‖, Universal Law Publishing - An imprint of Lexis Nexis, 14th edition, 2017, ISBN-108131262375

Course Syllabus

Open Elective-2,3,4

Semester-V and VI

Offered by Civil Engineering to other department

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Total Quality Management (OEC-2)			Code:	BCI5602A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge: Quality and need of Quality in any work

Course Objectives: After Completing this course, student will have adequate background :

1. To understand the importance of Quality
2. To understand the need of Total Quality management & it's tools.
3. To understand role of ISO in quality management

Course Outcomes:

After learning the course, the students should be able to:

1. Articulate quality and quality ideas as presented by many gurus and philosophers after learning.
2. Apply different quality control tools.
3. Apply ISO concepts and the cost of quality to quality assurance.
4. Apply various methods of TQM.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Unit I: Quality in Construction** a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus(Juran, Deming, Crossby, Ishikawa). b) Evolution of TQM- QC, TQC, QA, QMS, TQM.	07
2	**Unit II: TQM & Six Sigma** a) TQM – Necessity, advantages , Quality Function Deployment(QFD). b) Six sigma – Importance, levels.	08
3	**Unit III: Cost of Quality and ISO** a) Categories of cost of Quality. b) Study of ISO 9001 principles., Quality manual – Importance, contents, documentation, Corrective and Preventive actions, Conformity and NC reports	08
4	**Unit IV: Techniques in TQM Implementation** a) Benchmarking in TQM, Kaizen in TQM, b) '5-S' techniques, Zero Defects.	08
5	**Unit V: Applications of Quality Control tools through Case study** a) Quality Circle Concept and applications through Quality Circle Formation b) Implementation of 7 QC tools through case study	07
6	**Unit VI: Failure Mode Effect Analysis** a) FMEA problems b) Decision Tree problems	07
	Total	45

Text Books:

1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Program:	B. Tech. (Civil Engineering)			Semester:	V		
Course:	Intelligent Transport System (OEC-2)			Code:	BCI5602B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge:

1. Fundamentals of Transportation and Traffic engineering
1. Transportation Planning and Designing

Course Objectives: After Completing this course, student will have adequate background :

1. To identify all the aspects related to intelligent transportation system and its application
2. To use the fundamental concepts of transportation system management.
3. To nurture their necessary skills to develop their career in transportation industry

Course Outcomes: After learning the course, the students will be able to:

1. Describe the fundamentals and principles of Intelligent transport system and its background
2. Demonstrate the knowledge of telecommunication practices in Intelligent transport system
3. Distinguish the physical architecture and hardware composition in the implementation of Intelligent transport system
4. Implement the Intelligent transport system concepts in various transportation domains
5. Explain the user needs and services in the context of implementing effective strategies
6. Identify and evaluate the practical constraints in the implementation of the technology and the grass root level.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction:** Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection	07
2	**Telecommunications in Intelligent Transport System:** Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Roadside communication – Vehicle Positioning System	08
3	**IIntelligent Transport System architecture and Hardware:** Architecture – ITS Architecture Framework – Hardware Sensors – Vehicle Detection – Techniques – Dynamic Message Sign – GPRS – GPS – Toll Collection	08
4	**Intelligent Transport System Functional Area:** Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).	07
5	**Intelligent Transport System User Needs and Services:** Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.	08
6	**Case Studies:** Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries	07
	Total	45

Text Books:

1. Ghosh, S., Lee, T.S.,"Intelligent Transportation Systems: New Principles and Architectures", CRC Press, 2000.
2. Mashrur A. Chowdhury, and Adel Sadek, "Fundamentals of Intelligent Transportation Systems Planning", Artech House, Inc., 2003.

Reference Books:

1. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
2. Henry F.Korth, and Abraham Siberschatz, Data Base System Concepts, McGraw Hill, 1992.
3. Turban E.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
4. Sitausu S. Mittra, "Decision Support Systems – Tools and Techniques", John Wiley, New York, 1986.
5. Cycle W.Halsapple and Andrew B.Winston, "Decision Support Systems – Theory and Application", Springer Verlog, New York, 1987.

Standard Codes:

1. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.
2. Automotive Industry Standard by MoRTH, 2017 https://morth.nic.in/sites/default/files/Finalized_Draft_AIS_140_regarding_Intelligent_Transportation_Systems_.pdf

E-Resources:

1. **https://nptel.ac.in/courses/105105204**
2. **https://archive.nptel.ac.in/courses/105/101/105101008/**
3. **https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html**
4. **https://ocw.mit.edu/courses/1-212j-an-introduction-to-intelligent-transportation-systems-spring-2005/pages/lecture-notes/**

PCCOE "Knowledge Brings Freedom" Progress Credibility Confidence Optimism Excellence Since 1999

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Remote Sensing and GIS (OEC-3)			Code:	BCI6603A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Fundamental related to Surveying
2. Types and Importance of various surveys
3. Global Positioning System **(GPS)**

Course Objectives: After Completing this course, student will have adequate background :

1. To comprehend fundamentals and principles of RS and GIS techniques.
2. To enhance students' capacity to interpret images and extract information of earth surface from multi-resolution imagery at multi-scale level.
3. To develop skills of Image processing and Geographical Information System
4. To study satellite image processing, satellite image interpretation, digitization and generation of thematic maps in a GIS.
5. To learn buffering and layer analysis for various engineering applications

Course Outcomes: After learning the course, the students will be able to:

1. Articulate fundamentals and principles of RS techniques.
2. Demonstrate the knowledge of remote sensing and sensor characteristics.
3. Distinguish working of various spaces-based positioning systems.
4. Analyze the RS data and image processing to utilize in civil engineering
5. Explain fundamentals and applications of RS and GIS
6. Acquire skills of data processing and its applications using GIS

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to Remote Sensing:** Definition and scope, history and development of remote sensing technology, electromagnetic radiation (EMR) and electromagnetic spectrum, EMR interaction with atmosphere and earth surface; atmospheric window, RS platforms, elements of remote sensing for visual interpretation viz. tone, shape, size, pattern, texture, shadow and association, applications in civil engineering/town planning	07
2	**Remote Sensing Satellites and Sensor Characteristics:** Types and their characteristics, types of sensors, orbital and sensor characteristics of major earth resource satellites, Indian remote sensing satellite programs, introduction to various open-source satellite data portals, global satellite programs, sensor classification, applications of sensor, concept of Swath & Nadir, resolutions, digital image. Introduction to spatial resolution, spectral resolution, radiometric resolution and temporal resolution, visual image interpretation, image interpretation	08
3	**GPS and GNSS:** Introduction to GNSS and Types, IRNSS, GPS, GPS components, differential GPS, types of GPS tracking, application of GNSS in surveying, mapping and navigation	07
4	**Image Processing and Analysis:** Digital image, visual image interpretation, image interpretation keys, concept of spectral signatures curve, digital image processing, preprocessing and post processing, image registration, image enhancement, image transformations, digital image classification (supervised & unsupervised). Digital elevation model (DEM) and its derivatives, triangular irregular network model (TIN) and other models & their applications.	08
5	**Fundamentals of GIS:** Geographic information system, definition, spatial and non-spatial data, data inputs, data storage and retrieval, data transformation, Introduction to cloud computing (types & applications), data reporting, advantages of GIS, essential elements of GIS hardware, software GIS data types, applications of RS and GIS in civil engineering, hydrogeology, engineering geology, surveying and mapping.	07

6	**GIS Data and Case Studies:** GIS data types and data representation, data acquisition, geo-referencing of data, projection systems, raster and vector data, raster to vector conversion, attribute data models and its types, remote sensing data in GIS, GIS database and database management system. Case studies:	**08**
	Total	**45**

Textbooks:

1. J. George "Fundamentals of Remote Sensing", Universities Press, Hyderabad, 2005
2. Principles of Remote Sensing, Panda B C, Viva Books Private Limited, 2008
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022
4. S.K. Sinha "Fundamental of Remote Sensing and GIS", Ayushman Publication House,2014

Reference Books:

1. Remote Sensing & Digital Image Processing, John R. Jensen, Department of Geography University of South Carolina Columbia, 4th Edition, 2017
2. Remote Sensing and Image Interpretation, Lillesand Thomas M. and Kiefer Ralph, John, 7th Edition, 2015
3. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce84/preview
2. https://onlinecourses.nptel.ac.in/noc23_ce52/preview
3. https://onlinecourses.nptel.ac.in/noc22_ce26/preview
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/
5. https://www.classcentral.com/course/swayam-remote-sensing-and-gis-14272

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Program:	B. Tech. (Civil Engineering)			Semester:		VI	
Course:	Building Services and Maintenance (OEC-3)			Code:		BCI6603B	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Course Objectives:

1. To understand the different building services provisions.
2. To study the suitable electrical and mechanical services, fire protection, acoustic, water supply and sound Insulations.
3. To examine the the purpose and type of building maintenance.

Course Outcomes: After learning the course, the students should be able to:

1. Understand different building services provisions.
2. Interpret the importance of building ventilation.
3. Distinguish the suitable electrical as well mechanical services for particular requirements of buildings.
4. Discover the knowledge of Fire Protection, Acoustic, Sound Insulations.
5. Provide awareness of laws and regulations of water supply systems related to building services.
6. Select different types of maintenance in building services.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to Building Services**: Definitions, Objective and uses of services-different types building, Classification of building services, Types of services and selection of appropriate services for given project.	07
2	**Building Ventilation:** Natural and artificial lighting principles and factors, Arrangement of luminaries, Distribution of illumination, Utilization factors, Necessity of Ventilation Types – Natural and Mechanical Factors to be considered in the design of Ventilation.	08
3	**Electrical Services & Mechanical Services in Buildings:** Electrical services in the building technical terms and symbols for electrical installations and Accessories of wiring, Systems of wiring Plumbing & Air-Conditioning, Air Distribution system, Cleaners,	08
4	**Fire Protection, Acoustic and Sound Insulations:** Introduction, causes of fire and Effects of fire, General Requirements of Fire Resisting building as per IS and NBC 2005, Requirement of good Acoustic, Various sound absorbent, Factors to be followed for noise control in residential building.	08
5	**Water and Sanitation Water quality Purification and treatment**: - water supply systems-distribution systems municipal bye laws and regulations, Rain Water Harvesting Sanitation in buildings, arrangement of sewerage systems in housing.	07
6	**Building Maintenance:** Role of maintenance in durability and serviceability of buildings, Economic aspects of maintenance. Different types of maintenance.	07
	Total	45

Text Books:

1. A text book on Building Services R. Udaykumar Eswar Press, Chennai
2. Building Services S. M. Patil Seema Publication, Mumbai Revised edition
3. National Building Code of India - 2005 Bureau of Indian Standards BIS, New Delhi.

Reference Books:

1. Building Construction Dr. B. C. Punmia Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd .

E-resource-https://nptel.ac.in/courses/105102176

Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Smart Cities & Building Automations (OEC-4)			Code:	BCI6604A		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Physics
2. Mathematics
3. Programming Language

Course Objectives:

1. To understand the concept of smart city and associated challenges
2. To understand latest technologies used in intelligent building
3. To recognize the concepts of Internet of Things and able to build IoT applications
4. To apply the programming and use of Arduino and Raspberry Pi boards for Smart Cities

Course Outcomes:

After learning the course, the students will be able to:-

1. Understand the concept of smart city and associated challenges
2. Identify latest technologies used in intelligent building
3. Implement program and configure Arduino boards for various designs
4. Demonstrate Python programming and interfacing for Raspberry Pi.
5. To design IoT applications in different domains

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to Smart cities** Introduction to city planning, Concept, Principle stakeholders, key trends in smart cities developments	07
2	**Smart Cities Regulations** Understanding smart cities, Global Standards and performance benchmarks, Practice codes for smart city development	07
3	**Smart Cities Planning and Development** Smart city planning and development, Dimension of smart cities, Financing smart cities development, Governance of smart cities	07
4	**IoT in Construction** Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.	08
5	**Introduction to Arduino Programming,** Integration of Sensors and Actuators with Arduino for smart city applications	08
6	**Introduction to Python and Raspberry pi for Smart Cities** Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi for Smart Cities and Smart Homes	08
	Total	45

Text Books:

1. Jo Beall (1997); "A city for all: valuing differences and working with diversity"; Zed books limited, London (ISBN: 1-85649-477-2).
2. UN-Habitat; "Inclusive and sustainable urban planning: a guide for municipalities"; Volume 3: Urban Development Planning (2007); United Nations Human Settlements Programme (ISBN: 978- 92-1-132024-4).
3. Arup Mitra; "Insights into inclusive growth, employment and wellbeing in India"; Springer (2013), New Delhi (ISBN: 978-81-322-0655-2).
4. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases"(2018), by Pethuru Raj and Anupama C. Raman (CRC Press).
5. "Make sensors"(2014) Terokarvinen, Kemo, Karvinen and Villey Valtokari, 1st edition, Maker media.
6. "Internet of Things: A Hands-on Approach"(2018), by Arshdeep Bahga and Vijay Madisetti.

Reference Books

1. "Urban Planning and cultural identity" (2004); William J. V. Neill, Routledge, London (ISBN: 0- 415-19747-3)
2. "Remaking the city: Social science perspective on urban design"(2015) John S. Pipkin, Mark E. La Gory, Judith R. Balu (Editors); State University of New York Press, Albany (ISBN: 0-87395-678-8)
3. "Smart cities – Ranking of European medium-sized cities". Smart Cities. Vienna: Centre of Regional Science (2007) Giffinger, Rudolf; Christian Fertner; Hans Kramar; Robert Kalasek; Nataša Pichler-Milanovic; Evert Meijers
4. "Draft Concept Note on Smart City Scheme". Government of India – Ministry of Urban Development (http://indiansmartcities.in/downloads/CONCEPT_NOTE_-_.12.2014__REVISED_AND_LATEST_.pdf)
5. "Internet of Things: A Hands-On Approach"(2018) Vijay Madisetti, Arshdeep Bahga,
6. "Fundamentals of Wireless Sensor Networks: Theory and Practice" (2018), Waltenegus Dargie,Christian Poellabauer, Beginning Sensor networks with Arduino and Raspberry Pi (2013) Charles Bell, A press.

e-References

1. Smart City Mission Guidelines, India, https://smartcities.gov.in/guidelines
2. Smart Cities – Management of Smart Urban Infrastructures by Coursera, https://www.coursera.org/learn/smart-cities
3. e-Learning Course on Smart City by edx, https://www.edx.org/course/smart-city

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Program:	B. Tech. (Civil Engineering)			Semester:	VI		
Course:	Mechanical Electrical Plumbing (MEP) Systems (OEC-4)			Code:	BCI6604B		
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Credit	Hours	IE	MTE	ETE	Total
3	-	3	3	20	30	50	100

Prior Knowledge of:

1. Basics of air conditioning
2. Basics of Electrical Engineering
3. Basics of Mechanical Engineering

Course Objectives:

After Completing this course, student will have adequate background :

1. To learn the concept of HVAC
2. To recognize the technologies used in electrical services
3. To understand the concepts of plumbing services
4. To learn the fire protection system

Course Outcomes: After learning the course, the students will be able to:

1. Analyse and design HVAC system
2. Implement the technologies used in electrical services
3. Apply plumbing services
4. Design fire protection system

Detailed Syllabus

Unit	Description	Duration(H)
1	**HVAC** Introduction to HVAC, Basic Components of Air-Conditioning and Refrigeration machines, Classification of Air-Conditioning System , Categories of Air Conditioning , Study of sychometric Charts , Load Calculation, Air Distribution System, Static Pressure Calculation, Hydronic System, VRF/VRV System, Air Conditioning Concepts, Ventilation systems.	07
2	**Basics of Electrical Implementations** General, Codes & Standards to be followed, Electrical equipment's and its application used in the installation, Means of electrical distribution for installation, Major electrical loads used in the installation, Electrical design calculations, Various design stages & Sequence of electrical design procedure.	08
3	**Electrical Analysis and Design** Major electrical loads used in the installation, Electrical design calculations, Various design stages & Sequence of electrical design procedure.	07
4	**Plumbing** Plumbing Systems, Design of Domestic Water Supply and Distribution System, Design of Sanitary Drainage System, Drawings – Plumbing Layouts.	08
5	**Fire Protection system** Introduction To Fire Fighting, Classification Of Fire (Description), Fire Extinguisher Types- Using Procedure And General Maintenance, Fire Protection Systems-1. Active 2. Passive Refuge Areas – Rules & Regulations.	07
6	**Fire Alarm System** Designing of fire alarm system, NFPA, NBA & FSAI Code For Fire Fighting System Designing, Fire Fighting, Hydraulic Calculation For High Rise Buildings, Fire norms for new project construction.	08
	Total	45

Text Books:

1. Design of Mechanical & Electrical Systems. Trost, Pearson Publishing, ISBN 978-0-13097235-4 .
2. MEP Planning Manual: Become a Professional Construction Engineer: 1 (Arabmep H), ISBN-10 : 1677068930, ISBN-13 : 978-1677068937.
3. MEP Databook (Construction Databooks) Hardcover – 16 August 2000 by Sidney Levy, McGraw-Hill Education.
4. Electrical and Mechanical Services in High Rise Building (English, Paperback, Mittal A.K.), CBS Publisher and Distrubutor Pvt.Ltd.

Reference Books

1. MEP Guide for Planning and Scheduling by Planningengineer.net
2. Handbook of Building Construction; Data for Architects, Designing and Construction Engineers, and Contractors by Hool George, Publisher: Nabu Press.

e-Reference

1. Online Mechanical, Electrical and Plumbing Design Training Course by Advance Electrical Design & Engineering Institute (AEDEI) https://www.advanceelectricaldesign.com/
2. Revit MEP Essentials by CADD Centre, India. https://www.cloudkampus.com/clp/revit-mep-essentials
3. MEP Course by MEP Training Institute, India. https://www.mepcentre.com/course/mep
4. Foundation Course on Building MEP Services by MEPA (Mechanical Electrical Plumbing engineers Association) http://www.mepaworld.com/training

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Vision and Mission of the Civil Engineering Department

Vision of the Department

To be recognized as one of the leading department in respect of professional education and innovation in the western region.

Mission of the Department

To develop a multidisciplinary approach to relate civil engineering challenges to social and human context through team spirit, right attitude, morals, and higher education.

PEOs of Civil Engineering

I. To impart sound academic fundamentals among the students to formulate, analyze and solve civil engineering problems.
II. To develop student's ability to adopt and apply recent trends in civil engineering.
III. To prepare students for the challenging needs of civil engineering profession and higher academic pursuits.
IV. To develop professional ethics among students for functioning as an individual or in a team for betterment of society and environment.

PSOs of Civil Engineering

I. The graduate will be able to apply necessary Civil Engineering skill sets for quality construction work in industrial and infrastructural development.
II. The graduate will be able to demonstrate skill sets required for entrepreneur in Civil Engineering