PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune
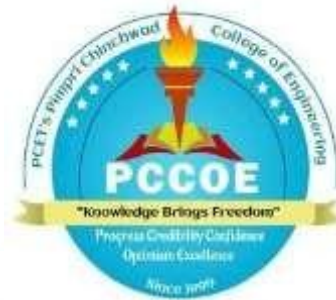
Curriculum Structure and Syllabus of
Final Year B.Tech Civil Engineering
(Regulations 2020)

Effective from Academic Year 2024-25

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

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.
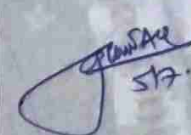
We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

Department of Civil Engineering

Course Approval Summary

Board of Studies - Department of Civil Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Estimation, Costing and Tenders	BCI7421 / BCI8421	15-16	
2	Construction Management	BCI7422 / BCI8422	17-18	
3	Air Pollution and Control	BCI7501A/ BCI8501A	19-20	
4	Construction Techniques and Retrofitting System	BCI7501B/ BCI8501B	21	
5	Design of RC Bridges	BCI7501C/ BCI8501C	22	
6	Air Transportation and Bridge Engineering	BCI7501D/ BCI8501D	23-24	
7	Watershed Management	BCI7502A /BCI8502A	25-26	
8	Construction Contracts and Legal Aspects in Construction	BCI7502B/ BCI8502B	27-28	
9	Structural Dynamics	BCI7502C/ BCI8502C	29-30	
10	Advanced Foundation Engineering	BCI7502D/ BCI8502D	31-32	
11	E- waste management	BCI7605A/ BCI8605A	42-43	
12	Advanced Instrumentation in Infrastructural Engineering	BCI7605B/ BCI8605B	44-45	
13	MOOC (only for civil department student)	BCI7605C/ BCI8605C	46-47	
14	3-D printing technique for construction	BCI7606A/ BCI8606A	62-63	
15	Structural Health Monitoring and Audit	BCI7606B/ BCI8606B	64	
16	Estimation, Costing and Tenders Lab	BCI7423/ BCI8423	33	
17	Design of Steel Structures Lab	BCI7424/ BCI8424	34	
18	Air Pollution and Control Lab	BCI7503A/ BCI8503A	36	
19	Construction Techniques and Retrofitting System Lab	BCI7503B/ BCI8503B	37	
20	Design of RC Bridges Lab	BCI7503C/ BCI8503C	38	
21	Air Transportation and Bridge Engineering Lab	BCI7503D/ BCI8503D	39	
22	Massive Open Online Courses (MOOC):(OEC-5)	BCI7605C/ BCI8605C	46	
23	Project Work (Scheme A/B)	BCI8701/ BCI7701	149	
24	Project Stage 1-(Scheme C)	BCI7702	150	
25	Project Stage 2-(Scheme C)	BCI8702	151	
26	B.Tech. (UG) Project Guidelines	-	152-159	

*Chairman
BoS, Civil Engineering
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44*

Final Year B.Tech.(Civil Engineering), PCCoE Pune

1

Department of Civil Engineering

Board of study - Department of Computer Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Web Technology and its Applications (OEC-5)	BCE7607 / BCE8607	48-49	
2	Software Testing & Quality Assurance (OEC-5)	BCE7608 / BCE8608	50-51	
3	Database Management System (OEC-6)	BCE7610 / BCE8610	65-66	Chairman BoS, Computer Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
4	Introduction to Blockchain (OEC-6)	BCE7611 / BCE8611	67-68	
5	Android App Development with Kotlin (OEC-6)	BCE7612 / BCE8612	69-70	
6	Agile Project Management (OEC-6)	BCE7613 / BCE8613	71-72	

Board of study - Department of E &TC
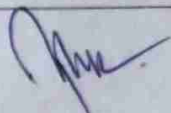
Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Bio inspired systems and Computing (OEC-5)	BET7601/ BET8601	52-53	
2	Sensor and Automation with IoT (OEC-5)	BET7602 / BET 8602	54-55	Chairman BoS, Electronics & Telecommunication Engineering PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
3	Drone Technology (OEC-6)	BET7604 / BET8604	73	
4	Advanced Driver Assistance System(ADAS) (OEC-6)	BET7605 / BET8605	74-75	

Board of study - Department of Information Technology

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Cloud Computing (OEC-5)	BIT7601/ BIT8601	56	Chairman BoS, Information Technology PCET's, Pimpri Chinchwad College of Engineering Sector No. 26, Pradhikaran, Nigdi, Pune-44
2	Data Science for Engineers (OEC-5)	BIT7602/ BIT8602	76-77	

Final Year B.Tech.(Civil Engineering), PCCoE Pune

2

Department of Civil Engineering

Board of study - Department of Mechanical Engineering

Sr. No	Name of the course	Course code	Page number	Signature and stamp of BoS
1	Project Management & Governance (OEC-5)	BME7605A / BME8605A	57-58	
2	Industrial Engineering (OEC-5)	BME7605B/ BME8605B	59-60	
3	Lean Six Sigma (OEC-6)	BME7606A/ BME8606A	78-79	
4	Professional Ethics (OEC-6)	BME7606B/ BME8606B	80	

Chairman
BoS, Mechanical Engineering
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Approved by Academic Council:

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44
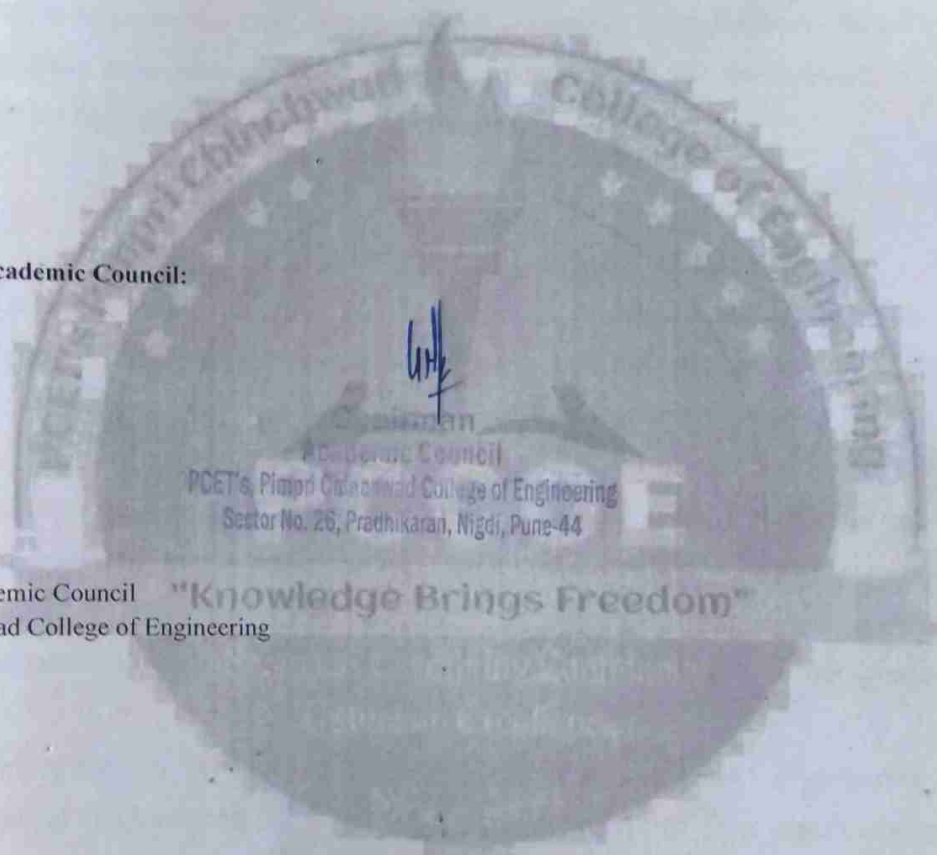
Chairman, Academic Council
Pimpri Chinchwad College of Engineering

"Knowledge Brings Freedom"

INDEX

LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

Sr. No.	Abbreviation	Type of Course
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Programme Core Course
4	PEC	Programme Elective Course
5	MDM	Multidisciplinary Minor
6	OEC	Open Elective Course
7	VSEC	Vocational and Skill Enhancement Course
8	AEC	Ability Enhancement Course
9	EEM	Entrepreneurship/Economics/Management Course
10	IKS	Indian Knowledge System
11	VEC	Value Education Course
12	ELC	Experiential Learning Courses
13	LLC	Liberal Learning Courses

CURRICULUM FRAMEWORK

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
Final Year B Tech
Civil Engineering

CURRICULUM STRUCTURE FOR FINAL YEAR B.TECH. CIVIL ENGINEERING
Scheme A
Semester-VII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA2					
BCI7421	PCC	Estimation, Costing and Tenders	3	-	-	3	3	20	20	60	-	-	-	100
BCI7422	PCC	Construction Management	2	-	-	2	2	20	20	60	-	-	-	100
BCI7501 A/B/C/D	PEC	Professional Elective Course– V	2	-	-	2	2	20	20	60	-	-	-	100
BCI7502 A/B/C/D	PEC	Professional Elective Course– VI	3	-	-	3	3	20	20	60	-	-	-	100
BCI7605 A/B/C	OEC	Open Elective – 5	3	-	-	3	3	20	20	60	-	-	-	100
BCI7606 A/B	OEC	Open Elective – 6	3	-	-	3	3	20	20	60	-	-	-	100
BCI7423	PCC	Estimation, Costing and Tenders Lab	-	2	-	2	1	-	-	-	25	-	25	50
BCI7424	PCC	Design of Steel Structures Lab	-	4	-	4	2	-	-	-	50	-	25	75
BCI7503 A/B/C/D	PEC	Professional Elective Lab– V	-	-	1	1	1	-	-	-	25	-	-	25
Total			16	6	1	23	20							750

Semester-VIII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA 2					
BCI8701	PROJ	Project	-	28	-	28	14	-	-	-	200	-	150	350
BCI8801	INTR	Internship	-	-	-	-	3	-	-	-	100	-	-	100
Total			-	28	-	28	17							450

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, FA – Formative Assessment, SA –Summative Assessment, TW – Term Work, PR- Practical Exam, OR – Oral Exam

CURRICULUM STRUCTURE FOR FINAL YEAR B.TECH. CIVIL ENGINEERING
Scheme B
Semester-VII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA 2					
BCI7701	PROJ	Project	-	28	-	28	14	-	-	-	200	-	150	350
BCI7801	INTR	Internship	-	-	-	-	3	-	-	-	100	-	-	100
Total			-	28	-	28	17							450

Semester-VIII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA 2					
BCI8421	PCC	Estimation, Costing and Tenders	3	-	-	3	3	20	20	60	-	-	-	100
BCI8422	PCC	Construction Management	2	-	-	2	2	20	20	60	-	-	-	100
BCI8501 A/B/C/D	PEC	Professional Elective Course– V	2	-	-	2	2	20	20	60	-	-	-	100
BCI8502 A/B/C/D	PEC	Professional Elective Course– VI	3	-	-	3	3	20	20	60	-	-	-	100
BCI8605 A/B/C	OEC	Open Elective – 5	3	-	-	3	3	20	20	60	-	-	-	100
BCI8606 A/B	OEC	Open Elective – 6	3	-	-	3	3	20	20	60	-	-	-	100
BCI8423	PCC	Estimation, Costing and Tenders Lab	-	2	-	2	1	-	-	-	25	-	25	50
BCI8424	PCC	Design of Steel Structures Lab	-	4	-	4	2	-	-	-	50	-	25	75
BCI8503 A/B/C/D	PEC	Professional Elective Lab– V	-	-	1	1	1	-	-	-	25	-	-	25
Total			16	6	1	23	20							750

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, FA – Formative Assessment, SA –Summative Assessment, TW – Term Work, PR- Practical Exam, OR – Oral Exam

CURRICULUM STRUCTURE FOR FINAL YEAR B.TECH. CIVIL ENGINEERING
Scheme C
Semester-VII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA 2					
BCI7421	PCC	Estimation, Costing and Tenders	3	-	-	3	3	20	20	60	-	-	-	100
BCI7422	PCC	Construction Management	2	-	-	2	2	20	20	60	-	-	-	100
BCI7501 A/B/C/D	PEC	Professional Elective Course– V	2	-	-	2	2	20	20	60	-	-	-	100
BCI7502 A/B/C/D	PEC	Professional Elective Course– VI	3	-	-	3	3	20	20	60	-	-	-	100
BCI7423	PCC	Estimation, Costing and Tenders Lab	-	2	-	2	1	-	-	-	25	-	25	50
BCI7424	PCC	Design of Steel Structures Lab	-	4	-	4	2	-	-	-	50	-	25	75
BCI7503 A/B/C/D	PEC	Professional Elective Lab– V	-	-	1	1	1	-	-	-	25	-	-	25
BCI7702	PROJ	Project Stage -1	-	14	-	14	7	-	-	-	100	-	50	150
Total			10	20	1	31	21							750

Semester-VIII

Course Code	Course Type	Course Name	Teaching Scheme					Evaluation Scheme							
			L	P	T	H	CR	FA		SA	TW	PR	OR	Total
								FA 1	FA 2					
BCI8605 A/B/C	OEC	Open Elective – 5	3	-	-	3	3	20	20	60	-	-	-	100
BCI8606 A/B	OEC	Open Elective – 6	3	-	-	3	3	20	20	60	-	-	-	100
BCI8702	PROJ	Project Stage -2	-	14	-	14	7	-	-	-	100	-	100	200
BCI8801	INTR	Internship	-	-	-	-	3	-	-	-	100	-	-	100
Total			6	14		20	16							500

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, FA – Formative Assessment, SA –Summative Assessment, TW – Term Work, PR- Practical Exam, OR – Oral Exam

Open Elective Courses offered by Civil Department

Scheme-A			
Open Elective Course- 5	Semester VII	BCI7605A	E- waste management
		BCI7605B	Advanced Instrumentation in Infrastructural Engineering
		BCI7605C	MOOC (only for civil department student)
Open Elective Course- 6	Semester VII	BCI7606A	3-D printing technique for construction
		BCI7606B	Structural Health Monitoring and Audit
Scheme-B			
Open Elective Course- 5	Semester VIII	BCI8605A	E- waste management
		BCI8605B	Advanced Instrumentation in Infrastructural Engineering
		BCI8605C	MOOC (only for civil department student)
Open Elective Course- 6	Semester VIII	BCI8606A	3-D printing technique for construction
		BCI8606B	Structural Health Monitoring and Audit
Scheme-C			
Open Elective Course- 5	Semester VIII	BCI8605A	E- waste management
		BCI8605B	Advanced Instrumentation in Infrastructural Engineering
		BCI8605C	MOOC (only for civil department student)
Open Elective Course- 6	Semester VIII	BCI8606A	3-D printing technique for construction
		BCI8606B	Structural Health Monitoring and Audit

Scheme A
PEC and OEC Courses offered in Semester – VII
List of courses – Professional Elective Course – V

Course Code	Professional Elective Course Name	
BCI7501A	Air Pollution and Control	
BCI7503A	Air Pollution and Control Lab	
BCI7501B	Construction Techniques and Retrofitting System	
BCI7503B	Construction Techniques and Retrofitting System Lab	Choose any one
BCI7501C	Design of RC Bridges	
BCI7503C	Design of RC Bridges Lab	
BCI7501D	Air Transportation and Bridge Engineering	
BCI7503D	Air Transportation and Bridge Engineering Lab	

List of courses – Professional Elective Course – VI

Course Code	Professional Elective Course Name	
BCI7502A	Watershed Management	
BCI7502B	Construction Contracts and Legal Aspects in Construction	Choose any one
BCI7502C	Structural Dynamics	
BCI7502D	Advanced Foundation Engineering	

List of courses – Open Elective Course – 5 offered to Civil

Course Code	Department	Open Elective Course Name	
BCE7607	COMPUTER	Web Technology and its Applications	
BCE7608		Software Testing & Quality Assurance	
BET7601	E&TC	Bio- Inspired Systems And Computing	
BET7602		Sensor and Automation using IoT	Choose any one
BIT7601	IT	Cloud Computing	
BME7605A	MECH	Project Management & Governance	
BME7605B		Industrial Engineering	

List of courses – Open Elective Course – 6 offered to Civil

Course Code	Department	Course Name	
BCE7610	COMPUTER	Database Management System	
BCE7611		Introduction to Blockchain	
BCE7612		Android App Development with Kotlin	
BCE7613		Agile Project Management	
BET7604	E&TC	Drone Technology.	Choose any one
BET7605		Advanced Driver Assistance System(ADAS)	
BIT7602	IT	Data Science for Engineers	
BME7606A	MECH	Lean Six Sigma	
BME7606B		Professional Ethics	

Scheme B
PEC and OEC Courses offered in Semester – VII
List of courses – Professional Elective Course – V

Course Code	Course Name	
BCI8501A BCI8503A	Air Pollution and Control Air Pollution and Control Lab	
BCI8501B BCI8503B	Construction Techniques and Retrofitting System Construction Techniques and Retrofitting System Lab	Choose any one
BCI8501C BCI8503C	Design of RC Bridges Design of RC Bridges Lab	
BCI8501D BCI8503D	Air Transportation and Bridge Engineering Air Transportation and Bridge Engineering Lab	

List of courses – Professional Elective Course – VI

Course Code	Course Name	
BCI8502A	Watershed Management	
BCI8502B	Construction Contracts and Legal Aspects in Construction	Choose any one
BCI8502C	Structural Dynamics	
BCI8502D	Advanced Foundation Engineering	

List of courses – Open Elective Course – 5 offered to Civil

Course Code	Department	Course Name	
BCE8607	COMPUTER	Web Technology and its Applications	
BCE8608		Software Testing & Quality Assurance	
BET8601	E&TC	Bio- Inspired Systems And Computing	
BET8602		Sensor and Automation using IoT	Choose any one
BIT8601	IT	Cloud Computing	
BME8605A	MECH	Project Management & Governance	
BME8605B		Industrial Engineering	

List of courses – Open Elective Course – 6 offered to Civil

Course Code	Department	Course Name	
BCE8610	COMPUTER	Database Management System	
BCE8611		Introduction to Blockchain	
BCE8612		Android App Development with Kotlin	
BCE8613		Agile Project Management	
BET8604	E&TC	Drone Technology.	Choose any one
BET8605		Advanced Driver Assistance System(ADAS)	
BIT8602	IT	Data Science for engineers	
BME8606A	MECH	Lean Six Sigma	
BME8606B		Professional Ethics	

Scheme C
PEC and OEC Courses offered in Semester – VII
List of courses – Professional Elective Course – V

Course Code	Course Name	
BCI7501A BCI7503A	Air Pollution and Control Air Pollution and Control Lab	
BCI7501B BCI7503B	Construction Techniques and Retrofitting System Construction Techniques and Retrofitting System Lab	Choose any one
BCI7501C BCI7503C	Design of RC Bridges Design of RC Bridges Lab	
BCI7501D BCI7503D	Air Transportation and Bridge Engineering Air Transportation and Bridge Engineering Lab	

List of courses – Professional Elective Course – VI

Course Code	Course Name	
BCI7502A	Watershed Management	
BCI7502B	Construction Contracts and Legal Aspects in Construction	Choose any one
BCI7502C	Structural Dynamics	
BCI7502D	Advanced Foundation Engineering	

List of courses – Open Elective Course – 5 offered to Civil

Course Code	Department	Course Name	
BCE8607	COMPUTER	Web Technology and its Applications	
BCE8608		Software Testing & Quality Assurance	
BET8601	E&TC	Bio- Inspired Systems And Computing	
BET8602		Sensor and Automation using IoT	Choose any one
BIT8601	IT	Cloud Computing	
BME8605A	MECH	Project Management & Governance	
BME8605B		Industrial Engineering	

List of courses – Open Elective Course – 6 offered to Civil

Course Code	Department	Course Name	
BCE8610	COMPUTER	Database Management System	
BCE8611		Introduction to Blockchain	
BCE8612		Android App Development with Kotlin	
BCE8613		Agile Project Management	
BET8604	E&TC	Drone Technology.	Choose any one
BET8605		Advanced Driver Assistance System (ADAS)	
BIT8602	IT	Data Science for engineers	
BME8606A	MECH	Lean Six Sigma	
BME8606B		Professional Ethics	

Course Syllabus
Final Year B Tech
Civil Engineering
Semester-VII/VIII
Scheme A or B

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Estimating , Costing and Tenders			Code:	BCI7421/ BCI8421		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Building Planning, Construction & Materials
2. Design of Reinforced Concrete Structure

Course Objectives:
1. To make students aware about quantity survey for the preparation of preliminary and detailed estimates.
2. To teach the students cost analysis of individual items above for the estimation purpose.
3. To make the students aware of those factors that affect the cost of construction work and to analyze the influences that affect change in these factors.
4. To inculcate habit of systematic recording of all those statistics which are required for cost estimation.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the appropriate tendering and procurement selection.
2. Prepare the approximate cost of the projects through preliminary and detailed estimates.
3. Record measurements of the items of work for the calculation of quantities, Prepare schedule of quantities required to be attached with the tender documents.
4. Prepare estimation of quantities and cost of structure other than buildings
5. Perform rate analysis for items of work as per provisions in Specifications
6. Evaluate value of property by different methods.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to Estimates and related terms:** Definitions of estimation and valuation. Purpose of estimation. Type of estimates, data required for estimation as a prerequisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, Schedule A & B abstract sheet (BOQ), measurement sheet, Rate Analysis, lead- Lift statement. Provisional sum & prime cost items, contingencies, work charge establishment, centage charges. Introduction to S. S. R. **Approximate Estimates:** Meaning, purpose, methods of approximate estimation of building & other civil engineering projects like roads and Building works.	08
2	**Taking out quantities:** Methods of estimating - P.W.D. and center-line methods of working out quantities. Calculation of quantities for Load bearing and R.C.C framed structures. Detailed estimates, Factors to be considered while Preparing detailed Estimates. Bar Bending Schedule Detailed Estimate : Detailed estimates of Load bearing and R.C.C framed structures, Calculation of quantities and detailed estimate for Load bearing and framed structures. Deduction rules for different items of work as per IS: 1200. Abstracting quantities, preparing BOQ.	08
3	**Estimates of other construction works:** Earthwork for road work, estimate of septic tank, , estimate of Community well, estimate of a culvert, estimate of an Underground water tank.	07
4	**Tenders & Contracts:** **Tenders:** Definition. Methods of inviting tenders, tender notice, tendering procedure, Pre-bid conference, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, acceptance/ rejection of tenders. Types of Tender open, restricted, E- tendering. **Contracts:** Definition, objectives & essentials of a valid contract as per Indian Contract Act(1872), termination of contract. Forms of contract- BOT, target Contract, Turn Key contract & FIDIC contract etc, Types of contracts: lump sum, item rate, Percentage rate, Conditions of contract: General and Specific conditions. **Introduction to Arbitration**	07

5	**Specifications :** Meaning & purpose, types. Drafting detailed specifications for materials, quality, workmanship, method of execution, mode of measurement and payment for major items like, excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work. **Rate Analysis :** Meaning and factors affecting rate of an item of work, materials, sundries, labour, tools & plant, overheads & profit. Working out Rate Analysis for the items mentioned in specifications above. Task work or out turn, factors affecting task work.	08
6	**Valuation :** Purpose of valuation. Meaning of price, cost and value. Factors affecting 'value'. Types of value: only Fair Market Value, Book Value, Salvage/ Scrap Value, Distressed Value and Sentimental Value. Concept of freehold and leasehold property. Estimation versus valuation. Meanings of depreciation & obsolescence. **Methods of Valuation:** Methods of valuation of land and building: rental basis, direct comparison method, profit based method, development method, and rent fixation for building. Methods of Valuation of land-belting method of land valuation and other methods. Qualification of Valuer, Valuation report in O1 format.	07
	Total	**45**

Text Books:

1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N. Dutta – S. Dutta & Company, Lucknow. 27 th Edition 2020.
2. Estimating, Costing Specifications & Valuation in Civil Engineering: M. Chakraborty. 11th Edition 2020
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand 17th Edition 2017
4. Building and Engineering Contracts by B.S.Patil , 7th Edition CRC Press 2019

Reference Books:

1. Theory and Practice of Valuation: Dr. Roshan Namavati, Lakhani Publications 2016
2. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.2010
3. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO- CARE, 2010

E-Resources:

1. http://mahapwd.gov.in/
2. https://mjp.maharashtra.gov.in/wp-content/uploads/2022/12/MAHARASHTRA_JEEVAN_PRADHIKARAN__4_.pdf
3. https://theconstructor.org/practical-guide/rate-analysis-of-civil-works-elements-and-requirements/10952/
4. https://cpwd.gov.in/Publication/DAR_Vol2_UPDATE_DEC_2021.pdf

IS Code:

1. IS 1200- Measurement rules for Items of work
2. IS 650 – 1991- Specification for standand sand testing
3. IS 14032 – 1988- Specification for standand Cement testing
4. IS 2386 (Part I To VIII) 1963- Methods of testing Aggregates
5. IS 3495 (Parts I TO iv) 1976- Methods of Tests for Burned Bricks
6. IS: 2720 (Part. XIII) 1986, IS:2720 (Part.30) 1980- Methods of Tests for Soil

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Construction Management			Code:	BCI7422/ BCI8422		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Construction Equipment and Material Management
2. Project Management and Economics

Course Objectives:
1. To provide an introduction to the construction sector, including the role of the construction industry in infrastructure development, materials management, and construction equipment.
2. To understand of risk management in the construction industry, including the identification and nature of construction risks, contractual allocations of risk, and methods for minimizing risks and mitigating losses.
3. To understand of labour laws and construction claims in the construction sector, including the need and importance of labour laws, important labour laws associated with construction, types of construction claims, and dispute resolution.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the fundamental concepts associated with the construction sector, the principles of materials management in construction projects, and the significance of construction equipment in the overall construction process.
2. Apply effective risk mitigation methods, including analyzing construction risks, evaluating contractual risk allocations, and to minimize losses in construction projects.
3. Understand the legal and contractual aspects of the construction sector, including dispute identification and mitigation, by evaluating and applying labour laws and construction claims knowledge.

Detailed Syllabus		
Unit	Description	Duration(H)
1	**Overview of construction sector:** Role of construction industry in infrastructure development, project management consultants – role, types, selection and appointment process, project monitoring and reporting systems, managerial correspondence and communications. **Materials Management**: Objectives and functions. Classification and codification, Material Research, Planning. Vendor analysis. **Construction Equipment** – Understanding basics, Introduction to construction equipment, its usage; equipment cost.	08
2	**Documentation and Risk Identification**: Familiarization with construction documents, Certainty, Risk and Uncertainty, Risk Management, Identification and Nature of Construction Risks, Contractual allocations of Risk, Types of Risks, Minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Control of Quality in Construction. case study	07
3	**Labour laws:** Need and importance of labour laws, study of some important labour laws associated with construction sector- workmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act. The Code of occupational Safety, Health and working Condition, 2020	08
4	**Construction Claims:** Construction Claims: Extra items and causes of claims. Types of construction claims, documentation. Settlement of claims Dispute Resolution: Causes of disputes and importance of role of various stakeholders in prevention of disputes.	07
	Total	45

Text Books:
1. Construction planning, equipment and methods by Purifoy R and schexnayder C (2006)
2. Construction Technology: Analysis and Choice, 2ed,Bryan, Wiley India(2014)
3. Materials Management An Integrated Approach , by P. Gopalakrishnan and Sundaresan, Prentice Hall of India(2015)

Reference Books:
1. Journals such as CE & CR. Construction world, International Construction.
2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
3. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
4. Arnold, "Introduction to Materials Management", Pearson Education India,2009
5. Lee and Dobler, Purchasing and Material Management, McGraw Hill Publications

Web References:
1. Construction Management Association of America (CMAA) - https://www.cmaanet.org/
2. Construction Management Association of America (CMAA) Knowledge Library - https://www.cmaanet.org/knowledge-library
3. Construction Management Institute - http://construction-management.org/
4. Construction Management Association of America (CMAA) YouTube Channel – https://www.youtube.com/user/CMAANET
5. Project Management Institute (PMI) - https://www.pmi.org/
6. American Society of Civil Engineers (ASCE) - https://www.asce.org/
7. Construction Industry Institute (CII) - https://www.construction-institute.org/
8. Construction Management Guide - https://www.constructionmanagementguide.com/
9. Construction Executive - https://www.constructionexecutive.com/

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Air Pollution and Control (PEC-V)			Code:	BC17501A/ BCI8501A		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Basic understanding of environmental studies
2. Basic concepts of science and mathematics.

Course Objectives:
1. To impart the knowledge of indoor and outdoor air pollution along with the understanding of meteorological parameters affecting air pollution phenomenon.
2. To provide the understanding of the sampling, analysis and pollution control techniques

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the ambient air sampling and analysis of particulates and gaseous air pollutants.
2. Calculate the minimum height of the industrial stack.
3. Determine the ground level concentration of the gaseous pollutants downwind of the stack and apply the knowledge of emission inventory.
4. Design the control equipment's for control of particulate pollutant for an industry.

	Detailed Syllabus	
Unit	Description	Duration(H)
1	**Introduction to air pollution, Ambient Air Samplings, Analysis and Standards** Basics of Air Pollution, Air Pollution episodes, Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009, Determination of Air Quality Index, Air Act, Low-Cost sensors,	07
2	**Meteorological Aspects** Meteorological parameters and measurements, scales of meteorology, Lapse rates, Inversion and its types, Atmospheric stability, Determination of mixing height, Stack height determination, CPCB recommendations, Plume rise estimation using Brigg's formula.	07
3	**Emission Inventory, Air Quality Modelling and Indoor Air Pollution** Point source, Line Source and area sources. Collection of data, emission factor, estimation of emission load, Air Quality Modeling: Need & Significance, Introduction to various models, Gaussian dispersion equation for point source; assumptions, advantages and limitations (Numerical included), Introduction to air quality management, source apportionment studies, Introduction to Indoor Air Pollution	07
4	**Control of Air Pollution** Natural self-cleansing properties, Control by process modification, change of raw materials, fuels, process equipment and process operation. Control of particulates from stationary sources: Working principle and design of Settling chamber, inertial separators, cyclone, fabric filter and electro Static precipitator. Scrubbers, Factors affecting selection of device (Numerical included) Control of gaseous pollutants from stationary sources: Absorption, adsorption, incineration/ combustion, carbon sequestration for CO_2. Control of specific pollutants Control of emissions from mobile sources, Control of emissions from fugitive sources Shifting towards cleaner vehicular technology, smart transportation systems, reduction in emissions (electric/hydrogen fuel over fossil fuels)	09
	Total	30

Text Books:
1. Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015
2. Air Pollution, M. N. Rao and H. V. N. Rao, 58th Edition, McGraw-Hill Education, 2020
3. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.2017

Reference Books:
1. Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010
2. Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., 4th Edition, Academic Press, 2008.
3. Atmospheric Chemistry and Physics, Seinfeld, J.H., Pandis, S.N., 3rd Edition, John Wiley, 2016.

E-Resources
1. https://archive.nptel.ac.in/courses/105/107/105107213/
2. http://cpcb.nic .in https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf
3. Guidelines for the Measurement of Ambient Air Pollutants:
   https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMjdfMTQ1ODExMDQyNl9OZXdkJdGVtXzE5Nl9OQUFRTVNfVm9sdW1lLLUkucGRm
4. USEPA Manual for Emission Inventory: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors
5. http://moef.nic .in https://moef.gov.in/en/division/environment-divisions/climate-changecc-2/documents-publications/

Program:	B. Tech. (Civil Engineering)			Semester :	VII/VIII Scheme A/B		
Course:	Construction Techniques and Retrofitting System (PEC-V)			Code:	BCI7501B/ BCI8501B		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Building construction,2.Strength of Material 3.Concrete technology, transportation and tunnel engineering.

Course Objectives:
1. To know the various methods and techniques involved in sub structure foundations and ground improvements.
2. To provide a coherent development to the students in area of construction techniques for super structure.
3. To give awareness of various retrofitting systems.

Course Outcomes:
After learning the course, the students should be able to:
1. Identify the suitable techniques for sub structure construction.
2. Select the suitable ground improvement technique as per the field requirements.
3. Decide suitable techniques of form work and concrete work for super structure construction
4. Recommend the repair or retrofitting technology as per structure requirements.

	Detailed Syllabus	
Unit	Description	Duration (H)
1	**Sub structure construction techniques:** Various pile driving and boring techniques, well and cofferdam construction techniques, diaphragm wall construction, shoring techniques for deep cuts, No dig techniques-box pushing and Pipe jacking.	08
2	**Ground improvement techniques:** ground improvement techniques such as- vibro-flotation, stone column, micro pile, soil nailing, grouting techniques in soft and hard strata, dewatering techniques such as single and double point system	07
3	**Super structure construction techniques:** Formwork techniques: table form, tunnel form. slip form, advanced form work technique. Concreting for tall building, prefab construction techniques, road pavement construction as per IRC and MoRTH guidelines, Bridge construction techniques: segmental construction and launching techniques. Use of automation in construction.	07
4	**Retrofitting Systems:** techniques for identification of distresses, Use of NDT in retrofitting systems. Repairing techniques for structure like sealing, grouting, rock bolting, jacketing, shotcreting, ferrocement, Introduction to retrofitting materials and retrofitting techniques for columns, beams, slabs, masonry structures.	08
	Total	30

Text Books:
1. Construction techniques and practices by Dr.V.Kannan, first edition, V. Kannna publication, 2021.
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020
3. Construction Techniques and Practice by V. Sankara Subramaniyan from Lakshmi Publications, 2017
4. Construction Technology, Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008.

Reference Books:
1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication
2. Modi, P.I., Patel, C.N., Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi, 2016.
3. CPWD Handbook (2011). Repair and Rehabilitation of RCC Buildings.
4. ACI 201.1R-08:American Concrete Institute, Guide for Conducting a Visual Inspection of Concrete in Service
5. ACI RAP-11-American Concrete Institute, Field Guide to Concrete Repair Application Procedures
6. Dyer, Thomas. (2014). Concrete Durability, CRC Press, Taylor & Francis Group, Florida.

E-Resources
1. https://nptel.ac.in/courses/ground improvement techniques
2. https://nptel.ac.in/courses/ Construction methods and equipment management
3. https://archive.nptel.ac.in/courses/105/105/105105213/
4. https://www.cecr.in/

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Design of RC Bridges (PEC – V)			Code:	BCI7501C/ BCI8501C		
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Knowledge of fundamentals of RCC and Prestress Design.
2. Knowledge of fundamentals of Structural Analysis and Geotechnical Engineering.

Course Objectives:
1. To impart fundamental knowledge of Bridge Engineering and loads acting on the bridges
2. To build the concept of analysis and design of the RCC bridge slab
3. To provide knowledge of Analyze and design of bridge girders.
4. To impart knowledge of the design of bridge substructure.

Course Outcomes:
After learning the course, the students should be able to:
1. Classify the type of bridges that are appropriate for the terrain and classify IRC loads and their distribution over a bridge's longitudinal beams.
2. Design the bridge superstructure's RCC deck slab, culvert slab, and T-beam deck slab.
3. Analyze and design girders built of post-tension prestressed and reinforced concrete.
4. Design the bearings and components of the substructure.

	Detailed Syllabus	
Unit	**Description**	**Duration (H)**
1	**Introduction to Bridge Engineering:** Types of bridges, classification based on structural form, IRC loading standard for RC highway bridges, Choice of Bridge Type and Economic Span Length, Super Structure Philosophy, Geometric Alignment, Drainage, Road Kerb, Bridge Foundations. **Loading on bridges:** IRC loading, D.L., L.L., Impact load, wind load, Earthquake load, Longitudinal force, centrifugal forces, buoyancy, water current forces, and thermal forces.	07
2	**RC Slab Bridge Deck:** Analysis of slab decks for the solid slab and solid cantilever slab, Pigeaud's method, design of slab culvert, and design of RC slabs supported on all sides for T-beam and slab deck.	08
3	**Design of Bridge Girders:** Analysis Methods, design of longitudinal and cross girders as per Courbon's theory, design of post-tensioned prestressed concrete T beam bridge deck and girders, steel girders	08
4	**Design of substructure:** Bearings - types, functions, and requirements as per IRC. Piers and Abutments- type, shape, and their suitability, Design of sub-structure – abutments, piers.	07
	Total	**30**

Text Books:
1. Principles and Practice of Bridge Engineering"- S P Bindra Dhanpat Rai & Sons New Delhi, 2012.
2. Reinforced Concrete Structures – Vol. II by Dr. B. C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications, 2018.

Reference Books:
1. Essentials of Bridge Engineering by D. Johnsons Victor, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 6th edition 2019.
2. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill, 2nd edition 2015.
3. Concrete Bridge Practice by Dr. V. K. Raina, Tata McGraw Hill; 4th edition 2014.

IS Code and Specifications
1. IRC 6 – 1966 "Standard Specifications and Code of Practice for Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi
2. IRC 21 – 1966 "Standard Specifications and Code of Practice for Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
3. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi.
4. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi

Program:	B. Tech. (Civil Engineering)		Semester:	VII/VIII Scheme A/B	
Course:	Air Transportation and Bridge Engineering (PEC-V)		Code:	BC17501D/ BCI8501D	
Teaching Scheme				**Evaluation Scheme**	
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Fundamental knowledge of types of Transportation.
2. Fundamentals of land use zoning and Geotechnical engineering.
3. Functions of elevated structures

Objectives:
1. To aware the students with the concept of airport planning and orientation of runways
2. To introduce the students to the design aspects of Taxiways, Heliports and landing instrumentation.
3. To propagate the design criteria for bridge and its components
4. To integrate the conventional/modern techniques for erection and maintenance of bridges

Outcomes:
After learning the course, the learners should be able to:
1. Describe the airplane components-characteristics and orient the runway as per recommendations.
2. Apply the knowledge to plan for taxiways,heliports and landing aids.
3. Classify the types of bridges as per loadings and design characteristics.
4. Demonstrate design parameters for erection and maintenance of Bridges.

Detailed Syllabus		
Unit	Description	Duration(H)
1	**Airport Planning and Runway Orientation**: Airplane: components and important technical terms, Airport Classification and components, (ICAO, FAA, AAI, IATA) – Roles and Responsibilities, Aircraft characteristics,Selection of sites; Survey and drawings to be prepared for airport planning, Characteristics of airport layout, R/W configuration, Zoning Requirements, Runway orientation, wind coverage, use of wind rose diagram, R/W length correction as per ICAO-FAA recommendations	07
2	**Taxiways, Heliports and Landing Systems:** Taxiways – Concept, types, design criteria, Airport Lighting, Heliports: Helicopter characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, Heliport marking and lighting, Airport Navigation (Future Air Navigation System) and landing aids, overview of Air Traffic Control (ATC) systems.	08
3	**Bridge Components and Design Criteria :** Classification and types of bridges, Site selection and investigation, Bridge alignment and controlling factors, Technical terms: linear waterway, economic span, afflux, scour depth, effective width, Components of Bridge; Sub and Superstructure, Introduction to functions and types of Abutment, Wingwalls, Foundation, Bearings.	07
4	**Erection and Maintenance of Bridge** Temporary and Permanent bridge, Causeway: Erection techniques and use, Merits and demerits of prestressed bridge, Culverts: Types and functions, Steps involved in Bridge construction, Bridge inspection, Reasons for Failure of Bridges, Maintenance of Bridge: Types and Techniques, Introduction to Modern trends in erection and maintenance of bridge structures.	08
	Total	30

Text Books:
1. Airport planning and Design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee, 6th Edition, 2019.
2. Airport Engineering by Rangwala, Charotar Publication, 17th Edition 2019.
3. Bridge Engineering by Rangwala, Charotar Publication, 17th Edition 2023.

Reference Books:

1. Ashford, N., and P. H. Wright. Airport Engineering, 3rd ed. New York: John Wiley & Sons, 1992
2. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi, 2017.
3. Bridge Engineering by Ponnuswamy, Mcgraw Hill Publication , Third Edition, 2017
4. Airport Engineering, by Saxena S.C., CBS Publishers & Distributors, 2017

Standard Codes:

1. Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902
2. Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000
3. https:///panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridgesdirect-download-links-from-panchayatraj-engineers-blog
4. Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.
5. International Civil Aviation Organization (ICAO). International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention on International Civil Aviation, Volume 1 Aerodrome Design and Operations, 3rd edition, International Civil Aviation Organization, 2004.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/107/105107123/
2. https://onlinecourses.nptel.ac.in/noc22_ce63/preview
3. https://onlinecourses.nptel.ac.in/noc22_ae14/preview
4. https://archive.nptel.ac.in/courses/105/105/105105107/

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Watershed Management (PEC VI)			Code:	BCI7502A /BCI8502A		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Fluid mechanics 2. Hydrology and Water Resource Engineering

Course Objectives:
1. To promote the knowledge on integrated watershed management and sustainable management of groundwater resources.
2. To build the concept of soil erosion and sediment erosion management.
3. To make aware of surface water management.
4. To acclimatize students with the watershed modeling framework.

Course Outcomes:
After learning the course, the students should be able to:
1. Determine the concepts of watershed planning and management
2. Classify the technologies for development of integrated watershed plan
3. Develop the approaches in management of Groundwater resources
4. Estimate land erosion and sedimentation
5. Classify surface water management concepts
6. Develop concepts of watershed modelling

	Detailed Syllabus:	
Unit	**Description**	**Duration (H)**
1	**Introduction and basic concepts** Concept and characteristics of watershed, principles of watershed management, hydrology and water availability, surface water, groundwater, conjunctive use, human influence in water resources system, people participation in watershed management, National programs on watershed management	08
2	**Integrated Watershed Management** Concept, principle, objectives and importance, components of integrated watershed management, technologies for the management of watershed, holistic sustainable watershed management, Integrated watershed management in India.	07
3	**Sustainable management of groundwater resources** Introduction, groundwater situation in India, challenges, prospects, approaches of groundwater management, water quantity and quality management, scientific development of groundwater resources, National project on Aquifer Mapping and Management(NAQUIM),Atal Bhujal, Yojana.	07
4	**Soil Erosion Modeling** Introduction, sediment erosion and transportation, soil erosion and degradation, estimation of soil erosion, Universal Soil Loss Equation (USLE),soil erosion in India, management of sediment and soil erosion, reservoir sedimentation management, benefits of soil conservation.	08
5	**Surface Water Management** Storm water management, design of drainage system, flood control and reservoir operation, Interlinking of rivers and Interbasin Water Transfer(IBWT) in India, National River linking Project (NRLP) – objectives, components, benefits of NRLP.	08
6.	**Watershed modeling** Introduction, types of watershed models, standard modeling approaches, hydrologic process, modeling of rainfall runoff process ,SWAT model, subsurface flows and groundwater flow	07
	Total	45

Text Books:

1. Watershed Management by J. V.S. Murthy, 2nd Edition, New Age International (P) Ltd, 2004.

2. Hydrology and Management of Watersheds by Kenneth N. Brooks,Peter F. Ffolliott, 4th Edition, John Wiley & Sons, 2012.

3. Water Resources Management and Modelling, Purna Nayak,eBook (PDF) ISBN 978-953-51-6159 ,2012.

Reference Books:

1. Watershed Management , Guide lines for Indian Conditions byE. M. Tideman, Omega Scientific Publishers, 2012.

2. Hydrology and Soil Conservation Engineering,Ghanshyam Das, Prentice Hall India.

3. Watersheds – Process,Assessment and Management,Paul A. DeBerry,John Wiley & Sons

4. Numerical Groundwater Hydrology,Ashok Kumar Rastogi,Penram International Publishing,2012

E-Resources

1. https://www.mygov.in/group/watershed-management-

2.https://www.india.gov.in/integrated-watershed-management-programme-ministry-rural-development

3.NPTEL :: Civil Engineering - NOC:Groundwater hydrology and management

Program:	B. Tech. (Civil Engineering)		Semester:	VII/VIII Scheme A/B
Course:	Construction contract and legal aspects in construction (PEC-VI)		Code:	BCI7502B/ BCI8502B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Objectives:
After Completing this course, student will have adequate background to understand and solve the problem involving:
1. Knowledge for preparing construction contracts clauses.
2. Contractual and tender documents satisfying need of project.
3. Exhibit role and responsibilities of Arbitrator for resolution of disputes in construction projects.

Outcomes:
After learning the course, the students should be able to:
1. Understand Administrative Procedures
2. Prepare construction contracts clauses and conditions.
3. Explain Conditions of Contracts & Construction Claims.
4. Identify role and responsibilities of Arbitrator in contract execution
5. Understand Tenders & Bidding process for BOT &Global Tendering including Documentation and Risk Identification.

	Detailed Syllabus:	

Unit	Description	Duration(H)
1.	**Administrative Procedures:** Methods of Executing Works: PWD procedure of work execution, administrative approval, budget provision, technical sanction. Construction Administration, Organizational Structure, Lines of Authority on Construction Projects, Responsibility, Staffing Responsibilities, Methods of execution of minor works in PWD: Piecework, Rate List, Daily Labour. Introduction to registration as a contractor in PWD	8
2.	**Construction Contracts Formation:** Indian Contract Act (1872) :Definition of the contract as per the ACT. Valid, Voidable, Void contracts, Objectives of the act.(from model 5) Clauses 1 to 75- Contract formation, contract performance, valid excuses for non-performance, Breach of contract, effects of breach- understanding the clauses and applying them to situations/scenarios on construction projects.	7
3.	**Conditions of Contracts & Construction Claims :** Construction Claims: Extra items and causes of claims. Types of construction claims, documentation, Conditions of contract with respect to various parameters .Case study	7
4.	**Alternative Dispute Resolution & Arbitration :** Disputes – Settlement through arbitration Indian Arbitration Act 1940 – Clauses and advantages of arbitration. Alternate Dispute Resolution methods- mediation, conciliation, arbitration and Dispute Resolution Boards.	8
5.	**Tenders & Bidding process :** Tenders: Definition. Methods of inviting tenders, tender notice, bidding procedure, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, Pre-bid conference, acceptance/rejection of tenders. Various forms of BOT &Global Tendering, E- tendering.	7
6.	**Documentation and Risk Identification :** Familiarization with construction documents, Certainty, Risk and Uncertainty, Risk Management, Identification and Nature of Construction Risks, Contractual allocations of Risk, Types of Risks, Minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Control of Quality in Construction.	8
	Total	45

Text books:
1. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
2. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.

Reference Books:
1. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency.
2. Arbitration, Conciliation and Alternative Dispute Resolution Systems- Dr. S.R. Myneni- 2004 Edition, reprinted in 2005- Asia Law House Publishers.
3. Standard General Conditions for Domestic Contracts- 2001 Ministry Of Statistics and Program Implementation, Government of India.
4. FIDIC Document (1999).

E-Resources:
1. www.drbf.org. Dispute Resolution Board foundation manual -

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Structural Dynamics (PEC – VI)			Code:	BCI7502C/ BCI8502C		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Fundamental concept of physics, Engineering Mechanics, and Earthquake Engineering.
2. Mathematics: ordinary differential equations.

Course Objectives:
1. To introduce the fundamental concepts of structural dynamics.
2. To impart knowledge of mathematical modeling.
3. To obtain solutions for the dynamic response of single degree of freedom systems.
4. To obtain solutions for the dynamic response of multi degree of freedom systems.
5. To introduce the fundamental knowledge of mode analysis and methods used.
6. To impart knowledge of the free and forced vibration response of structural systems.

Course Outcomes:
After learning the course, the students should be able to:
1. Apply the concepts of dynamics of structural systems.
2. Prepare mathematical models for different types of vibration problems.
3. Apply computational methods to solve the problems of single degree of freedom systems.
4. Formulate, and solve the dynamic response of the multi degree of freedom systems.
5. Classify mode shapes and analyze structural systems.
6. Analyze and interpret the free and forced vibrations response of structural systems.

	Detailed Syllabus	
Unit	**Description**	**Duration (H)**
1	**Single-Degree-of-Freedom System:** Types of vibration, Degrees of freedom, Analysis models, Equations of motion, Free vibration, Damping, Types of damping Logarithmic Decrement.	06
2	**SDOF subjected to harmonic loading:** Solution to undamped and damped harmonic excitation, Bandwidth method, Response to support the motion, Force transmitted to the foundation.	07
3	**SDOF subjected to general loading:** Duhamel's Integral, Application to simple loading cases, Numerical evaluation of response integral, Piecewise exact method, Newmark Beta Method.	08
4	**Multi-Degree-of-Freedom System I:** Selection of DOFs, Formulation of Equation of motion, Structure matrices, Static condensation, Free vibration as Eigenvalue problem, Frequencies, Mode Shapes, Determination of natural frequencies and mode shapes, Orthogonality conditions .	08
5	**Multi-Degree-of-Freedom System II:** Fundamental mode analysis, Rayleigh method, Response of MDOF systems to dynamic loading, Numerical evaluation of modal equations by Newmark's-Beta method, Mode superposition Method.	08
6	**Structures Modeled with Distributed Properties:** Distributed-Parameter Systems, Partial differential equations of motion, Free and forced vibrations, Application to beams in flexure.	08
	Total	**45**

Text Books:
1. Elements of Earthquake Engineering by Jaikrishna, A.R. Chandrashekharan, Brijesh Chandra. Standard Publishers & Distributors, 2nd edition 2019
2. Dynamics of Structures by Madhujit Mukhopadhyay. Ane Books Pvt Ltd, 2015

Reference Books:

1. Dynamics of structures by R.W. Clough and J. Penxiene. McGraw-Hill Pub, 2nd edition 2015.
2. Structural Dynamics by Roy Craig, Andrew J. Kurdila. John Wiley & Sons, 2nd edition 2006.
3. Dynamics of Structures – Theory & Application to Earthquake Engineering by A.K. Chopra. Prentice Hall Publications, 5th edition 2016
4. Structural Dynamics – Mario Paz, Young Hoon Kim. Springer, 6th edition 2018

E-Resources:

1. https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-ce32/
2. https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ce64/
3. https://courses.degreetutors.com/the-structural-dynamics-course-bundle
4. Welcome to Virtual Labs - A MHRD Govt of india Initiative (vlabs.ac.in)

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester :	VII/VIII Scheme A/B		
Course:	Advanced Foundation Engineering (PEC – VI)			Code:	BCI7502D/ BCI8502D		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Engineering Geology (Subsurface Investigation)
2. Geotechnical Engineering (Index and Engineering Properties of soil)
3. Foundation Engineering (Basic Concepts)
4. Advanced Geotechnical Engineering (Index and Engineering Properties of soil)

Course Objectives:
1. To impart the knowledge of design of different foundations.
2. To get acquainted with different types of foundations.
3. To make aware of ground improvement techniques, sheet pile walls and cofferdams.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain different IS code provisions of subsoil exploration for various structures.
2. Design raft foundations for different types of soils..
3. Design pile foundation and under reamed piles for tensile loads..
4. Recognize the concepts of machine foundations.
5. Explain the different ground improvement techniques and their significance.
6. Classify the types of cofferdams and sheet piles and their applications.

	Detailed Syllabus	
Unit	Description	Duration (H)
1	**Introduction:** IS code provision in respect of subsoil exploration for dams, canals, tunnels, off shore structure, air ports and bridges. IRC, provisions for exploration in respect of roads. Case studies of failures of foundation.	07
2	**Raft foundations:** Types of rafts, Bearing capacity and settlements of raft, Design considerations and I.S. Code method of analysis, De sign of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement.	08
3	**Pile Foundations:** Design of pile based on cyclic load test, Study of provision made in different IS codes related to deep foundation, Testing and Design of piles subjected to tensile loads; Design of under reamed pile foundation subjected to tensile loads.	08
4	**Machine Foundations:** Types of machine foundations, mathematical models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.	07
5	**Ground Improvement:** In-situ ground improvement by compaction piles, dynamic loads, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation, Design of sand drains and stone columns.	08
6	**Sheet Pile walls and Cofferdams:** Types and uses of sheet piles, design of cantilever sheet pile walls in granular and cohesive soils, anchored bulkhead, free earth support and fixed earth support method, Types and uses of cofferdams.	07
	Total	**45**

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 Foundation".
2. IS: 2950 (Part 1) – 1981"Code of Practice for design and construction of raft foundations".
3. IS 2911 (Part 1) – 2010 "Code of Practice for Design and Construction of Pile Foundation".
4. IS 2974 (Part 1) – 1982 "Code of Practice for design and construction of machine foundations".

e –Resources:
1. https://archive.nptel.ac.in/courses/105/105/105105207/
2. https://onlinecourses.nptel.ac.in/noc22_ce32/preview

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Estimation, Costing and Tenders Lab			Code:	BCI7423/ BCI8423		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
2	-	2	1	25	25	-	50

Prior Knowledge:
1. Building Planning, Construction & Materials
2. Design of Reinforced Concrete Structures

Course Objective:
After Completing this course, student will have adequate background to understand and solve the problem involving :
1. Understanding various methods of estimation
2. Knowledge of valuation & its methods.
3. Analyzing the rate of various materials and labours based on current market rates of materials and wages of labours.
4. Understanding tendering system

Course Outcomes:
After learning the course, the students will be able to:
1. Analyze quantities of various items of work and cost of construction
2. Analyze value of property by different methods.
3. Draft specifications and analyze rates of various items of work based on material & labour charges.
4. Select appropriate bidder for tendering process

Lab Experiments / Assignments:
1. Working out quantities using C-L and PWD method for a small single storied load bearing structure and working out cost of building using SSR(Regional)
2. Detailed estimate of a two storied R. C. C. framed building using S.S.R
3. Working out quantities of steel reinforcement for a column footing, a column, a beam, stairs with waist slab and a RCC slab by preparing bar bending schedule.
4. Estimating quantities for any one of the following:
    a) community well   b) Underground Water Tank   c) Pipe Culvert,
    d) Earthwork for road project   e) Septic tank
5. Drafting detailed specifications of any 2 items of building & analyzing their rates based on prevailing market.
6. Drafting of tender notice for Building Structure as per Assignment No 1 or 2.
7. Preparation of tender documents for the problem No.1 or 2
a) Tender Notice.
b) Schedule A and Schedule B
c) Conditions of contracts regarding time- cost over run, extra items etc
8. Report on contents and use of current SSR.
9. Valuation report O1 Farmat.

Text Books:
1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N. Dutta – S. Dutta & Company, Lucknow. 27 th Edition 2020.
2. Estimating, Costing Specifications & Valuation in Civil Engineering: M. Chakraborty. 11th Edition 2020
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand 17th Edition 2017
1. Building and Engineering Contracts by B.S.Patil , 7th Edition CRC Press 2019

Reference Books:
1. Theory and Practice of Valuation: Dr. Roshan Namavati, Lakhani Publications 2016
2. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.2010
3. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO- CARE, 2010

IS Code:
1. IS 1200- Measurement rules for Items of work
2. IS 650 – 1991- Specification for standand sand testing
3. IS 14032 – 1988- Specification for standand Cement testing
4. IS 2386 (Part I To VIII) 1963- Methods of testing Aggregates
5. IS 3495 (Parts I TO iv) 1976- Methods of Tests for Burned Bricks
6. IS: 2720 (Part. XIII) 1986, IS:2720 (Part.30) 1980- Methods of Tests for Soil

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Design of Steel Structures Lab			Code:	BCI7424/BCI8424		
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
4	-	4	2	50	25	-	75

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. Design the Structural components of Industrial building
    2. Structural drawings

Course Outcomes:
After learning the course, the students should be able to:
1. Classify the types of structural steel and rolled steel sections given in Steel Table.
2. Apply design concept of structural components of Industrial buildings as per IS:800 2007.
3. Apply knowledge to Prepare Structural drawings showing details of different elements of the buildings as per SP:38.

Detailed Syllabus

Term work consists of a journal containing the following assignments, and site visit report. Note: Sr. No. 01 to 03, 05 and 08 are compulsory and any one from Sr. No.06 and 07. Term work consists of following experiments, assignment, and report of site visit. Term work marks will be based on continuous assessment.

Full imperial size hand drawn drawing sheets on
Part A
1. Types of structural steel sections, stress strain curve for steel.
2. Types of Trusses & truss member connection.
3. Types of joints, types of connections
4. Structural details of column and beam splices

Part B
5. Design of industrial building including roof truss, purlins, bracings, column, column base and connections. Analysis of truss by using software and cross check manually. Full imperial size hand drawn drawing sheets presenting the design details.

Part C
6. Assignment on Design of any one structural component using excel Programming.
7. Analysis of P re-engineered Industrial shed using software.
8. Report of a site visit mentioning structural details with relevant sketches of structural connections

Text Books:
1. Negi, B.S. "Design of Steel Structures", Tata McGraw Hill India, 1995.
2. Shah & Gore, "Limit State Design of Steel Structures".
3. M. R. Shiyekar, "Limit State Design of Steel Structures".

Reference Books:
1. S. S. Bhavikatti "Design of Steel Structures" I. K. International publishing House Pvt. Limited (2009)
2. Ram Chandra. "Steel Structure Vol. I & II", Standard Publishers; Delhi (2013)
3. Gaylords, E.H. &Gaylords, C. N. "Design of Steel Structures", McGraw Hill Publication, 1998.
4. N. Subramaniam, "Design of Steel Structures as per IS:800-2007", Oxford university press.
5. S. K. Duggal, "Limit State design of Steel Structures:, McGraw Hill Education Private Limited 2010.

IS Codes:

1. SP: 6 (1995) : Handbook for Structural Engineers
2. IS 800 (2007) General Construction in Steel — Code of Practice
3. IS 808 (1989) Dimensions for Hollow Rolled Steel Beam, Column, Channel and Angle Sections
4. IS 875 (Part-I)-1997 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 1 : Dead Loads — Unit Weights of Building Materials and Stored Materials (Reaffirmed 1997).
5. IS 875 (Part-II)-1987 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 2 : Imposed Loads(Reaffirmed 1997).
6. IS 875 (Part-III)-2015 – Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 3 : Wind Loads.
7. IS 875 (Part-IV)-1987 Code of Practice, for Design Loads (Other Than Earthquake) for Buildings and Structures Part 4 : Snow Loads (Reaffirmed 1997).
8. IS 875 (Part-V)-1987 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 5 : Special Loads and Combinations (Reaffirmed 1997)
9. IS 812 2008 Code of Practice for Glossary of terms relating to welding and cutting of Metals.
10. IS 813:2008 Code of Practice for Scheme of symbols for welding.
11. IS 817(Part 1):2008 Code of practice for Manual metal arc welding
12. IS 817(Part 1):2008 code of practice for Oxyfuel welding

E-Resources

1. https://archive.nptel.ac.in/courses/105/105/105105162/#
2. https://www.insdag.in/

Program:	B. Tech. (Civil Engineering)		Semester:	VII/VIII Scheme A/B
Course:	Air Pollution and Control Lab (PEC-V)		Code:	BCI7503A/ BCI8503A

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives:
1. To impart the knowledge of sampling and analysis of ambient air for particulate and gaseous pollutants concentration.
2. To impart the knowledge of laws and regulation related to air pollution control.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the laws and regulations related to air pollution control.
2. Perform the sampling and analysis of ambient air for particulates and gaseous pollutants.
3. Explain working of air pollution control devices.

Detailed Syllabus

Term work consists of a journal containing details of assignments and visit report (Any 8, one site visit compulsory)

1. Presentation (in a group of four) on laws and regulations related to air pollution control.
2. Report / Case Study on use of modern technologies to curb the air pollution (RS & GIS, new inventions, etc.)
3. Site Visit to Indian Meteorological Institute (IMD) or Indian Institute of Institute of Tropical Meteorology
4. Site Visit to any industry to study the pollution control device
5. Sampling and Analysis of PM10 and PM2.5 using (High Volume Sampler/ Fine Dust Sampler) in Ambient Air
6. Sampling and Analysis of SO_2 and NO_2 (High Volume Sampler/ Fine Dust Sampler) in Ambient Air
7. An interactive session with experts from Indian Institute of Tropical Meteorology/ Central Pollution Control Board/ State Pollution control board/ Municipal corporation or Nagar Panchayat/ smart city centers/ National Environmental Engineering Research Institute (NEERI)/any authority with reference to air quality and its report.
8. Exercise on software for air quality modelling (Screen3/ ISC/ CALINE4/ HIWAY2/ CAR-FMI/ OSPM/ CALPUFF/ AERMOD/ ADMS)
9. Demonstration of sampling and analysis of indoor air quality
10. Demonstration of sampling and analysis of sample collected through stack.

Text Books:
1. Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015
2. Air Pollution, M. N. Rao and H. V. N. Rao, 58th Edition, McGraw-Hill Education, 2020
3. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.2017

Reference Books:
1. Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010
2. Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., 4th Edition, Academic Press, 2008.
3. Atmospheric Chemistry and Physics, Seinfeld, J.H., Pandis, S.N., 3rd Edition, John Wiley, 2016.

E-Resources
1. http://cpcb.nic .in https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf
2. http://moef.nic .in https://moef.gov.in/en/division/environment-divisions/climate-changecc-2/documents-publications/

Program:	B. Tech. (Civil Engineering)		Semester:	VII/VIII Scheme A/B
Course:	Construction Techniques and Retrofitting System Lab (PEC-V)		Code:	BCI7503B/ BCI8503B

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives :
To impart broad knowledge in the area of Construction techniques and retrofitting of structures

Course Outcomes:
After learning the course, the students should be able to:
1. Recommend the suitable techniques for sub and super structure construction.
2. Apply the knowledge to select repair and retrofitting technology for RC structure.

<table><tr><td align="center">Detailed Syllabus</td></tr></table>

Term work consists of assignments and visit report (Any 8 of following).

1. Assignment on pile construction techniques
2. Assignment on shoring techniques *or* no dig techniques
3. Assignment on ground improvement technique
4. Assignment on soil drainage *or* grouting technique
5. Individual field visit report of formwork system *or* any advance super structure construction system.
6. Assignment on rigid pavement *or* bridge construction technique.
7. Assignment on repair or rehabilitation technique.
8. Assignment on any retrofitting system.
9. One case study presentation individual/group on any of the advanced construction technology.
10. Visit report which explores the construction technology practical aspects or Exhibition visit report related to construction techniques.
11. Preparation of model *or* e-poster related to any advance construction/retrofitting technology.
12. Write a review on any recent research article from standard peer-reviewed journal on any topic related to syllabus content.

Text Books:
1. Construction techniques and practices by Dr.V.Kannan, first edition, V. Kannna publication, 2021.
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020
3. Construction Techniques and Practice by V. SankaraSubramaniyan from Lakshmi Publications, 2017
4. Construction Technology, Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008.

Reference Books:
1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication
2. Modi, P.I., Patel, C.N., Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi, 2016.
3. CPWD Handbook (2011). Repair and Rehabilitation of RCC Buildings.
4. ACI 201.1R-08: American Concrete Institute, Guide for Conducting a Visual Inspection of Concrete in Service
5. ACI RAP-11-American Concrete Institute , Field Guide to Concrete Repair Application Procedures
6. Dyer, Thomas. (2014). Concrete Durability, CRC Press, Taylor & Francis Group, Florida.

E-Resources
1. https://nptel.ac.in/courses/ground improvement techniques
2. https://nptel.ac.in/courses/ Construction methods and equipment management
3. https://archive.nptel.ac.in/courses/105/105/105105213/
4. https://www.cecr.in/

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Design of RC Bridges Lab (PEC – V)			Code:	BCI7503C/ BCI8503C		
Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives:
1. To provide an understanding of various loads acting on the bridges and design of RCC bridge superstructure.
2. To introduce the analysis and design of RC bridge substructure components.

Course Outcomes:
After learning the course, the students should be able to:
1. To calculate the loading of the RC bridge and design the RCC deck slab and girders.
2. To analyze and design bridge pier, abutment, and bearings.

Detailed Syllabus

Term work consists of a journal containing details of assignments and a visit report (Any 08 assignments and a site visit report are compulsory).

1. Bridge Deck Analysis
2. Design of RC slab bridge.
3. Design of slab culvert
4. Design of longitudinal and cross girders as per Courbon's theory
5. Design of post-tensioned prestressed concrete T-beam bridge deck and girders.
6. Design of steel girder.
7. Design of Pier.
8. Design of the Abutment.
9. Expansion joints (Types and Requirements)
10. Site visit / Industrial visit report (Study of structural drawing and details)
11. Analysis and design of bridge using the software.

Text Books:
1. Principles and Practice of Bridge Engineering- S P Bindra Dhanpat Rai & Sons New Delhi, 2012.
2. Reinforced Concrete Structures – Vol. II by Dr. B. C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications, 2018.

Reference Books:
1. Essentials of Bridge Engineering by D. Johnsons Victor, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 6th edition 2019
2. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill, 2nd edition 2015.
3. Concrete Bridge Practice by Dr. V. K. Raina, Tata McGraw Hill; 4th edition 2014.

IS Code and Specifications
1. IRC 6 – 1966 "Standard Specifications and Code of Practice for Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi.
2. IRC 21 – 1966 "Standard Specifications and Code of Practice for Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi.
3. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi.
4. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi.

E-Resources:
https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ce43/
https://www.udemy.com/course/concrete-bridges-design-fundamentals/

Program:	B. Tech. (Civil Engineering)			Semester:	VII/VIII Scheme A/B		
Course:	Air Transportation and Bridge Engineering Lab (PEC – V)			Code:	BCI7503D/ BCI8503D		
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives :
1. To impart the knowledge related to the technical aspects of air transportation.
2. To make the students aware about various types of bridges and its components.

Course Outcomes: After learning the course, the students should be able to:
1. Identify the various airplane components.
2. Apply the aspects to plan for the airport features
3. Describe the bridge components and allied phenomenon.

Detailed Syllabus

Lab assignments:
A. Compulsory assignment

1. Examples based on Runway design for length and related corrections
2. Drawings of various types of Bridge and its components
3. Assignment based on Wind rose type 1 and type 2 diagrams for runway orientation

B. Any five from the following

1. A Digital Report/PPT on study of recent trends in airport planning and design.
2. Assignment based on Selection criteria of bridge site, alignment and collection of design data.
3. Site visit to bridge site or airport site (report on visit)
4. Seminar on one topic of building information modeling (BIM) systems.
5. Report on guest lecture in applications of AR and VR/ in Airport or bridge engineering OR Report on guest lecture in airfield pavement construction.
6. Prepare the drawing/plate (A3)/PPTs on airport marking and lighting. (Describing importance)
7. PowerPoint presentation on bridge substructure and superstructure and Bridge types.

Textbooks:
1. Airport planning and Design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee, 6th Edition (2019)
2. Airport Engineering by Rangwala, Charotar Publication, 17th Edition (2019)
3. Bridge Engineering by Rangwala, Charotar Publication, 17th Edition (2023)

Reference Book:
1. Ashford, N., and P. H. Wright. 1992. Airport Engineering, 3rd ed. New York: John Wiley & Sons
2. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi. (2017)
3. Bridge Engineering by Ponnuswamy, Mcgraw Hill Publication (2008)
4. Airport Engineering, by Saxena S.C., CBS Publishers & Distributors, (2017)

Standard Codes:
1. Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902
2. Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000
3. https:///panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridgesdirect-download-links-from-panchayatraj-engineers-blog
4. Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.
5. International Civil Aviation Organization (ICAO). International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention on International Civil Aviation, Volume 1 Aerodrome Design and Operations, 3rd edition, International Civil Aviation Organization, 2004.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/107/105107123/
2. https://onlinecourses.nptel.ac.in/noc22_ce63/preview
3. https://onlinecourses.nptel.ac.in/noc22_ae14/preview
4. https://archive.nptel.ac.in/courses/105/105/105105107/

Open Elective-5
Final Year B Tech
Civil Engineering
Semester-VII/VIII
Scheme A or B

Open Elective 5 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII/VIII** **Scheme A/B**	
Course:	**E- waste management (OEC-5)**				**Code:**	**BCI7605A/BCI8605A**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
1. Fundamentals of Environmental Engineering.
2. Fundamentals of Sustainable Engineering.

Course Objectives:
1. To impart knowledge of e-waste in Indian and Global scenarios and role of engineering in e-waste management.
2. To build the concept of the role and responsibility of different stakeholders in the e-waste business.
3. To make aware of e-waste legislation (Acts and guidelines)
4. To get acquainted with recycling and recovering technologies.
5. To create awareness on e-waste global trade.
6. To impart knowledge of the circular economy and e-waste for a sustainable future.

Course Outcomes:
After learning the course, the students should be able to:
1. Identify the issues and challenges of e-waste management for a sustainable environment.
2. Explain the role and responsibilities of stakeholders and directory bodies for e-waste control measures.
3. Explain legislation (Acts and guidelines) and apply sustainable approaches.
4. Identify the e-waste handling process, recycling, and recovery techniques for a sustainable future.
5. Explain e-waste global trade and economy.
6. Apply a circular economy road map for an e-waste sustainable future.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Electronic and Electrical Waste (e-Waste)** What is E-Waste, Indian and global scenario of e-Waste, Growth of the Electrical and Electronics industry in India and global, Composition and characteristics of e-waste, e-waste pollutants, Possible hazardous substances present in e-waste, Environmental and Health implications-waste disposal issues and challenges for domestic and commercial, Awareness and approach towards E-waste, Role and responsibility of engineering in e-waste management Case Study.	**07**
2	**Electronic and Electrical Waste (e-Waste) control measures** Need for stringent health safeguards and environmental protection laws in India, Regulatory compliance including roles and responsibilities of different stakeholders, Proposed reduction in the use of hazardous substances(RoHS), Extended Producer's Responsibility (EPR) targets Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source. Case Study.	**07**
3	**E-waste Legislation** The regulatory regime for e-waste in India, Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016, e-waste (Management) Amendment Rules, 2018, 2022 .A comprehensive analysis of e-waste legislation worldwide. International Conventions, Regulations and Laws, handling e-waste in developed and developing countries: initiatives, practices, and consequences with a case study. G20 summit 2023.	**07**

4	**Electronic and Electrical Waste (e-Waste) Management** Basic principles of e-waste management, Technologies for segregation and recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India. Reuse of E-waste. Carbon footprint and credits for recycling, Case study on recycling and recovering technology.	**08**
5	**E-waste hazards on Global trade** Essential factors in the global e-waste trade economy, e-waste trading as a quintessential part of electronic recycling, free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India with case study.	**08**
6	**Circular economy and e-waste** Sustainable management of e-waste and circular economy, Achieving UN Sustainable Development Goals (SDGs) and E-Waste, Urban mining towards sustainable future and circular economy, Entrepreneurship and expertise in e-waste, global challenges and opportunities in structured e-waste management. Circular electronics roadmap, Circular economy startup in India with a case study.	**08**
	Total	**45**

Text Books:
1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, Latest edition
2. Electronic Waste Management: Edition 2, by G H Eduljee, R M Harrison, Royal Society of Chemistry 2022, ISBN 978-1-78801-744-2
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books:
1. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017 Elsevier

E-Resources
1. https://cpcb.nic.in/e-waste/
2. https://courses.iid.org.in/course/e-waste-recycling-business
3. https://www.suritex.co.in/
4. http://greenscape-eco.com/
5. https://onlinecourses.nptel.ac.in/noc20_ce12/preview
6. https://nielit.gov.in/gangtok/content/paid-course-e-waste-management

Department of Civil Engineering

Open Elective 5 offered by Civil Department to other department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VII/VIII Scheme A/B	
Course:	Advanced Instrumentation in Infrastructural Engineering (OEC-5)				**Code:**	BCI7605B/ BCI8605B	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Knowledge of fundamentals of Infrastructure engineering
2. Knowledge of fundamentals of geotechnical and transportation engineering

Course Objectives:
1. To impart knowledge of advanced instruments used in Road Infrastructure
2. To Identify the advancement in various modes of transportation
3. To make aware of the scope of various instruments in monitoring fields.
4. To get acquainted with sensors and transducers.

Course Outcomes:
After learning the course, the students should be able to:
1. Elaborate the role of various agencies involved in building road infrastructure and allied areas
2. Explain different attributes related to urban transportation
3. Analyze the various tools and measures to delineate with the traffic conflicts in an urban city
4. Determine the properties of soils using various advanced instruments.
5. Apply the knowledge of instruments in various monitoring fields.
6. Discover the additional attributes in advanced sensors and their role in Civil Engineering.

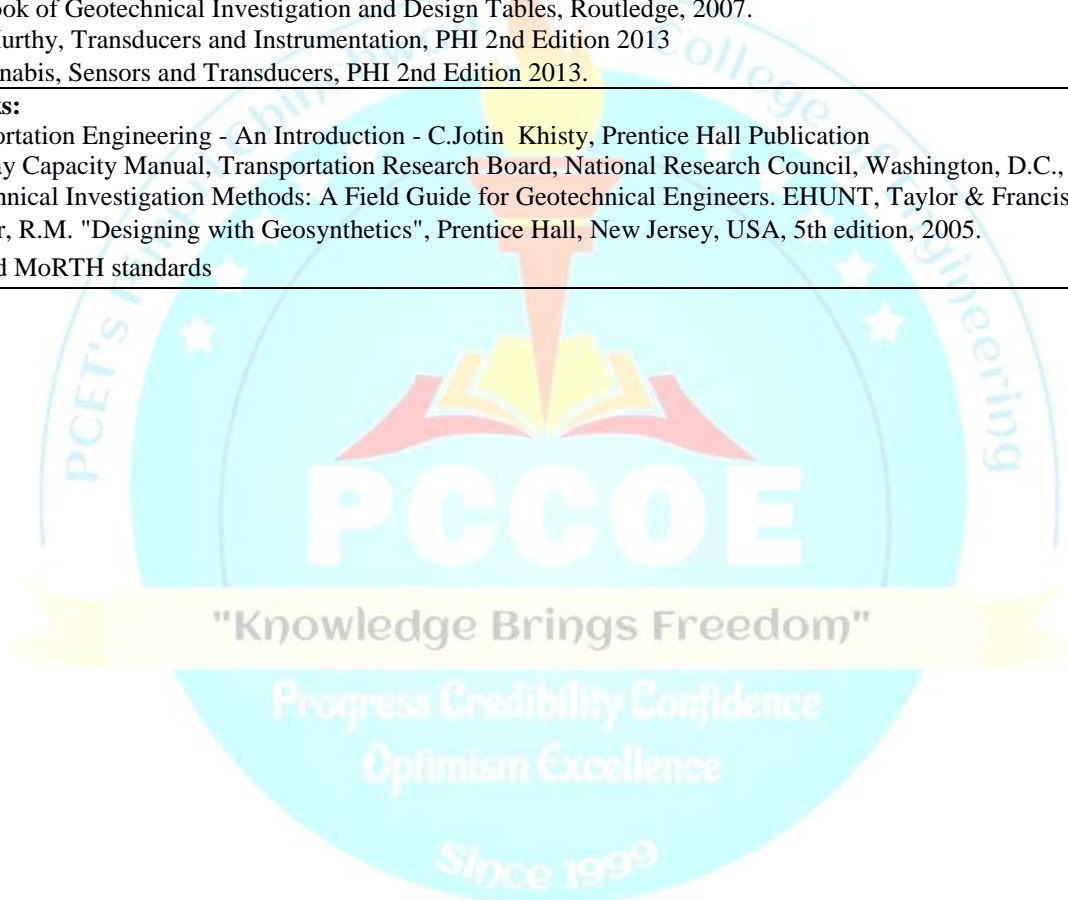| Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Pavement Infrastructure** Introduction to pavement infrastructure, Types of pavement (Flexible, Rigid and Composite), IRC (Indian Roads Congress)and MoRTH (Ministry of Road Transport and Highways) guidelines, Role of National Highway Authority of India in pavement construction, Advanced Instrumentation in Pavement construction, Modern Modes of Transportation (Road, Rail, Air and Water transportation)	07
2	**Urban Public Transportation** Urban growth and public transport needs – Transit mode classifications -Transit characteristics- Demand estimation- Frequency & Fleet size determination, Advanced Survey Instruments Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design. Types of Road Markings,Traffic Impact Attenuators, Safety Barriers, Traffic signals: types and principles of phasing	09
3	**Traffic Monitoring and Control** Traffic Studies: Basic characteristics of Traffic, Volume, Speed and Density, Traffic Volume studies, Speed and Delay studies, Accident Studies and road safety auditing, Traffic calming measures and modern traffic control devices	06
4	**Soil properties using advanced instruments** Pore pressure measurement, Earth pressure cell, Settlement gauges. Inclinometers, Stress measurements, Seismic measurements. Advanced instrumentation in Earthquake resistant structures	07

5	**Scope of Geotechnical Instruments In Various Monitoring Fields** Dam Monitoring Solutions-Water level, Water pressure and seepage, Lateral ground movement, Deformation, Displacement, Stress, Strain, Load Temperature, Tilt, Surface Settlement. Tunnel Monitoring Solutions- Lateral ground movement, Deformation, Displacement, Stress, Strain, Load ,Temperature Tilt, Surface Settlement. Structural Monitoring Solutions- Tilt Monitoring, Crack Monitoring, Settlement Monitoring, Lateral Ground Movement, Temperature Monitoring, Pore Pressure Monitoring.	08
6	**Sensors & Transducer:** Introduction to digital encoding transducer- digital displacement transducers- shaft encoder- optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Infrastructural Engineering.	08
	Total	45

Text Books:
1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
3. 3.ChakrobortyP.,DasN.,Principlesof Transportation Engineering(2nd edition),PHI,NewDelhi,2017
4. Handbook of Geotechnical Investigation and Design Tables, Routledge, 2007.
5. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
6. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.

Reference Books:
1. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication
2. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2010
3. Geotechnical Investigation Methods: A Field Guide for Geotechnical Engineers. EHUNT, Taylor & Francis, .2006.
4. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 5th edition, 2005.
5. IRC and MoRTH standards

Open Elective 5 offered by Civil Department to civil engineering students							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII/VIII** **Scheme A/B**	
Course:	**Massive Open Online Courses (MOOC): (OEC-5)**				**Code:**	**BCI7605C/BCI8605C**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	70	-	30	100

Course Objectives:
1. MOOC courses are introduced to imbibe self learning in students.
2. To prepare students for modern tools and techniques.

Course Outcomes: After learning the course, the students will be able to:
1. Build self-learning skills.
2. Discuss the application of modern tools and techniques in civil engineering.

Guidelines for Students:

1. The MOOC courses can be chosen from the **online platform** such as NPTEL/Coursera/ /Udemy etc.

2. Individual student needs to take approval from project guide for MOOC course and then proceed for registration. MOOC course should be exclusive to courses undertaken by students. (Repetition of Course is not allowed.)

3. While selecting the course, student should be opted for the different courses based on the available latest courses apart from courses offered in the program curriculum.

4. Total duration of course should be 8-12 weeks. (minimum 45 hrs)

5. Regular assignments need to be completed as per requirement of course.

6. Submission of the regular assignments needed as per requirement of course.

7. At the end of course submission of MOOCs report of (3- 4 Pages) in hardcopy is mandatory along with certificate of completion.

8. 50% weightage given to internal evaluation based on assignment submitted and 20% weightage given to MOOC course report (notes). Remaining 30% weightage given to certification of the course as external evaluation by selected platform. Final examination for this course is mandatory irrespective of the platform.

9. If student is not able to earned 3 credit, he/she will be failed in the course, in such case the student can registered or opted for open elective courses floated by department and earned 3 credits in stipulated time frame.

Evaluation Guidelines and Rubrics:

1. **Continuous Internal Evaluation (50 Marks)**

2. **MOOCs report Submission (20 Marks)**

3. **Final Examination Certificate (30 Marks)**

   1. Continuous Internal Evaluation (50 Marks)

   a. Timely completion of assignment (25 marks)

   b. Progress of assignment (25 Marks)

Rubrics for CIA (50 marks)

	Excellent (100 % Weightage) 25	Good (80 % Weightage)	Average (60 % Weightage)	Poor (50-40 % Weightage)
Timely completion of assignment (25 marks)	25	20	15	12
Progress of assignment (25 marks)	25	20	15	12

2. MOOCs report Submission (20 Marks)
The student should summarize learning outcomes in report of 3-4 pages or student may submit good quality paper with some application implemented using the knowledge gained through the course to comply these rubrics:
a. Report must be drafted appropriately (LATEX tool but not compulsory) (10 Marks)
b. Content of the report/ paper (10 Marks)
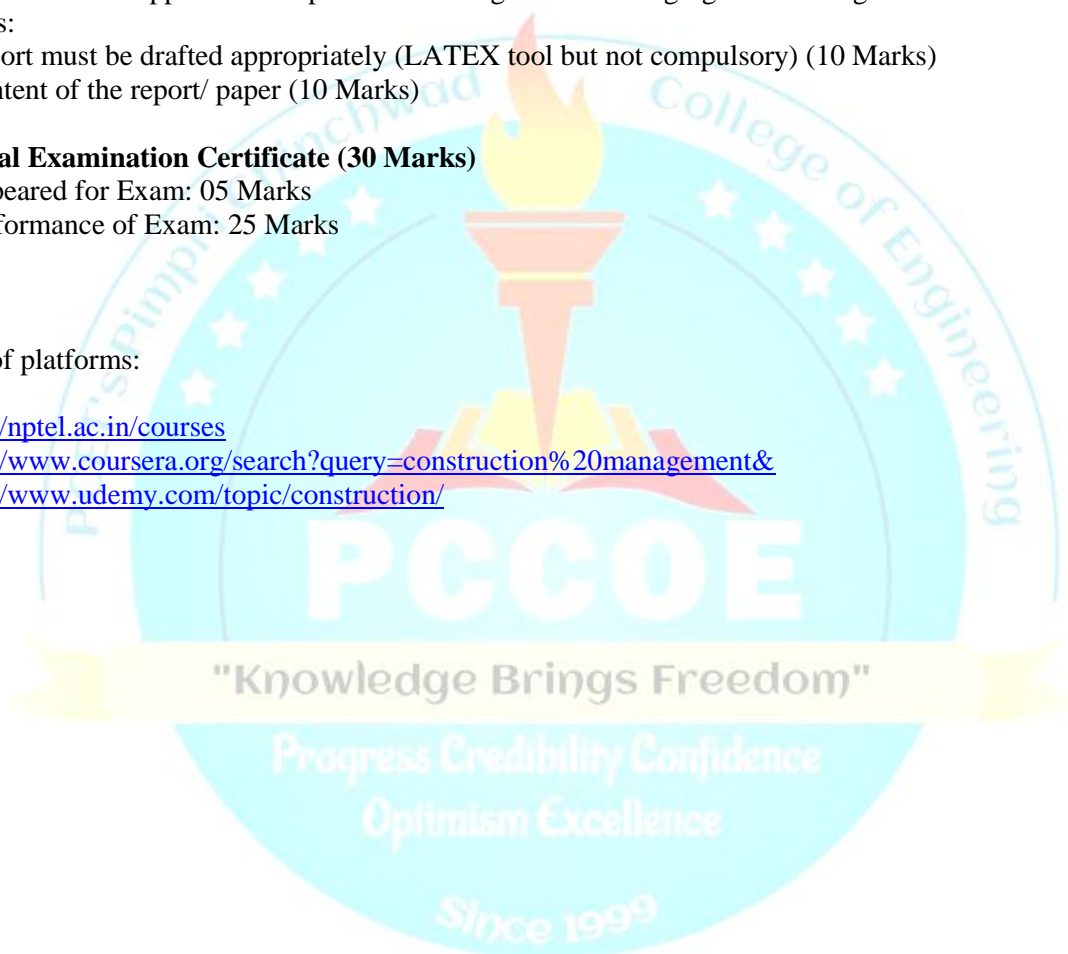
3. Final Examination Certificate (30 Marks)
a. Appeared for Exam: 05 Marks
b. Performance of Exam: 25 Marks

Link of platforms:

https://nptel.ac.in/courses
https://www.coursera.org/search?query=construction%20management&
https://www.udemy.com/topic/construction/

Department of Civil Engineering

Open Elective 5 offered by Computer department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**	**VII /VIII** **Scheme A/B**		
Course:	**Web Technology and its Applications (OEC-5)**			**Code:**	**BCE7607 / BCE8607**		
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior knowledge of
   www- world wide web, HTML

Course Objectives:
1. To understand the basics of Web Designing using HTML, CSS and JavaScript
2. To learn the basics about Client side scripts
3. To learn the basics about Client side framework.
4. To understand the web services and frameworks.

Course Outcomes: After completion of this course students will be able to,
1. Elaborate the behavior of web pages using HTML.
2. Demonstrate the client-side technologies for media in web development.
3. Illustrate the client-side technologies for design/layout in web development.
4. Apply the scripting language for web development.
5. Apply server-side technologies for web development.
6. Use dynamic web applications for advanced web development platforms.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Web Essentials and Mark-up language- HTML** HTML- Basics, List, Tables, Images, Forms, Frames. Designing a webpage in HTML for displaying Boiler readings/ displaying oscilloscope readings/ displaying building plans, etc.	**07**
2	**HTML Media and API** HTML: Media, Video, Audio, YouTube, GeoTag, Drag and Drop. Creating a Web Page and inserting video/audio with controls and AutoPlay. Designing a webpage in HTML displaying the location of your device/ place consisting of GPS.	**08**
3	**Client Side Technologies-CSS** Introduction to cascading style sheets. Inserting CSS in an HTML page, CSS selectors. **Advanced CSS -** Round Corners, Boundary Images, Gradients, Shadows, 2D and 3D transformations. Designing a layout for any application such as displaying readings for an oscilloscope (or any example of your domain).	**07**
4	**Client Side Technologies-XML and JavaScript** XML- Document type definition, XML Schemas, Document Object model. Java Script - Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script. Designing a calculator using JavaScript.	**07**
5	**Server Side Scripting Languages** PHP-Origins and Uses of PHP, Overview of PHP and General Syntactic Characteristics, Primitives, Operations, and Expressions, Output and Control Statements, Arrays, Functions, Basic Pattern Matching, Form Handling, Files Handling, Cookies.	**08**
6	**Current Trends in Web Technology** **Progressive Web Apps**- Case Study FlipBorad, 2048 Game, SoundSlide, **Single-page applications (SPA)** – AngularJS, ReactJS, Vue.js, example- Youtube, Chatbots and virtual assistants, Responsive design, Cloud-based development and deployment	**08**
	Total	**45**

Text Books:
1. Brown, Ethan, "Web Development with Node and Express: Leveraging the JavaScript Stack", O'Reilly Media, 2019.
2. HTML5 Canvas: Native Interactivity and Animation for the Web, 2 nd edition, Steve Fulton, Jeff Fulton · 2013.
3. Web Technologies: HTML, Javascript, Php, Java, Jsp, Asp.Net, Xml And Ajax, Black Book-2009.
4. Achyut Godbole & Atul Kahate :Web Technologies TCP/IP, Web/Java Programming, and Cloud Computing- 2013.
5. Dom Scripting: Web Design with Javascript and the Document, 2nd Edition, Jeremy Keith, Jeffrey Sambells · 2011.

Reference Books:
1. Adam Bretz & Colin J Ihrig, "Full Stack Javascript Development with MEAN", SPD, ISBN-13: 978-0992461256,2014
2. Giulio Zambon, "Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10:1430246235; ISBN-13: 978-1430246237,2012.
3. Jeremy McPeak& Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937,2012
4. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3, 2014.

Web references:
1. https://www.w3.org/html/
2. HTML, The Complete Reference http://www.htmlref.com/
3. http://w3schools.org/
4. http://php.net/
5. https://jquery.com/
6. http://www.tutorialspoint.com/css/
7. https://www.simicart.com/blog/progressive-web-apps-examples/
8. http://www.nptelvideos.in/2012/11/internet-technologies.html
9. https://freevideolectures.com/course/2308/internet-technology/25 video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
10. https://www.digimat.in/nptel/courses/video/106105191/L01.html
11. http://www.nptelvideos.com/php/php_video_tutorials.php

Open Elective 5 offered by Computer department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Software Testing & Quality Assurance (OEC-5)**				**Code:**	**BCE7608 / BCE8608**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior knowledge of
  Software engineering basics

Course Objectives:
1. To study and understand the software development life cycle.
2. To introduce basic concepts of software testing
3. To understand white box, block box, automation and other testing techniques
4. To understand the software quality processes and management.

Course Outcomes: After completion of this course students will be able to,
1. Understand the software development life cycle.
2. Comprehend the software testing basic concepts and terminologies.
3. Demonstrate the different testing types.
4. Demonstrate understanding of automation testing.
5. Outline the test planning and management process.
6. Elaborate the different Software Quality techniques and tools.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Software Development Life Cycle Models** Phases of Software Project, Quality, Quality Assurance, and Quality Control Testing, Verification, and Validation Process, Model to Represent Different Phases, Life Cycle Models	07
2	**Introduction to Software Testing** Goals Of Software Testing, Model for Software Testing, Effective Software Testing Vs. Exhaustive Software Testing, Software Testing As A Process, Software Testing Terminology Definitions	07
3	**Types of Testing** White Box Testing, Static Testing, Black Box Testing, requirement of Black Box Testing, when to do Black Box Testing? Integration Testing, System Testing requirement of System Testing, Challenges in testing. Software Failure case studies (any two)	08
4	**Introduction to test automation** Terms Used in Automation, Skills Needed for Automation, What to Automate, Scope of Automation, Design and Architecture for Automation, Process Model for Automation, Selecting a Test Tool, Challenges in Automation	08
5	**Test Planning and Management** Introduction, Test Planning, Test Management, Choice of Standards, Test Infrastructure Management, Test Process, Test cases & test plan preparation	08
6	**Software Quality Management** Software Quality, Broadening the Concept of Quality, Quality Control And Quality Assurance, Methods Of Quality Management, Software Quality Metrics, SQA Models	07
	Total	45

Text Book:
1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson, 2017.
2. Naresh Chauhan, "SOFTWARE TESTING   Principles and Practices", OXFORD UNIVERSITY PRESS, 2nd edition 2016

Reference Books:
1. Paul Ammann, Jeff Offutt, "Introduction to Software Testing", Cambridge University Press, Dec 2016.
2. Ilene Burnstein, "Practical Software Testing A Process-Oriented Approach", Springer-Verlag New York, Inc., 2006 ISBN 0-387-95131-8

Web References:
1. https://pdfcoffee.com/download/se-4-pdf-free.html

Department of Civil Engineering

Open Elective 5 offered by E& TC to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VII /VIII** **Scheme A/B**	
Course:	**Bio inspired systems and Computing (OEC-5)**			**Code:**		**BET7601/BET8601**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior knowledge of
   1. Data Science and Statistics is essential

Course Objectives:
   1. To explain bio-inspired theorem and algorithms
   2. To demonstrate role of random walk and simulated annealing
   3. To discuss genetic algorithm and differential evolution with their applications
   4. To elaborate use of swarm optimization and ant colony for feature selection

Course Outcomes: After completion of this course students will be able to,
   1. Understand bio-inspired algorithms used in computing.
   2. Implement optimization using genetic algorithms.
   3. Explore role of swam optimization in computing algorithms
   4. Apply bio inspired algorithms in image processing applications.
   5. Describe bio-inspired routing protocols for VANETs
   6. Understand bio-mimetically inspired robot prototype

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction:** Bio-inspired Computing, The influence of brain science on Brain-inspired computing, Development focus of bio-inspired algorithms, Paradigm of evolution of algorithms with increase of complexity of problems. Current Issues in Bio-Inspired Computing	**06**
2	**Genetic Algorithms and Differential Evolution:** Introduction to genetic algorithms, Components of genetic algorithms, Properties of genetic algorithms, Linear genetic programming, Biological vs. artificial evolution. Applications: Prediction of cancer survival	**07**
3	**Swarm Optimization And Firefly Algorithm:** Swarm intelligence - PSO algorithm, Properties of PSO, binary PSO , Types of Swarm-Intelligence-Based Algorithms. The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.	**08**
4	**Application In Image Processing:** Bio-Inspired Computation and its Applications in Image Processing: An Overview, Improved Weighted Threshold based Histogram Equalization Algorithm for Digital Image, Contrast Enhancement Using Bat Algorithm, Mobile Object Tracking Using Cuckoo Search.	**08**
5	**Bio-Inspired Routing Protocols For Vanets:** Motivations for using bio-inspired approaches in VANET routing, Fundamental concepts and operations of bio-inspired VANET routing, Basic bio-inspired algorithms used in VANET routing literature, Swarm intelligence for VANET routing	**08**
6	**Bio-Mimetically Inspired Robot Prototype:** Definition: Bionics, Biomimetic, Bio-inspired, and Biotechnology, State of the Art in Robotics and Robotic Actuation, Biomimetically Inspired Robot Prototype, The Robot's Performance, Field of Application	**08**
	Total	**45**

Department of Civil Engineering

Text Books:
1. Yang ,Cui,XIao, Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier, First Edition, 2013
2. Xin-She Yang, Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier First edition 2016
3. Abdelhamid Mellouk, Salim Bitam, "Bio-Inspired Routing Protocols for Vehicular Ad Hoc Networks",Wiley , First edition 2014.
4. Ralf Simon King , "BiLBIQ_ A Biologically Inspired Robot with Walking and Rolling Locomotion" Volume 2, [Biosystems & Biorobotics] , Springer Berlin Heidelberg, 2012

Reference Books:
1.Mattias Wahde, "Biologically Inspired Optimization Methods: An Introduction", WIT Press, First edition 2008
2.Eiben, A.E.,Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
3.Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
4.Acharjya, D. P._ Santhi, V - Bio-Inspired Computing for Image and Video Processing-CRC Press, 2018.
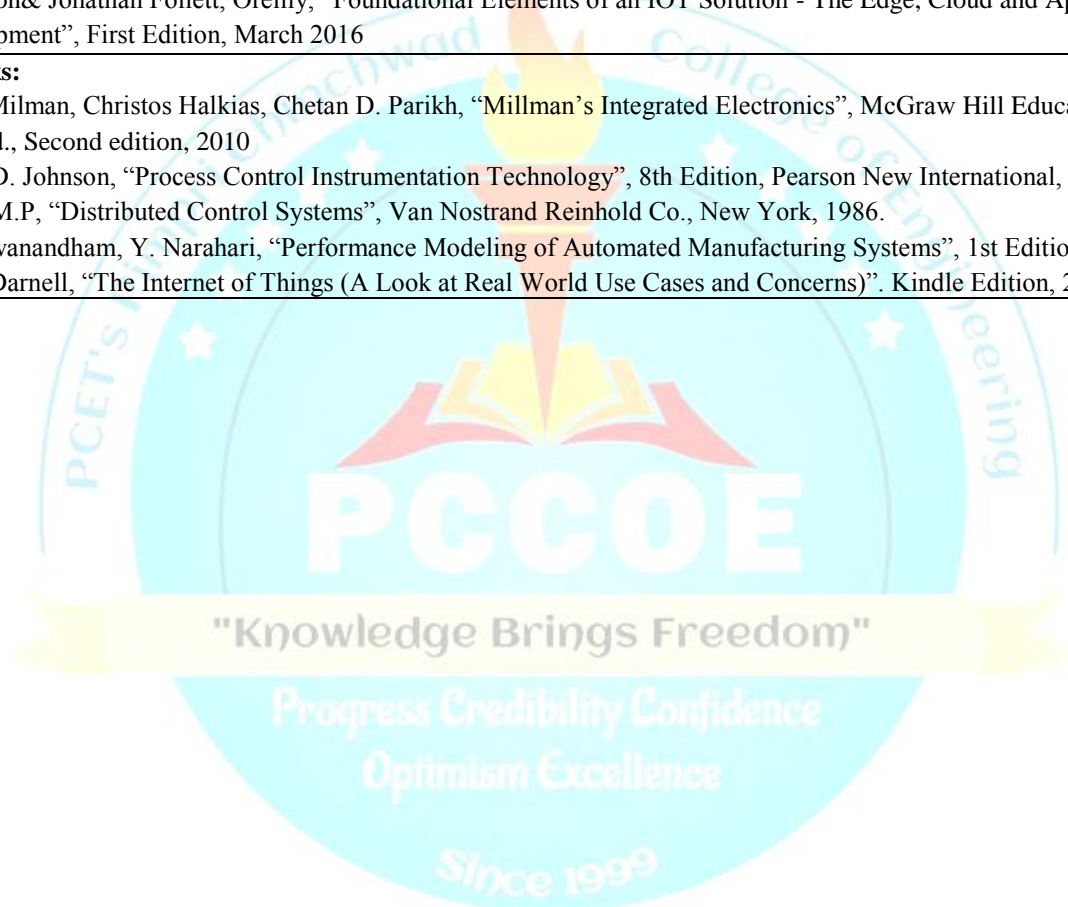5.Xin-She Yang, "Nature Inspired Optimization Algorithm, Elsevier First Edition 2014

Papers:
1. Arpan Kumar Kar,Bio inspired computing – A review of algorithms and scope of applications, Expert Systems with Applications,Volume 59,2016,Pages 20-32,ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2016.04.018.

Open Elective 5 offered by E& TC to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII** **Scheme A/B**	
Course:	**Sensor and Automation using IoT (OEC-5)**				**Code:**	**BET7602 / BET 8602**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of:
1. Basic Electronics Engineering
2. Programming with Arduino   is essential

Course Objectives:
1. Explain fundamental methods and characteristics of measurement systems.
2. Introduction to various types of transducers with working principles
3. Make students aware of need of computer aided process automation in industrial applications.
4. Demonstrate PLC ladder programming for design of basic logic gates for various applications
5. Make students familiar with various applications of IoT.

Course Outcomes:
After completion of this course students will be able to,
1. Illustrate the working principle of various types of transducers and their characteristics.
2. Choose proper sensor comparing different standards, guidelines and requirements for measurements of displacement, velocity, acceleration and level.
3. Select proper sensor comparing different standards, guidelines and requirements for measurements of Temperature and Force
4. Describe the need and concept of process control and automation systems
5. Design of basic logic gates using ladder programming.
6. Explain applications of IoT for real life application in automobile and healthcare

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Sensors and Transducers** Introduction to Sensors, Description and Working principle, Types of sensors, Specifications of Sensors. Introduction to transducers, Advantages and Disadvantages of Electrical Transducers, Classification of Transducers, Static and Dynamic characteristics, Difference between sensors and transducers	**07**
2	**Sensors for Displacement, Vibration, Acceleration and Level** Classification of Displacement Sensors: Potentiometer, Strain-gauged element, Capacitive element, Differential transformers, Eddy current proximity sensors, Inductive and Capacitive Proximity switch, Optical encoders. Pneumatic sensors (Bellows, Diaphragm), Hall effect sensors, Accelerometer, Gyroscope and Magnetometer (ADXL335/345), Electro-Optical Sensors, Position Encoders.	**08**
3	**Force and Temperature Sensors** Basic methods and types of force measurement: elastic force, strain gauge, piezoelectric, inductive, Capacitive load cells. Methods of temperature measurement: Optical Fiber, Resistance Temperature Detectors, Thermistor, Thermocouples	**07**
4	**Computer Aided Process Control and Automation Systems** Introduction of computer aided process control hardware, Industrial communication systems, Introduction of Computer based data acquisition system (**DAQ**), fundamentals of automation, Automation principles and strategies, reasons for Automating, basic elements of an automated system: Power, Program and control system.	**08**
5	**Introduction of Programmable Logic Controllers** Fundamentals of PLC, PLC selection criteria and applications of PLC Introduction to PLC programming, Ladder diagram, Sequential flow chart, Industrial bus systems.	**08**

6	**Case Study**: Basic Logic Gates implementation using Ladder programming, Temperature Measurement with interfacing to DAQ	
	Introduction to Internet of Things: Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Basic Concept of IoT, Sensor Interface in IoT systems, Design Model for IOT Case Study 1: IoT based Automobile Sector (Engine Management System) (Mention of Fuel Level, Ignition, Exhaust Sensors) Case Study 2: IoT based Healthcare Systems (Block Diagram and Simulation)	07
	Total	**45**

Text Books:
1. A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications, 2001
2. D. Patranbis, "Sensor and Transducers", 2nd Edition, PHI publication, 2005.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011
4. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Joe Biron& Jonathan Follett, Oreilly, "Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development", First Edition, March 2016

Reference Books:
1. Jacob Milman, Christos Halkias, Chetan D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education India Pvt. Ltd., Second edition, 2010
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
3. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
4. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009
5. Lucas Darnell, "The Internet of Things (A Look at Real World Use Cases and Concerns)". Kindle Edition, 2016

Open Elective 5 offered by IT department to Civil Department

Program:	B. Tech. (Civil Engineering)			Semester:	VII /VIII Scheme A/B		
Course:	Cloud Computing (OEC-5)			Code:	BIT7601/BIT8601		

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge of: Computer Networks Basics

Course Objectives:
1. To learn the concept of cloud computing.
2. To have knowledge on the various issues in cloud computing
3. To appreciate the emergence of cloud as the next generation computing paradigm.

Course Outcomes: Students will be able to,
1. Explore the basic terminologies in cloud computing
2. Describe cloud delivery models with examples
3. Illustrate cloud enabling technology
4. Discuss hardware and infrastructure requirements
5. Administer/determine cloud security mechanisms
6. Examine common standard in cloud computing

	Detailed Syllabus	
Unit	Description	Duration(H)
1	**Understanding Cloud Computing:** Origin and Influences- History, definitions, technology innovations; Cloud Computing terminologies, Applications, benefits and limitations, risk and challenges; Roles and Boundaries, Cloud characteristics, Cloud Delivery Models, Deployment Models.	08
2	**Cloud Service Types:** Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services, Service providers: Google App Engine, Microsoft Azure Service Platform, Amazon EC2, Salesforce, IBM.	08
3	**Cloud Enabling Technology:** Broadband Networks and Internet Architecture, Data centre technology, virtualization technology, Web technology, Multitenant technology, Service Technology.	08
4	**Hardware and Infrastructure:** Clients- mobile, thin, thick; Security- data leakage, offloading work, logging, forensics, development, auditing; Network-basic public Internet and accelerated Internet; Services- Identity, Integration, Mapping, Payments, Search.	08
5	**Cloud Security:** Basic Terms and concepts-Confidentiality, Integrity, Authenticity, availability, Threat, Vulnerability, Risk, Security Control, Security Mechanisms, Security Policies.	07
6	**Common Standards in Cloud Computing:** Open Cloud Consortium- Open Virtualization Format, Standards for Application Developers- browsers, data and solution Stack; Standards for Messaging- SMTP, POP, IMAP, RSS, HTTP; Standards for Security- Security (SAML OAuth, OpenID, SSL/TLS).	06
	Total	45

Text Books:
1. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", Pearson May 2013, ISBN: 9780133387568.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill,
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press,

Online Material :
1. NPTEL Course on Cloud Computing : https://nptel.ac.in/courses/106105167
2. Google Cloud Computing Foundation Course: https://nptel.ac.in/courses/106105223

Open Elective 5 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	VII /VIII Scheme A/B	
Course:	**Project Management & Governance (OEC-5)**				**Code:**	BME7605A / BME8605A	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge of: Statistics

Course Objectives: After learning this course, the students will be able to:
1. Course is designed to introduce students to the principles and practices of project management as they relate to mechanical engineering projects.
2. Students will learn the skills and knowledge required to successfully plan, execute, and complete projects in the field of mechanical engineering.

Course Outcomes: Students will be able to,
1. Understand the concept of project management
2. Apply the knowledge of project planning to develop project schedules and resources
3. Apply appropriate project management practices, tools, and methodologies.
4. Define, analyze, refine, and document project requirements, assumptions, and constraints
5. Analyze and refine project time and cost estimates to define project baseline, schedule and budget.
6. Understand how to manage project resources, budgets, and timelines.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Project Management** Objectives of Project Management- Importance of Project Management- Types of Projects Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility Steps in feasibility study, Introduction to project management softwares.	08
2	**Project planning and Implementation** Project Scope- Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations - Basic Scheduling Concepts - Resource Levelling – Resource Allocation, case studies on PP&I, NPV, IRR, and ROI	08
3	**Project Monitoring and Control** Setting a base line- Project management Information System – Indices to monitor progress. Importance of Contracts in projects- Teamwork in Project Management - Attributes of a good project team – Formation of effective teams – stages of team formation	08
4	**Project Risk Management** Introduction to project risk management, Key risk management concepts and terminology, Importance of risk management in projects, Risk identification techniques, Qualitative risk assessment, Quantitative risk assessment, Risk response planning, Risk management strategies, Risk monitoring and control, case study on Risk management in engineering projects	08
5	**Project Resource Management** Introduction to project resource management, resource management concepts and terminology, identifying project resources, Resource allocation techniques, Resource optimization techniques, Resource leveling, Resource smoothing, Resource scheduling techniques, Project timeline management, Cost estimation techniques, Cost control and monitoring	07
6	**Project Communication** Introduction to Project Communication, Key communication concepts and terminology, Importance of communication in projects, Developing communication plans, Communication channels and methods, Communication Strategies, Communication during project execution, Communication with Stakeholders, Crisis communication strategies	06
	Total	**45**

Textbook:
1. Project Management, Harold Kerzner, Wiley Publishing, 2013, 11th Edition, ISBN 9781118022276

Reference Books:
1. Berkun, Scott (2005), The Art of Project Management, O'Reilly Media: Cambridge, MA.
2. Berkun, Scott (2008), Making Things Happen: Mastering Project Management, O'Reilly Media: Cambridge, MA.
3. Karen (2001), Getting Started in Project Management, Wiley: New York.

Open Elective 5 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**		**VII /VIII Scheme A/B**
Course:	**Industrial Engineering (OEC-5)**				**Code:**		**BME7605B/ BME8605B**
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of: Basics of Engineering

Course Objectives:
1. To make students aware of management, its principles, organizations and structure, and Types of production systems.
2. To make students aware of productivity, measures of productivity and its improvement techniques.
3. To make students aware of Human factors at the workplace and Human resource management.
4. To make students aware of financial management in an organization.

Course Outcomes: Students will be able to,
1. Apply principles of management
2. Use various productivity measures and suggest suitable productivity improvement techniques.
3. Calculate economic order quantity and cost associated with inventory decisions.
4. Suggest a suitable plant location and layout.
5. Understand facets of Human resource management.
6. Calculate the break-even point and payback period.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction** Management definition, importance, functions, Taylors scientific management theory, Principles of Management, Organization types and structures.	**07**
2	**Productivity** Definition, measures and indexes, Productivity improvement techniques, Method Study and Work measurement	**07**
3	**Inventory** Types of Inventory, Need, Cost associated with inventory, Economic order quantity, Models of Inventory Control, Selective control of Inventories	**07**
4	**Plant Location and Layout** Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate. Introduction to computer-aided ergonomic analysis of workstation. Assessment of postures and identification of risks to body regions.	**08**
5	**Human factors** Human Error, Accidents, and Safety, Human relation in industry, Introduction to computer-aided ergonomic workstation analysis. Assessment of postures and identification of risks to body regions. Performance appraisal, Human Factors in Systems Design, Human resource management.	**08**
6	**Costing** Introduction to Marginal Costing: Elements of Cost, Break-Even Analysis. Techniques for Evaluation of capital investments. The pay-back period for investments.	**08**
	Total	**45**

Text Books:
1. M. Telsang, Industrial Engineering and Production Management, S. Chand Publication, 2018
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication, 2018
3. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co., 2015

Reference books:

1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi,
2. Second Indian Adaptation, 2008.
3. H. B. Maynard, K Jell, Maynard_s Industrial Engineering Hand Book, McGraw Hill Education, 2001
4. R. Al-Aomar, A. Williams, O. M. Uigen _Process Simulation using WITNESS', Wiley, 2015
5. Brien Shakel, Applied Ergonomics, Hand Book, Butterworth Scientific, 1988
6. R. C. Bridger, Introduction to Human factor and Ergonomics, McGraw Hill, 2017
7. M. Sanders and E. McCormick, Human Factor Engineering and Design, McGraw Hill, 1992
8. K. Elbert and H. Kroemer, Ergonomics: How to Design for Ease and Efficiency, Prentice Hall, 2018

Open Elective-6
Final Year B Tech
Civil Engineering
Semester-VII/VIII
Scheme A or B

Open Elective 6 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**	**VII /VIII Scheme A/B**		
Course:	**3-D printing technique for construction (OEC-6)**			**Code:**	**BCI7606A/ BCI8606A**		
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
1. Computer Aided Design & Drafting.
2. Engineering Materials, Strength of Material
3. Properties of Concrete

Course Objectives:

After Completing this course, student will be able to:
1. To gain knowledge and skills related to 3D printing technologies.
2. To understand the various software tools, process, material and techniques for construction technology.
3. To apply these techniques into civil Engineering applications like Building, Bridge, wall element, roof ceiling and decorative building elements.

Course Outcomes:

After learning the course, the students should be able to:
1. Develop CAD models for 3D printing.
2. Process software files
3. Optimize concrete mix
4. Analyze behavior for strength and challenges in printing
5. Design Mechanism and nozzle
6. Identify defects in post process of printing

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**3D Printing (Additive Manufacturing)** Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications. **CAD for 3D Manufacturing** CAD Data formats, Data translation, Data loss, STL format.	**07**
2	**3D Techniques** Stereo- Lithography, Laminated Object Manufacturing (LOM), Fused deposition modeling (FDM), Selective laser sintering (SLS), Selective laser melting (SLM), Binder Jet technology. Processing of software file, Process parameter, Process Selection for various applications,	**07**
3	**Material Properties** Properties of concrete ingredient like cement, sand, fly ash, silica fume, fibers, Concrete Mix proportioning and optimization considering admixtures like super plasticizer, retarders, water reducing agents, quick setting agent etc, viscosity modifying agents, geo-polymers, fibers, alternative material used for printing,	**07**
4	**Material Testing & Behavior** Testing on material like compressive strength, bonding strength, workability, setting time, build ability, flow ability, etc, Structural behavior and its Integrity. Challenges like problems of aggregate jamming in the nozzle, compacting obstacles, and the spacing limitations due to rebar and formwork installation.	**08**
5	**Equipment Mechanism** Process Equipment- Design and process parameters, Nozzle design and optimization like shape, diameter, piston type or screw type. Process Design-synchronization of components	**08**
6	**Post Processing:** Requirement and Techniques, Support Removal, Finishing treatment, polishing **Product Quality:** Inspection and testing, Defects and their causes	**08**
	Total	**45**

Text Books:
1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Lan Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. 3D Printing and Rapid Prototyping- Principles and Applicationsby CK Chua, Kah Fai Leong,World Scientific, 2017.
3. 3D Printing and Design by Hanser Publisher, Khanna Editorial, Khanna Publishing House, Delhi, 2011.
4. Concrete Technology: Theory and Practice byM. S. Shetty & A K Jain, S. Chand Publication, 2019.

Reference Books:
1. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing".

E Resources:
1. 3D Printing and Additive Manufacturing Specialization
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
2. 3D Printing Software',Jeffrey Smith, Education Manager, Coursera Course by University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3. 3D Printing Applications',Vishal Sachdev Clinical Assistant Professor , Director, Illinois MakerLab, Coursera Course ,University of Illinois at Urbana-Champaign, USA.
   https://www.coursera.org/learn/3d-printing-applications

Open Elective 6 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Structural Health Monitoring & Audit (OEC-6)**				**Code:**	**BCI7606B/ BCI8606B**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Knowledge of Concrete Technology is essential.
2. Knowledge of Rehabilitation and Retrofitting of Structures.

Course Objectives:
1. To impart knowledge of diagnosis the distress in the structure, its causes and factors.
2. To assess the health of structure using static field methods and dynamic field methods.
3. To introduce the repairs and rehabilitation measures of the structure.

Course Outcomes:
After learning the course, the students should be able to:
1. Understand the deterioration and distress in structures.
2. Evaluate causes and prevention methods for structural health monitoring.
3. Understand Simulation and Loading Methods in static field.
4. Analyze Data Acquisition Systems in dynamic field testing methods.
5. Understand piezo– electric materials and other smart materials in structural health monitoring.
6. Apply the knowledge of NDT techniques on real field.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Structural Health:** Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.	07
2	**Structural Health Monitoring & Audit:** Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	08
3	**Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	08
4	**Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	08
5	**Introduction to Repairs and Rehabilitations of Structures:** Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	07
6	**NDT (Non Destructive Testing)Techniques:** Application of NDT Techniques on real-life problems.	07
	Total	45

Text Books:
 1. Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 2006.
 2. Douglas E Adams, "Health Monitoring of Structural Materials and Components_Methods with Applications", John Wiley and Sons, 2000

Reference Books:
 1. J. P. Ou, H. Li and Z. D. Duan, "Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
 2. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

E-Resources:
 https://archive.nptel.ac.in/courses/114/106/114106046/

Department of Civil Engineering

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Database Management System (OEC-6)**				**Code:**	**BCE7610 / BCE8610**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
    Mathematics

Course Objectives:
1. To understand the fundamental concepts of database management.
2. To provide a strong formal foundation in database concepts, technology, and practice.
3. To make students familiar with building good database design.
4. To Learn different SQL queries and concepts.

Course Outcomes:
After learning the course, the students should be able to:
1. Understand the fundamental concepts of database management systems.
2. Design E-R Model for given requirements and convert the same into database tables.
3. Design schema in appropriate normal form considering actual requirements.
4. Write SQL queries to perform basic operations on tables in the database.
5. Write DML SQL queries for a given database.
6. Write SQL queries to perform operations on different database objects

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database System Structure.	**07**
2	Data Models, Database Design, Entity Relationship Model, ER Diagram, Extended ER diagram, converting E-R and Extended ER diagram into tables.	**07**
3	Relational Model: Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.	**07**
4	Database Languages DDL, DML, SQL: Characteristics and advantages, SQL Data Types, SQL Operators, Tables: Creating, Modifying, Deleting, Updating. Demonstration and practice of DDL and DML queries in Oracle	**08**
5	SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL, SQL - Ordering of Tuples, Aggregate Functions, SQL Functions, Synonym. Demonstration and practice of DDL and DML queries in Oracle	**08**
6	SQL Views: Creating, Dropping, Updating using Indexes, Set Operations, Joins, Set membership, Nested Queries. Introduction to PL/SQL. Demonstration of DDL and DML queries in Oracle	**08**
	Total	**45**

Text Book:
1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020, ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.

Reference Books:
1. Coronel, C. and S. Morris, "Database Systems: Design, Implementation, & Management," 12th edition, Cengage, 2016
2. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009, ISBN 9788177585674

Web References:
   http://w3schools.org/

MOOC Courses:
   Data Base Management System - https://nptel.ac.in/courses/106105175

Department of Civil Engineering

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII** **Scheme A/B**	
Course:	**Introduction to Blockchain (OEC-6)**				**Code:**	**BCE7611 / BCE8611**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
Information Security

Course Objectives:
1. To explain basic components of a Blockchain, its operations, underlying algorithms, and essentials of trust
2. To provide the fundamental cryptographic base for Blockchain.
3. To make students familiar with the working of Smart Contracts
4. To provide a detailed understanding of workings of a blockchain, its transactions, blocks and mining.

Course Outcomes:
After learning the course, the students should be able to:
1. Comprehend the fundamental characteristics of Blockchain.
2. Relate the basic cryptographic primitives essential for Blockchain.
3. Compare and contrast the private and public Blockchain.
4. Select and apply appropriate distributed consensus algorithms for the real life problem.
5. Analyze the working of Smart Contracts for verification or execution of agreement.
6. Identify relative application where block chain technology can be effectively used and implemented.

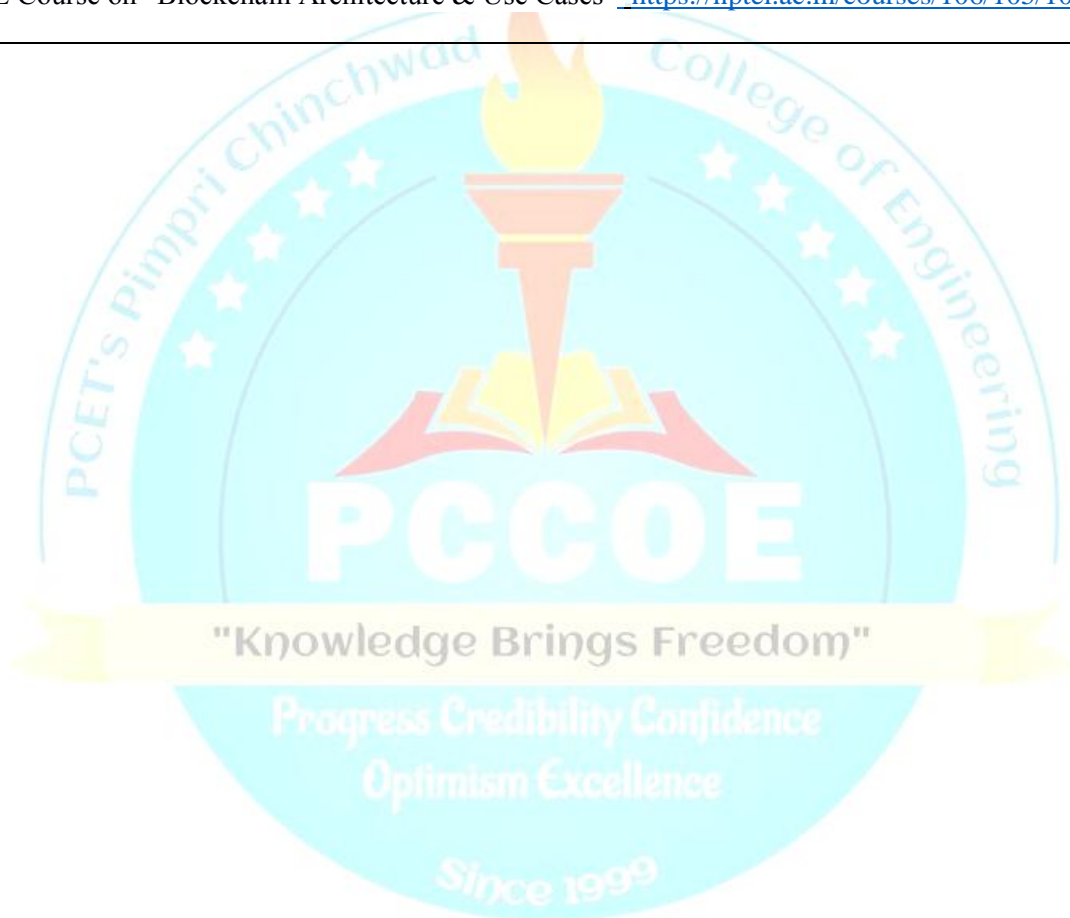|	**Detailed Syllabus**	
Unit	**Description**	**Duration(H)**
1	**Introduction to Blockchain** Introduction to decentralized system, History, Conceptualization, Architectural principles behind Blockchain, Characteristics of Blockchain.	**07**
2	**Basic Crypto Primitives** Structure of Block, Merkle Tree and Merkle Root in a Block, Symmetric and Asymmetric Encryption, Digital Signature, Hashing, public key cryptosystems, Mining strategy.	**07**
3	**Types of Blockchains** Permissionless, Permissioned, Consortium, Hybrid Blockchain, Blockchain protocol and use cases, Introduction to Bitcoin Blockchain, Layers of Blockchain: Application Layer Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer	**08**
4	**Distributed Consensus** Consensus approach, Consensus elements. **Consensus Algorithms** Proof of Work, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn, Proof of Authority, Paxos, RAFT Consensus Byzantine General problem, Practical Byzantine Fault Tolerance	**08**
5	**Smart Contracts and Ethereum** History, Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. Consensus in Ethereum, scripts in Ethereum. Developing and executing smart contracts in Ethereum.	**07**
6	**Prominent Blockchain Applications** Retail, Banking and Financial Services, Government Sector, Healthcare and IOT, Energy and Utilities, Blockchain Integration with other Domains	**08**
	Total	**45**

Text Books:
1. Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency", Kevin Wolhuter, 2021, ISBN: 1922590061, 9781922590060.
2. Mark Watney, Blockchain for Beginners: The Complete Step by Step Guide to Understanding Blockchain Technology", CreateSpace Independent Publishing Platform, 2017, ISBN: 1548766887, 9781548766887

Reference Books:
1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, Inc.2017, ISBN: 9781491954386
2. Alwyn Bishop, "Blockchain Technology Explained", CreateSpace Independent Publishing Platform, 2018, ISBN: 9781986273800

Web References:

1. NPTEL Course "Introduction to Block Chain Technology & Applications" https://nptel.ac.in/courses/106/104/106104220/
2. NPTEL Course on "Blockchain Architecture & Use Cases" https://nptel.ac.in/courses/106/105/106105184/

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Android App Development with Kotlin (OEC-6)**				**Code:**	**BCE7612 / BCE8612**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
   Basic programming knowledge (Preferably Java or any other object-oriented language)

Course Objectives:
1. To explore the Kotlin programming language features and scripts.
2. To differentiate between kotlin and java as OOP concepts.
3. To learn the fundamentals of writing Kotlin scripts.
4. To elaborate on the Network and Data Handling Techniques.
5. To learn the advanced Android features.
6. To develop an android application with all features.

Course Outcomes:
After learning the course, students will be able to:
1. Differentiate the data types, variables in kotlin.
2. Explore the object oriented programming concepts with Looping.
3. Demonstrate the android studio development environment.
4. Apply the Network and Data Handling Techniques.
5. Illustrate the Advance Android application development features.
6. Deploy the Android application with testing.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Kotlin and Android Studio** Introduction to Kotlin programming language, Setting up the Android Studio development environment, Kotlin syntax and basic programming concepts, Variables, data types, and operators in Kotlin.	**07**
2	**Kotlin Fundamentals and Object-Oriented Programming with Kotlin** Conditional statements (if, when), Loops (for, while, do-while), Functions, parameters, and return types Kotlin collections: arrays, lists, and maps, Classes and objects, Properties, fields, and methods, Inheritance, polymorphism, and interfaces, Data classes and sealed classes	**08**
3	**Android Basics and User Interface, Components and Navigation** Understanding Android architecture, Activities, intents, and the activity lifecycle, Designing UI with XML and Kotlin, Working with views, view groups, and layouts, Fragments and their lifecycle, Navigation and passing data between fragments, RecyclerView and ListView, Android storage options: Shared Preferences, Files, and Databases	**08**
4	**Networking and Data Handling** Working with RESTful APIs and JSON data, Using Retrofit and OkHttp for network communication, Implementing Live Data and View Model, Basic understanding of Coroutines for asynchronous programming	**08**
5	**Advanced Android Features** Notifications and Pending Intent, Location and Google Maps integration, Permissions and runtime permission handling, Material Design components and theming	**07**
6	**Testing, Debugging, and Deployment** Unit testing and UI testing with JUnit and Espresso, debugging tools and techniques in Android Studio, Optimizing app performance and memory management, Preparing and publishing your app to Google Play Store	**07**
	Total	**45**

Text Books:

1. Programming Android with Kotlin by Pierre-Olivier Laurence, Amanda Hinchman-Dominguez, Mike Dunn, G. Blake Meike, ISBN:9781492063001, Publisher: O'Reilly Media, Inc. (December 2021)
2. Beginning Android Development With Kotlin,Publisher: Greg Lim,2020 ISBN:9811477973, 9789811477973

Reference Books:

1. Android application development with Kotlin by Trivedi Hardik, Publisher: BPB Publications (12 May 2020)
2. Kotlin and Android Development featuring Jetpack: Build Better, Safer Android Apps by Michael Fazio Publisher: Pragmatic Bookshelf (July 2021)

Department of Civil Engineering

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Agile Project Management (OEC-6)**				**Code:**	**BCE7613 / BCE8613**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
   Software Engineering

Course Objectives:
1. Learn to create a framework of Agile Project Management for a project.
2. To understand the Agile project communication and team building.
3. To learn the Agile Retrospectives for planning and monitoring a project.
4. To learn the Agile project analysis and design.
5. To learn how to use the tools that allow taking advantage of an Agile project environment.
6. To get aquatinted with capabilities and knowledge in Agile Project Management.

Course Outcomes: After learning the course, students will be able to:
1. Explore the framework for agile project communication
2. Elaborate the agile retrospectives for planning and monitoring of agile project
3. Apply the techniques for Agile project estimation.
4. Build the Agile stories for project management
5. Apply the verification and validation for Agile project
6. Adopt the Soft skills negotiation practices.

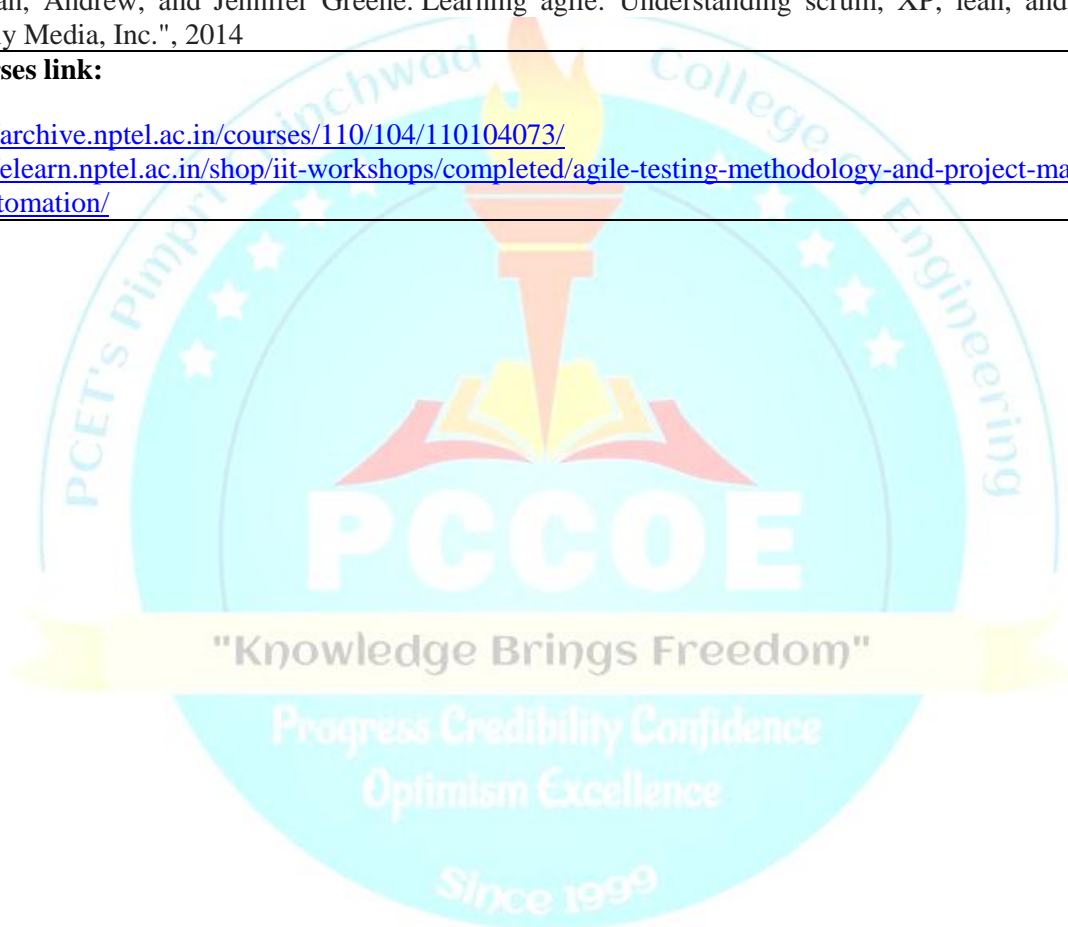| **Detailed Syllabus**		
Unit	**Description**	**Duration(H)**
1	**Introduction to Agile project communications** Introduction, Definition of Agile, Difference between Agile and other methodologies, Agile Principles. Agile Information radiator, Agile Team space, Agile tooling, Osmotic communications for collocated teams, Osmotic communications for distributed teams, Agile Daily stand-ups, **Case Study:** IT service delivery centre	**07**
2	**Creating High-Performance Team** Build A Team, Define Team Ground Rules, Negotiate Project Agreements, Empower Team Members and Stakeholders, Train Team Members And Stakeholders, Engage And Support Virtual Teams, Build Shared Understanding About A Project, **Case Study**: Creating High Performance Team Leadership	**08**
3	**Project Planning** Determine Appropriate Project Methodology/Methods And Practices, Plan And Manage Scope, Plan And Manage Budget And Resources, Plan And Manage Schedule, Plan And Manage Quality Of Products And Deliverables, Integrate Project Planning Activities, Plan And Manage Procurement, Establish Project Governance Structure, Plan And Manage Project/Phase Closure, **Case Study:** Virtual Research Environment Development Project	**07**
4	**Monitoring and Adopting** Introduction, Agile Retrospectives, Agile task and Kanban boards, Scrum, Agile Timeboxing, Agile Iteration and release planning, Agile WIP limits, Agile Burn down/up charts, Agile cumulative flow diagrams, Agile process tailoring **Case Study:** Management of a Multidisciplinary Research Project	**07**
5	**Assess and Manage Risks** Assess and Manage Risks, Execute Project To Deliver Business Value, Manage Communications, Engage Stakeholders, Create Project Artifacts, Manage Project Changes, Manage Project Issues, Ensure Knowledge Transfer For Project Continuity, **Case Study:** Agile Risk Management Process in Multiple Projects Environments	**08**
6	**Agile analysis and design** Introduction, Agile product roadmap, Agile user stories and backlog, Agile story maps, Agile progressive elaboration, Agile wireframes, Agile chartering, Agile personas, Agile modeling, Agile estimation: Agile relative sizing/story points, Agile wide band Delphi, Agile planning poker, **Case Study:** project management in a multidisciplinary production environment	**08**
	Total	**45**

Text Books:

1. Layton, Mark C., Steven J. Ostermiller, and Dean J. Kynaston. Agile project management for dummies. John Wiley & Sons, 2020.
2. Mesjasz, Czesław, Katarzyna Bartusik, Tomasz Małkus, and Mariusz Sołtysik. Agile Project Management and Complexity: A Reappraisal. Routledge, 2022.
3. Ajam, Mounir. Project management beyond waterfall and agile. CRC Press, 2018

Reference Books:

1. Adkins, Lyssa. Coaching agile teams: a companion for ScrumMasters, agile coaches, and project managers in transition. Pearson Education India, 2010.
2. Verma, Rahul. "Agile Project Management: Experience and Adoption." In Contemporary Challenges for Agile Project Management, pp. 44-51. IGI Global, 2022.
3. Chatterjee, Sheshadri, Ranjan Chaudhuri, Demetris Vrontis, Alkis Thrassou, and Soumya Kanti Ghosh. "Adoption of artificial intelligence-integrated CRM systems in agile organizations in India." Technological Forecasting and Social Change 168 (2021): 120783.
4. Stellman, Andrew, and Jennifer Greene. Learning agile: Understanding scrum, XP, lean, and kanban. " O'Reilly Media, Inc.", 2014

MOOCs Courses link:

1. https://archive.nptel.ac.in/courses/110/104/110104073/
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/agile-testing-methodology-and-project-management-test-automation/

Open Elective 6 offered by E&TC to Civil department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VII /VIII Scheme A/B	
Course:	Drone Technology (OEC-6)				**Code:**	BET7604 / BET8604	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
 Basic understanding of physics, sensors and actuators, Control systems and python programming

Course Objectives:
1. To introduce students about the accessories of drone and its functionality.
2. To describe the students about mathematical model of quad copter drone.
3. To make the students, design and development of drone model using Simulink.
4. To discuss the implementation models of different drone based case studies.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the basic concepts of drone technology
2. Justify specifications and requirements of customized drone design.
3. determine different accessories of Drones as per applications.
4. Comprehend drone control system development using Simulink
5. Design Simulink model simulating the complete dynamics of quadcopter drone.
6. Evaluate the design model of existing drone base systems.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to drones:** Unmanned Aerial Systems (UAS), Basics of drones, different body materials used for drone, different types of drones, Laws of Motion, Bernoulli's Principle, four forces of Flight, three axes of Flight.	06
2	**Drone accessories I:** Sensors & Motors, its types and specifications, design constraints, Test and measurement methods for drone sensors and actuators, Introduction of different types of batteries used in drone. Understand different specifications and their significance of batteries.	07
3	**Drone accessories II:** Propellers, Concept of propulsion, Forces working on a Flight, Principle axes and rotation of aerial systems, Role of GPS navigation and telemetry model, interfacing of GPS module to navigation drone.	07
4	**Drone control system development using Simulink:** Control system architecture, Quadcopter with actuator & propellers functionality block, Sensing & estimation functionality block, controller functionality block.	08
5	**Modelling, Simulation & Flight control design:** Dynamic quad copter system Model, flight control design, 3D visualization, testing & Tuning the model, Flight operations, Applicable software for data collection, processing, and analysis	09
6	**Applications of Drone Technology:** Drones in delivering mail, parcels and other cargo, Drones in agriculture, Drones in inspection of transmission lines and power distribution, Drones in disaster management (Flood, Fire etc), Case Study: Eagle Eye drone.	08
	Total	**45**

Text Books:
1. John Baichtal ,"Building your own drones, a beginner's guide to drones, UAVS, and ROVs" Pearson Education, 1st Edition,2015
2. Muhammad Usman , "Quadcopter modeling and control with Matlab/Simulink implementation" LAB University of Applied Sciences, 1st Edition, 2020
3. K.S.Fu, R.C.Gonzalez, C.G.Lee , "Robotics control, sensing, vision and intelligence" MGH, 1st Edition, 1987

Reference Books:
1. R.K.Mittal , I.J.Nagrath, "Robotics and control" Tata McGraw-Hill, 1st Edition,2005
2. Ben Rupert , "Drones (The ultimate guide)", Create Space Independent Publishing Platform, 1st Edition,2017
3. Agam Kumar Tyagi, "Matlab and Simulink for engineers", Oxford University Press, 1st Edition,2012

Department of Civil Engineering

Open Elective 6 offered by E&TC to Civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII** **Scheme A/B**	
Course:	**Advanced Driver Assistance System(ADAS) (OEC-6)**				**Code:**	**BET7605 / BET8605**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
    eVehicle and Automotive Electronics

Course Objectives:
   1.   To introduce Autonomous and Intelligent Vehicle Technology
   2.   To elaborate ADAS system architecture and features.
   3.   To explore role of AI in ADAS using various application in autonomous vehicle.

Course Outcomes: After learning the course, the students should be able to:
   1.   Understand the importance of ADAS in Autonomous and intelligent vehicle
   2.   Model Sensor technology required in prototype design used in ADAS
   3.   Apply AI concepts in automated analysis using vision based algorithms
   4.   Design automated electronics systems for driver assistance.
   5.   Develop models for safety system in autonomous vehicles.
   6.   Evaluate the test for maintenance, calibration and diagnostics of ADAS systems

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	Introduction to ADAS, General Block Diagram, Role of ADAS in Autonomous vehicle, Integration of ADAS Technology into Vehicle Electronics, Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation, Intelligent Vehicles	**06**
2	Prototype, Test, Evaluate and Validate ADAS : Generic dynamic and distributed architecture, Environment and climatic conditions , Modeling of perception sensors: Optical Sensor, RADAR, LIDAR, GNSS.	**07**
3	AI for ADAS: The construction of the intelligent vehicle's basic building blocks employing AI methods, Vision sensors, Vision algorithms, Automated Guided Autonomous Car Using Deep Learning and Computer Vision, Deep Learning for Obstacle Avoidance in Autonomous Driving	**08**
4	Electronics Systems in ADAS, Adaptive Cruise Control (ACC), Rear Cross Traffic Alert (RCTA), Vehicle Exit Alert, Front Cross Traffic Alert, Forward Collision Warning	**08**
5	Safety Systems in ADAS , Blind Spot Detection, Parking Assistance System, Intelligent Head Light Control, Occupant Protection System, Pedestrian Protection System, Evasive Steering Support.	**08**
6	Calibration of ADAS and Automated Driving Features: Calibration—An Overview Based on Ideality Equation , Common Types of Calibration in an Automated Driving System: End of Line (EoL) Calibration, Service Calibration, Online Calibration, Functional Calibration, Calibration of ADAS and Automated Driving Features , Calibration Environment for Automated Driving Vehicles, Calibration over Diagnostics Interface	**08**
	Total	**45**

Text Books:
   1.   Abdelaziz Bensrhair (editor), Thierry Bapin (editor) - From AI to Autonomous and Connected Vehicles_ Advanced Driver-Assistance Systems (ADAS)-Wiley-ISTE (2021)
   2.   Plato Pathrose - ADAS and Automated Driving_ A Practical Approach to Verification and Validation-SAE International (2022)

Reference Books:
1. Harald Waschl, Ilya Kolmanovsky, Frank Willems - Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions-Springer, Vol. 476, 2019.
2. Lentin Joseph (editor), Amit Kumar Mondal (editor) - Autonomous Driving and Advanced Driver-Assistance Systems (ADAS)_ Applications, Development, Legal Issues, and Testing (Chapman & Hall_CRC
3. Yan Li, Hualiang Shi - Advanced Driver Assistance Systems and Autonomous Vehicles_ From Fundamentals to Applications-Springer (2022)
4. https://www.udemy.com/course/advanced-driver-assistance-systems/

Open Elective 5 offered by IT department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VII /VIII** **Scheme A/B**	
Course:	**Data Science for Engineers OEC-5)**			**Code:**		**BIT7602/BIT8602**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of: Database Management, Data Mining

Course Objectives:
1. To learn the basics and process of Data Science.
2. To introduce the mathematical foundations required for Data Science.
3. To use Optimization techniques to obtain best solution.
4. To demonstrate patterns in data through a variety of statistical modeling.
5. To identify the strength of predictors, forecast an effect, a trend in data.
6. To classify data into a given number of classes to provide predictions.

Course Outcomes: After learning the course, the students will be able to:
1. Describe a flow process for Data Science problems.
2. Differentiate mathematical foundations required for Data Science.
3. Use Optimization to obtain best solution.
4. Demonstrate patterns in data through a variety of statistical modeling.
5. Identify the strength of predictors, forecast an effect, a trend in data.
6. Classify Data Science problems into standard topology.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction** Definition – Big Data and Data Science, Hype, Need of Data Science, Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration , Data modeling, Introduction to R, Advanced Programming in R, Data visualization in R Basic graphics.	**07**
2	**Linear Algebra for Data Science** Solving Linear Equations, Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors.	**08**
3	**Optimization for Data Science** Introduction, unconstrained multivariate optimization, Gradient (Steepest) Descent (OR) Learning Rules, Multivariate Optimization With Equality Constraints, Multivariate Optimization With Inequality Constraints.	**08**
4	**Statistical Modeling for Data Science** Event Space, Random variable, Probability density function, Distributions and Hypotheses Testing.	**06**
5	**Regression for Data Science** Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multi collinearity, Polynomial Regression, Cross Validation, Simple Linear Regression Model Building and assessment, Predictive Modelling, Dataset.	**08**
6	**Classification for Data Science** Logistic regression, K - Nearest Neighbors (kNN) and k-means clustering, Naive Bayes, Discriminant Analysis, K - Nearest Neighbors implementation in R, K - means implementation in R, Performance Measures.	**08**
	Total	**45**

Text Books:
1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", , Manning Publications Co., 1st edition, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani., "An Introduction to Statistical Learning: with Applications in R", , Springer, 1st edition, 2013

Reference Books:
1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets. v2.1", Cambridge University Press, 2014
2. Joel Grus, "Science from Scratch: First Principles with Python", O'Reilly, 1st edition, 2015
3. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013
4. Kalyanmoy, Deb. "Optimization for engineering design: Algorithms and examples", Prentice-Hall of India Pvt. Limited, 2012.

Online Courses:
1. Coursera Course on "What is Data Science?" offered by IBM. Available at https://www.coursera.org/learn/what-is-datascience?specialization=ibm-data-science
2. NPTEL Course on "Data Science for Engineers" offered by IIT, Madras. Available at https://onlinecourses.nptel.ac.in/noc21_cs69/preview

Open Elective 6 offered by Mechanical to Civil Department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VII /VIII Scheme A/B	
Course:	Lean Six Sigma (OEC-6)				**Code:**	BME7606A/BME8606A	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge: Statistics is essential

Course Objectives:
1. Students can apply strategic approaches to eliminate defects within the manufacturing processes.
2. Students will be able to apply the tools and techniques of Lean and six sigma to increase productivity.
3. Students will learn the DMAIC (Define, Measure, Analyze, Improve, Control) methodology, including hands-on exercises and case studies.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the principles and benefits of Lean Six Sigma.
2. Apply statistical tools for defining the quality attributes and measuring the performance of attributes.
3. Apply various tools to identify sources of variation affecting the quality of the process.
4. Apply advanced quantitative techniques to improve processes in manufacturing industries.
5. Understand the Six Sigma Implementation and Challenges in the manufacturing industry.
6. Apply continuous improvement methods to improve the efficiency and effectiveness of the process.

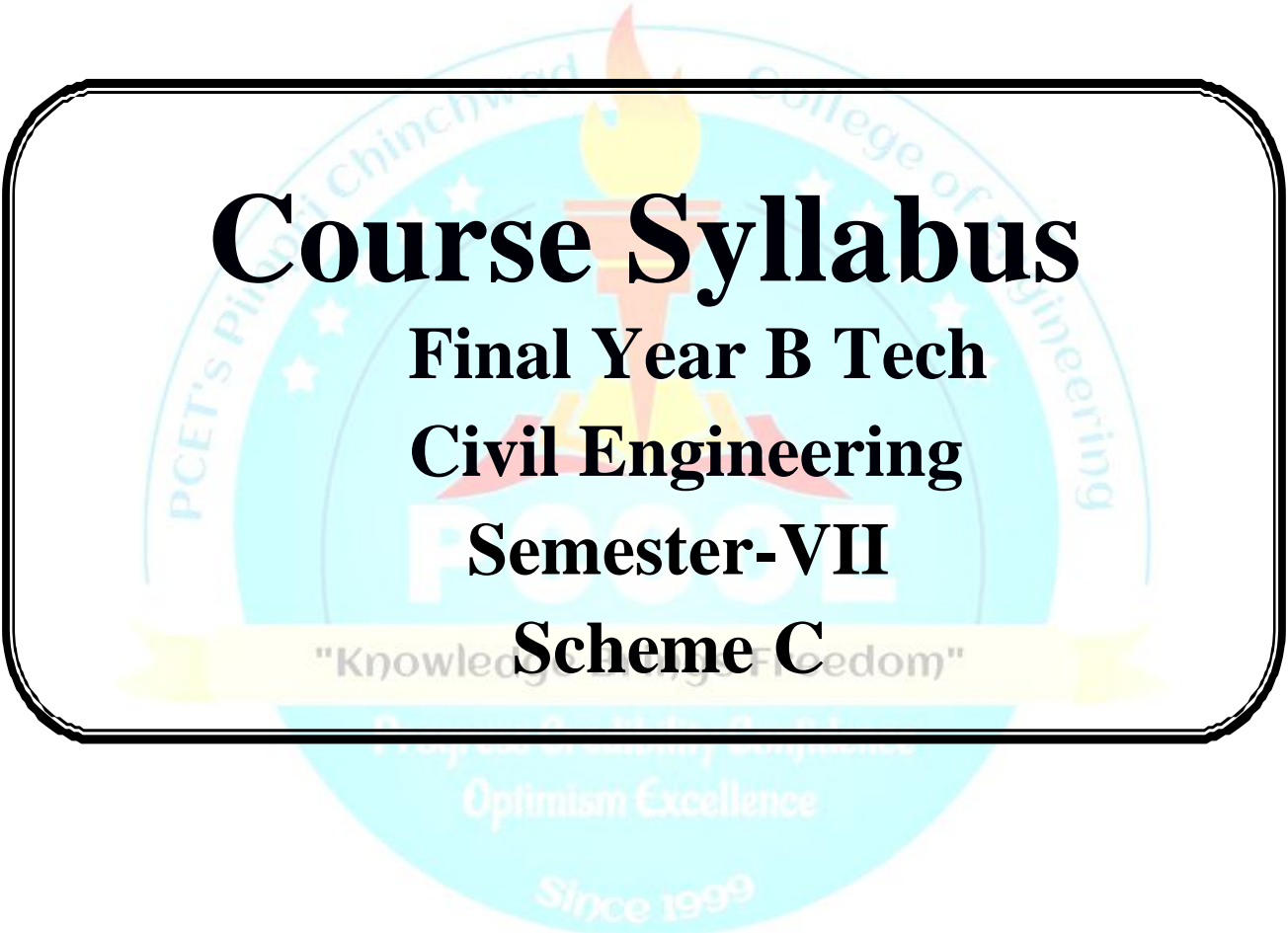| Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Lean and Six Sigma:** Introduction to Lean and quality, Cost of Quality (COQ), the background of quality improvement process, quality characteristics, Introduction to Six Sigma, Principles, and methodologies of lean and six sigma, history and evolution of lean and six sigma, roles and responsibilities of six sigma, benefits of using Six sigma in industries, Introduction to DMAIC approach.	07
2	**Tools used for defining and Measurement of Quality:** IPO diagram, Ishikawa diagram, SIPOC diagram, Flow diagram, CTQ tree, Project charter, Histograms, Run Chart, Scatter diagram, Cause and Effect diagram, Pareto chart, Control chart, Flow process chart, Process capability measurement.	08
3	**Tools used for Analysis, Improvement, and Control of quality:** Process mapping, Regression analysis, SWOT analysis, TRIZ, PESTLE, 5 why's, interrelationship diagram, overall equipment effectiveness, Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis, Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.	08
4	**Advanced Quantitative Techniques for Six Sigma:** Design for six sigma (DFSS), Failure mode effect analysis (FMEA), Change acceleration process (CAP), Risk priority number (RPN).	08
5	**Six Sigma Implementation and Challenges:** Lean and Six sigma Implementation cycle, Selection of tools and techniques, Six sigma for startups, Supplier Input Process Output Customer (SIPOC), Quality Function Deployment or House of Quality (QFD), customer quality index (CQI),	08
6	**Continuous Improvement Methods:** Introduction to continuous improvement methods, the approach of Poka-Yoke, Kanban, 5's, Lean manufacturing methods: 3M's, 4M's, Kaizen, 5's, case studies on continuous improvement methods.	06
	Total	45

Reference Books:
1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000

E-sources:
1. https://www.sixsigmacouncil.org/six-sigma-training-material/
2. https://onlinecourses.nptel.ac.in/noc20_mg19/preview

Open Elective 6 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VII /VIII Scheme A/B**	
Course:	**Professional Ethics (OEC-6)**				**Code:**	**BME7606B/BME8606B**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge: None

Course Objectives:
1. To provide students with an understanding of the ethical issues and responsibilities involved in engineering.
2. To create awareness on ethical principles that govern the engineering profession, the potential consequences of unethical behavior, and strategies for making ethical decisions in complex engineering situations.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the fundamental ethical principles that govern engineering
2. Recognize ethical dilemmas and learn to analyze them,
3. Develop critical thinking and decision-making skills for ethical engineering practices
4. Learn how to identify and address ethical issues in engineering research and development
5. Identify and analyse complex issues and problems in social impact and develop appropriate and well-justified solutions for the given context.
6. Develop an understanding of the social and global impacts of engineering decisions.

Detailed Syllabus			
Unit	**Description**		**Duration(H)**
1	**Introduction to Engineering Ethics** Overview of the importance of ethics in engineering, The role of engineers in society, Ethical principles and theories, Case Studies in Practical application of ethical principles and theories.,		08
2	**Ethical Decision Making** Frameworks for ethical decision making, Analysis and discussion of case studies and group discussions/role plays on ethical dilemmas, Identifying stakeholders and ethical responsibilities.		07
3	**Professional Codes of Ethics** Codes of ethics in engineering professions, Understanding the code of ethics and its application in practice, Comparison of different codes of ethics: Selection Criteria, Matrix for the best suited code.		08
4	**Engineering and Social Responsibility** Social, cultural, and safety, health and environmental impacts of engineering, Ethical considerations in engineering design and implementation, Addressing issues of sustainability, circular economy and social justice in engineering.		08
5	**Engineering Research and Development** Ethical considerations in research design, Intellectual property and ownership, Ethical issues in emerging technologies.		07
6	**Engineering and Globalization** The global impact of engineering decisions, Ethical considerations in international engineering projects, Cultural differences and engineering ethics with due consideration to Diversity, Equity and Inclusion		07
	Total		45

Text Books:
1. Harris, C. E., Pritchard, M. S., &Rabins, M. J. (2019). Engineering ethics: Concepts and cases. 6th Edition, Cengage Learning, Inc..

Reference books:
1. Mike W. Martin and Roland Schinzinger, (2019). Ethics in Engineering, 3rdEdition,Tata McGraw Hill, New Delhi,
2. Caroline Whitbeck, Ethics in Engineering practice and Research. (2011) 2nd Edition, Cambridge.

Course Syllabus
Final Year B Tech
Civil Engineering
Semester-VII
Scheme C

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Estimating , Costing and Tenders			Code:	BCI7421		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Building Planning, Construction & Materials
2. Design of Reinforced Concrete Structure

Course Objectives:
1. To make students aware about quantity survey for the preparation of preliminary and detailed estimates.
2. To teach the students cost analysis of individual items above for the estimation purpose.
3. To make the students aware of those factors that affect the cost of construction work and to analyze the influences that affect change in these factors.
4. To inculcate habit of systematic recording of all those statistics which are required for cost estimation.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the appropriate tendering and procurement selection.
2. Prepare the approximate cost of the projects through preliminary and detailed estimates.
3. Record measurements of the items of work for the calculation of quantities, Prepare schedule of quantities required to be attached with the tender documents.
4. Prepare estimation of quantities and cost of structure other than buildings
5. Perform rate analysis for items of work as per provisions in Specifications
6. Evaluate value of property by different methods.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Estimates and related terms:** Definitions of estimation and valuation. Purpose of estimation. Type of estimates, data required for estimation as a prerequisite. Meaning of an item of work, and enlisting the items of work for different Civil Engineering projects. Units of measurement. Mode of measurement of building items/ works. Introduction to components of estimates: face sheet, Schedule A & B abstract sheet (BOQ), measurement sheet, Rate Analysis, lead- Lift statement. Provisional sum & prime cost items, contingencies, work charge establishment, centage charges. Introduction to S. S. R. **Approximate Estimates:** Meaning, purpose, methods of approximate estimation of building & other civil engineering projects like roads and Building works.	08
2	**Taking out quantities:** Methods of estimating - P.W.D. and center-line methods of working out quantities. Calculation of quantities for Load bearing and R.C.C framed structures. Detailed estimates, Factors to be considered while Preparing detailed Estimates. Bar Bending Schedule Detailed Estimate : Detailed estimates of Load bearing and R.C.C framed structures, Calculation of quantities and detailed estimate for Load bearing and framed structures. Deduction rules for different items of work as per IS: 1200. Abstracting quantities, preparing BOQ.	08
3	**Estimates of other construction works:** Earthwork for road work, estimate of septic tank, , estimate of Community well, estimate of a culvert, estimate of an Underground water tank.	07
4	**Tenders & Contracts:** **Tenders:** Definition. Methods of inviting tenders, tender notice, tendering procedure, Pre-bid conference, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, acceptance/ rejection of tenders. Types of Tender open, restricted, E- tendering. **Contracts:** Definition, objectives & essentials of a valid contract as per Indian Contract Act(1872), termination of contract. Forms of contract- BOT, target Contract, Turn Key contract & FIDIC contract etc, Types of contracts: lump sum, item rate, Percentage rate, Conditions of contract: General and Specific conditions. **Introduction to Arbitration**	07

5	**Specifications :** Meaning & purpose, types. Drafting detailed specifications for materials, quality, workmanship, method of execution, mode of measurement and payment for major items like, excavation, stone/ brick masonry, plastering, ceramic tile flooring, R.C.C. work. **Rate Analysis :** Meaning and factors affecting rate of an item of work, materials, sundries, labour, tools & plant, overheads & profit. Working out Rate Analysis for the items mentioned in specifications above. Task work or out turn, factors affecting task work.	08
6	**Valuation :** Purpose of valuation. Meaning of price, cost and value. Factors affecting 'value'. Types of value: only Fair Market Value, Book Value, Salvage/ Scrap Value, Distressed Value and Sentimental Value. Concept of freehold and leasehold property. Estimation versus valuation. Meanings of depreciation & obsolescence. **Methods of Valuation:** Methods of valuation of land and building: rental basis, direct comparison method, profit based method, development method, and rent fixation for building. Methods of Valuation of land-belting method of land valuation and other methods. Qualification of Valuer, Valuation report in O1 format.	07
	Total	**45**

Text Books:
1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N. Dutta – S. Dutta & Company, Lucknow. 27 th Edition 2020.
2. Estimating, Costing Specifications & Valuation in Civil Engineering: M. Chakraborty. 11th Edition 2020
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand 17th Edition 2017
4. Building and Engineering Contracts by B.S.Patil , 7th Edition CRC Press 2019

Reference Books:
1. Theory and Practice of Valuation: Dr. Roshan Namavati, Lakhani Publications 2016
2. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.2010
3. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO- CARE, 2010

E-Resources:
1. http://mahapwd.gov.in/
2. https://mjp.maharashtra.gov.in/wp-content/uploads/2022/12/MAHARASHTRA_JEEVAN_PRADHIKARAN__4_.pdf
3. https://theconstructor.org/practical-guide/rate-analysis-of-civil-works-elements-and-requirements/10952/
4. https://cpwd.gov.in/Publication/DAR_Vol2_UPDATE_DEC_2021.pdf

IS Code:
1. IS 1200- Measurement rules for Items of work
2. IS 650 – 1991- Specification for standand sand testing
3. IS 14032 – 1988- Specification for standand Cement testing
4. IS 2386 (Part I To VIII) 1963- Methods of testing Aggregates
5. IS 3495 (Parts I TO iv) 1976- Methods of Tests for Burned Bricks
6. IS: 2720 (Part. XIII) 1986, IS:2720 (Part.30) 1980- Methods of Tests for Soil

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester:		VII Scheme C	
Course:	Construction Management			Code:		BCI7422	
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge Prior Knowledge:
1. Construction Equipment and Material Management
2. Project Management and Economics

Course Objectives:
1. To provide an introduction to the construction sector, including the role of the construction industry in infrastructure development, materials management, and construction equipment.
2. To understand of risk management in the construction industry, including the identification and nature of construction risks, contractual allocations of risk, and methods for minimizing risks and mitigating losses.
3. To understand of labour laws and construction claims in the construction sector, including the need and importance of labour laws, important labour laws associated with construction, types of construction claims, and dispute resolution.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the fundamental concepts associated with the construction sector, the principles of materials management in construction projects, and the significance of construction equipment in the overall construction process.
2. Apply effective risk mitigation methods, including analyzing construction risks, evaluating contractual risk allocations, and to minimize losses in construction projects.
3. Understand the legal and contractual aspects of the construction sector, including dispute identification and mitigation, by evaluating and applying labour laws and construction claims knowledge.

Detailed Syllabus		
Unit	Description	Duration(H)
1	**Overview of construction sector:** Role of construction industry in infrastructure development, project management consultants – role, types, selection and appointment process, project monitoring and reporting systems, managerial correspondence and communications. **Materials Management**: Objectives and functions. Classification and codification, Material Research, Planning. Vendor analysis. **Construction Equipment** – Understanding basics, Introduction to construction equipment, its usage; equipment cost.	08
2	**Documentation and Risk Identification**: Familiarization with construction documents, Certainty, Risk and Uncertainty, Risk Management, Identification and Nature of Construction Risks, Contractual allocations of Risk, Types of Risks, Minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Control of Quality in Construction. case study	07
3	**Labour laws:** Need and importance of labour laws, study of some important labour laws associated with construction sector- workmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act. The Code of occupational Safety, Health and working Condition, 2020	08
4	**Construction Claims:** Construction Claims: Extra items and causes of claims. Types of construction claims, documentation. Settlement of claims Dispute Resolution: Causes of disputes and importance of role of various stakeholders in prevention of disputes.	07
	Total	45

Text Books:
1. Construction planning, equipment and methods by Purifoy R and schexnayder C (2006)
2. Construction Technology: Analysis and Choice, 2ed,Bryan, Wiley India(2014)
3. Materials Management An Integrated Approach , by P. Gopalakrishnan and Sundaresan, Prentice Hall of India(2015)

Reference Books:
1. Journals such as CE & CR. Construction world, International Construction.
2. Construction Technology by Roy Chudley and Roger Greeno, Prentice Hall, 2005
3. Richard J. Tersine, "Modern Materials Management", John Hardin Campbell – 2007
4. Arnold, "Introduction to Materials Management", Pearson Education India,2009
5. Lee and Dobler, Purchasing and Material Management, McGraw Hill Publications

Web References:
1. Construction Management Association of America (CMAA) - https://www.cmaanet.org/
2. Construction Management Association of America (CMAA) Knowledge Library - https://www.cmaanet.org/knowledge-library
3. Construction Management Institute - http://construction-management.org/
4. Construction Management Association of America (CMAA) YouTube Channel – https://www.youtube.com/user/CMAANET
5. Project Management Institute (PMI) - https://www.pmi.org/
6. American Society of Civil Engineers (ASCE) - https://www.asce.org/
7. Construction Industry Institute (CII) - https://www.construction-institute.org/
8. Construction Management Guide - https://www.constructionmanagementguide.com/
9. Construction Executive - https://www.constructionexecutive.com/

Program:	B. Tech. (Civil Engineering)			Semester:		VII Scheme C	
Course:	Air Pollution and Control (PEC-V)			Code:		BC17501A	
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Basic understanding of environmental studies
2. Basic concepts of science and mathematics.

Course Objectives:
1. To impart the knowledge of indoor and outdoor air pollution along with the understanding of meteorological parameters affecting air pollution phenomenon.
2. To provide the understanding of the sampling, analysis and pollution control techniques

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the ambient air sampling and analysis of particulates and gaseous air pollutants.
2. Calculate the minimum height of the industrial stack.
3. Determine the ground level concentration of the gaseous pollutants downwind of the stack and apply the knowledge of emission inventory.
4. Design the control equipment's for control of particulate pollutant for an industry.

Detailed Syllabus

Unit	Description	Duration(H)
1	**Introduction to air pollution, Ambient Air Samplings, Analysis and Standards** Basics of Air Pollution, Air Pollution episodes, Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009, Determination of Air Quality Index, Air Act, Low-Cost sensors,	07
2	**Meteorological Aspects** Meteorological parameters and measurements, scales of meteorology, Lapse rates, Inversion and its types, Atmospheric stability, Determination of mixing height, Stack height determination, CPCB recommendations, Plume rise estimation using Brigg's formula.	07
3	**Emission Inventory, Air Quality Modelling and Indoor Air Pollution** Point source, Line Source and area sources. Collection of data, emission factor, estimation of emission load, Air Quality Modeling: Need & Significance, Introduction to various models, Gaussian dispersion equation for point source; assumptions, advantages and limitations (Numerical included), Introduction to air quality management, source apportionment studies, Introduction to Indoor Air Pollution	07
4	**Control of Air Pollution** Natural self-cleansing properties, Control by process modification, change of raw materials, fuels, process equipment and process operation. Control of particulates from stationary sources: Working principle and design of Settling chamber, inertial separators, cyclone, fabric filter and electro Static precipitator. Scrubbers, Factors affecting selection of device (Numerical included) Control of gaseous pollutants from stationary sources: Absorption, adsorption, incineration/ combustion, carbon sequestration for CO_2. Control of specific pollutants Control of emissions from mobile sources, Control of emissions from fugitive sources Shifting towards cleaner vehicular technology, smart transportation systems, reduction in emissions (electric/hydrogen fuel over fossil fuels)	09
	Total	30

Text Books:
1. Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015
2. Air Pollution, M. N. Rao and H. V. N. Rao, 58th Edition, McGraw-Hill Education, 2020
3. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.2017

Reference Books:
1. Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010
2. Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., 4th Edition, Academic Press, 2008.
3. Atmospheric Chemistry and Physics, Seinfeld, J.H., Pandis, S.N., 3rd Edition, John Wiley, 2016.

E-Resources
1. https://archive.nptel.ac.in/courses/105/107/105107213/
2. http://cpcb.nic .in https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf
3. Guidelines for the Measurement of Ambient Air Pollutants:
   https://cpcb.nic.in/openpdffile.php?id=UmVwb3J0RmlsZXMvMjdfMTQ1ODExMDQyNl9OZXdkJdGVtXzE5Nl9OQUFRTVNfVm9sdW1lLUkucGRm
4. USEPA Manual for Emission Inventory: https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors
5. http://moef.nic .in https://moef.gov.in/en/division/environment-divisions/climate-changecc-2/documents-publications/

Program:	B. Tech. (Civil Engineering)		Semester :	VII Scheme C
Course:	Construction Techniques and Retrofitting System (PEC-V)		Code:	BCI7501B

Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Building construction,2.Strength of Material 3.Concrete technology, transportation and tunnel engineering.

Course Objectives:
1. To know the various methods and techniques involved in sub structure foundations and ground improvements.
2. To provide a coherent development to the students in area of construction techniques for super structure.
3. To give awareness of various retrofitting systems.

Course Outcomes:
After learning the course, the students should be able to:
1. Identify the suitable techniques for sub structure construction.
2. Select the suitable ground improvement technique as per the field requirements.
3. Decide suitable techniques of form work and concrete work for super structure construction
4. Recommend the repair or retrofitting technology as per structure requirements.

	Detailed Syllabus	
Unit	Description	Duration (H)
1	**Sub structure construction techniques:** Various pile driving and boring techniques, well and cofferdam construction techniques, diaphragm wall construction, shoring techniques for deep cuts, No dig techniques-box pushing and Pipe jacking.	08
2	**Ground improvement techniques:** ground improvement techniques such as- vibro-flotation, stone column, micro pile, soil nailing, grouting techniques in soft and hard strata, dewatering techniques such as single and double point system	07
3	**Super structure construction techniques:** Formwork techniques: table form, tunnel form. slip form, advanced form work technique. Concreting for tall building, prefab construction techniques, road pavement construction as per IRC and MoRTH guidelines, Bridge construction techniques: segmental construction and launching techniques. Use of automation in construction.	07
4	**Retrofitting Systems:** techniques for identification of distresses, Use of NDT in retrofitting systems. Repairing techniques for structure like sealing, grouting, rock bolting, jacketing, shotcreting, ferrocement, Introduction to retrofitting materials and retrofitting techniques for columns, beams, slabs, masonry structures.	08
	Total	30

Text Books:
1. Construction techniques and practices by Dr.V.Kannan, first edition, V. Kannna publication, 2021.
2.Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020
3.Construction Techniques and Practice by V. Sankara Subramaniyan from Lakshmi Publications, 2017
4. Construction Technology, Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008.

Reference Books:
1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication
2. Modi, P.I., Patel, C.N., Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi, 2016.
3. CPWD Handbook (2011). Repair and Rehabilitation of RCC Buildings.
4. ACI 201.1R-08:American Concrete Institute, Guide for Conducting a Visual Inspection of Concrete in Service
5. ACI RAP-11-American Concrete Institute, Field Guide to Concrete Repair Application Procedures
6. Dyer, Thomas. (2014). Concrete Durability, CRC Press, Taylor & Francis Group, Florida.

E-Resources
1. https://nptel.ac.in/courses/ground improvement techniques
2. https://nptel.ac.in/courses/ Construction methods and equipment management
3. https://archive.nptel.ac.in/courses/105/105/105105213/
4. https://www.cecr.in/

Program:	B. Tech. (Civil Engineering)				Semester:	VII Scheme C	
Course:	Design of RC Bridges (PEC – V)				Code:	BCI7501C	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
2	-	2	2	20	20	60	100

Prior Knowledge:
1. Knowledge of fundamentals of RCC and Prestress Design.
2. Knowledge of fundamentals of Structural Analysis and Geotechnical Engineering.

Course Objectives:
1. To impart fundamental knowledge of Bridge Engineering and loads acting on the bridges
2. To build the concept of analysis and design of the RCC bridge slab
3. To provide knowledge of Analyze and design of bridge girders.
4. To impart knowledge of the design of bridge substructure.

Course Outcomes:
After learning the course, the students should be able to:
1. Classify the type of bridges that are appropriate for the terrain and classify IRC loads and their distribution over a bridge's longitudinal beams.
2. Design the bridge superstructure's RCC deck slab, culvert slab, and T-beam deck slab.
3. Analyze and design girders built of post-tension prestressed and reinforced concrete.
4. Design the bearings and components of the substructure.

	Detailed Syllabus	
Unit	Description	Duration (H)
1	**Introduction to Bridge Engineering:** Types of bridges, classification based on structural form, IRC loading standard for RC highway bridges, Choice of Bridge Type and Economic Span Length, Super Structure Philosophy, Geometric Alignment, Drainage, Road Kerb, Bridge Foundations. **Loading on bridges:** IRC loading, D.L., L.L., Impact load, wind load, Earthquake load, Longitudinal force, centrifugal forces, buoyancy, water current forces, and thermal forces.	07
2	**RC Slab Bridge Deck:** Analysis of slab decks for the solid slab and solid cantilever slab, Pigeaud's method, design of slab culvert, and design of RC slabs supported on all sides for T-beam and slab deck.	08
3	**Design of Bridge Girders:** Analysis Methods, design of longitudinal and cross girders as per Courbon's theory, design of post-tensioned prestressed concrete T beam bridge deck and girders, steel girders	08
4	**Design of substructure:** Bearings - types, functions, and requirements as per IRC. Piers and Abutments- type, shape, and their suitability, Design of sub-structure – abutments, piers.	07
	Total	30

Text Books:
1. Principles and Practice of Bridge Engineering"- S P Bindra Dhanpat Rai & Sons New Delhi, 2012.
2. Reinforced Concrete Structures – Vol. II by Dr. B. C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications, 2018.

Reference Books:
1. Essentials of Bridge Engineering by D. Johnsons Victor, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 6th edition 2019.
2. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill, 2nd edition 2015.
3. Concrete Bridge Practice by Dr. V. K. Raina, Tata McGraw Hill; 4th edition 2014.

IS Code and Specifications
1. IRC 6 – 1966 "Standard Specifications and Code of Practice for Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi
2. IRC 21 – 1966 "Standard Specifications and Code of Practice for Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi
3. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi.
4. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)				Semester:	VII Scheme C		
Course:	Air Transportation and Bridge Engineering (PEC-V)				Code:	BC17501D		
Teaching Scheme				**Evaluation Scheme**				
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA		Total
2	-	2	2	20	20	60		100

Prior Knowledge:
1. Fundamental knowledge of types of Transportation.
2. Fundamentals of land use zoning and Geotechnical engineering.
3. Functions of elevated structures

Objectives:
1. To aware the students with the concept of airport planning and orientation of runways
2. To introduce the students to the design aspects of Taxiways, Heliports and landing instrumentation.
3. To propagate the design criteria for bridge and its components
4. To integrate the conventional/modern techniques for erection and maintenance of bridges

Outcomes:
After learning the course, the learners should be able to:
1. Describe the airplane components-characteristics and orient the runway as per recommendations.
2. Apply the knowledge to plan for taxiways,heliports and landing aids.
3. Classify the types of bridges as per loadings and design characteristics.
4. Demonstrate design parameters for erection and maintenance of Bridges.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Airport Planning and Runway Orientation**: Airplane: components and important technical terms, Airport Classification and components, (ICAO, FAA, AAI, IATA) – Roles and Responsibilities, Aircraft characteristics,Selection of sites; Survey and drawings to be prepared for airport planning, Characteristics of airport layout, R/W configuration, Zoning Requirements, Runway orientation, wind coverage, use of wind rose diagram, R/W length correction as per ICAO-FAA recommendations	**07**
2	**Taxiways, Heliports and Landing Systems:** Taxiways – Concept, types, design criteria, Airport Lighting, Heliports: Helicopter characteristics, planning of heliports - site selection, size of landing area, orientation of landing area, Heliport marking and lighting, Airport Navigation (Future Air Navigation System) and landing aids, overview of Air Traffic Control (ATC) systems.	**08**
3	**Bridge Components and Design Criteria :** Classification and types of bridges, Site selection and investigation, Bridge alignment and controlling factors, Technical terms: linear waterway, economic span, afflux, scour depth, effective width, Components of Bridge; Sub and Superstructure, Introduction to functions and types of Abutment, Wingwalls, Foundation, Bearings.	**07**
4	**Erection and Maintenance of Bridge** Temporary and Permanent bridge, Causeway: Erection techniques and use, Merits and demerits of prestressed bridge, Culverts: Types and functions, Steps involved in Bridge construction, Bridge inspection, Reasons for Failure of Bridges, Maintenance of Bridge: Types and Techniques, Introduction to Modern trends in erection and maintenance of bridge structures.	**08**
	Total	**30**

Text Books:
1. Airport planning and Design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee, 6th Edition, 2019.
2. Airport Engineering by Rangwala, Charotar Publication, 17th Edition 2019.
3. Bridge Engineering by Rangwala, Charotar Publication, 17th Edition 2023.

Reference Books:

1. Ashford, N., and P. H. Wright. Airport Engineering, 3rd ed. New York: John Wiley & Sons, 1992
2. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi, 2017.
3. Bridge Engineering by Ponnuswamy, Mcgraw Hill Publication , Third Edition, 2017
4. Airport Engineering, by Saxena S.C., CBS Publishers & Distributors, 2017

Standard Codes:

1. Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902
2. Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000
3. https:///panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridgesdirect-download-links-from-panchayatraj-engineers-blog
4. Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.
5. International Civil Aviation Organization (ICAO). International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention on International Civil Aviation, Volume 1 Aerodrome Design and Operations, 3rd edition, International Civil Aviation Organization, 2004.

E-Resources:

1. https://archive.nptel.ac.in/courses/105/107/105107123/
2. https://onlinecourses.nptel.ac.in/noc22_ce63/preview
3. https://onlinecourses.nptel.ac.in/noc22_ae14/preview
4. https://archive.nptel.ac.in/courses/105/105/105105107/

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Watershed Management (PEC VI)			Code:	BCI7502A		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Fluid mechanics 2. Hydrology and Water Resource Engineering

Course Objectives:
1. To promote the knowledge on integrated watershed management and sustainable management of groundwater resources.
2. To build the concept of soil erosion and sediment erosion management.
3. To make aware of surface water management.
4. To acclimatize students with the watershed modeling framework.

Course Outcomes:
After learning the course, the students should be able to:
1. Determine the concepts of watershed planning and management
2. Classify the technologies for development of integrated watershed plan
3. Develop the approaches in management of Groundwater resources
4. Estimate land erosion and sedimentation
5. Classify surface water management concepts
6. Develop concepts of watershed modelling

Detailed Syllabus:		
Unit	Description	Duration (H)
1	**Introduction and basic concepts** Concept and characteristics of watershed, principles of watershed management, hydrology and water availability, surface water, groundwater, conjunctive use, human influence in water resources system, people participation in watershed management, National programs on watershed management	08
2	**Integrated Watershed Management** Concept, principle, objectives and importance, components of integrated watershed management, technologies for the management of watershed, holistic sustainable watershed management, Integrated watershed management in India.	07
3	**Sustainable management of groundwater resources** Introduction, groundwater situation in India, challenges, prospects, approaches of groundwater management, water quantity and quality management, scientific development of groundwater resources, National project on Aquifer Mapping and Management(NAQUIM),Atal Bhujal, Yojana.	07
4	**Soil Erosion Modeling** Introduction, sediment erosion and transportation, soil erosion and degradation, estimation of soil erosion, Universal Soil Loss Equation (USLE),soil erosion in India, management of sediment and soil erosion, reservoir sedimentation management, benefits of soil conservation.	08
5	**Surface Water Management** Storm water management, design of drainage system, flood control and reservoir operation, Interlinking of rivers and Interbasin Water Transfer(IBWT) in India, National River linking Project (NRLP) – objectives, components, benefits of NRLP.	08
6.	**Watershed modeling** Introduction, types of watershed models, standard modeling approaches, hydrologic process, modeling of rainfall runoff process ,SWAT model, subsurface flows and groundwater flow	07
	Total	45

Text Books:

1. Watershed Management by J. V.S. Murthy, 2nd Edition, New Age International (P) Ltd, 2004.

2. Hydrology and Management of Watersheds by Kenneth N. Brooks,Peter F. Ffolliott, 4th Edition, John Wiley & Sons, 2012.

3. Water Resources Management and Modelling, Purna Nayak,eBook (PDF) ISBN 978-953-51-6159 ,2012.

Reference Books:

1. Watershed Management , Guide lines for Indian Conditions byE. M. Tideman, Omega Scientific Publishers, 2012.

2. Hydrology and Soil Conservation Engineering,Ghanshyam Das, Prentice Hall India.

3. Watersheds – Process,Assessment and Management,Paul A. DeBerry,John Wiley & Sons

4. Numerical Groundwater Hydrology,Ashok Kumar Rastogi,Penram International Publishing,2012

E-Resources

1. https://www.mygov.in/group/watershed-management-

2.https://www.india.gov.in/integrated-watershed-management-programme-ministry-rural-development

3.NPTEL :: Civil Engineering - NOC:Groundwater hydrology and management

Program:	B. Tech. (Civil Engineering)			Semester:		VII	
Course:	Construction contract and legal aspects in construction (PEC-VI)			Code:		BCI7502B	
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Objectives:
After Completing this course, student will have adequate background to understand and solve the problem involving:
1. Knowledge for preparing construction contracts clauses.
2. Contractual and tender documents satisfying need of project.
3. Exhibit role and responsibilities of Arbitrator for resolution of disputes in construction projects.

Outcomes:
After learning the course, the students should be able to:
1. Understand Administrative Procedures
2. Prepare construction contracts clauses and conditions.
3. Explain Conditions of Contracts & Construction Claims.
4. Identify role and responsibilities of Arbitrator in contract execution
5. Understand Tenders & Bidding process for BOT &Global Tendering including Documentation and Risk Identification.

Detailed Syllabus:

Unit	Description	Duration(H)
1.	**Administrative Procedures:** Methods of Executing Works: PWD procedure of work execution, administrative approval, budget provision, technical sanction. Construction Administration, Organizational Structure, Lines of Authority on Construction Projects, Responsibility, Staffing Responsibilities, Methods of execution of minor works in PWD: Piecework, Rate List, Daily Labour. Introduction to registration as a contractor in PWD	8
2.	**Construction Contracts Formation:** Indian Contract Act (1872) :Definition of the contract as per the ACT. Valid, Voidable, Void contracts, Objectives of the act.(from model 5) Clauses 1 to 75- Contract formation, contract performance, valid excuses for non-performance, Breach of contract, effects of breach- understanding the clauses and applying them to situations/scenarios on construction projects.	7
3.	**Conditions of Contracts & Construction Claims :** Construction Claims: Extra items and causes of claims. Types of construction claims, documentation, Conditions of contract with respect to various parameters .Case study	7
4.	**Alternative Dispute Resolution & Arbitration :** Disputes – Settlement through arbitration Indian Arbitration Act 1940 – Clauses and advantages of arbitration. Alternate Dispute Resolution methods- mediation, conciliation, arbitration and Dispute Resolution Boards.	8
5.	**Tenders & Bidding process :** Tenders: Definition. Methods of inviting tenders, tender notice, bidding procedure, Pre and post qualification of contractors, tender documents. 3 bid/ 2 bid or single bid system. Qualitative and quantitative evaluation of tenders. Comparative statement, Pre-bid conference, acceptance/rejection of tenders. Various forms of BOT &Global Tendering, E- tendering.	7
6.	**Documentation and Risk Identification :** Familiarization with construction documents, Certainty, Risk and Uncertainty, Risk Management, Identification and Nature of Construction Risks, Contractual allocations of Risk, Types of Risks, Minimizing risks and mitigating losses, use of expected values, utility in investment decisions, decision trees, sensitivity analysis. Control of Quality in Construction.	8
	Total	45

Text books:
1. The Indian Contract Act (9 of 1872), 1872- Bare Act- 2006 edition, Professional Book Publishers.
2. The Arbitration and Conciliation Act,(1996), 1996 (26 of 1996)- 2006 Edition, Professional Book Publisher.

Reference Books:
1. Law of contract Part I and Part II, Dr. R.K. Bangia- 2005 Edition, Allahabad Law Agency.
2. Arbitration, Conciliation and Alternative Dispute Resolution Systems- Dr. S.R. Myneni- 2004 Edition, reprinted in 2005- Asia Law House Publishers.
3. Standard General Conditions for Domestic Contracts- 2001 Ministry Of Statistics and Program Implementation, Government of India.
4. FIDIC Document (1999).

E-Resources:
   www.drbf.org. Dispute Resolution Board foundation manual -

Program:	B. Tech. (Civil Engineering)			Semester:		VII	
Course:	Structural Dynamics (PEC – VI)			Code:		BCI7502C	
Teaching Scheme				Evaluation Scheme			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Fundamental concept of physics, Engineering Mechanics, and Earthquake Engineering.
2. Mathematics: ordinary differential equations.

Course Objectives:
1. To introduce the fundamental concepts of structural dynamics.
2. To impart knowledge of mathematical modeling.
3. To obtain solutions for the dynamic response of single degree of freedom systems.
4. To obtain solutions for the dynamic response of multi degree of freedom systems.
5. To introduce the fundamental knowledge of mode analysis and methods used.
6. To impart knowledge of the free and forced vibration response of structural systems.

Course Outcomes:
After learning the course, the students should be able to:
1. Apply the concepts of dynamics of structural systems.
2. Prepare mathematical models for different types of vibration problems.
3. Apply computational methods to solve the problems of single degree of freedom systems.
4. Formulate, and solve the dynamic response of the multi degree of freedom systems.
5. Classify mode shapes and analyze structural systems.
6. Analyze and interpret the free and forced vibrations response of structural systems.

Detailed Syllabus		
Unit	Description	Duration (H)
1	**Single-Degree-of-Freedom System:** Types of vibration, Degrees of freedom, Analysis models, Equations of motion, Free vibration, Damping, Types of damping Logarithmic Decrement.	06
2	**SDOF subjected to harmonic loading:** Solution to undamped and damped harmonic excitation, Bandwidth method, Response to support the motion, Force transmitted to the foundation.	07
3	**SDOF subjected to general loading:** Duhamel's Integral, Application to simple loading cases, Numerical evaluation of response integral, Piecewise exact method, Newmark Beta Method.	08
4	**Multi-Degree-of-Freedom System I:** Selection of DOFs, Formulation of Equation of motion, Structure matrices, Static condensation, Free vibration as Eigenvalue problem, Frequencies, Mode Shapes, Determination of natural frequencies and mode shapes, Orthogonality conditions .	08
5	**Multi-Degree-of-Freedom System II:** Fundamental mode analysis, Rayleigh method, Response of MDOF systems to dynamic loading, Numerical evaluation of modal equations by Newmark's-Beta method, Mode superposition Method.	08
6	**Structures Modeled with Distributed Properties:** Distributed-Parameter Systems, Partial differential equations of motion, Free and forced vibrations, Application to beams in flexure.	08
	Total	45

Text Books:
1. Elements of Earthquake Engineering by Jaikrishna, A.R. Chandrashekharan, Brijesh Chandra. Standard Publishers & Distributors, 2nd edition 2019
2. Dynamics of Structures by Madhujit Mukhopadhyay. Ane Books Pvt Ltd, 2015

Reference Books:
1. Dynamics of structures by R.W. Clough and J. Penxiene. McGraw-Hill Pub, 2nd edition 2015.
2. Structural Dynamics by Roy Craig, Andrew J. Kurdila. John Wiley & Sons, 2nd edition 2006.
3. Dynamics of Structures – Theory & Application to Earthquake Engineering by A.K. Chopra. Prentice Hall Publications, 5th edition 2016
4. Structural Dynamics – Mario Paz, Young Hoon Kim. Springer, 6th edition 2018

E-Resources:
https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-ce32/
https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ce64/
https://courses.degreetutors.com/the-structural-dynamics-course-bundle
Welcome to Virtual Labs - A MHRD Govt of india Initiative (vlabs.ac.in)

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester :	VII Scheme C		
Course:	Advanced Foundation Engineering (PEC – VI)			Code:	BCI7502D		
Teaching Scheme				**Evaluation Scheme**			
Lecture	Tutorial	Hours	Credit	FA1	FA2	SA	Total
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Engineering Geology (Subsurface Investigation)
2. Geotechnical Engineering (Index and Engineering Properties of soil)
3. Foundation Engineering (Basic Concepts)
4. Advanced Geotechnical Engineering (Index and Engineering Properties of soil)

Course Objectives:
1. To impart the knowledge of design of different foundations.
2. To get acquainted with different types of foundations.
3. To make aware of ground improvement techniques, sheet pile walls and cofferdams.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain different IS code provisions of subsoil exploration for various structures.
2. Design raft foundations for different types of soils..
3. Design pile foundation and under reamed piles for tensile loads..
4. Recognize the concepts of machine foundations.
5. Explain the different ground improvement techniques and their significance.
6. Classify the types of cofferdams and sheet piles and their applications.

Detailed Syllabus		
Unit	Description	Duration (H)
1	**Introduction:** IS code provision in respect of subsoil exploration for dams, canals, tunnels, off shore structure, air ports and bridges. IRC, provisions for exploration in respect of roads. Case studies of failures of foundation.	07
2	**Raft foundations:** Types of rafts, Bearing capacity and settlements of raft, Design considerations and I.S. Code method of analysis, De sign of Raft foundation on different types of soil. Design of combined and isolated footing based on field test including calculation of settlement.	08
3	**Pile Foundations:** Design of pile based on cyclic load test, Study of provision made in different IS codes related to deep foundation, Testing and Design of piles subjected to tensile loads; Design of under reamed pile foundation subjected to tensile loads.	08
4	**Machine Foundations:** Types of machine foundations, mathematical models, response of foundation – soil system to machine excitation, cyclic plate load test, block resonance test, criteria for design.	07
5	**Ground Improvement:** In-situ ground improvement by compaction piles, dynamic loads, sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation, Design of sand drains and stone columns.	08
6	**Sheet Pile walls and Cofferdams:** Types and uses of sheet piles, design of cantilever sheet pile walls in granular and cohesive soils, anchored bulkhead, free earth support and fixed earth support method, Types and uses of cofferdams.	07
	Total	45

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 Foundation".
2. IS: 2950 (Part 1) – 1981"Code of Practice for design and construction of raft foundations".
3. IS 2911 (Part 1) – 2010 "Code of Practice for Design and Construction of Pile Foundation".
4. IS 2974 (Part 1) – 1982 "Code of Practice for design and construction of machine foundations".

e –Resources:

https://archive.nptel.ac.in/courses/105/105/105105207/
https://onlinecourses.nptel.ac.in/noc22_ce32/preview

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Estimation, Costing and Tenders Lab			Code:	BCI7423		
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
2	-	2	1	25	25	-	50

Prior Knowledge:
1. Building Planning, Construction & Materials
2. Design of Reinforced Concrete Structures

Course Objective:
After Completing this course, student will have adequate background to understand and solve the problem involving :
1. Understanding various methods of estimation
2. Knowledge of valuation & its methods.
3. Analyzing the rate of various materials and labours based on current market rates of materials and wages of labours.
4. Understanding tendering system

Course Outcomes:
After learning the course, the students will be able to:
1. Analyze quantities of various items of work and cost of construction
2. Analyze value of property by different methods.
3. Draft specifications and analyze rates of various items of work based on material & labour charges.
4. Select appropriate bidder for tendering process

Lab Experiments / Assignments:
1. Working out quantities using C-L and PWD method for a small single storied load bearing structure and working out cost of building using SSR(Regional)
2. Detailed estimate of a two storied R. C. C. framed building using S.S.R
3. Working out quantities of steel reinforcement for a column footing, a column, a beam, stairs with waist slab and a RCC slab by preparing bar bending schedule.
4. Estimating quantities for any one of the following:
   a) community well   b) Underground Water Tank   c) Pipe Culvert,
   d) Earthwork for road project   e) Septic tank
5. Drafting detailed specifications of any 2 items of building & analyzing their rates based on prevailing market.
6. Drafting of tender notice for Building Structure as per Assignment No 1 or 2.
7. Preparation of tender documents for the problem No.1 or 2
a) Tender Notice.
b) Schedule A and Schedule B
c) Conditions of contracts regarding time- cost over run, extra items etc
8. Report on contents and use of current SSR.
9. Valuation report O1 Farmat.

Text Books:
1. Estimating and Costing in Civil Engineering: Theory and Practice: B.N. Dutta – S. Dutta & Company, Lucknow.27 th Edition 2020.
2. Estimating, Costing Specifications & Valuation in Civil Engineering: M. Chakraborty. 11th Edition 2020
3. Estimating and Costing: R. C. Rangwala - Charotar Publ. House, Anand 17th Edition 2017
4. Building and Engineering Contracts by B.S.Patil , 7th Edition CRC Press 2019

Reference Books:
1. Theory and Practice of Valuation: Dr. Roshan Namavati, Lakhani Publications 2016
2. Valuation Principles and Procedures: Ashok Nain, Dewpoint Publ.2010
3. Laws for Engineers : Dr. Vandana Bhat and Priyanka Vyas –Published by PRO- CARE, 2010

IS Code:
1. IS 1200- Measurement rules for Items of work
2. IS 650 – 1991- Specification for standand sand testing
3. IS 14032 – 1988- Specification for standand Cement testing
4. IS 2386 (Part I To VIII) 1963- Methods of testing Aggregates
5. IS 3495 (Parts I TO iv) 1976- Methods of Tests for Burned Bricks
6. IS: 2720 (Part. XIII) 1986, IS:2720 (Part.30) 1980- Methods of Tests for Soil

Program:	B. Tech. (Civil Engineering)			Semester:		VII Scheme C	
Course:	Design of Steel Structures Lab			Code:		BCI7424	
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
4	-	4	2	50	25	-	75

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. Design the Structural components of Industrial building
2. Structural drawings

Course Outcomes:
After learning the course, the students should be able to:
1. Classify the types of structural steel and rolled steel sections given in Steel Table.
2. Apply design concept of structural components of Industrial buildings as per IS:800 2007.
3. Apply knowledge to Prepare Structural drawings showing details of different elements of the buildings as per SP:38.

Detailed Syllabus

Term work consists of a journal containing the following assignments, and site visit report. Note: Sr. No. 01 to 03, 05 and 08 are compulsory and any one from Sr. No.06 and 07. Term work consists of following experiments, assignment, and report of site visit. Term work marks will be based on continuous assessment.

Full imperial size hand drawn drawing sheets on
Part A
1. Types of structural steel sections, stress strain curve for steel.
2. Types of Trusses & truss member connection.
3. Types of joints, types of connections
4. Structural details of column and beam splices

Part B
5. Design of industrial building including roof truss, purlins, bracings, column, column base and connections. Analysis of truss by using software and cross check manually. Full imperial size hand drawn drawing sheets presenting the design details.

Part C
6. Assignment on Design of any one structural component using excel Programming.
7. Analysis of P re-engineered Industrial shed using software.
8. Report of a site visit mentioning structural details with relevant sketches of structural connections

Text Books:
1. Negi, B.S. "Design of Steel Structures", Tata McGraw Hill India, 1995.
2. Shah & Gore, "Limit State Design of Steel Structures".
3. M. R. Shiyekar, "Limit State Design of Steel Structures".

Reference Books:
1. S. S. Bhavikatti "Design of Steel Structures" I. K. International publishing House Pvt. Limited (2009)
2. Ram Chandra. "Steel Structure Vol. I & II", Standard Publishers; Delhi (2013)
3. Gaylords, E.H. &Gaylords, C. N. "Design of Steel Structures", McGraw Hill Publication, 1998.
4. N. Subramaniam, "Design of Steel Structures as per IS:800-2007", Oxford university press.
5. S. K. Duggal, "Limit State design of Steel Structures:, McGraw Hill Education Private Limited 2010.

IS Codes:
1. SP: 6 (1995) : Handbook for Structural Engineers
2. IS 800 (2007) General Construction in Steel — Code of Practice
3. IS 808 (1989) Dimensions for Hollow Rolled Steel Beam, Column, Channel and Angle Sections
4. IS 875 (Part-I)-1997 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 1 : Dead Loads — Unit Weights of Building Materials and Stored Materials (Reaffirmed 1997).
5. IS 875 (Part-II)-1987 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 2 : Imposed Loads(Reaffirmed 1997).
6. IS 875 (Part-III)-2015 – Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures Part 3 : Wind Loads.
7. IS 875 (Part-IV)-1987 Code of Practice, for Design Loads (Other Than Earthquake) for Buildings and Structures Part 4 : Snow Loads (Reaffirmed 1997).
8. IS 875 (Part-V)-1987 Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Part 5 : Special Loads and Combinations (Reaffirmed 1997)
9. IS 812 2008 Code of Practice for Glossary of terms relating to welding and cutting of Metals.
10. IS 813:2008 Code of Practice for Scheme of symbols for welding.
11. IS 817(Part 1):2008 Code of practice for Manual metal arc welding
12. IS 817(Part 1):2008 code of practice for Oxyfuel welding

E-Resources
https://archive.nptel.ac.in/courses/105/105/105105162/#
https://www.insdag.in/

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Air Pollution and Control Lab (PEC-V)			Code:	BCI7503A		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
-	1	1	1	25	-	-	25

Course Objectives:
1. To impart the knowledge of sampling and analysis of ambient air for particulate and gaseous pollutants concentration.
2. To impart the knowledge of laws and regulation related to air pollution control.

Course Outcomes:
After learning the course, the students should be able to:
1. Explain the laws and regulations related to air pollution control.
2. Perform the sampling and analysis of ambient air for particulates and gaseous pollutants.
3. Explain working of air pollution control devices.

Detailed Syllabus

Term work consists of a journal containing details of assignments and visit report (Any 8, one site visit compulsory)

1. Presentation (in a group of four) on laws and regulations related to air pollution control.
2. Report / Case Study on use of modern technologies to curb the air pollution (RS & GIS, new inventions, etc.)
3. Site Visit to Indian Meteorological Institute (IMD) or Indian Institute of Institute of Tropical Meteorology
4. Site Visit to any industry to study the pollution control device
5. Sampling and Analysis of PM10 and PM2.5 using (High Volume Sampler/ Fine Dust Sampler) in Ambient Air
6. Sampling and Analysis of SO_2 and NO_2 (High Volume Sampler/ Fine Dust Sampler) in Ambient Air
7. An interactive session with experts from Indian Institute of Tropical Meteorology/ Central Pollution Control Board/ State Pollution control board/ Municipal corporation or Nagar Panchayat/ smart city centers/ National Environmental Engineering Research Institute (NEERI)/any authority with reference to air quality and its report.
8. Exercise on software for air quality modelling (Screen3/ ISC/ CALINE4/ HIWAY2/ CAR-FMI/ OSPM/ CALPUFF/ AERMOD/ ADMS)
9. Demonstration of sampling and analysis of indoor air quality
10. Demonstration of sampling and analysis of sample collected through stack.

Text Books:
1. Air Pollution and Control, K.V.S.G. Murali Krishna, University Science Press, 2015
2. Air Pollution, M. N. Rao and H. V. N. Rao, 58th Edition, McGraw-Hill Education, 2020
3. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.2017

Reference Books:
1. Air Pollution: Health and Environmental Impacts, Gurjar, B.R., Molina, L., Ojha, C.S.P. (Eds.), CRC Press, 2010
2. Fundamentals of Air Pollution, Boubel, R.W., Fox, D.L., Turner, D.B., Stern, A.C., 4th Edition, Academic Press, 2008.
3. Atmospheric Chemistry and Physics, Seinfeld, J.H., Pandis, S.N., 3rd Edition, John Wiley, 2016.

E-Resources
1. http://cpcb.nic .in https://cpcb.nic.in/uploads/National_Ambient_Air_Quality_Standards.pdf
2. http://moef.nic .in https://moef.gov.in/en/division/environment-divisions/climate-changecc-2/documents-publications/

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)		Semester:	VII Scheme C
Course:	Construction Techniques and Retrofitting System Lab (PEC-V)		Code:	BCI7503B

Teaching Scheme				Evaluation Scheme			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives :
To impart broad knowledge in the area of Construction techniques and retrofitting of structures

Course Outcomes:
After learning the course, the students should be able to:
1. Recommend the suitable techniques for sub and super structure construction.
2. Apply the knowledge to select repair and retrofitting technology for RC structure.

<div align="center">Detailed Syllabus</div>

Term work consists of assignments and visit report (Any 8 of following).

1. Assignment on pile construction techniques
2. Assignment on shoring techniques *or* no dig techniques
3. Assignment on ground improvement technique
4. Assignment on soil drainage *or* grouting technique
5. Individual field visit report of formwork system *or* any advance super structure construction system.
6. Assignment on rigid pavement *or* bridge construction technique.
7. Assignment on repair or rehabilitation technique.
8. Assignment on any retrofitting system.
9. One case study presentation individual/group on any of the advanced construction technology.
10. Visit report which explores the construction technology practical aspects or Exhibition visit report related to construction techniques.
11. Preparation of model *or* e-poster related to any advance construction/retrofitting technology.
12. Write a review on any recent research article from standard peer-reviewed journal on any topic related to syllabus content.

Text Books:
1. Construction techniques and practices by Dr.V.Kannan, first edition, V. Kannna publication, 2021.
2. Concrete Structures: Repair, Rehabilitation and Strengthening, Dr. Mohamed A. El-Reedy, 2020
3. Construction Techniques and Practice by V. SankaraSubramaniyan from Lakshmi Publications, 2017
4. Construction Technology, Sankar, S.K. and Saraswati, S., Oxford University Press, New Delhi, 2008.

Reference Books:
1. Construction Planning, Equipment and methods – Peurifoy- Tata McGraw Hill Publication
2. Modi, P.I., Patel, C.N., Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi, 2016.
3. CPWD Handbook (2011). Repair and Rehabilitation of RCC Buildings.
4. ACI 201.1R-08: American Concrete Institute, Guide for Conducting a Visual Inspection of Concrete in Service
5. ACI RAP-11-American Concrete Institute , Field Guide to Concrete Repair Application Procedures
6. Dyer, Thomas. (2014). Concrete Durability, CRC Press, Taylor & Francis Group, Florida.

E-Resources
https://nptel.ac.in/courses/ground improvement techniques
https://nptel.ac.in/courses/ Construction methods and equipment management
https://archive.nptel.ac.in/courses/105/105/105105213/
https://www.cecr.in/

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Design of RC Bridges Lab (PEC – V)			Code:	BCI7503C		
Teaching Scheme				**Evaluation Scheme**			
Practical	**Tutorial**	**Hours**	**Credit**	**TW**	**OR**	**PR**	**Total**
-	1	1	1	25	-	-	25

Course Objectives:
1. To provide an understanding of various loads acting on the bridges and design of RCC bridge superstructure.
2. To introduce the analysis and design of RC bridge substructure components.

Course Outcomes:
After learning the course, the students should be able to:
1. To calculate the loading of the RC bridge and design the RCC deck slab and girders.
2. To analyze and design bridge pier, abutment, and bearings.

Detailed Syllabus

Term work consists of a journal containing details of assignments and a visit report (Any 08 assignments and a site visit report are compulsory).

1. Bridge Deck Analysis
2. Design of RC slab bridge.
3. Design of slab culvert
4. Design of longitudinal and cross girders as per Courbon's theory
5. Design of post-tensioned prestressed concrete T-beam bridge deck and girders.
6. Design of steel girder.
7. Design of Pier.
8. Design of the Abutment.
9. Expansion joints (Types and Requirements)
10. Site visit / Industrial visit report (Study of structural drawing and details)
11. Analysis and design of bridge using the software.

Text Books:
1. Principles and Practice of Bridge Engineering- S P Bindra Dhanpat Rai & Sons New Delhi, 2012.
2. Reinforced Concrete Structures – Vol. II by Dr. B. C.Punmia, Ashok Kumar Jain, Arun Kumar Jain, Laxmi Publications, 2018.

Reference Books:
1. Essentials of Bridge Engineering by D. Johnsons Victor, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 6th edition 2019
2. Ponnuswamy. S, "Bridge Engineering"- Tata McGraw Hill, 2nd edition 2015.
3. Concrete Bridge Practice by Dr. V. K. Raina, Tata McGraw Hill; 4th edition 2014.

IS Code and Specifications
1. IRC 6 – 1966 "Standard Specifications and Code of Practice for Road Bridges"- Section II Loads and Stresses, The Indian Road Congress New Delhi.
2. IRC 21 – 1966 "Standard Specifications and Code of Practice for Road Bridges"-Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi.
3. IS 456 – 2000 "Indian Standard Plain and Reinforced Concrete Code of Practice"- (Fourth Revision) BIS New Delhi.
4. IS 1343 – "Indian Standard Prestressed Concrete Code of Practice"- BIS New Delhi.

E-Resources:
https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ce43/
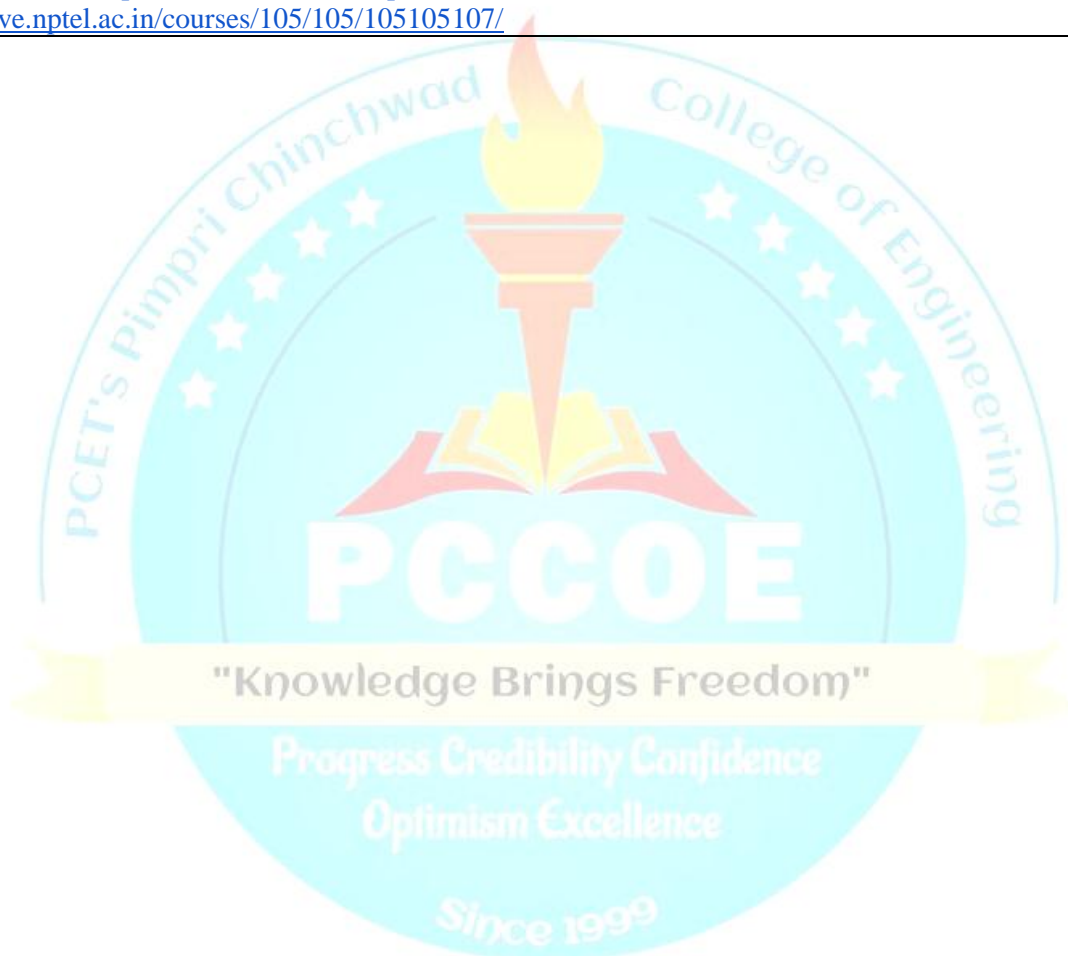https://www.udemy.com/course/concrete-bridges-design-fundamentals/

Program:	B. Tech. (Civil Engineering)			Semester:	VII Scheme C		
Course:	Air Transportation and Bridge Engineering Lab (PEC – V)			Code:	BCI7503D		
Teaching Scheme				**Evaluation Scheme**			
Practical	Tutorial	Hours	Credit	TW	OR	PR	Total
-	1	1	1	25	-	-	25

Course Objectives :
1. To impart the knowledge related to the technical aspects of air transportation.
2. To make the students aware about various types of bridges and its components.

Course Outcomes: After learning the course, the students should be able to:
1. Identify the various airplane components.
2. Apply the aspects to plan for the airport features
3. Describe the bridge components and allied phenomenon.

Detailed Syllabus

Lab assignments:
B. Compulsory assignment

1. Examples based on Runway design for length and related corrections
2. Drawings of various types of Bridge and its components
3. Assignment based on Wind rose type 1 and type 2 diagrams for runway orientation

B. Any five from the following

4. A Digital Report/PPT on study of recent trends in airport planning and design.
5. Assignment based on Selection criteria of bridge site, alignment and collection of design data.
6. Site visit to bridge site or airport site (report on visit)
7. Seminar on one topic of building information modeling (BIM) systems.
8. Report on guest lecture in applications of AR and VR/ in Airport or bridge engineering OR Report on guest lecture in airfield pavement construction.
9. Prepare the drawing/plate (A3)/PPTs on airport marking and lighting. (Describing importance)
10. PowerPoint presentation on bridge substructure and superstructure and Bridge types.

Textbooks:
1. Airport planning and Design – S.K. Khanna , M.G. Arora , S.S. Jain, Nem Chand and Brothers, Roorkee, 6th Edition (2019)
2. Airport Engineering by Rangwala, Charotar Publication, 17th Edition (2019)
3. Bridge Engineering by Rangwala, Charotar Publication, 17th Edition (2023)

Reference Book:
1. Ashford, N., and P. H. Wright. 1992. Airport Engineering, 3rd ed. New York: John Wiley & Sons
2. Essentials of Bridge Engineering – D. Johnson and Victor, Oxford and IBH publishing Co. Pvt. Ltd. , New Delhi. (2017)
3. Bridge Engineering by Ponnuswamy, Mcgraw Hill Publication (2008)
4. Airport Engineering, by Saxena S.C., CBS Publishers & Distributors, (2017)

Standard Codes:
1. Airport Planning Manual, Part 2 Land Use and Environmental Control, Doc 9184 AN/902
2. Airport Planning and Development Handbook, Paul Stephen Dempsey, Paul Dempsey, McGraw Hill Professional, 2000
3. https:///panchayatrajengineers.wordpress.com/2019/01/27/irc-codes-for-roads-and-bridgesdirect-download-links-from-panchayatraj-engineers-blog
4. Indian Road Congress (IRC) – Standard Specifications and code of practice for bridges.
5. International Civil Aviation Organization (ICAO). International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention on International Civil Aviation, Volume 1 Aerodrome Design and Operations, 3rd edition, International Civil Aviation Organization, 2004.

E-Resources:

https://archive.nptel.ac.in/courses/105/107/105107123/
https://onlinecourses.nptel.ac.in/noc22_ce63/preview
https://onlinecourses.nptel.ac.in/noc22_ae14/preview
https://archive.nptel.ac.in/courses/105/105/105105107/

Open Elective-5

Final Year B Tech
Civil Engineering
Semester-VIII
Scheme C

Open Elective 5 offered by Civil Department to other department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VIII Scheme C	
Course:	E- waste management (OEC-5)				**Code:**	BCI8605A	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
1. Fundamentals of Environmental Engineering.
2. Fundamentals of Sustainable Engineering.

Course Objectives:
1. To impart knowledge of e-waste in Indian and Global scenarios and role of engineering in e-waste management.
2. To build the concept of the role and responsibility of different stakeholders in the e-waste business.
3. To make aware of e-waste legislation (Acts and guidelines)
4. To get acquainted with recycling and recovering technologies.
5. To create awareness on e-waste global trade.
6. To impart knowledge of the circular economy and e-waste for a sustainable future.

Course Outcomes:
After learning the course, the students should be able to:
1. Identify the issues and challenges of e-waste management for a sustainable environment.
2. Explain the role and responsibilities of stakeholders and directory bodies for e-waste control measures.
3. Explain legislation (Acts and guidelines) and apply sustainable approaches.
4. Identify the e-waste handling process, recycling, and recovery techniques for a sustainable future.
5. Explain e-waste global trade and economy.
6. Apply a circular economy road map for an e-waste sustainable future.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Electronic and Electrical Waste (e-Waste)** What is E-Waste, Indian and global scenario of e-Waste, Growth of the Electrical and Electronics industry in India and global, Composition and characteristics of e-waste, e-waste pollutants, Possible hazardous substances present in e-waste, Environmental and Health implications-waste disposal issues and challenges for domestic and commercial, Awareness and approach towards E-waste, Role and responsibility of engineering in e-waste management Case Study.	07
2	**Electronic and Electrical Waste (e-Waste) control measures** Need for stringent health safeguards and environmental protection laws in India, Regulatory compliance including roles and responsibilities of different stakeholders, Proposed reduction in the use of hazardous substances(RoHS), Extended Producer's Responsibility (EPR) targets Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source. Case Study.	07
3	**E-waste Legislation** The regulatory regime for e-waste in India, Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016, e-waste (Management) Amendment Rules, 2018, 2022 .A comprehensive analysis of e-waste legislation worldwide. International Conventions, Regulations and Laws, handling e-waste in developed and developing countries: initiatives, practices, and consequences with a case study. G20 summit 2023.	07

4	**Electronic and Electrical Waste (e-Waste) Management** Basic principles of e-waste management, Technologies for segregation and recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India. Reuse of E-waste. Carbon footprint and credits for recycling, Case study on recycling and recovering technology.	**08**
5	**E-waste hazards on Global trade** Essential factors in the global e-waste trade economy, e-waste trading as a quintessential part of electronic recycling, free trade agreements as a means of waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India with case study.	**08**
6	**Circular economy and e-waste** Sustainable management of e-waste and circular economy, Achieving UN Sustainable Development Goals (SDGs) and E-Waste, Urban mining towards sustainable future and circular economy, Entrepreneurship and expertise in e-waste, global challenges and opportunities in structured e-waste management. Circular electronics roadmap, Circular economy startup in India with a case study.	**08**
	Total	**45**

Text Books:
1. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, Latest edition
2. Electronic Waste Management: Edition 2, by G H Eduljee, R M Harrison, Royal Society of Chemistry 2022, ISBN 978-1-78801-744-2
3. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

Reference Books:
1. Fowler B, Electronic Waste – 1 st Edition (Toxicology and Public Health Issues), 2017 Elsevier

E-Resources
https://cpcb.nic.in/e-waste/
https://courses.iid.org.in/course/e-waste-recycling-business
https://www.suritex.co.in/
http://greenscape-eco.com/
https://onlinecourses.nptel.ac.in/noc20_ce12/preview
https://nielit.gov.in/gangtok/content/paid-course-e-waste-management

Open Elective 5 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Advanced Instrumentation in Infrastructural Engineering (OEC-5)**				**Code:**	**BCI8605B**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
1. Knowledge of fundamentals of Infrastructure engineering
2. Knowledge of fundamentals of geotechnical and transportation engineering

Course Objectives:
1. To impart knowledge of advanced instruments used in Road Infrastructure
2. To Identify the advancement in various modes of transportation
3. To make aware of the scope of various instruments in monitoring fields.
4. To get acquainted with sensors and transducers.

Course Outcomes:
After learning the course, the students should be able to:
1. Elaborate the role of various agencies involved in building road infrastructure and allied areas
2. Explain different attributes related to urban transportation
3. Analyze the various tools and measures to delineate with the traffic conflicts in an urban city
4. Determine the properties of soils using various advanced instruments.
5. Apply the knowledge of instruments in various monitoring fields.
6. Discover the additional attributes in advanced sensors and their role in Civil Engineering.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Pavement Infrastructure** Introduction to pavement infrastructure, Types of pavement (Flexible, Rigid and Composite), IRC (Indian Roads Congress)and MoRTH (Ministry of Road Transport and Highways) guidelines, Role of National Highway Authority of India in pavement construction, Advanced Instrumentation in Pavement construction, Modern Modes of Transportation (Road, Rail, Air and Water transportation)	**07**
2	**Urban Public Transportation** Urban growth and public transport needs – Transit mode classifications -Transit characteristics- Demand estimation- Frequency & Fleet size determination, Advanced Survey Instruments Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays – Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design. Types of Road Markings,Traffic Impact Attenuators, Safety Barriers, Traffic signals: types and principles of phasing	**09**
3	**Traffic Monitoring and Control** Traffic Studies: Basic characteristics of Traffic, Volume, Speed and Density, Traffic Volume studies, Speed and Delay studies, Accident Studies and road safety auditing, Traffic calming measures and modern traffic control devices	**06**
4	**Soil properties using advanced instruments** Pore pressure measurement, Earth pressure cell, Settlement gauges. Inclinometers, Stress measurements, Seismic measurements. Advanced instrumentation in Earthquake resistant structures	**07**

5	**Scope of Geotechnical Instruments In Various Monitoring Fields** Dam Monitoring Solutions-Water level, Water pressure and seepage, Lateral ground movement, Deformation, Displacement, Stress, Strain, Load Temperature, Tilt, Surface Settlement. Tunnel Monitoring Solutions- Lateral ground movement, Deformation, Displacement, Stress, Strain, Load ,Temperature Tilt, Surface Settlement. Structural Monitoring Solutions- Tilt Monitoring, Crack Monitoring, Settlement Monitoring, Lateral Ground Movement, Temperature Monitoring, Pore Pressure Monitoring.	08
6	**Sensors & Transducer:** Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Infrastructural Engineering.	08
	Total	45

Text Books:
1. Traffic Engineering and Transportation Planning – L.R. Kadiyali, Khanna Publishers
2. Highway Engineering, C.E.G.Justo and S.K.Khanna, Nem Chand and Brothers.
3. 3.ChakrobortyP.,DasN.,Principlesof Transportation Engineering(2nd edition),PHI,NewDelhi,2017
4. Handbook of Geotechnical Investigation and Design Tables, Routledge, 2007.
5. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
6. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.

Reference Books:
1. Transportation Engineering - An Introduction - C.Jotin Khisty, Prentice Hall Publication
2. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington, D.C., 2010
3. Geotechnical Investigation Methods: A Field Guide for Geotechnical Engineers. EHUNT, Taylor & Francis, .2006.
4. Koerner, R.M. "Designing with Geosynthetics", Prentice Hall, New Jersey, USA, 5th edition, 2005.
5. IRC and MoRTH standards

Open Elective 5 offered by Civil Department to civil engineering students						
Program:	**B. Tech. (Civil Engineering)**			**Semester:**	**VIII** **Scheme C**	
Course:	**Massive Open Online Courses (MOOC): (OEC-5)**			**Code:**	**BCI8605C**	
Teaching Scheme				**Evaluation Scheme**		
Lecture	**Tutorial**	**Hours**	**Credit**	**FA**	**SA**	**Total**
3	**-**	**3**	**3**	**70**	**30**	**100**

Course Objectives:
1. MOOC courses are introduced to imbibe self learning in students.
2. To prepare students for modern tools and techniques.

Course Outcomes: After learning the course, the students will be able to:
1. Build self-learning skills.
2. Discuss the application of modern tools and techniques in civil engineering.

Guidelines for Students:

1. The MOOC courses can be chosen from the **online platform** such as NPTEL/Coursera/ /Udemy etc.

2. Individual student needs to take approval from project guide for MOOC course and then proceed for registration. MOOC course should be exclusive to courses undertaken by students. (Repetition of Course is not allowed.)

3. While selecting the course, student should be opted for the different courses based on the available latest courses apart from courses offered in the program curriculum.

4. Total duration of course should be 8-12 weeks. (minimum 45 hrs)

5. Regular assignments need to be completed as per requirement of course.

6. Submission of the regular assignments needed as per requirement of course.

7. At the end of course submission of MOOCs report of (3- 4 Pages) in hardcopy is mandatory along with certificate of completion.

8. 50% weightage given to internal evaluation based on assignment submitted and 20% weightage given to MOOC course report (notes). Remaining 30% weightage given to certification of the course as external evaluation by selected platform. Final examination for this course is mandatory irrespective of the platform.

9. If student is not able to earned 3 credit, he/she will be failed in the course, in such case the student can registered or opted for open elective courses floated by department and earned 3 credits in stipulated time frame.

Evaluation Guidelines and Rubrics:

1. **Formative Assessment (50 Marks)**

2. **MOOCs report Submission (20 Marks)**

3. **Final Examination Certificate (30 Marks)**

   1. Formative Assessment (50 Marks)

   a. Timely completion of assignment (25 marks)

   b. Progress of assignment (25 Marks)

Rubrics for FA (50 marks)

	Excellent (100 % Weightage) 25	Good (80 % Weightage)	Average (60 % Weightage)	Poor (50-40 % Weightage)
Timely completion of assignment (25 marks)	25	20	15	12
Progress of assignment (25 marks)	25	20	15	12

2. MOOCs report Submission (20 Marks)

The student should summarize learning outcomes in report of 3-4 pages or student may submit good quality paper with some application implemented using the knowledge gained through the course to comply these rubrics:

a. Report must be drafted appropriately (LATEX tool but not compulsory) (10 Marks)
b. Content of the report/ paper (10 Marks)

3. Final Examination Certificate –SA (30 Marks)

a. Appeared for Exam: 05 Marks
b. Performance of Exam: 25 Marks

Link of platforms:

https://nptel.ac.in/courses
https://www.coursera.org/search?query=construction%20management&
https://www.udemy.com/topic/construction/

Open Elective 5 offered by Computer department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Web Technology and its Applications (OEC-5)**			**Code:**		**BCE8607**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior knowledge of
 www- world wide web, HTML

Course Objectives:
1. To understand the basics of Web Designing using HTML, CSS and JavaScript
2. To learn the basics about Client side scripts
3. To learn the basics about Client side framework.
4. To understand the web services and frameworks.

Course Outcomes: After completion of this course students will be able to,
1. Elaborate the behavior of web pages using HTML.
2. Demonstrate the client-side technologies for media in web development.
3. Illustrate the client-side technologies for design/layout in web development.
4. Apply the scripting language for web development.
5. Apply server-side technologies for web development.
6. Use dynamic web applications for advanced web development platforms.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Web Essentials and Mark-up language- HTML** HTML- Basics, List, Tables, Images, Forms, Frames. Designing a webpage in HTML for displaying Boiler readings/ displaying oscilloscope readings/ displaying building plans, etc.	**07**
2	**HTML Media and API** HTML: Media, Video, Audio, YouTube, GeoTag, Drag and Drop. Creating a Web Page and inserting video/audio with controls and AutoPlay. Designing a webpage in HTML displaying the location of your device/ place consisting of GPS.	**08**
3	**Client Side Technologies-CSS** Introduction to cascading style sheets. Inserting CSS in an HTML page, CSS selectors. **Advanced CSS -** Round Corners, Boundary Images, Gradients, Shadows, 2D and 3D transformations. Designing a layout for any application such as displaying readings for an oscilloscope (or any example of your domain).	**07**
4	**Client Side Technologies-XML and JavaScript** XML- Document type definition, XML Schemas, Document Object model. Java Script - Control statements, Functions, Arrays, Objects, Events, Dynamic HTML with Java Script. Designing a calculator using JavaScript.	**07**
5	**Server Side Scripting Languages** PHP-Origins and Uses of PHP, Overview of PHP and General Syntactic Characteristics, Primitives, Operations, and Expressions, Output and Control Statements, Arrays, Functions, Basic Pattern Matching, Form Handling, Files Handling, Cookies.	**08**
6	**Current Trends in Web Technology** **Progressive Web Apps**- Case Study FlipBorad, 2048 Game, SoundSlide, **Single-page applications (SPA)** – AngularJS, ReactJS, Vue.js, example- Youtube, Chatbots and virtual assistants, Responsive design, Cloud-based development and deployment	**08**
	Total	**45**

Text Books:
1. Brown, Ethan, "Web Development with Node and Express: Leveraging the JavaScript Stack", O'Reilly Media, 2019.
2. HTML5 Canvas: Native Interactivity and Animation for the Web, 2 nd edition, Steve Fulton, Jeff
    a. Fulton · 2013.
3. Web Technologies: HTML, Javascript, Php, Java, Jsp, Asp.Net, Xml And Ajax, Black Book-2009.
4. Achyut Godbole & Atul Kahate :Web Technologies TCP/IP, Web/Java Programming, and Cloud Computing- 2013.
5. Dom Scripting: Web Design with Javascript and the Document, 2nd Edition, Jeremy Keith, Jeffrey Sambells · 2011.

Reference Books:
1. Adam Bretz & Colin J Ihrig, "Full Stack Javascript Development with MEAN", SPD, ISBN-13: 978-0992461256,2014
2. Giulio Zambon, "Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10:1430246235; ISBN-13: 978-1430246237,2012.
3. Jeremy McPeak& Paul Wilton," Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937,2012
4. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3, 2014.

Web references:
https://www.w3.org/html/
HTML, The Complete Reference http://www.htmlref.com/
http://w3schools.org/
http://php.net/
https://jquery.com/
http://www.tutorialspoint.com/css/
https://www.simicart.com/blog/progressive-web-apps-examples/
http://www.nptelvideos.in/2012/11/internet-technologies.html
https://freevideolectures.com/course/2308/internet-technology/25 video lecture by Prof. Indranil Sengupta, IIT, Kharagpur
https://www.digimat.in/nptel/courses/video/106105191/L01.html
http://www.nptelvideos.com/php/php_video_tutorials.php

Open Elective 5 offered by Computer department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Software Testing & Quality Assurance (OEC-5)**			**Code:**		**BCE8608**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior knowledge of
  Software engineering basics

Course Objectives:
1. To study and understand the software development life cycle.
2. To introduce basic concepts of software testing
3. To understand white box, block box, automation and other testing techniques
4. To understand the software quality processes and management.

Course Outcomes: After completion of this course students will be able to,
1. Understand the software development life cycle.
2. Comprehend the software testing basic concepts and terminologies.
3. Demonstrate the different testing types.
4. Demonstrate understanding of automation testing.
5. Outline the test planning and management process.
6. Elaborate the different Software Quality techniques and tools.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Software Development Life Cycle Models** Phases of Software Project, Quality, Quality Assurance, and Quality Control Testing, Verification, and Validation Process, Model to Represent Different Phases, Life Cycle Models	07
2	**Introduction to Software Testing** Goals Of Software Testing, Model for Software Testing, Effective Software Testing Vs. Exhaustive Software Testing, Software Testing As A Process, Software Testing Terminology Definitions	07
3	**Types of Testing** White Box Testing, Static Testing, Black Box Testing, requirement of Black Box Testing, when to do Black Box Testing? Integration Testing, System Testing requirement of System Testing, Challenges in testing. Software Failure case studies (any two)	08
4	**Introduction to test automation** Terms Used in Automation, Skills Needed for Automation, What to Automate, Scope of Automation, Design and Architecture for Automation, Process Model for Automation, Selecting a Test Tool, Challenges in Automation	08
5	**Test Planning and Management** Introduction, Test Planning, Test Management, Choice of Standards, Test Infrastructure Management, Test Process, Test cases & test plan preparation	08
6	**Software Quality Management** Software Quality, Broadening the Concept of Quality, Quality Control And Quality Assurance, Methods Of Quality Management, Software Quality Metrics, SQA Models	07
	Total	**45**

Text Book:
1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson, 2017.
2. Naresh Chauhan, "SOFTWARE TESTING Principles and Practices", OXFORD UNIVERSITY PRESS, 2nd edition 2016

Reference Books:
1. Paul Ammann, Jeff Offutt, "Introduction to Software Testing", Cambridge University Press, Dec 2016.
2. Ilene Burnstein, "Practical Software Testing A Process-Oriented Approach", Springer-Verlag New York, Inc., 2006 ISBN 0-387-95131-8

Web References:
https://pdfcoffee.com/download/se-4-pdf-free.html

Open Elective 5 offered by E& TC to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Bio inspired systems and Computing (OEC-5)**				**Code:**	**BET8601**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior knowledge of
  Data Science and Statistics is essential

Course Objectives:
1. To explain bio-inspired theorem and algorithms
2. To demonstrate role of random walk and simulated annealing
3. To discuss genetic algorithm and differential evolution with their applications
4. To elaborate use of swarm optimization and ant colony for feature selection

Course Outcomes: After completion of this course students will be able to,
1. Understand bio-inspired algorithms used in computing.
2. Implement optimization using genetic algorithms.
3. Explore role of swam optimization in computing algorithms
4. Apply bio inspired algorithms in image processing applications.
5. Describe bio-inspired routing protocols for VANETs
6. Understand bio-mimetically inspired robot prototype

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction:** Bio-inspired Computing, The influence of brain science on Brain-inspired computing, Development focus of bio-inspired algorithms, Paradigm of evolution of algorithms with increase of complexity of problems. Current Issues in Bio-Inspired Computing	**06**
2	**Genetic Algorithms and Differential Evolution:** Introduction to genetic algorithms, Components of genetic algorithms, Properties of genetic algorithms, Linear genetic programming, Biological vs. artificial evolution. Applications: Prediction of cancer survival	**07**
3	**Swarm Optimization And Firefly Algorithm:** Swarm intelligence - PSO algorithm, Properties of PSO, binary PSO, Types of Swarm-Intelligence-Based Algorithms. The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.	**08**
4	**Application In Image Processing:** Bio-Inspired Computation and its Applications in Image Processing: An Overview, Improved Weighted Threshold based Histogram Equalization Algorithm for Digital Image, Contrast Enhancement Using Bat Algorithm, Mobile Object Tracking Using Cuckoo Search.	**08**
5	**Bio-Inspired Routing Protocols For Vanets:** Motivations for using bio-inspired approaches in VANET routing, Fundamental concepts and operations of bio-inspired VANET routing, Basic bio-inspired algorithms used in VANET routing literature, Swarm intelligence for VANET routing	**08**
6	**Bio-Mimetically Inspired Robot Prototype:** Definition: Bionics, Biomimetic, Bio-inspired, and Biotechnology, State of the Art in Robotics and Robotic Actuation, Biomimetically Inspired Robot Prototype, The Robot's Performance, Field of Application	**08**
	Total	**45**

Text Books:
1. Yang ,Cui,XIao, Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier, First Edition, 2013
2. Xin-She Yang, Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier First edition 2016
3. Abdelhamid Mellouk, Salim Bitam, "Bio-Inspired Routing Protocols for Vehicular Ad Hoc Networks",Wiley , First edition 2014.
4. Ralf Simon King , "BiLBIQ_ A Biologically Inspired Robot with Walking and Rolling Locomotion" Volume 2, [Biosystems & Biorobotics] , Springer Berlin Heidelberg, 2012

Reference Books:
1. Mattias Wahde, "Biologically Inspired Optimization Methods: An Introduction", WIT Press, First edition 2008
2. Eiben, A.E.,Smith, James E, "Introduction to Evolutionary Computing", Springer 2015.
3. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
4. Acharjya, D. P._ Santhi, V - Bio-Inspired Computing for Image and Video Processing-CRC Press, 2018.
5. Xin-She Yang, "Nature Inspired Optimization Algorithm, Elsevier First Edition 2014
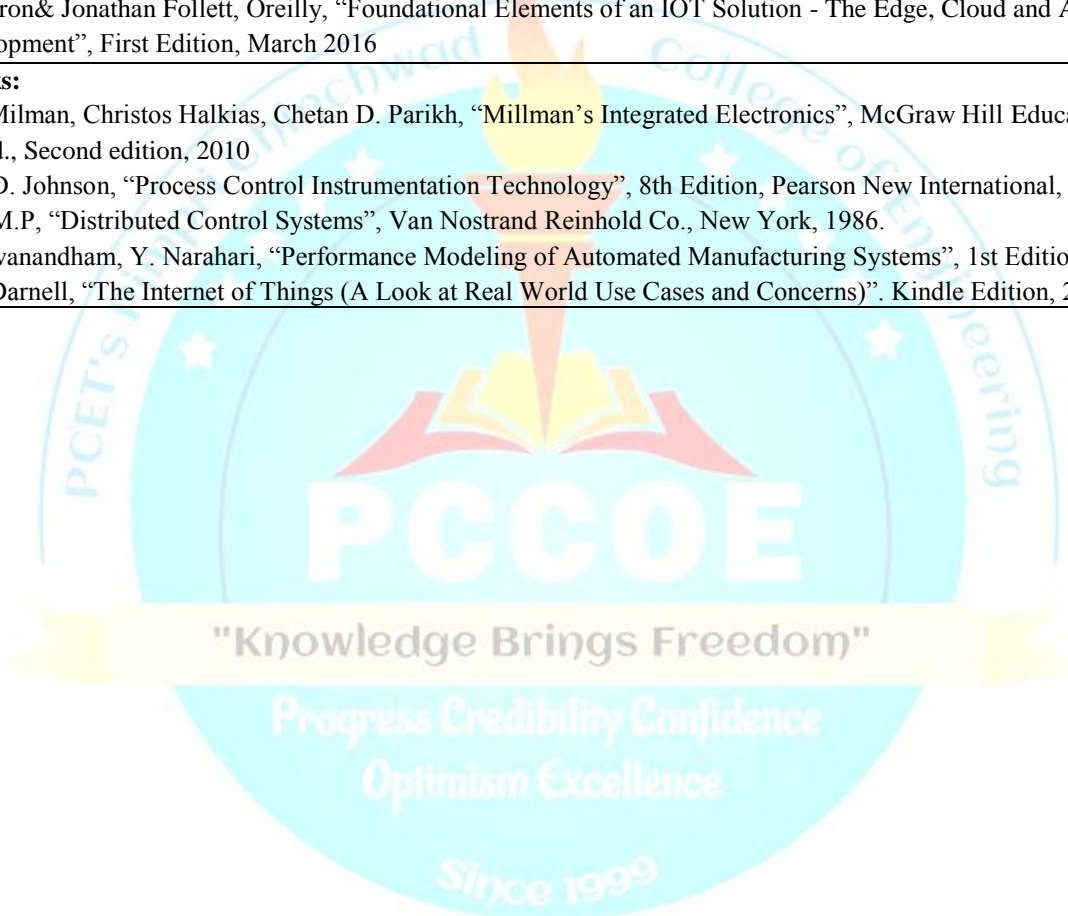
Papers:
1. Arpan Kumar Kar,Bio inspired computing – A review of algorithms and scope of applications, Expert Systems with Applications,Volume 59,2016,Pages 20-32,ISSN 0957-4174, https://doi.org/10.1016/j.eswa.2016.04.018.

Open Elective 5 offered by E& TC to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Sensor and Automation using IoT (OEC-5)**			**Code:**		**BET 8602**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of:
1. Basic Electronics Engineering
2. **Programming with Arduino** is essential

Course Objectives:
1. Explain fundamental methods and characteristics of measurement systems.
2. Introduction to various types of transducers with working principles
3. Make students aware of need of computer aided process automation in industrial applications.
4. Demonstrate PLC ladder programming for design of basic logic gates for various applications
5. Make students familiar with various applications of IoT.

Course Outcomes:
After completion of this course students will be able to,
1. Illustrate the working principle of various types of transducers and their characteristics.
2. Choose proper sensor comparing different standards, guidelines and requirements for measurements of displacement, velocity, acceleration and level.
3. Select proper sensor comparing different standards, guidelines and requirements for measurements of Temperature and Force
4. Describe the need and concept of process control and automation systems
5. Design of basic logic gates using ladder programming.
6. Explain applications of IoT for real life application in automobile and healthcare

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Sensors and Transducers** Introduction to Sensors, Description and Working principle, Types of sensors, Specifications of Sensors. Introduction to transducers, Advantages and Disadvantages of Electrical Transducers, Classification of Transducers, Static and Dynamic characteristics, Difference between sensors and transducers	**07**
2	**Sensors for Displacement, Vibration, Acceleration and Level** Classification of Displacement Sensors: Potentiometer, Strain-gauged element, Capacitive element, Differential transformers, Eddy current proximity sensors, Inductive and Capacitive Proximity switch, Optical encoders. Pneumatic sensors (Bellows, Diaphragm), Hall effect sensors, Accelerometer, Gyroscope and Magnetometer (ADXL335/345), Electro-Optical Sensors, Position Encoders.	**08**
3	**Force and Temperature Sensors** Basic methods and types of force measurement: elastic force, strain gauge, piezoelectric, inductive, Capacitive load cells. Methods of temperature measurement: Optical Fiber, Resistance Temperature Detectors, Thermistor, Thermocouples	**07**
4	**Computer Aided Process Control and Automation Systems** Introduction of computer aided process control hardware, Industrial communication systems, Introduction of Computer based data acquisition system (**DAQ**), fundamentals of automation, Automation principles and strategies, reasons for Automating, basic elements of an automated system: Power, Program and control system.	**08**
5	**Introduction of Programmable Logic Controllers** Fundamentals of PLC, PLC selection criteria and applications of PLC Introduction to PLC programming, Ladder diagram, Sequential flow chart, Industrial bus systems.	**08**

	Case Study: Basic Logic Gates implementation using Ladder programming, Temperature Measurement with interfacing to DAQ	
6	**Introduction to Internet of Things:** Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Basic Concept of IoT, Sensor Interface in IoT systems, Design Model for IOT Case Study 1: IoT based Automobile Sector (Engine Management System) (Mention of Fuel Level, Ignition, Exhaust Sensors) Case Study 2: IoT based Healthcare Systems (Block Diagram and Simulation)	07
	Total	**45**

Text Books:
1. A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", 18th Edition, Dhanpat Rai Publications, 2001
2. Patranbis, "Sensor and Transducers", 2nd Edition, PHI publication, 2005.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011
4. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Joe Biron& Jonathan Follett, Oreilly, "Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development", First Edition, March 2016

Reference Books:
1. Jacob Milman, Christos Halkias, Chetan D. Parikh, "Millman's Integrated Electronics", McGraw Hill Education India Pvt. Ltd., Second edition, 2010
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013.
3. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
4. N. Viswanandham, Y. Narahari, "Performance Modeling of Automated Manufacturing Systems", 1st Edition, 2009
5. Lucas Darnell, "The Internet of Things (A Look at Real World Use Cases and Concerns)". Kindle Edition, 2016

Open Elective 5 offered by IT department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Cloud Computing (OEC-5)**			**Code:**		**BIT8601**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of: Computer Networks Basics

Course Objectives:
1. To learn the concept of cloud computing.
2. To have knowledge on the various issues in cloud computing
3. To appreciate the emergence of cloud as the next generation computing paradigm.

Course Outcomes: Students will be able to,
1. Explore the basic terminologies in cloud computing
2. Describe cloud delivery models with examples
3. Illustrate cloud enabling technology
4. Discuss hardware and infrastructure requirements
5. Administer/determine cloud security mechanisms
6. Examine common standard in cloud computing

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Understanding Cloud Computing:** Origin and Influences- History, definitions, technology innovations; Cloud Computing terminologies, Applications, benefits and limitations, risk and challenges; Roles and Boundaries, Cloud characteristics, Cloud Delivery Models, Deployment Models.	**08**
2	**Cloud Service Types:** Software as a Service, Platform as a Service, Infrastructure as a Service, Database as a Service, Monitoring as a Service, Communication as services, Service providers: Google App Engine, Microsoft Azure Service Platform, Amazon EC2, Salesforce, IBM.	**08**
3	**Cloud Enabling Technology:** Broadband Networks and Internet Architecture, Data centre technology, virtualization technology, Web technology, Multitenant technology, Service Technology.	**08**
4	**Hardware and Infrastructure:** Clients- mobile, thin, thick; Security- data leakage, offloading work, logging, forensics, development, auditing; Network-basic public Internet and accelerated Internet; Services- Identity, Integration, Mapping, Payments, Search.	**08**
5	**Cloud Security:** Basic Terms and concepts-Confidentiality, Integrity, Authenticity, availability, Threat, Vulnerability, Risk, Security Control, Security Mechanisms, Security Policies.	**07**
6	**Common Standards in Cloud Computing:** Open Cloud Consortium- Open Virtualization Format, Standards for Application Developers- browsers, data and solution Stack; Standards for Messaging- SMTP, POP, IMAP, RSS, HTTP; Standards for Security- Security (SAML OAuth, OpenID, SSL/TLS).	**06**
	Total	**45**

Text Books:
1. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, "Cloud Computing: Concepts, Technology & Architecture", Pearson May 2013, ISBN: 9780133387568.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill,
3. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press,

Online Material :
NPTEL Course on Cloud Computing : https://nptel.ac.in/courses/106105167
Google Cloud Computing Foundation Course: https://nptel.ac.in/courses/106105223

Open Elective 5 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Project Management & Governance (OEC-5)**				**Code:**	**BME8605A**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge of: Statistics

Course Objectives: After learning this course, the students will be able to:
1. Course is designed to introduce students to the principles and practices of project management as they relate to mechanical engineering projects.
2. Students will learn the skills and knowledge required to successfully plan, execute, and complete projects in the field of mechanical engineering.

Course Outcomes: Students will be able to,
1. Understand the concept of project management
2. Apply the knowledge of project planning to develop project schedules and resources
3. Apply appropriate project management practices, tools, and methodologies.
4. Define, analyze, refine, and document project requirements, assumptions, and constraints
5. Analyze and refine project time and cost estimates to define project baseline, schedule and budget.
6. Understand how to manage project resources, budgets, and timelines.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Project Management** Objectives of Project Management- Importance of Project Management- Types of Projects Project Management Life Cycle- Project Selection – Feasibility study: Types of feasibility Steps in feasibility study, Introduction to project management softwares.	08
2	**Project planning and Implementation** Project Scope- Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations - Basic Scheduling Concepts - Resource Levelling – Resource Allocation, case studies on PP&I, NPV, IRR, and ROI	08
3	**Project Monitoring and Control** Setting a base line- Project management Information System – Indices to monitor progress. Importance of Contracts in projects- Teamwork in Project Management - Attributes of a good project team – Formation of effective teams – stages of team formation	08
4	**Project Risk Management** Introduction to project risk management, Key risk management concepts and terminology, Importance of risk management in projects, Risk identification techniques, Qualitative risk assessment, Quantitative risk assessment, Risk response planning, Risk management strategies, Risk monitoring and control, case study on Risk management in engineering projects	08
5	**Project Resource Management** Introduction to project resource management, resource management concepts and terminology, identifying project resources, Resource allocation techniques, Resource optimization techniques, Resource leveling, Resource smoothing, Resource scheduling techniques, Project timeline management, Cost estimation techniques, Cost control and monitoring	07
6	**Project Communication** Introduction to Project Communication, Key communication concepts and terminology, Importance of communication in projects, Developing communication plans, Communication channels and methods, Communication Strategies, Communication during project execution, Communication with Stakeholders, Crisis communication strategies	06
	Total	**45**

Textbook: **1.** Project Management, Harold Kerzner, Wiley Publishing, 2013, 11th Edition, ISBN 9781118022276

Reference Books:
    1. Berkun, Scott (2005), The Art of Project Management, O'Reilly Media: Cambridge, MA.
    2. Berkun, Scott (2008), Making Things Happen: Mastering Project Management, O'Reilly Media: Cambridge, MA.
    3. Karen (2001), Getting Started in Project Management, Wiley: New York.

Open Elective 5 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**		**VIII** **Scheme C**
Course:	**Industrial Engineering (OEC-5)**				**Code:**		**BME8605B**
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge of: Basics of Engineering

Course Objectives:
1. To make students aware of management, its principles, organizations and structure, and Types of production systems.
2. To make students aware of productivity, measures of productivity and its improvement techniques.
3. To make students aware of Human factors at the workplace and Human resource management.
4. To make students aware of financial management in an organization.

Course Outcomes: Students will be able to,
1. Apply principles of management
2. Use various productivity measures and suggest suitable productivity improvement techniques.
3. Calculate economic order quantity and cost associated with inventory decisions.
4. Suggest a suitable plant location and layout.
5. Understand facets of Human resource management.
6. Calculate the break-even point and payback period.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction** Management definition, importance, functions, Taylors scientific management theory, Principles of Management, Organization types and structures.	**07**
2	**Productivity** Definition, measures and indexes, Productivity improvement techniques, Method Study and Work measurement	**07**
3	**Inventory** Types of Inventory, Need, Cost associated with inventory, Economic order quantity, Models of Inventory Control, Selective control of Inventories	**07**
4	**Plant Location and Layout** Plant Location: Need and factors influencing plant location, Plant Layout: Objectives, principles, types of plant layouts, Introduction to Assembly Line Balancing and Layout parameters to evaluate. Introduction to computer-aided ergonomic analysis of workstation. Assessment of postures and identification of risks to body regions.	**08**
5	**Human factors** Human Error, Accidents, and Safety, Human relation in industry, Introduction to computer-aided ergonomic workstation analysis. Assessment of postures and identification of risks to body regions. Performance appraisal, Human Factors in Systems Design, Human resource management.	**08**
6	**Costing** Introduction to Marginal Costing: Elements of Cost, Break-Even Analysis. Techniques for Evaluation of capital investments. The pay-back period for investments.	**08**
	Total	**45**

Text Books:
1. M. Telsang, Industrial Engineering and Production Management, S. Chand Publication, 2018
2. O. P. Khanna, Industrial engineering and management, Dhanpat Rai publication, 2018
3. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co., 2015

Reference books:
1. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford & IBHPublishing Company, New Delhi,
2. Second Indian Adaptation, 2008.
3. H. B. Maynard, K Jell, Maynard_s Industrial Engineering Hand Book, McGraw Hill Education, 2001
4. R. Al-Aomar, A. Williams, O. M. Uigen _Process Simulation using WITNESS', Wiley, 2015
5. Brien Shakel, Applied Ergonomics, Hand Book, Butterworth Scientific, 1988
6. R. C. Bridger, Introduction to Human factor and Ergonomics, McGraw Hill, 2017
7. M. Sanders and E. McCormick, Human Factor Engineering and Design, McGraw Hill, 1992
8. K. Elbert and H. Kroemer, Ergonomics: How to Design for Ease and Efficiency, Prentice Hall, 2018

Open Elective-6
Final Year B Tech
Civil Engineering
Semester-VIII
Scheme C

Open Elective 6 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII Scheme C**	
Course:	**3-D printing technique for construction (OEC-6)**				**Code:**	**BCI8606A**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
1. Computer Aided Design & Drafting.
2. Engineering Materials, Strength of Material
3. Properties of Concrete

Course Objectives:
After Completing this course, student will be able to:
1. To gain knowledge and skills related to 3D printing technologies.
2. To understand the various software tools, process, material and techniques for construction technology.
3. To apply these techniques into civil Engineering applications like Building, Bridge, wall element, roof ceiling and decorative building elements.

Course Outcomes:
After learning the course, the students should be able to:
1. Develop CAD models for 3D printing.
2. Process software files
3. Optimize concrete mix
4. Analyze behavior for strength and challenges in printing
5. Design Mechanism and nozzle
6. Identify defects in post process of printing

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**3D Printing (Additive Manufacturing)** Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications. **CAD for 3D Manufacturing** CAD Data formats, Data translation, Data loss, STL format.	**07**
2	**3D Techniques** Stereo- Lithography, Laminated Object Manufacturing (LOM), Fused deposition modeling (FDM), Selective laser sintering (SLS), Selective laser melting (SLM), Binder Jet technology. Processing of software file, Process parameter, Process Selection for various applications,	**07**
3	**Material Properties** Properties of concrete ingredient like cement, sand, fly ash, silica fume, fibers, Concrete Mix proportioning and optimization considering admixtures like super plasticizer, retarders, water reducing agents, quick setting agent etc, viscosity modifying agents, geo-polymers, fibers, alternative material used for printing,	**07**
4	**Material Testing & Behavior** Testing on material like compressive strength, bonding strength, workability, setting time, build ability, flow ability, etc, Structural behavior and its Integrity. Challenges like problems of aggregate jamming in the nozzle, compacting obstacles, and the spacing limitations due to rebar and formwork installation.	**08**
5	**Equipment Mechanism** Process Equipment- Design and process parameters, Nozzle design and optimization like shape, diameter, piston type or screw type. Process Design-synchronization of components	**08**
6	**Post Processing:** Requirement and Techniques, Support Removal, Finishing treatment, polishing **Product Quality:** Inspection and testing, Defects and their causes	**08**
	Total	**45**

Text Books:
1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Lan Gibson, David W. Rosen and Brent Stucker, Springer, 2010.
2. 3D Printing and Rapid Prototyping- Principles and Applicationsby CK Chua, Kah Fai Leong,World Scientific, 2017.
3. 3D Printing and Design by Hanser Publisher, Khanna Editorial, Khanna Publishing House, Delhi, 2011.
4. Concrete Technology: Theory and Practice byM. S. Shetty & A K Jain, S. Chand Publication, 2019.

Reference Books:
1. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing".

E Resources:
3D Printing and Additive Manufacturing Specialization
https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3D Printing Software',Jeffrey Smith, Education Manager, Coursera Course by University of Illinois at Urbana-Champaign, USA.
https://www.coursera.org/specializations/3d-printing-additive-manufacturing
3D Printing Applications',Vishal Sachdev Clinical Assistant Professor , Director, Illinois MakerLab, Coursera Course ,University of Illinois at Urbana-Champaign, USA.
https://www.coursera.org/learn/3d-printing-applications

Open Elective 6 offered by Civil Department to other department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Structural Health Monitoring & Audit (OEC-6)**			**Code:**		**BCI8606B**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
1. Knowledge of Concrete Technology is essential.
2. Knowledge of Rehabilitation and Retrofitting of Structures.

Course Objectives:
1. To impart knowledge of diagnosis the distress in the structure, its causes and factors.
2. To assess the health of structure using static field methods and dynamic field methods.
3. To introduce the repairs and rehabilitation measures of the structure.

Course Outcomes:
After learning the course, the students should be able to:
1. Understand the deterioration and distress in structures.
2. Evaluate causes and prevention methods for structural health monitoring.
3. Understand Simulation and Loading Methods in static field.
4. Analyze Data Acquisition Systems in dynamic field testing methods.
5. Understand piezo– electric materials and other smart materials in structural health monitoring.
6. Apply the knowledge of NDT techniques on real field.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Structural Health:** Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.	**07**
2	**Structural Health Monitoring & Audit:** Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.	**08**
3	**Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	**08**
4	**Dynamic Field Testing:** Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	**08**
5	**Introduction to Repairs and Rehabilitations of Structures:** Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.	**07**
6	**NDT (Non Destructive Testing)Techniques:** Application of NDT Techniques on real-life problems.	**07**
	Total	**45**

Text Books:
1. Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 2006.
2. Douglas E Adams, "Health Monitoring of Structural Materials and Components_Methods with Applications", John Wiley and Sons, 2000

Reference Books:
1. J. P. Ou, H. Li and Z. D. Duan, "Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
2. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

E-Resources:
https://archive.nptel.ac.in/courses/114/106/114106046/

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Database Management System (OEC-6)**				**Code:**	**BCE8610**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
    Mathematics

Course Objectives:
1. To understand the fundamental concepts of database management.
2. To provide a strong formal foundation in database concepts, technology, and practice.
3. To make students familiar with building good database design.
4. To Learn different SQL queries and concepts.

Course Outcomes:
After learning the course, the students should be able to:
1. Understand the fundamental concepts of database management systems.
2. Design E-R Model for given requirements and convert the same into database tables.
3. Design schema in appropriate normal form considering actual requirements.
4. Write SQL queries to perform basic operations on tables in the database.
5. Write DML SQL queries for a given database.
6. Write SQL queries to perform operations on different database objects

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database System Structure.	07
2	Data Models, Database Design, Entity Relationship Model, ER Diagram, Extended ER diagram, converting E-R and Extended ER diagram into tables.	07
3	Relational Model: Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF.	07
4	Database Languages DDL, DML, SQL: Characteristics and advantages, SQL Data Types, SQL Operators, Tables: Creating, Modifying, Deleting, Updating. Demonstration and practice of DDL and DML queries in Oracle	08
5	SQL DML Queries: SELECT Query and clauses, Index and Sequence in SQL, SQL - Ordering of Tuples, Aggregate Functions, SQL Functions, Synonym. Demonstration and practice of DDL and DML queries in Oracle	08
6	SQL Views: Creating, Dropping, Updating using Indexes, Set Operations, Joins, Set membership, Nested Queries. Introduction to PL/SQL. Demonstration of DDL and DML queries in Oracle	08
	Total	**45**

Text Book:
1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020, ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.
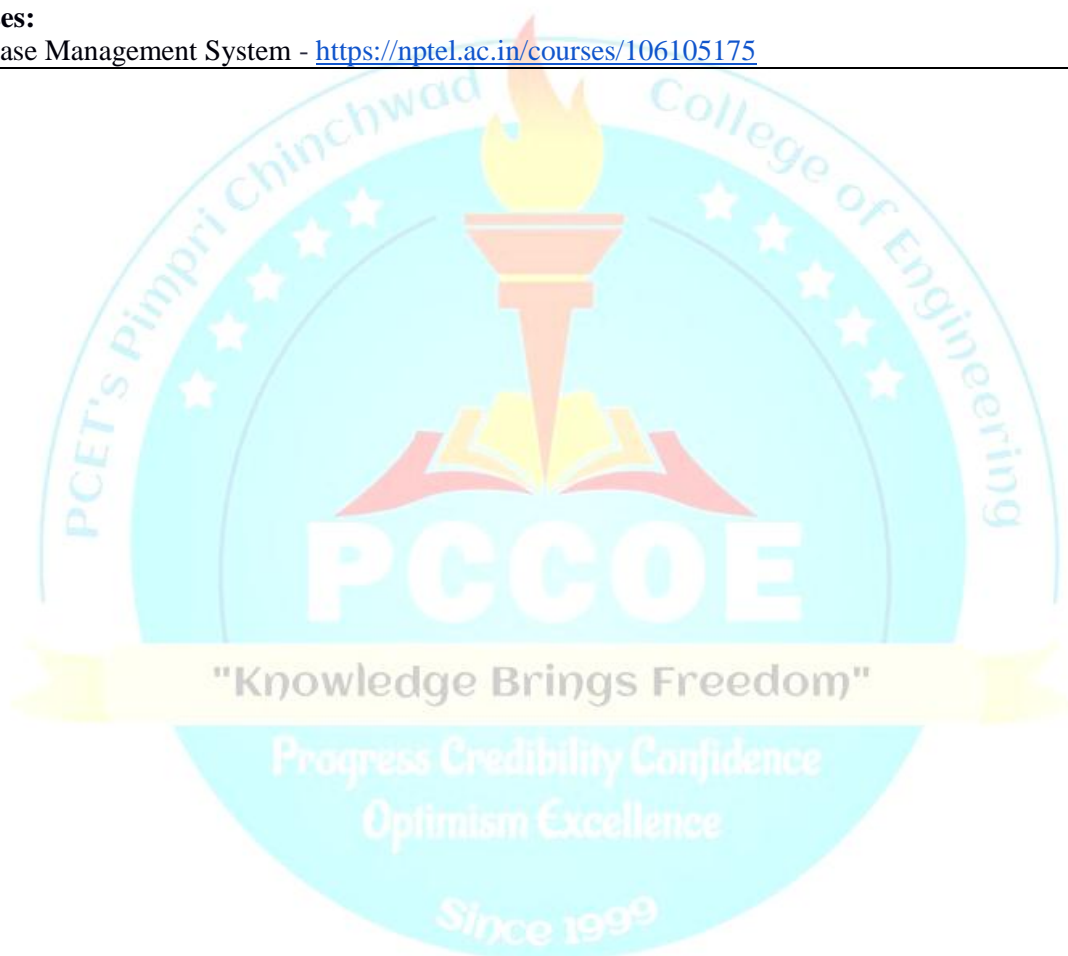
Reference Books:
1. Coronel, C. and S. Morris, "Database Systems: Design, Implementation, & Management," 12th edition, Cengage, 2016
2. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009, ISBN 9788177585674

Web References:
http://w3schools.org/

MOOC Courses:
Data Base Management System - https://nptel.ac.in/courses/106105175

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Introduction to Blockchain (OEC-6)**				**Code:**	**BCE8611**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
Information Security

Course Objectives:
1. To explain basic components of a Blockchain, its operations, underlying algorithms, and essentials of trust
2. To provide the fundamental cryptographic base for Blockchain.
3. To make students familiar with the working of Smart Contracts
4. To provide a detailed understanding of workings of a blockchain, its transactions, blocks and mining.

Course Outcomes:
After learning the course, the students should be able to:
1. Comprehend the fundamental characteristics of Blockchain.
2. Relate the basic cryptographic primitives essential for Blockchain.
3. Compare and contrast the private and public Blockchain.
4. Select and apply appropriate distributed consensus algorithms for the real life problem.
5. Analyze the working of Smart Contracts for verification or execution of agreement.
6. Identify relative application where block chain technology can be effectively used and implemented.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Blockchain** Introduction to decentralized system, History, Conceptualization, Architectural principles behind Blockchain, Characteristics of Blockchain.	**07**
2	**Basic Crypto Primitives** Structure of Block, Merkle Tree and Merkle Root in a Block, Symmetric and Asymmetric Encryption, Digital Signature, Hashing, public key cryptosystems, Mining strategy.	**07**
3	**Types of Blockchains** Permissionless, Permissioned, Consortium, Hybrid Blockchain, Blockchain protocol and use cases, Introduction to Bitcoin Blockchain, Layers of Blockchain: Application Layer Execution Layer, Semantic Layer, Propagation Layer, Consensus Layer	**08**
4	**Distributed Consensus** Consensus approach, Consensus elements. **Consensus Algorithms** Proof of Work, Proof of Stake, Proof of Elapsed Time, Proof of Activity, Proof of Burn, Proof of Authority, Paxos, RAFT Consensus Byzantine General problem, Practical Byzantine Fault Tolerance	**08**
5	**Smart Contracts and Ethereum** History, Purpose and types of smart contracts, Introduction to Ethereum, bitcoin vs Ethereum stack. Consensus in Ethereum, scripts in Ethereum. Developing and executing smart contracts in Ethereum.	**07**
6	**Prominent Blockchain Applications** Retail, Banking and Financial Services, Government Sector, Healthcare and IOT, Energy and Utilities, Blockchain Integration with other Domains	**08**
	Total	**45**

Text Books:
1. Artemis Caro, "Blockchain: The Beginners Guide to Understanding the Technology Behind Bitcoin & Cryptocurrency", Kevin Wolhuter, 2021, ISBN: 1922590061, 9781922590060.
2. Mark Watney, Blockchain for Beginners: The Complete Step by Step Guide to Understanding Blockchain Technology", CreateSpace Independent Publishing Platform, 2017, ISBN: 1548766887, 9781548766887

Reference Books:
1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Media, Inc.2017, ISBN: 9781491954386
2. Alwyn Bishop, "Blockchain Technology Explained", CreateSpace Independent Publishing Platform, 2018, ISBN: 9781986273800

Web References:

NPTEL Course "Introduction to Block Chain Technology & Applications" https://nptel.ac.in/courses/106/104/106104220/
NPTEL Course on "Blockchain Architecture & Use Cases" https://nptel.ac.in/courses/106/105/106105184/

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Android App Development with Kotlin (OEC-6)**				**Code:**	**BCE8612**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
Basic programming knowledge (Preferably Java or any other object-oriented language)

Course Objectives:
1. To explore the Kotlin programming language features and scripts.
2. To differentiate between kotlin and java as OOP concepts.
3. To learn the fundamentals of writing Kotlin scripts.
4. To elaborate on the Network and Data Handling Techniques.
5. To learn the advanced Android features.
6. To develop an android application with all features.

Course Outcomes:
After learning the course, students will be able to:
1. Differentiate the data types, variables in kotlin.
2. Explore the object oriented programming concepts with Looping.
3. Demonstrate the android studio development environment.
4. Apply the Network and Data Handling Techniques.
5. Illustrate the Advance Android application development features.
6. Deploy the Android application with testing.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Kotlin and Android Studio** Introduction to Kotlin programming language, Setting up the Android Studio development environment, Kotlin syntax and basic programming concepts, Variables, data types, and operators in Kotlin.	**07**
2	**Kotlin Fundamentals and Object-Oriented Programming with Kotlin** Conditional statements (if, when), Loops (for, while, do-while), Functions, parameters, and return types Kotlin collections: arrays, lists, and maps, Classes and objects, Properties, fields, and methods, Inheritance, polymorphism, and interfaces, Data classes and sealed classes	**08**
3	**Android Basics and User Interface, Components and Navigation** Understanding Android architecture, Activities, intents, and the activity lifecycle, Designing UI with XML and Kotlin, Working with views, view groups, and layouts, Fragments and their lifecycle, Navigation and passing data between fragments, RecyclerView and ListView, Android storage options: Shared Preferences, Files, and Databases	**08**
4	**Networking and Data Handling** Working with RESTful APIs and JSON data, Using Retrofit and OkHttp for network communication, Implementing Live Data and View Model, Basic understanding of Coroutines for asynchronous programming	**08**
5	**Advanced Android Features** Notifications and Pending Intent, Location and Google Maps integration, Permissions and runtime permission handling, Material Design components and theming	**07**
6	**Testing, Debugging, and Deployment** Unit testing and UI testing with JUnit and Espresso, debugging tools and techniques in Android Studio, Optimizing app performance and memory management, Preparing and publishing your app to Google Play Store	**07**
	Total	**45**

Text Books:

1. Programming Android with Kotlin by Pierre-Olivier Laurence, Amanda Hinchman-Dominguez, Mike Dunn, G. Blake Meike, ISBN:9781492063001, Publisher: O'Reilly Media, Inc. (December 2021)
2. Beginning Android Development With Kotlin,Publisher: Greg Lim,2020 ISBN:9811477973, 9789811477973

Reference Books:

1. Android application development with Kotlin by Trivedi Hardik, Publisher: BPB Publications (12 May 2020)
2. Kotlin and Android Development featuring Jetpack: Build Better, Safer Android Apps by Michael Fazio Publisher: Pragmatic Bookshelf (July 2021)

Open Elective 6 offered by Computer department to civil department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Agile Project Management (OEC-6)**			**Code:**		**BCE8613**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge:
    Software Engineering

Course Objectives:
1. Learn to create a framework of Agile Project Management for a project.
2. To understand the Agile project communication and team building.
3. To learn the Agile Retrospectives for planning and monitoring a project.
4. To learn the Agile project analysis and design.
5. To learn how to use the tools that allow taking advantage of an Agile project environment.
6. To get aquatinted with capabilities and knowledge in Agile Project Management.

Course Outcomes: After learning the course, students will be able to:
1. Explore the framework for agile project communication
2. Elaborate the agile retrospectives for planning and monitoring of agile project
3. Apply the techniques for Agile project estimation.
4. Build the Agile stories for project management
5. Apply the verification and validation for Agile project
6. Adopt the Soft skills negotiation practices.

Detailed Syllabus		
Unit	**Description**	**Duration(H)**
1	**Introduction to Agile project communications** Introduction, Definition of Agile, Difference between Agile and other methodologies, Agile Principles. Agile Information radiator, Agile Team space, Agile tooling, Osmotic communications for collocated teams, Osmotic communications for distributed teams, Agile Daily stand-ups, **Case Study:** IT service delivery centre	**07**
2	**Creating High-Performance Team** Build A Team, Define Team Ground Rules, Negotiate Project Agreements, Empower Team Members and Stakeholders, Train Team Members And Stakeholders, Engage And Support Virtual Teams, Build Shared Understanding About A Project, **Case Study**: Creating High Performance Team Leadership	**08**
3	**Project Planning** Determine Appropriate Project Methodology/Methods And Practices, Plan And Manage Scope, Plan And Manage Budget And Resources, Plan And Manage Schedule, Plan And Manage Quality Of Products And Deliverables, Integrate Project Planning Activities, Plan And Manage Procurement, Establish Project Governance Structure, Plan And Manage Project/Phase Closure, **Case Study:** Virtual Research Environment Development Project	**07**
4	**Monitoring and Adopting** Introduction, Agile Retrospectives, Agile task and Kanban boards, Scrum, Agile Timeboxing, Agile Iteration and release planning, Agile WIP limits, Agile Burn down/up charts, Agile cumulative flow diagrams, Agile process tailoring **Case Study:** Management of a Multidisciplinary Research Project	**07**
5	**Assess and Manage Risks** Assess and Manage Risks, Execute Project To Deliver Business Value, Manage Communications, Engage Stakeholders, Create Project Artifacts, Manage Project Changes, Manage Project Issues, Ensure Knowledge Transfer For Project Continuity, **Case Study:** Agile Risk Management Process in Multiple Projects Environments	**08**
6	**Agile analysis and design** Introduction, Agile product roadmap, Agile user stories and backlog, Agile story maps, Agile progressive elaboration, Agile wireframes, Agile chartering, Agile personas, Agile modeling, Agile estimation: Agile relative sizing/story points, Agile wide band Delphi, Agile planning poker, **Case Study:** project management in a multidisciplinary production environment	**08**
	Total	**45**

Text Books:

1. Layton, Mark C., Steven J. Ostermiller, and Dean J. Kynaston. Agile project management for dummies. John Wiley & Sons, 2020.
2. Mesjasz, Czesław, Katarzyna Bartusik, Tomasz Małkus, and Mariusz Sołtysik. Agile Project Management and Complexity: A Reappraisal. Routledge, 2022.
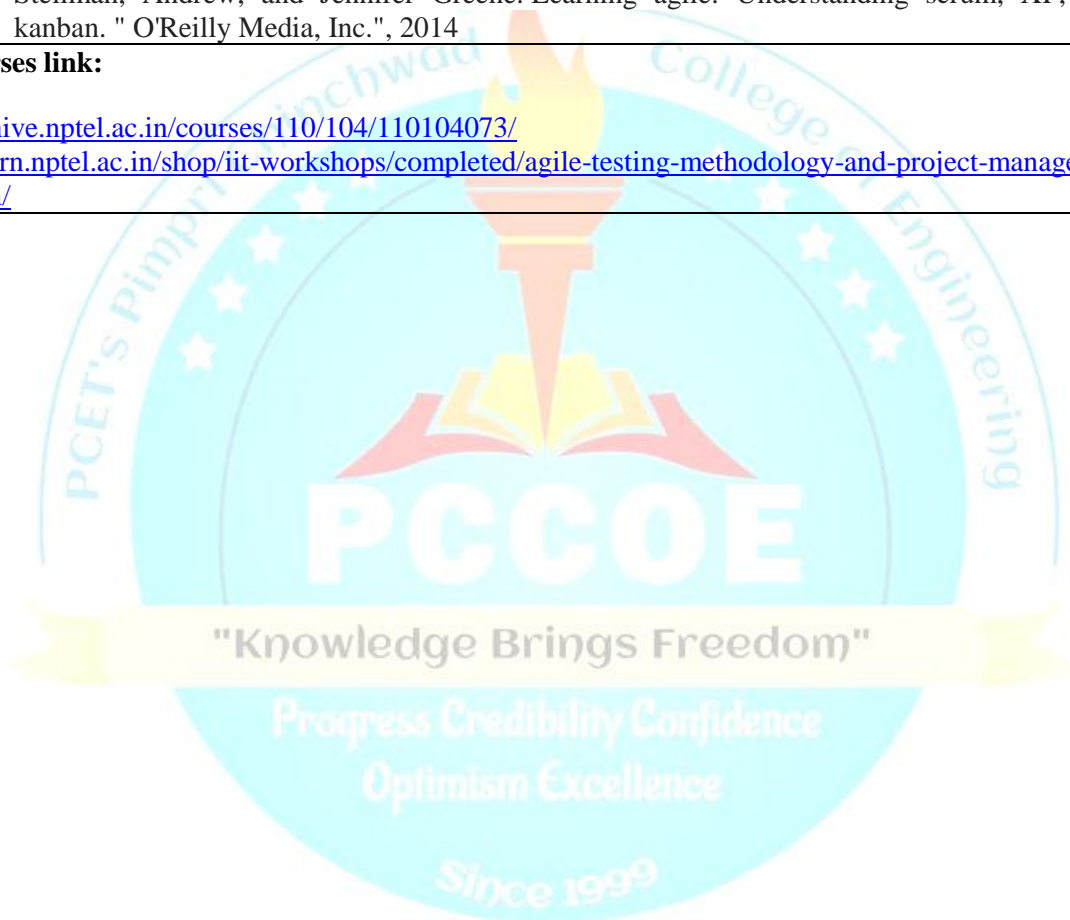3. Ajam, Mounir. Project management beyond waterfall and agile. CRC Press, 2018

Reference Books:

1. Adkins, Lyssa. Coaching agile teams: a companion for ScrumMasters, agile coaches, and project managers in transition. Pearson Education India, 2010.
2. Verma, Rahul. "Agile Project Management: Experience and Adoption." In Contemporary Challenges for Agile Project Management, pp. 44-51. IGI Global, 2022.
3. Chatterjee, Sheshadri, Ranjan Chaudhuri, Demetris Vrontis, Alkis Thrassou, and Soumya Kanti Ghosh. "Adoption of artificial intelligence-integrated CRM systems in agile organizations in India." Technological Forecasting and Social Change 168 (2021): 120783.
4. Stellman, Andrew, and Jennifer Greene. Learning agile: Understanding scrum, XP, lean, and kanban. " O'Reilly Media, Inc.", 2014

MOOCs Courses link:

https://archive.nptel.ac.in/courses/110/104/110104073/
https://elearn.nptel.ac.in/shop/iit-workshops/completed/agile-testing-methodology-and-project-management-test-automation/

Open Elective 6 offered by E&TC to Civil department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VIII Scheme C	
Course:	Drone Technology (OEC-6)				**Code:**	BET8604	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge: 2

Basic understanding of physics, sensors and actuators, Control systems and python programming

Course Objectives:
1. To introduce students about the accessories of drone and its functionality.
2. To describe the students about mathematical model of quad copter drone.
3. To make the students, design and development of drone model using Simulink.
4. To discuss the implementation models of different drone based case studies.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the basic concepts of drone technology
2. Justify specifications and requirements of customized drone design.
3. determine different accessories of Drones as per applications.
4. Comprehend drone control system development using Simulink
5. Design Simulink model simulating the complete dynamics of quadcopter drone.
6. Evaluate the design model of existing drone base systems.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to drones:** Unmanned Aerial Systems (UAS), Basics of drones, different body materials used for drone, different types of drones, Laws of Motion, Bernoulli's Principle, four forces of Flight, three axes of Flight.	06
2	**Drone accessories I:** Sensors & Motors, its types and specifications, design constraints, Test and measurement methods for drone sensors and actuators, Introduction of different types of batteries used in drone. Understand different specifications and their significance of batteries.	07
3	**Drone accessories II:** Propellers, Concept of propulsion, Forces working on a Flight, Principle axes and rotation of aerial systems, Role of GPS navigation and telemetry model, interfacing of GPS module to navigation drone.	07
4	**Drone control system development using Simulink:** Control system architecture, Quadcopter with actuator & propellers functionality block, Sensing & estimation functionality block, controller functionality block.	08
5	**Modelling, Simulation & Flight control design:** Dynamic quad copter system Model, flight control design, 3D visualization, testing & Tuning the model, Flight operations, Applicable software for data collection, processing, and analysis	09
6	**Applications of Drone Technology:** Drones in delivering mail, parcels and other cargo, Drones in agriculture, Drones in inspection of transmission lines and power distribution, Drones in disaster management (Flood, Fire etc), Case Study: Eagle Eye drone.	08
	Total	45

Text Books:
1. John Baichtal ,"Building your own drones, a beginner's guide to drones, UAVS, and ROVs" Pearson Education, 1st Edition,2015
2. Muhammad Usman , "Quadcopter modeling and control with Matlab/Simulink implementation" LAB University of Applied Sciences, 1st Edition, 2020
3. K.S.Fu, R.C.Gonzalez, C.G.Lee , "Robotics control, sensing, vision and intelligence" MGH, 1st Edition, 1987

Reference Books:
1. R.K.Mittal , I.J.Nagrath, "Robotics and control" Tata McGraw-Hill, 1st Edition,2005
2. Ben Rupert , "Drones (The ultimate guide)", Create Space Independent Publishing Platform, 1st Edition,2017
3. Agam Kumar Tyagi, "Matlab and Simulink for engineers", Oxford University Press, 1st Edition,2012

Department of Civil Engineering

Open Elective 6 offered by E&TC to Civil department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII Scheme C**	
Course:	**Advanced Driver Assistance System(ADAS) (OEC-6)**				**Code:**	**BET8605**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge:
eVehicle and Automotive Electronics

Course Objectives:
1. To introduce Autonomous and Intelligent Vehicle Technology
2. To elaborate ADAS system architecture and features.
3. To explore role of AI in ADAS using various application in autonomous vehicle.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the importance of ADAS in Autonomous and intelligent vehicle
2. Model Sensor technology required in prototype design used in ADAS
3. Apply AI concepts in automated analysis using vision based algorithms
4. Design automated electronics systems for driver assistance.
5. Develop models for safety system in autonomous vehicles.
6. Evaluate the test for maintenance, calibration and diagnostics of ADAS systems

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	Introduction to ADAS, General Block Diagram, Role of ADAS in Autonomous vehicle, Integration of ADAS Technology into Vehicle Electronics, Non-Passenger Car Advanced Driver Assistance Systems and Autonomous Operation, Intelligent Vehicles	06
2	Prototype, Test, Evaluate and Validate ADAS : Generic dynamic and distributed architecture, Environment and climatic conditions , Modeling of perception sensors: Optical Sensor, RADAR, LIDAR, GNSS.	07
3	AI for ADAS: The construction of the intelligent vehicle's basic building blocks employing AI methods, Vision sensors, Vision algorithms, Automated Guided Autonomous Car Using Deep Learning and Computer Vision, Deep Learning for Obstacle Avoidance in Autonomous Driving	08
4	Electronics Systems in ADAS, Adaptive Cruise Control (ACC), Rear Cross Traffic Alert (RCTA), Vehicle Exit Alert, Front Cross Traffic Alert, Forward Collision Warning	08
5	Safety Systems in ADAS , Blind Spot Detection, Parking Assistance System, Intelligent Head Light Control, Occupant Protection System, Pedestrian Protection System, Evasive Steering Support.	08
6	Calibration of ADAS and Automated Driving Features: Calibration—An Overview Based on Ideality Equation , Common Types of Calibration in an Automated Driving System: End of Line (EoL) Calibration, Service Calibration, Online Calibration, Functional Calibration, Calibration of ADAS and Automated Driving Features , Calibration Environment for Automated Driving Vehicles, Calibration over Diagnostics Interface	08
	Total	**45**

Text Books:
1. Abdelaziz Bensrhair (editor), Thierry Bapin (editor) - From AI to Autonomous and Connected Vehicles_ Advanced Driver-Assistance Systems (ADAS)-Wiley-ISTE (2021)
2. Plato Pathrose - ADAS and Automated Driving_ A Practical Approach to Verification and Validation-SAE International (2022)

Reference Books:
1. Harald Waschl, Ilya Kolmanovsky, Frank Willems - Control Strategies for Advanced Driver Assistance Systems and Autonomous Driving Functions-Springer, Vol. 476, 2019.
2. Lentin Joseph (editor), Amit Kumar Mondal (editor) - Autonomous Driving and Advanced Driver-Assistance Systems (ADAS)_ Applications, Development, Legal Issues, and Testing (Chapman & Hall_CRC
3. Yan Li, Hualiang Shi - Advanced Driver Assistance Systems and Autonomous Vehicles_ From Fundamentals to Applications-Springer (2022)
4. https://www.udemy.com/course/advanced-driver-assistance-systems/

Open Elective 5 offered by IT department to Civil Department							
Program:	**B. Tech. (Civil Engineering)**			**Semester:**		**VIII** **Scheme C**	
Course:	**Data Science for Engineers OEC-5)**			**Code:**		**BIT8602**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**
Prior Knowledge of: Database Management, Data Mining							

Course Objectives:
    1. To learn the basics and process of Data Science.
    2. To introduce the mathematical foundations required for Data Science.
    3. To use Optimization techniques to obtain best solution.
    4. To demonstrate patterns in data through a variety of statistical modeling.
    5. To identify the strength of predictors, forecast an effect, a trend in data.
    6. To classify data into a given number of classes to provide predictions.							

Course Outcomes: After learning the course, the students will be able to:
    1. Describe a flow process for Data Science problems.
    2. Differentiate mathematical foundations required for Data Science.
    3. Use Optimization to obtain best solution.
    4. Demonstrate patterns in data through a variety of statistical modeling.
    5. Identify the strength of predictors, forecast an effect, a trend in data.
    6. Classify Data Science problems into standard topology.							

Detailed Syllabus							

Unit	Description	Duration(H)
1	**Introduction** Definition – Big Data and Data Science, Hype, Need of Data Science, Data Science Process Overview, Defining goals, Retrieving data, Data preparation, Data exploration , Data modeling, Introduction to R, Advanced Programming in R, Data visualization in R Basic graphics.	07
2	**Linear Algebra for Data Science** Solving Linear Equations, Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors.	08
3	**Optimization for Data Science** Introduction, unconstrained multivariate optimization, Gradient (Steepest) Descent (OR) Learning Rules, Multivariate Optimization With Equality Constraints, Multivariate Optimization With Inequality Constraints.	08
4	**Statistical Modeling for Data Science** Event Space, Random variable, Probability density function, Distributions and Hypotheses Testing.	06
5	**Regression for Data Science** Simple Linear Regression, Multiple Linear Regression, Confidence and Prediction Intervals, Categorical Variables, Multi collinearity, Polynomial Regression, Cross Validation, Simple Linear Regression Model Building and assessment, Predictive Modelling, Dataset.	08
6	**Classification for Data Science** Logistic regression, K - Nearest Neighbors (kNN) and k-means clustering, Naive Bayes, Discriminant Analysis, K - Nearest Neighbors implementation in R, K - means implementation in R, Performance Measures.	08
	Total	45

Text Books:
1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", , Manning Publications Co., 1st edition, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani., "An Introduction to Statistical Learning: with Applications in R", , Springer, 1st edition, 2013

Reference Books:
1. Jure Leskovek, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets. v2.1", Cambridge University Press, 2014
2. Joel Grus, "Science from Scratch: First Principles with Python", O'Reilly, 1st edition, 2015
3. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013
4. Kalyanmoy, Deb. "Optimization for engineering design: Algorithms and examples", Prentice-Hall of India Pvt. Limited, 2012.

Online Courses:
Coursera Course on "What is Data Science?" offered by IBM. Available at https://www.coursera.org/learn/what-is-datascience?specialization=ibm-data-science
NPTEL Course on "Data Science for Engineers" offered by IIT, Madras. Available at https://onlinecourses.nptel.ac.in/noc21_cs69/preview

Department of Civil Engineering

Open Elective 6 offered by Mechanical to Civil Department							
Program:	B. Tech. (Civil Engineering)				**Semester:**	VIII Scheme C	
Course:	Lean Six Sigma (OEC-6)				**Code:**	BME8606A	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	-	3	3	20	20	60	100

Prior Knowledge: Statistics is essential

Course Objectives:
1. Students can apply strategic approaches to eliminate defects within the manufacturing processes.
2. Students will be able to apply the tools and techniques of Lean and six sigma to increase productivity.
3. Students will learn the DMAIC (Define, Measure, Analyze, Improve, Control) methodology, including hands-on exercises and case studies.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the principles and benefits of Lean Six Sigma.
2. Apply statistical tools for defining the quality attributes and measuring the performance of attributes.
3. Apply various tools to identify sources of variation affecting the quality of the process.
4. Apply advanced quantitative techniques to improve processes in manufacturing industries.
5. Understand the Six Sigma Implementation and Challenges in the manufacturing industry.
6. Apply continuous improvement methods to improve the efficiency and effectiveness of the process.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Lean and Six Sigma:** Introduction to Lean and quality, Cost of Quality (COQ), the background of quality improvement process, quality characteristics, Introduction to Six Sigma, Principles, and methodologies of lean and six sigma, history and evolution of lean and six sigma, roles and responsibilities of six sigma, benefits of using Six sigma in industries, Introduction to DMAIC approach.	07
2	**Tools used for defining and Measurement of Quality:** IPO diagram, Ishikawa diagram, SIPOC diagram, Flow diagram, CTQ tree, Project charter, Histograms, Run Chart, Scatter diagram, Cause and Effect diagram, Pareto chart, Control chart, Flow process chart, Process capability measurement.	08
3	**Tools used for Analysis, Improvement, and Control of quality:** Process mapping, Regression analysis, SWOT analysis, TRIZ, PESTLE, 5 why's, interrelationship diagram, overall equipment effectiveness, Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis, Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.	08
4	**Advanced Quantitative Techniques for Six Sigma:** Design for six sigma (DFSS), Failure mode effect analysis (FMEA), Change acceleration process (CAP), Risk priority number (RPN).	08
5	**Six Sigma Implementation and Challenges:** Lean and Six sigma Implementation cycle, Selection of tools and techniques, Six sigma for startups, Supplier Input Process Output Customer (SIPOC), Quality Function Deployment or House of Quality (QFD), customer quality index (CQI),	08
6	**Continuous Improvement Methods:** Introduction to continuous improvement methods, the approach of Poka-Yoke, Kanban, 5's, Lean manufacturing methods: 3M's, 4M's, Kaizen, 5's, case studies on continuous improvement methods.	06
	Total	**45**

Reference Books:
1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000

E-sources:
https://www.sixsigmacouncil.org/six-sigma-training-material/
https://onlinecourses.nptel.ac.in/noc20_mg19/preview

Department of Civil Engineering

Open Elective 6 offered by Mechanical to Civil Department							
Program:	**B. Tech. (Civil Engineering)**				**Semester:**	**VIII** **Scheme C**	
Course:	**Professional Ethics (OEC-6)**				**Code:**	**BME8606B**	
Teaching Scheme				**Evaluation Scheme**			
Lecture	**Tutorial**	**Hours**	**Credit**	**FA1**	**FA2**	**SA**	**Total**
3	**-**	**3**	**3**	**20**	**20**	**60**	**100**

Prior Knowledge: None

Course Objectives:
1. To provide students with an understanding of the ethical issues and responsibilities involved in engineering.
2. To create awareness on ethical principles that govern the engineering profession, the potential consequences of unethical behavior, and strategies for making ethical decisions in complex engineering situations.

Course Outcomes: After learning the course, the students should be able to:
1. Understand the fundamental ethical principles that govern engineering
2. Recognize ethical dilemmas and learn to analyze them,
3. Develop critical thinking and decision-making skills for ethical engineering practices
4. Learn how to identify and address ethical issues in engineering research and development
5. Identify and analyse complex issues and problems in social impact and develop appropriate and well-justified solutions for the given context.
6. Develop an understanding of the social and global impacts of engineering decisions.

	Detailed Syllabus	
Unit	**Description**	**Duration(H)**
1	**Introduction to Engineering Ethics** Overview of the importance of ethics in engineering, The role of engineers in society, Ethical principles and theories, Case Studies in Practical application of ethical principles and theories.,	**08**
2	**Ethical Decision Making** Frameworks for ethical decision making, Analysis and discussion of case studies and group discussions/role plays on ethical dilemmas, Identifying stakeholders and ethical responsibilities.	**07**
3	**Professional Codes of Ethics** Codes of ethics in engineering professions, Understanding the code of ethics and its application in practice, Comparison of different codes of ethics: Selection Criteria, Matrix for the best suited code.	**08**
4	**Engineering and Social Responsibility** Social, cultural, and safety, health and environmental impacts of engineering, Ethical considerations in engineering design and implementation, Addressing issues of sustainability, circular economy and social justice in engineering.	**08**
5	**Engineering Research and Development** Ethical considerations in research design, Intellectual property and ownership, Ethical issues in emerging technologies.	**07**
6	**Engineering and Globalization** The global impact of engineering decisions, Ethical considerations in international engineering projects, Cultural differences and engineering ethics with due consideration to Diversity, Equity and Inclusion	**07**
	Total	**45**

Text Books:
1. Harris, C. E., Pritchard, M. S., &Rabins, M. J. (2019). Engineering ethics: Concepts and cases. 6th Edition, Cengage Learning, Inc..

Reference books:
1. Mike W. Martin and Roland Schinzinger, (2019). Ethics in Engineering, 3rdEdition,Tata McGraw Hill, New Delhi,
2. Caroline Whitbeck, Ethics in Engineering practice and Research. (2011) 2nd Edition, Cambridge.

Project Syllabus & Guidelines
Final Year B Tech
Civil Engineering
Semester-VII/VIII
Scheme A/B/C

Program:	B. Tech. (Civil Engineering)			Semester:	VIII/VII Scheme A / B	
Course:	Project			Code:	BCI8701/BCI7701	
Teaching Scheme				**Evaluation Scheme**		
Practical	Tutorial	Credit	Hours	TW	OR	Total
28	-	14	28	200	150	350

Prior Knowledge:
1. Fundamentals of Civil Engineering

Course Objectives:
1. Identify latest technical/practical problems in the field of Civil Engineering.
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course Outcomes:
After learning the course, the students will be able to:
1. Demonstrate sound academic fundamentals to formulate and analyze Civil engineering problems.
2. Apply creative/innovative solution for Civil engineering problems by using modern tools.
3. Design Civil engineering systems, products and processes.
4. Communicate effectively with written, oral, and visual means in technical presentations/discussions.
5. Demonstrate skill for lifelong learning.
6. Recognize environmental constraints and safety issues in civil engineering.

Term Work:

The Project report should contain the following. Departmental Project Review Committee may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of **four** students.

Unit	Detailed Syllabus
1	Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
2	Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years
3	Problem statement and methodology
4	Concepts associated with the project topic
5	Results and discussion
6	Validation of results
7	a. Concluding and future scope b. References
8	Report Writing (Students publication/achievements)

ORAL EXAMINATION:

The students must prepare a presentation on Project work and present in presence of external examiners

through a viva-voce examination.

Program:	B. Tech. (Civil Engineering)			Semester:	VII (Scheme C)	
Course:	Project Stage 1			Code:	BCI7702	
Teaching Scheme				**Evaluation Scheme**		
Practical	Tutorial	Credit	Hours	TW	OR	Total
14	-	7	14	100	50	150

Prior Knowledge:
1. Fundamentals of Civil Engineering

Course Objectives:
1. Identify latest technical/practical problems in the field of Civil Engineering.
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

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

1. Demonstrate sound academic fundamentals to formulate and analyze Civil engineering problems.
2. Apply creative/innovative solution for Civil engineering problems by using modern tools.
3. Design Civil engineering systems, products and processes.
4. Communicate effectively with written, oral, and visual means in technical presentations/discussions.
5. Demonstrate skill for lifelong learning.
6. Recognize environmental constraints and safety issues in civil engineering.

Term Work:

The Project Stage 1 report should contain the following. Departmental Project Review Committee may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of **four** students.

Unit	Detailed Syllabus
1	Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
2	Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years
3	Problem statement and methodology
4	Concepts associated with the project topic
5	Results and discussion (Partial fulfillment of objective/s)
6	a. Conclusion b. References
7	Report Writing (Students publication/achievements)

ORAL EXAMINATION:

The students must prepare presentation on Project work and present in presence of external examiners

through a viva-voce examination.

Department of Civil Engineering

Program:	B. Tech. (Civil Engineering)			Semester:	VIII (Scheme C)	
Course:	Project Stage 2			Code:	BCI8702	
Teaching Scheme				**Evaluation Scheme**		
Practical	Tutorial	Credit	Hours	TW	OR	Total
14	-	7	14	100	100	200

Prior Knowledge:
1. Fundamentals of Civil Engineering

Course Objectives:
1. Identify latest technical/practical problems in the field of Civil Engineering.
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

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

1. Demonstrate sound academic fundamentals to formulate and analyze Civil engineering problems.
2. Apply creative/innovative solution for Civil engineering problems by using modern tools.
3. Design Civil engineering systems, products and processes.
4. Communicate effectively with written, oral, and visual means in technical presentations/discussions.
5. Demonstrate skill for lifelong learning.
6. Recognize environmental constraints and safety issues in civil engineering.

TERM WORK:-

The Project stage 2 report should contain the following. Departmental Project Review Committee may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of **four** students.

Unit	Detailed Syllabus
1	Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations.
2	Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years
3	Problem statement and methodology
4	Concepts associated with the project topic
5	Results and discussion
6	Validation of results
7	a. Concluding and future scope b. References
8	**Report Writing** (Students publication/achievements)

ORAL EXAMINATION:

The students must prepare presentation on Project work and present in presence of external examiners

through a viva-voce examination.

B.Tech. (UG) Project Guidelines

This document provides guidelines to the students in carrying out their Final Year project work in an effective way and to bring the uniformity in the conduction of project work. Project work is an important for the partial fulfillment of B.Tech degree in civil engineering. Project work is carried out in the semester VII/VIII. The classification of the project is done under the head of experimental investigation, product development, software development, simulation etc… For the smooth functioning of the activities and to maintain the co-ordination in all the project groups, **Departmental Project Assessment Committee (DPAC)** has been formed. The committee is headed by the Head of Department and Project Co-ordinators. The committee includes SIG in-charge and the SIG members.

The CO-PO and PSO mapping is as follows:

CO No	Course outcome for project	Relevance to POs/PSOs	
		POs	PSOs
1	Students will be able to demonstrate sound academic fundamentals to formulate and analyze Civil engineering problems.	1,2	1
2	Students will be able to apply creative/innovative solution for Civil engineering problems by using modern tools.	4,5	1,2
3	Students will be able to design Civil engineering systems, products and processes.	2,3	1,2
4	Students will be able to communicate effectively with written, oral, and visual means in technical presentations/discussions.	8,9,11,10	1
5	Students will be able to demonstrate skill for lifelong learning.	12	1,2
6	Students will be able to recognize environmental constraints and safety issues in civil engineering.	6,7	1

The B.Tech project evaluation process will be carried out in two stages i.e. review 1 and review 2 (review 3 and review 4 will be taken in case of project carried out in two phases).

Roles and responsibilities of Project coordinator:
1. Project coordinator along with HOD will be responsible to form the DPAC.
Project coordinators shall conduct the special session for the students in the mid of VII semester to create awareness among student related to final year project work. This special session includes information related to group formation, selection of project and activities involved to complete the project work.
2. Project coordinator shall appoint the project guides by considering area of interest of both the guides and students.
3. Project coordinators will be responsible for scheduling the reviews of all the project groups and compile the evaluation report received from DPAC for further processing.
4. The project coordinators shall arrange the reviews as follows:
a. Review 1: Starting of the semester (within 15 Days) [Presentation and synopsis]
b. Review 2: After 2 months of review 1 [Presentation]
c. Final Examination: At the end of semester
5. To maintain the uniformity in the documents, project coordinator can provide a rough draft format of all the documents required to be prepared by the students. The documents may include format of synopsis report, project report, PPT, A3 Size poster etc.

Roles and responsibilities of DPAC:

1. DPAC will be responsible for smooth and uniform conduction of the review of B.Tech projects.
2. The committee shall monitor the progress of project work on timely basis.
3. After conducting the reviews by the DPAC and the panel members, if they found that any particular group is not performing well and needs improvement, DPAC member can take an appropriate action or counsel the student project group.
4. DPAC shall conduct the reviews on a timely basis and submit the evaluation sheet as per the criteria decided for each review to the project coordinators for further process.
5. For each review the panel members shall recommend the suitable suggestions and take the follow up in the forthcoming reviews.
6. In the review presentation DPAC committee shall do the evaluation of each student on their individual participation, content, knowledge, skills and attitude.
7. Each DPAC shall submit names of 2 external examiners for conducting the final examination.

Roles and responsibilities of the Project Guide:

1. Project guide shall help student to identify the problem definition and set the path for completion of the same.
2. Project guide shall motivate the students to write patent, copy right, research funding proposal and paper publications for the overall development of the student.
3. Project guides can offer the problem statement to the students. Project guides shall submit the problem statement to the project coordinators in the mid of VII semester. These problem statements will float by the project coordinators to the students.
4. Project guides shall monitor the weekly progress of the respective project group and motivate them to achieve their project objectives. If the performance is not satisfactory then project guide can report to the DPAC.
5. Project guides shall ensure the completion of all the project related activities as per the requirement of review.

Guidelines for Students:
1. Project work shall be based on any of the following:
    I. Experimental investigation.
    II. Software development.
    III. Benefit Cost economic analysis.
    IV. Case study with own design.
    V. Working model design and fabrication.
    VI. Case study with development of methodology using soft computing tools.
2. It is mandatory for all students to undergo the project work as a part of their Final year academics.
3. It is the responsibility of the students to complete their project work in the given time frame.
4. The Project group shall have 4 students.
5. Students shall start working on the selection of problem statement for the project at the end of VI/VII semester.
6. Students can select interdisciplinary projects.
7. Students shall select the project and the project guide in their area of interest.
8. Following are the reference areas in which students can select the project from:
    a. Structural Engineering
    b. Construction Management
    c. Geotechnical and Transportation Engineering
    d. Water Resource and Environmental Engineering

9. The possible problem statements for project can be availed from
   a. Industries
   b. Research labs or organization
   c. Collegiate clubs
   d. In-house research projects
10. Each group will be assigned a faculty mentor to guide them for the project work.
11. Students shall meet their assigned project guide at least once in a week and convey the progress of the project work.
12. Student shall maintain the record of all the meetings, remarks given by DPAC and progress of the work in the project log-book.
13. The project log-book must be presented in front of DPAC before giving the next presentation.
14. The project sponsorship can be of following three categories:
    a. **Self-sponsored project:** The finance for the project will be done by the students
    b. **Industry sponsored project:** The finance for the project will be done by the industry. Students shall submit the necessary document which shall include sponsorship letter from the industry.
15. **Institute sponsored project:** The finance for the project will be done by any of the institutes or organizations. Students shall submit the necessary document which shall include sponsorship letter from the institute. Following types of work will not be considered as project work:
    a. Projects based on only Surveying
    b. Projects based on only Case study
    c. Only Computer simulation-based projects
    d. Assembly of ready-made components
    e. Only Mobile App development.
16. The project work assessment will be done in following stages:
    a. Review 1: Starting of the semester (within 15 Days) [Presentation and synopsis]
    b. Review 2: After 2 months of review 1 [Presentation]
    c. Final Examination: At the end of semester
17. Expected work to be completed in the review:
    a. Review 1: Problem definition identification and feasibility
    b. Review 2: Design and Analysis of the work, Result and Discussion
    c. Final Examination: Report Writing and Presentation
18. Student shall remain present for all the reviews and examination well before schedule time.
19. For final examination, student shall complete the project report in all aspect including formatting. Each Student shall prepare the report duly signed by project guide, head of the department, director and the external examiner. Along with this student are required to prepare two extra copies of the project report duly signed by above mentioned authorities.
20. Students shall submit all the data related to project work in soft copy to their guides which shall include project report, A3 size poster, and Presentation and Annexure.
21. Students are recommended to write a research article/paper, funding proposal, patent and copyright on their respective project work.

Evaluation Procedure:

For the smooth conduction of each project, the progress shall be monitored continuously by the DPAC and the project guide. For this Project coordinator shall plan two/four reviews and one external review for final examination. The evaluation scheme for the project is as follows:

	Internal Evaluation (50 Marks)	**TW evaluation (150)**	**Oral (150)**
Assessment criteria	Rubric 1 for project review 1	Rubric 2 for project review 2	External Examination (Rubric 3 for Final examination of project work)

Department of Civil Engineering

Following guidelines are provided for the conduction of reviews:

- **Review 1:** This will be planned at the beginning of the semester VII (Within 15 days of semester commencement). The Review 1 will be purely synopsis presentation, which will be taken by the DPAC. The assessment of this review will be considered for Internal evaluation. For this student shall prepare the presentation on selected project idea according to their area of interest. The brief presentation with clear aim and objectives of the project shall be presented Infront of the DPAC after taking the approval from the respective project guide.
- If presentation is not up to the mark then committee may recommend to the students with the concern of project guide to modify their Presentation/Project work in a week and present again.
- Following points can be considered for the preparation of review 1 presentation:
  - Title Page: (Title of Project, Names of Students, Name of Guide)
  - Introduction
  - Need of the project
  - Objectives
  - Scope
  - Problem Definition
  - Literature referred
  - Methodology Planned for achieving Aim and objectives of the project
  - Expenditure (if any)
  - Time Activity Chart
  - References

Project Review 1		
Reviews	**Criteria**	**Weight age**
Review-1 (Marks 50)	Topic selection & understanding of area	10
	Required analysis for selection of topic & Problem statement	10
	Aim & objective	10
	Presentation	15
	Punctuality	5
	Total	**50 Marks**

Criteria	Excellent (100% Weightage of Marks)	Good (80 % Weightage of Marks)	Satisfactory (40-60% Weightage of Marks)	Unsatisfactory (10-30 % Weightage of Marks)
Topic selection & understanding of area (10 Marks)	Understanding of area is clear and topic selection is innovative, creative.	Understanding of area is clear and topic selection is somewhat innovative.	Understanding of area is somewhat clear and topic selection is not innovative and creative	Understanding of area and topic not clear and innovative.
Required analysis for selection of topic & Problem statement (10 Marks)	Required analysis for selection of topic was done properly & Problem statement is clearly defined.	Required analysis for selection of topic was done proper but problem statement is not properly defined.	Required analysis for selection of topic was done satisfactory but poor problem statement defined.	Required analysis for selection of topic & Problem statement are unsatisfactory
Aim & objective (10 Marks)	Project aim identified and objectives fairly defined.	Project aim and objectives defined partially well.	Project aim defined but objectives are not clearly defined.	Aim and objective statements are not clear.
Presentation skill (15 Marks)	Observed creative/organized presentation skills	Observed organized and average presentation skills	Minimally effective presentation	Observed poor presentation skills
Punctuality (5 Marks)	Punctual and hard working	Punctual and somewhat instructive nature	Instructive approach, hard worker but not punctual	Not Punctual at all

- **Review 2:** This will be planned after 1 month of review 1. The aim of the review 2 is to look in to the progress of the student after review 1. The assessment of this review will be considered for Term work evaluation. The DPAC shall check whether the student have answered and compiled the queries raised in review 1. The objective of review 2 is to identify the progress of students group in line with their methodology planned. Following points can be considered for Review 2 presentation:
  - Study of data
  - Modeling/prototype- Design
  - Design calculations
  - Numerical Simulation /Mathematical model
  - Finalization of design

Project Review 2		
Review-2 (Marks 150)	Appropriate introduction related with area	10
	Well defined problem statement, objective & scope of work	10
	Literature Review & summary	20
	Action plan/schedule (flowchart)	10
	Methodology	10
	Result & Discussion	20
	Presentation	10
	Individual contribution in team	10
	Project Report	50
	Total	**150**

Project Review 2				
Criteria	**Excellent** (100% Weightage of Marks)	**Good** (80 % Weightage of Marks)	**Satisfactory** (40-60% Weightage of Marks)	**Unsatisfactory** (10-30 % Weightage of Marks)
Appropriate introduction related with area (10 Marks)	Appropriate and creative introduction of area of research found	Partially appropriate introduction of area of research is found.	Relevant introduction of area of research is found but not up to the mark.	No appropriate introduction is found related to area of research.
Well defined problem statement, objective & scope of work (10Marks)	Project problem statement, aim, objectives and scope are clearly defined.	Problem statement, objectives and scope are somewhat defined.	Project problem statement, aim and objectives are satisfactory defined but scope is yet not clear.	Project problem statement, aim, objectives and scope are poorly defined.
Literature Review & summary (20 Marks)	Literature review (minimum 8 papers) and findings clearly identified and well written summery.	Literature review (minimum 8 papers) and findings somewhat clear and written good.	Literature review and findings are identified but summery not written well.	Incomplete and insufficient literature and summery not well defined.
Action plan/schedule (flowchart) (10 Marks)	Well plan schedule and work flow is proper and progress is as per plan	Planning and schedule is good but work flow is not as per plan.	Action plan/schedule poorly prepared and progress is not on track.	Action plan/schedule is not well defined and no expected progress is observed.
Methodology (10 Marks)	Well defined methodology with proper tools to solve the problem statement	Good methodology with proper tools to solve the problem statement	Averagely define methodology with proper tools to solve the problem statement	Poor methodology with proper tools to solve the problem statement

Result & Discussion (10 Marks)	Obtained derived results with proper description and discussion cited with reference	Obtained good results with description and discussion cited with reference	Results reported with average description and discussion cited with reference	Results reported with poor description and discussion not cited with reference
Presentation (10 Marks)	Observed creative/organized presentation skills. Innovative ideas observed.	Observed organized and average presentation skills.	Minimally effective presentation. Not so innovative.	Observed poor presentation skills. No innovative ideas.
Individual contribution in team(10 Marks)	Individual contribution of student will reflect in work and presentation during question and answer session	Individual contribution of student will reflect in work and presentation but not able to answer well.	Individual contribution of student will not fully reflect in work and presentation. Also not showing confidence during question and answer session	Individual contribution of student will neither reflect in presentation nor during question and answer session
Quality of report as per format (10 Marks)	Quality of report is very good. It is as per given format, neat and in own words	Quality of report is good. Most of the part of report as per given format, neat and in own words.	Quality of report is Average. Some of the part of written document is as per format, neat and in own words but not organized.	Quality of report is poor. Written document is not as per format, not well organized, messy and text part somewhat copied.

- **Final Examination:** Final Examination will be scheduled after review 2 as per the schedule provided by examination section. This examination will be carried out under the supervision of Project guide and appointed External examiner. For final examination, student shall complete the project report in all aspect including formatting. Each Student shall prepare the report duly signed by project guide, head of the department, director and the external examiner. Along with this student are required to prepare two extra copies of the project report duly signed by above mentioned authorities. Students shall submit all the data related to project work in soft copy to their guides which shall include project report, A3 size poster, Presentation and annexure. The assessment points for Final examination will be based on CO

Final Examination		
Final Review (Marks 150)	Depth of project area/knowledge	30
	Implementation/work done	30
	Literature survey and summary, action plan	15
	Paper published/conference presentation	15
	Quality of report as per format	30
	Presentation	15
	Individual contribution in team	15
	Total	**150**

Department of Civil Engineering

<table>
<tr><th colspan="5">Final Examination</th></tr>
<tr><th>Criteria</th><th>Excellent (15 Marks)</th><th>Good (12 Marks)</th><th>Satisfactory (9-6 Marks)</th><th>Unsatisfactory (1-0 Marks)</th></tr>
<tr>
<td>Depth of project area/ knowledge (30 Marks)</td>
<td>At the end of project completion, student has excellent depth of knowledge in the selected project area. It can verify during question and answer session.</td>
<td>At the end of project completion, student has good depth of knowledge in the selected project area. It can verify during question and answer session.</td>
<td>At the end of project completion, student has satisfactory depth of knowledge in the selected project area and there is scope for improvement.</td>
<td>At the end of project completion, student has poor depth of knowledge in the selected project area and there is scope for improvement. It can verify during question and answer session.</td>
</tr>
<tr>
<td>Implementation/ work done (30Marks)</td>
<td>At the end of project completion, implementation of project and analytical or experimental or design or R&I work done is very good. It fairly reflects problem solving ability, social befits, environmental concern and management aspects. Industrial sponsorship/funding for project work.</td>
<td>At the end of project completion, implementation of project and analytical or experimental or design or R&I work done is satisfactory. It reflects problem solving ability, social befits, environmental concern and management aspects. Industrial sponsorship/funding for project work.</td>
<td>At the end of project completion, implementation of project and analytical or experimental or design or R&I work done is satisfactory but scope for improvement. It somewhat reflects problem solving ability, social befits, environmental concern and management aspects.</td>
<td>At the end of project completion, implementation of project and analytical or experimental or design or R&I work done is poor and major scope for improvement. It shows poor consideration of problem solving ability, social befits, environmental concern and management aspects.</td>
</tr>
<tr>
<td>Literature survey and summary, action plan (15Marks)</td>
<td>Extensive literature survey including well written summery after phase -1 and well execution of project activities as per action plan or methodology defined</td>
<td>Satisfactory literature survey including well written summery after phase -1 and project execution is satisfactory as per action plan or methodology.</td>
<td>Satisfactory literature survey and summery written after phase -1. Execution of project activities are not as per action plan or methodology and somewhat delayed.</td>
<td>Insufficient literature survey and summery written is poor after phase-1. Project execution delayed and activities carried out are not as per action plan or methodology</td>
</tr>
<tr>
<td>Paper published/conference presentation -(15Marks)</td>
<td>High ability of project to publish patent, research paper, conference paper, copyright.</td>
<td>Good ability of project to publish patent, research paper, conference paper, copyright.</td>
<td>Moderate ability of project to publish patent, research paper, conference paper, copyright. No participation in state/ national/ intercollege events/ competitions.</td>
<td>Low ability of project to publish patent, research paper, conference paper, copyright. No participation in state/ national/ intercollege events/ competitions.</td>
</tr>
<tr>
<td>Presentation -(15Marks)</td>
<td>sented all information in a clear and organized way. Selected a highly effective and creative format for the presentation.</td>
<td>sented most of the information in a clear and organized way. Selected an effective format for the presentation.</td>
<td>sented information which is poorly organized, difficult to understand. Selected a format is somewhat effective for this topic.</td>
<td>sented information is poorly organized, hard to understand. Selected a format not effective.</td>
</tr>
</table>

Individual contribution in team (15Marks)	Individual contribution of student is excellent in project. During question and answer session he is able to explain well. Student's participation in various events and competitions organized by various institutes.	Individual contribution of student is good which reflect during presentation but student not having confidence to showcase his work during question answer session satisfactory. Student's participation in various events and competitions organized by various institutes.	Individual contribution of student is not fully reflected in project work. He is not able to explain during question answer session. No participation in any events and competitions organized by various institutes.	Individual contribution of student will neither reflect in project work and not reflect during question and answer session. No participation in any events and competitions organized by various institutes.
Quality of report as per format (30Marks)	Quality of report is very good. Written information and work is insightful, clear to understand. Report is neat, easy to read, clear images and in own words.	Quality of report is almost good. Written information and work is insightful, clear to understand. It is as per given format, neat and in own words.	Quality of report is average. Most of the part of written document is vary in accuracy and coherence related to ideas, images and literature. Write up not organized.	Quality of report is poor. Written document is not as per format, not well organized, messy and copied part observed.

Vision and Mission of the Civil Engineering Department

Vision of the Civil Engineering Department

To establish as a premier civil engineering department in Maharashtra in the coming five years by providing quality education, fostering innovation with ethical values to serve the society.

Mission of the Civil Engineering Department

1. Fostering value-based education to achieve academic excellence with the right attitude and professional ethics.

2. Inculcating a culture of research and innovation, with an aim of serving society in a sustainable manner.

3. Developing skilled civil engineers with an ability to provide solutions to meet national and global challenges in accordance with the needs of the society.

Program Specific Outcomes (PSO) of Civil Engineering Department

1. Graduates in civil Engineering will demonstrate proficiency in practical applications for quality construction work in the domain of Structural Engineering, Water Resources-Environmental Engineering, Geotechnical-Transport and Construction Management.

2. A graduate in Civil Engineering, equipped with the necessary skills and technical knowledge, can become an entrepreneur in the field, capable of identifying business opportunities, developing business plans, managing resources, designing and executing sustainable construction projects for infrastructural development.