

**DEPARTMENT OF CIVIL ENGINEERING
ANNA UNIVERSITY, CHENNAI**

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and International levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by

1. Providing a firm scientific and technological base in Civil Engineering to achieve self-reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering.
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the programme M E Construction Engineering & Management will

PEO1	Excel in research or will succeed in Construction Engineering and Management profession in the government, public and private sector organizations.
PEO2	Have a sound knowledge in statistics, project management and construction engineering fundamentals required for solving real time construction Engineering and Management problems using modern equipment and software tools.
PEO3	Become entrepreneurs and develop processes and construction technologies through innovation, by integrating their knowledge in multidisciplinary management to meet the needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.
PEO4	Have professional and ethical attitude, effective communication skills, teamwork skills, leadership quality, multidisciplinary approach and an ability to relate Construction Engineering and Management issues in broader social context.
PEO5	Have competence of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

PROGRAMME OUTCOMES (POs):

Graduates of the programme M. E. Construction Engineering and Management will be able to

PO#	Graduate Attribute	Programme Outcome
PO1	Engineering knowledge	Apply knowledge of mathematics, basic science and engineering science to conceptualize Construction Engineering and Management.
PO2	Problem analysis	Identify, formulate and solve problems in construction Engineering and Management.
PO3	Design/development of solutions	Design a technology or process to improve the performance of construction industry by satisfying its constraints.
PO4	Conduct investigations of complex problems	Conduct experiments & investigations, analyze and interpret the problems in construction industry through appropriate research methodologies and to provide valid conclusions.
PO5	Modern tool usage	Create, select and apply appropriate techniques and modern engineering tools including prediction and modelling software, with due understanding of the limitations.
PO6	The Engineer and society	Understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to construction engineering and management
PO7	Environment and sustainability	Understand the socio economic impact of Construction Engineering solutions and demonstrate knowledge of sustainable development
PO8	Ethics	Interact in industry, business and society in a professional and ethical manner.

PO9	Individual and team work	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings and demonstrating a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis.
PO10	Communication	Communicate effectively on construction Engineering and management issues with the engineering community and write reports and make effective presentations.
PO11	Project management and finance	Demonstrate a knowledge and understanding of construction project management and business practices, such as risk and change management, and understand their limitations
PO12	Life-long learning	Continue professional development and learning as a life-long activity by addressing construction engineering and management issues and learning from corrective and preventive measures.

PROGRAM SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Construction Engineering and Management will be able to

PSO1	Knowledge of Construction Engineering and Management discipline	In-depth knowledge in the construction management, engineering and technologies necessary to formulate, plan, schedule and execute construction projects.
PSO2	Critical analysis of Construction management problems and innovation	Critically analyze and solve construction engineering and management problems by applying the modern tools and concepts of Construction Engineering & Management and make innovative advances in theoretical and practical.
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	Conceptualize the problems in construction industry and develop appropriate solutions which are technically feasible and economically viable with due consideration of sustainability.

PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	-	✓	-	✓	-	✓	-	-	-	✓
II	✓	✓	✓	-	✓	-	-	-	✓	-	✓	-
III	✓	✓	✓	-	✓	-	✓	-	✓	✓	✓	-
IV	-	-	-	✓	-	✓	-	✓	✓	✓	✓	✓
V	-	-	-	-	-	✓	✓	✓	-	✓	-	✓

Mapping of Course Outcome and Programme Outcome

		Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
YEAR I	SEMESTER I	Statistical Methods for Engineers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Modern Construction Materials	H	M	L	M	L	L	-	-	-	M	-	-	M	L	H	
		Project Formulation and Appraisal	M	H	-	L	L	M	H	-	M	-	H	L	M	M	M	
		Construction Equipment and Management	M	-	M	M	M	M	L	M	L	M	H	M	H	M	H	
		Program Elective I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Research Methodology and IPR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Audit Course – I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Advanced Construction Engineering and Experimental Techniques Laboratory	H	M	H	H	M	M	L	H	L	M	L	H	H	L	M	
		Technical Seminar	H	-	M	M	-	H	H	-	-	M	-	M	H	-	H	
	SEMESTER II	Advanced Construction Techniques	M	H	H	H	M	L	L	M	L	M	M	L	H	L	H	
		Construction Planning, Scheduling and Control	H	H	H	L	H	M	M	L	M	L	H	L	H	H	M	
		Contract Laws and Regulations	H	H	M	H	-	M	H	H	M	L	M	L	M	M	L	
		Program Elective II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Program Elective III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Audit Course –II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
		Construction Management Studio Laboratory	H	M	M	M	H	H	H		L		M	M	M	L	M	
		Statistical Laboratory	L	H	H	M	H	L	M	L	L	L	M	H	H	H	M	
YEAR II	SEMESTER III	Program Elective IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		Program Elective V	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		Open Elective	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
		Practical training (4 weeks)	M	H	H	M	M	M	M	L	M	L	M	M	H	M	M	
		Project Phase I	M	H	H	H	H	L	M	L	L	L	M	H	M	M	H	
	SEMESTER IV	Project Phase II	M	H	H	M	H	M	M	M	L	L	M	M	H	H	M	

PROGRAM ELECTIVE COURSES (PEC)

S. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Advanced Concrete Technology	M	H	H	H	H	M	L	H	M	H	L	H	M	L	L
2.	Human Resources Management in Construction	M	M	M	H	L	H	H	M	M	M	H	H	H	M	L
3.	Construction Project Management	H	L	H	H	M	M	H	M	M	-	H	L	H	M	M
4.	Sustainable Construction	H	L	H	M	M	L	L	M	L	H	L	M	M	H	M
5.	Economics and Finance Management in Construction	M	M	-	M	L	-	-	-	-	-	M	L	M	M	M
6.	Design of Energy Efficient Buildings	H	M	H	M	L	L	L	M	L	H	L	M	H	H	H
7.	Project Safety Management	M	H	M	M	L	M	M	H	M	M	M	M	L	M	M
8.	Computer Applications in Construction Engineering and Planning	H	M	M	M	H	M	-	-	-	-	-	M	M	M	L
9.	Quantitative Techniques in Management	H	H	M	M	M	M	L	H	L	L	H	M	H	H	M
10.	Resource Management and Control in Construction	H	H	M	H	H	L	M	L	M	L	H	L	M	H	L
11.	Shoring, Scaffolding and Formwork	H	M	M	M	H	H	M	H	H	H	H	H	H	H	H
12.	System Integration in Construction	M	M	M	M	M	L	L	M	-	M	H	L	H	M	H
13.	Advanced Data Analysis	M	H	L	L	H	L	L	M	L	L	H	H	H	H	H
14.	Lean Construction Concepts, Tools & Practices	H	H	H	H	H	H	M	M	M	H	H	M	H	H	H
15.	Environmental Impact Assessment For Construction Engineers	H	M	M	M	M	M	L	M	M	M	M	L	M	M	M
16.	Maintenance, Repair and Rehabilitation Of Structures	M	M	H	H	H	M	L	M	M	H	L	M	M	H	M
17.	Quality control and assurance in construction	H	H	H	H	H	H	M	H	H	H	H	H	H	H	M
18.	Organizational Behaviour	-	-	-	-	-	H	H	-	H	-	-	-	-	-	L
19.	Management Information Systems	H	M	H	M	H	H	M	M	M	L	M	L	M	M	M
20.	Supply chain management and Logistics in construction	M	M	M	L	L	M	M	M	L	M	H	M	H	H	H

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. CONSTRUCTION ENGINEERING AND MANAGEMENT
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5157	Statistical Methods for Engineers	FC	3	1	0	4	4
2.	CN5101	Modern Construction Materials	PCC	3	0	0	3	3
3.	CN5102	Project Formulation and Appraisal	PCC	3	1	0	4	4
4.	CN5103	Construction Equipment and Management	PCC	3	0	0	3	3
5.		Program Elective I	PEC	3	0	0	3	3
6.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
7.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
8.	ST5161	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	4	4	2
9.	CN5111	Technical Seminar	EEC	0	0	2	2	1
TOTAL				19	2	6	27	22

* Audit Course is optional

SEMESTER II

S NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CN5201	Advanced Construction Techniques	PCC	3	0	0	3	3
2.	CN5202	Construction Planning, Scheduling and Control	PCC	3	0	0	3	3
3.	CN5203	Contract Laws and Regulations	PCC	3	0	0	3	3
4.		Program Elective II	PEC	3	0	0	3	3
5.		Program Elective III	PEC	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
7.	CN5211	Construction Management Studio Laboratory	PCC	0	0	4	4	2
8.	CN5212	Statistical Laboratory	PCC	0	0	4	4	2
TOTAL				17	0	8	25	19

* Audit Course is optional

SEMESTER III

S NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective IV	PEC	3	0	0	3	3
2.		Program Elective V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4.	CN5311	Practical Training (4 Weeks)	EEC	0	0	0	0	2
5.	CN5312	Project Phase I	EEC	0	0	12	12	6
TOTAL				9	0	12	21	17

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CN5411	Project Phase II	EEC	0	0	24	24	12
TOTAL				0	0	24	24	12

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: :70

FOUNDATION COURSES (FC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	MA5157	Statistical Methods for Engineers	3	1	0	4	1

PROGRAM CORE COURSES (PCC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	CN5101	Modern Construction Materials	3	0	0	3	1
2.	CN5102	Project Formulation and Appraisal	3	1	0	4	1
3.	CN5103	Construction Equipment and Management	3	0	0	3	1
4.	ST5161	Advanced Construction Engineering and Experimental Techniques Laboratory	0	0	4	2	1
5.	CN5201	Advanced Construction Techniques	3	0	0	3	2

6.	CN5202	Construction Planning, Scheduling and Control	3	0	0	3	2
7.	CN5203	Contract Laws and Regulations	3	0	0	3	2
8.	CN5211	Construction Management Studio Laboratory	0	0	4	2	2
9.	CN5212	Statistical Laboratory	0	0	4	2	2
TOTAL CREDITS						25	

PROGRAM ELECTIVE COURSES

PROGRAM ELECTIVE [PEC] – Group I (SEMESTER I)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PERWEEK			CREDITS	GROUP
			L	T	P		
1.	CN5071	Advanced Concrete Technology	3	0	0	3	1
2.	CN5001	Human Resources Management in Construction	3	0	0	3	1
3.	CN5002	Construction Project Management	3	0	0	3	1
4.	CN5003	Sustainable Construction	3	0	0	3	1

PROGRAM ELECTIVE COURSES [PEC] – Group II (SEMESTER II)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PERWEEK			CREDITS	GROUP
			L	T	P		
1.	CN5004	Economics and Finance Management in Construction	3	0	0	3	2
2.	CN5005	Design of Energy Efficient Buildings	3	0	0	3	2
3.	CN5006	Project Safety Management	3	0	0	3	2
4.	CN5007	Computer Applications in Construction Engineering and Planning	3	0	0	3	2

PROGRAM ELECTIVE COURSES [PEC] – Group III ((SEMESTER II)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	CN5008	Quantitative Techniques in Management	3	0	0	3	3
2.	CN5009	Resource Management and Control in Construction	3	0	0	3	3
3.	CN5010	Shoring, Scaffolding and Formwork	3	0	0	3	3
4.	CN5011	System Integration in Construction	3	0	0	3	3

PROGRAM ELECTIVE COURSES [PEC]- Group IV ((SEMESTER III))

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	CN5012	Advanced Data Analysis	3	0	0	3	4
2.	CN5013	Lean Construction Concepts, Tools and Practices	3	0	0	3	4
3.	CN5014	Environmental Impact Assessment For Construction Engineers	3	0	0	3	4
4.	ST5071	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	4

PROGRAM ELECTIVE COURSES [PEC] – Group V (SEMESTER III)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	CN5015	Quality Control and Assurance in Construction	3	0	0	3	5
2.	CN5016	Organizational Behaviour	3	0	0	3	5
3.	CN5017	Management Information Systems	3	0	0	3	5
4.	CN5018	Supply Chain Management and Logistics in Construction	3	0	0	3	5

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	RM5151	Research Methodology and IPR	2	0	0	2	1
TOTAL CREDITS						2	

OPEN ELECTIVE COURSES [OEC]

*(Out of 6 Courses one Course must be selected)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
TOTAL CREDITS						0	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	CN5111	Technical Seminar	0	0	2	1	1
2	CN5312	Project Phase I	0	0	12	6	3
3	CN5411	Project Phase II	0	0	24	12	4
4	CN5311	Practical Training (4 weeks)	0	0	0	2	3
TOTALCREDITS						21	

SUMMARY

Name of the Programme: M.E CONSTRUCTION ENGINEERING AND MANAGEMENT						
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	12	13	00	00	25
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	01	00	08	12	21
7.	Non Credit/ Audit Course	✓	✓	00	00	
	TOTAL CREDIT	22	19	17	12	70

OBJECTIVES:

- To enable them to estimate the value of the parameters involved in the specific distribution from a possible continuum of alternatives.
- To give an idea of testing the statistical hypothesis claimed based on a set of data points using suitable test statistics which follows standard sampling distributions.
- To establish a relationship that make it possible to predict one or more variable in terms of others using correlation and regression analysis.
- To introduce the various experimental designs and their corresponding analysis of variance which play vital role in many real time scenarios.
- To impart knowledge of handling random vectors which represent random variables in multi-dimensional space.

UNIT I ESTIMATION THEORY 12
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency–Maximum Likelihood Estimation – Method of moments.

UNIT II TESTING OF HYPOTHESIS 12
Tests based on Normal, t , F and χ^2 distributions for testing of means, variance and proportions – Analysis of $r \times c$ tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION 12
Multiple and Partial Correlation - Method of Least Squares- Plane of Regression - Properties of Residuals - Coefficient of Multiple Correlation - Coefficient of Partial Correlation - Multiple Correlation with total and partial correlations - Regression and Partial correlations in terms of lower order coefficients.

UNIT IV DESIGN OF EXPERIMENTS 12
Analysis of variance – One-way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS 12
Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density and its properties – Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, students will be able to

- Obtain the value of the point estimators using the method of moments and method of maximum likelihood.
- Use various test statistics in hypothesis testing for mean and variances of large and small samples.
- Determine the regression line using the method of least square and also to calculate the partial and multiple correlation coefficient for the given set of data points.
- Test the hypothesis for several means using one way, two way or three way classifications.
- Get exposure to the principal component analysis of random vectors and matrices.

REFERENCES:

1. Devore, J.L., “Probability and Statistics for Engineering and the Sciences”, Thomson and Duxbury, Singapore, 6th Edition, Boston, 2004.
2. Gupta, S.C., and Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, Eleventh Edition, Reprint, New Delhi, 2019.

3. Johnson, R. A. and Gupta, C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, Eighth Edition, New Delhi, 2015.
4. Johnson, R.A., and Wichern, D.W., "Applied Multivariate Statistical Analysis", Pearson Education, Sixth Edition, New Delhi, 2013.
5. Spiegel, M.R. and Stephens, L.J., "Schaum's outlines on Statistics", Tata McGraw-Hill, 6th Edition, New York, 2018.

CN5101

MODERN CONSTRUCTION MATERIALS

L T P C
3 0 0 3

OBJECTIVE:

- To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non-weathering materials, and smart materials.

UNIT I SPECIAL CONCRETES 9
Concretes Behavior of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self-compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

UNIT II METALS 9
Types of Steels – Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminum and its products – Types of Coatings & Coatings to reinforcement – Applications of Coatings.

UNIT III COMPOSITES 9
Types of Plastics – Properties & Manufacturing process – Advantages of Reinforced polymers – Types of FRP – FRP on different structural elements – Applications of FRP.

UNIT IV OTHER MATERIALS 9
Types and properties of Water Proofing Compounds – Types of Non-weathering Materials and its uses – Types of Flooring and Facade Materials and its application.

UNIT V SMART AND INTELLIGENT MATERIALS 9
Types & Differences between Smart and Intelligent Materials – Special features – Case studies showing the applications of smart & Intelligent Materials.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of the course, the student is expected to be able to

CO1	Explain the various types of special concretes
CO2	Select the different processing of steel and applications of coating
CO3	Explain the manufacturing process and applications of polymer composites
CO4	Identify the different flooring materials and application of façade materials
CO5	Apply the knowledge of smart and intelligent materials in construction field

REFERENCES:

1. Ganapathy, C. "Modern Construction Materials", Eswar Press, 2015.
2. Ashby, M.F. and Jones D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.
3. Santhakumar A.R. "Concrete Technology", Oxford University press, New Delhi.
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
5. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd., 2005.

CO – PO Mapping –MODERN CONSTRUCTION MATERIALS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	M	M	H
PO2	Problem analysis	M	M	M	L	L	M
PO3	Design / development of solutions	M	M	L	L	L	L
PO4	Investigation	M	M	M	L	L	M
PO5	Modern Tool Usage	L	L	M	L	M	L
PO6	Individual and Team work	L	L	L	L		L
PO7	Communication	-	-	-	-	-	-
PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	M	M	L	M	L	M
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	-	-	-	-	-	-
PSO1	Knowledge of Construction Engineering & Management discipline	M	M	L	M	L	M
PSO2	Critical analysis of Construction management problems and innovation	M	M	L	L	L	L
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H	H	M	L	H

CN5102

PROJECT FORMULATION AND APPRAISAL

**L T P C
3 1 0 4**

OBJECTIVE:

- To study and understand the formulation, costing of construction projects, appraisal, finance and private sector participation.

UNIT I PROJECT FORMULATION

12

Project – Concepts – Capital investments - Generation and Screening of Project Ideas - Project identification – Preliminary Analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

UNIT II PROJECT COSTING

12

Project Cash Flows – Time Value of Money – Cost of Capital.

UNIT III PROJECT APPRAISAL

12

NPV – BCR – IRR – ARR – Urgency – Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.

UNIT IV PROJECT FINANCING**12**

Project Financing – Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators – Ratios- financial cost-benefit analysis, social-cost benefit analysis'

UNIT V PRIVATE SECTOR PARTICIPATION**12**

Private sector participation in Infrastructure Development Projects - BOT, BOLT, BOOT - - Technology Transfer and Foreign Collaboration - Scope of Technology Transfer.

TOTAL: 60 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Perform Formulations Of Projects
CO2	Analyze Project Costing
CO3	Evaluate Project Appraisal
CO4	Apply Project Financing
CO5	Perform Private Sector Participation & Implementation

REFERENCES:

- Barcus, S.W. and Wilkinson.J.W., Hand Book of Management Consulting Services, McGraw Hill, New York, 1986.
- Joy P.K., Total Project Management - The Indian Context, New Delhi, Macmillan India Ltd., 1992
- Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review, McGraw Hill Publishing Company Ltd., New Delhi. 2006.
- United Nations Industrial Development Organisation (UNIDO) Manual for the Preparation of Industrial Feasibility Studies, (IDBI Reproduction) Bombay, 1987.
- Raina V.K, "Construction Management Practice – The inside Story", Tata McGraw Hill Publishing Limited, 2005

CO – PO Mapping - PROJECT FORMULATION AND APPRAISAL

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	M	H	H	M
PO2	Problem analysis	H	H	H	M	M	H
PO3	Design / development of solutions	-	-	-	-	-	-
PO4	Investigation	-	-	M	L	L	L
PO5	Modern Tool Usage	-	M	L	-	-	L
PO6	Individual and Team work	M	M	H	-	-	M
PO7	Communication	H	H	H	M	M	H
PO8	Engineer and Society	M	M	-	-	-	-
PO9	Ethics	M	M	-	-	M	M
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	H	H	M	H	M	H
PO12	Life Long Learning	L	L	-	-	-	L
PSO1	Knowledge of Construction Engineering & Management discipline	M	M	H	M	M	M
PSO2	Critical analysis of Construction management problems and innovation	M	M	M	L	L	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H	M	M	M	M

OBJECTIVE:

- To study and understand the various types of equipments used for earthwork, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

UNIT I CONSTRUCTION EQUIPMENTS AND MANAGEMENT 9

Identification – Planning of equipment – Selection of Equipment - Equipment Management in Projects - Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment - Depreciation Analysis – Replacement of Equipment- Replacement Analysis - Safety Management.

UNIT II EQUIPMENT FOR EARTHWORK 9

Fundamentals of Earth Work Operations - Earth Moving Operations - Types of Earth Work Equipment - Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and hauling equipment, Compacting Equipment, Finishing equipment.

UNIT III OTHER CONSTRUCTION EQUIPMENT 9

Equipment for Dredging, Trenching, Drag line and clamshells, Tunneling – Equipment for Drilling and Blasting - Pile driving Equipment - Erection Equipment - Crane, Mobile crane - Types of pumps used in Construction - Equipment for Dewatering and Grouting – Equipment for Demolition.

UNIT IV ASPHALT AND CONCRETE PLANTS 9

Aggregate production- Different Crushers – Feeders - Screening Equipment - Handling Equipment - Batching and Mixing Equipment - Pumping Equipment – Ready mix concrete equipment, Concrete pouring equipment. Asphalt Plant, Asphalt Pavers, Asphalt compacting Equipment.

UNIT V MATERIALS HANDLING EQUIPMENT 9

Forklifts and related equipment - Portable Material Bins – Material Handling Conveyors – Material Handling Cranes- Industrial Trucks.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Develop knowledge on planning of equipment and selection of equipment
CO2	Explain the knowledge on fundamentals of earth work operations, earth moving operations and types of earth work equipment
CO3	Develop the knowledge on special construction equipments
CO4	Apply the knowledge on asphalt and concrete plants
CO5	Apply the knowledge and select the proper materials handling equipment

REFERENCES:

- Peurifoy, R.L., Schexnayder, C. and AviadShapira., Construction Planning, Equipment and Methods, McGraw Hill, Singapore, 2010.
- Granberg G.,Popescu M Construction Equipment and Management for Engineers Estimators and Owners, Taylor and Francis Publishers, New York, 2006
- Deodhar, S.V. Construction Equipment and Job Planning, Khanna Publishers, New Delhi, 2001.
- Arora S.P. and Bindra S.P., Building Construction, Planning Techniques and Method of Construction, DhanpatRai and Sons, 2010.
- Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2008

CO – PO Mapping - CONSTRUCTION EQUIPMENTS AND MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	-	-	-	-	M
PO2	Problem analysis	-	L	-	-	-	-
PO3	Design / development of solutions	M	-	-	-	-	M
PO4	Investigation	M	-	-	-	-	M
PO5	Modern Tool Usage	-	M	H	M	M	M
PO6	Individual and Team work	M	-	-	-	-	M
PO7	Communication	L	-	-	-	-	L
PO8	Engineer and Society	M	-	-	-	-	M
PO9	Ethics	-	L	-	L	-	L
PO10	Environment and Sustainability	-	M	M	M	-	M
PO11	Project Management and Finance	H	-	-	-	-	H
PO12	Life Long Learning	H	M	M	M	L	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	-	-	-	-	H
PSO2	Critical analysis of Construction management problems and innovation	-	M	M	M	H	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	-	-	L	L

RM5151

RESEARCH METHODOLOGY AND IPR

**L T P C
2 0 0 2**

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION

6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW

6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING /PRESENTATION

6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

OUTCOME:

- On completion of the course the student will be able to

CO1	Do the mix proportion using IS and ACI codal provisions.
CO2	Prepare the self-compacting concrete and study the flow characteristics of SCC
CO3	Identify the proper portion of mineral and chemical admixture for concrete.
CO4	Test the concrete in a non-destructive manner using rebound hammer.
CO5	Know the permeability characteristics of concrete.

B) EXPERIMENTAL TECHNIQUES LABORATORY**OBJECTIVE**

- To provide a detailed account of modern experimental techniques in construction Engineering research.
- To introduce the basic working principles, the operational know how, and the strength and limitations of the techniques.

LIST OF EXPERIMENTS

- Determination of elastic constants – Hyperbolic fringes
- Determination of elastic constants – Elliptical fringes
- Strain gauge meter – Determination of Young's modulus of a metallic wire
- Ultrasonic interferometer – ultrasonic velocity in liquids
- Electrical conductivity of metals and alloys with temperature-four probe method
- Resistivity measurements
- NDT – Ultrasonic flaw detector
- Calibration of Proving Ring and LVDT

TOTAL : 30 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Gain practical knowledge by applying the experimental methods to correlate with the theory.
CO2	Learn the usage of electrical and optical systems for various measurements.
CO3	Describe and explain the working principles of the various measurement techniques
CO4	Identify the strength and limitation of each technique, and thereby choose the right technique
CO5	Apply the analytical techniques and graphical analysis to interpret the experimental data

CO – PO Mapping - ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY*

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H		H
PO2	Problem analysis			M			M
PO3	Design / development of solutions	H					H
PO4	Conduct investigations of complex problems				H		H
PO5	Modern Tool Usage	M					M
PO6	Individual and Team work	M		M			M
PO7	Communication		L			L	L
PO8	Engineer and Society	H		H			H
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability			M			M
PO11	Project Management and Finance	L	L	L	L	L	L

PO12	Life Long Learning	H					H
PSO1	Knowledge of Structural Engineering discipline	H	H	H			H
PSO2	Critical analysis of Structural Engineering problems and innovation					L	L
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues	M	M				M

CN5111

TECHNICAL SEMINAR

L T P C
0 0 2 1

OBJECTIVE:

- To work on a specific technical topic in Construction Engineering and Management in order to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

SYLLABUS: The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to construction engineering and management and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

CO – PO Mapping - SEMINAR

PO/PSO		Course Outcome	Overall Correlation of COs to POs
		CO1	
PO1	Knowledge of Engineering Sciences	H	H
PO2	Problem analysis	-	-
PO3	Design / development of solutions	M	M
PO4	Investigation	M	M
PO5	Modern Tool Usage	-	-
PO6	Individual and Team work	H	H
PO7	Communication	H	H
PO8	Engineer and Society	-	-
PO9	Ethics	-	-
PO10	Environment and Sustainability	M	M
PO11	Project Management and Finance	-	-
PO12	Life Long Learning	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	H
PSO2	Critical analysis of Construction management problems and innovation	-	-
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H

OBJECTIVE:

- To study and understand the latest construction techniques applied to engineering construction for sub structure, super structure, special structures, rehabilitation and strengthening techniques and demolition techniques.

UNIT I SUB STRUCTURE CONSTRUCTION 9

Box jacking - Pipe jacking - Under water construction of diaphragm walls and basement - Tunneling techniques - Piling techniques - Driving well and caisson - sinking cofferdam - cable anchoring and grouting - Driving diaphragm walls, Sheet piles - Laying operations for built up offshore system - Shoring for deep cutting - Large reservoir construction - well points - Dewatering for underground open excavation.

UNIT II SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS 9

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures.

UNIT III CONSTRUCTION OF SPECIAL STRUCTURES 9

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks.

UNIT IV REHABILITATION AND STRENGTHENING TECHNIQUES 9

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

UNIT V DEMOLITION 9

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Understand the modern construction techniques used in the sub structure construction.
CO2	Demonstrate knowledge and understanding of the principles and concepts relevant to super structure construction for buildings
CO3	Understand the concepts used in the construction of special structures
CO4	Knowledge on Various strengthening and repair methods for different cases.
CO5	Identify the suitable demolition technique for demolishing a building.

REFERENCES:

- Jerry Irvine, Advanced Construction Techniques, CA Rocket, 1984
- Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
- Peter H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
- Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
- Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University, New Delhi, 2008.

CO – PO Mapping - ADVANCED CONSTRUCTION TECHNIQUES

PO/PSO		Course Outcome					Overall Correlation of COs to Pos
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	L	M	M	L	M
PO2	Problem analysis	M	-	H	H	H	H
PO3	Design / development of solutions	L	-	H	H	H	H
PO4	Investigation	H	M	M	H	H	H
PO5	Modern Tool Usage	H	M	H	M	M	M
PO6	Individual and Team work	L	L	M	L	M	L
PO7	Communication	L	L	M	L	M	L
PO8	Engineer and Society	M	M	H	L	M	M
PO9	Ethics	-	-	L	L	L	L
PO10	Environment and Sustainability	M	H	M	M	L	M
PO11	Project Management and Finance	M	M	H	M	H	M
PO12	Life Long Learning	L	L	M	L	M	L
PSO1	Knowledge of Construction Engineering & Management discipline	H	M	H	H	M	H
PSO2	Critical analysis of Construction management problems and innovation	M	L	M	L	L	L
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	M	H	H	M	H

CN5202 CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

L T P C
3 0 0 3

OBJECTIVE:

- To study and understand the concept of planning, scheduling, cost and quality control, safety during construction, organization and use of project information necessary for construction project.

UNIT I CONSTRUCTION PLANNING

9

Basic Concepts in the Development of Construction Plans – Choice of Technology and Construction Method – Defining Work Tasks – Defining Precedence Relationships among Activities – Estimating Activity Durations – Estimating Resource Requirements for Work Activities – Coding Systems.

UNIT II SCHEDULING PROCEDURES AND TECHNIQUES

9

Construction Schedules – Critical Path Method – Scheduling Calculations – Float – Presenting Project Schedules – Scheduling for Activity-on-Node and with Leads, Lags, and Windows – Scheduling with Resource Constraints and Precedence's– Use of Advanced Scheduling Techniques – Scheduling with Uncertain Durations – Calculations for Monte Carlo Schedule Simulation – Crashing and Time/Cost Trade-offs – Improving the Scheduling Process.

UNIT III COST CONTROL, MONITORING AND ACCOUNTING 9

The Cost Control Problem – The Project Budget – Forecasting for Activity Cost Control – Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows – Schedule Control – Schedule and Budget Updates – Relating Cost and Schedule Information.

UNIT IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION 9

Quality and Safety Concerns in Construction – Organizing for Quality and Safety – Work and Material Specifications – Total Quality Control – Quality Control by Statistical Methods – Statistical Quality Control with Sampling by Attributes – Statistical Quality Control with Sampling by Variables – Safety.

UNIT V ORGANIZATION AND USE OF PROJECT INFORMATION 9

Types of Project Information – Accuracy and Use of Information – Computerized Organization and Use of Information – Organizing Information in Databases – Relational Model of Databases – Other Conceptual Models of Databases – Centralized Database Management Systems – Databases and Applications Programs – Information Transfer and Flow.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Identify and estimate the activity in the construction
CO2	Schedule the networking of activities using critical path method
CO3	Evaluate the project budget required for the particular construction project
CO4	Recognize the various quality control tool required in the construction industry
CO5	Explain the different databases that can be maintained in a construction industry using computers.

REFERENCES:

- Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA , 2017.
- Chitkara k k., Construction project management, planning, scheduling and control ,McGraw Hill (INDIA) publishers, New Delhi, third edition 2014.
- Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
- Calin M. Popescu, ChotchaiCharoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopaedia of terms and Applications, Wiley, New York, 1995.
- Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.

CO – PO Mapping - CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	-	-	H	L	H
PO2	Problem analysis	-	H	H	-	M	H
PO3	Design / development of solutions	-	H	-	-	H	H
PO4	Investigation	L	-	-	-	L	L
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	-	-	M	-	M	M
PO7	Communication	-	-	-	-	M	M
PO8	Engineer and Society	-	-	-	L	L	L
PO9	Ethics	-	-	-	M	M	M
PO10	Environment and Sustainability	L	L	L	L	L	L

PO11	Project Management and Finance	H	H	H	M	M	H
PO12	Life Long Learning	-	-	-	L	-	L
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	-	-	-	H
PSO2	Critical analysis of Construction management problems and innovation	H	H	H	-	-	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	M	-	-	-	M

CN5203

CONTRACT LAWS AND REGULATIONS

**L T P C
3 0 0 3**

OBJECTIVE:

- To study the various types of construction contracts and their legal aspects and provisions.

UNIT I CONSTRUCTION CONTRACTS 9

Indian Contracts Act – Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents – International Contract Document – Standard Contract Document – Law of Torts.

UNIT II TENDERS 9

Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Tamilnadu Transparency in Tenders Act.

UNIT III ARBITRATION 9

Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.

UNIT IV LEGAL REQUIREMENTS 9

Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and their Influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law – Local Government Laws for Approval – Statutory Regulations.

UNIT V LABOUR REGULATIONS 9

Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen’s Compensation Act – Indian Factory Act – Tamilnadu Factory Act – Child Labour Act - Other Labour Laws.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Design the construction contracts
CO2	Develop a skill for the tendering process.
CO3	Explain the duties of the arbitrator.
CO4	Develop an idea on the various legal requirements to be met in relation to land and construction.
CO5	Identify and apply the provisions provided in the labour welfare schemes.

REFERENCES:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, 2000.
2. Jimmie Hinze, Construction Contracts, McGraw Hill, 3rd Edition, 2013.
3. Kwaku, A., Tenah, P.E. Jose M.Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.
4. Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 4th Edition 2015.
5. DharmendraRautray, Principles of Law of Arbitration in India, Wolters Kluwer, 2018.

CO – PO Mapping - CONTRACT LAWS AND REGULATIONS:

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	M	-	-	H
PO2	Problem analysis	-	-	H	-	-	H
PO3	Design / development of solutions	M	M	H	-	-	M
PO4	Investigation	-	-	H	-	-	H
PO5	Modern Tool Usage	-	-	-	-	-	-
PO6	Individual and Team work	M	H	M	-	-	M
PO7	Communication	H	H	H	-	-	H
PO8	Engineer and Society	-	-	-	H	H	H
PO9	Ethics	M	M	H	M	M	M
PO10	Environment and Sustainability	-	-	-	-	L	L
PO11	Project Management and Finance	M	M	-	-	-	M
PO12	Life Long Learning	-	-	M	L	L	L
PSO1	Knowledge of Construction Engineering & Management discipline	-	-	-	M	M	M
PSO2	Critical analysis of Construction management problems and innovation	-	-	M	-	-	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	L	-	-	L

CN5211**CONSTRUCTION MANAGEMENT STUDIO LABORATORY****L T P C****0 0 4 2****OBJECTIVE:**

- This course gives an exposure to students in utilizing the sophisticated spread sheets programs, estimation software and other package programs

LIST OF EXPERIMENTS

1. Quantity takeoff, Preparation and delivery of the bid or proposal of an engineering construction project.
2. Design of a simple equipment information system for a construction project.

3. Scheduling of a small construction project using Primavera scheduling systems including reports and tracking.
4. Scheduling of a small construction project using tools like MS project scheduling systems including reports and tracking.
5. Simulation models for project risk analysis.
6. Virtual progress tracking of small construction project using Navisworks
7. Introduction to Building information Modelling (BIM) – Demo only

TOTAL:60 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Prepare the proposal for a construction project
CO2	Store and retrieve information about the equipments.
CO3	Track the activities and schedule a construction project using PRIMAVERA
CO4	Track and schedule a construction project using MS Project.
CO5	Develop a simulation model for analysing the project risk

CO – PO Mapping - CONSTRUCTION MANAGEMENT STUDIO LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	-	H	H	-	H
PO2	Problem analysis	-	-	M	M	L	M
PO3	Design / development of solutions	H	-	M	M	-	M
PO4	Investigation	-	M	-	-	-	M
PO5	Modern Tool Usage	M	H	H	H	L	H
PO6	Individual and Team work	M	H	H	H	L	H
PO7	Communication	M	H	H	H	L	H
PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	-	L	-	L	L	L
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	-	L	M	M	-	M
PO12	Life Long Learning	M	M	H	H	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	-	-	M	M	-	M
PSO2	Critical analysis of Construction management problems and innovation	L	-	L	L	-	L
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	M	-	M	-	M

OBJECTIVE:

- To understand the theory better and to have hands on training in spread sheet software and data analytical tools such as SPSS, R- Programming and Mat Lab.

LIST OF EXPERIMENTS:

- Descriptive Statistics: frequency distribution, Applications (Charts, Graphs etc.)
- Use of statistical packages Correlation, ANOVA , Cross Tabulation, *t*- Test and Simple and Multiple Regression
- Solving Linear Programming Problems, Transportation and Assignment Models
- Solving Network Flow Models
- Solving Decision making Problems in Project Management

TOTAL: 60 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Formulate descriptive statistics with charts and graphs using spreadsheet softwares
CO2	Interpret the data using various statistical analysis
CO3	Solve Linear Programming Problems, transportation and assignment problems by appropriate techniques and evaluate the behaviour under different range of parameters
CO4	Examine network flow models
CO5	Perform decision making in project management

CO – PO Mapping - STATISTICAL LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	L	L	M	L
PO2	Problem analysis	-	H	H	M	H	H
PO3	Design / development of solutions	H	M	H	M	H	H
PO4	Investigation	M	H	M	M	L	M
PO5	Modern Tool Usage	M	M	H	H	H	H
PO6	Individual and Team work	L	L	M	L	L	L
PO7	Communication	L	-	M	-	M	M
PO8	Engineer and Society	L	-	-	-	L	L
PO9	Ethics	-	L	-	-	L	L
PO10	Environment and Sustainability	-	-	L	L	L	L
PO11	Project Management and Finance	M	L	M	M	M	M
PO12	Life Long Learning	H	M	H	H	H	H
PSO1	Knowledge of Construction Engineering & Management discipline	H	M	H	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	M	-	M	M	M	M

OBJECTIVE:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Construction Management in carrying out engineering tasks.

SYLLABUS: The students individually undertake training in reputed engineering companies doing construction during the summer vacation for a specified duration of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:

- On completion of the course, the student is expected to be able to develop skills in facing and solving the problems experiencing in the Construction Management field.

CO – PO Mapping - PRACTICAL TRAINING

PO/PSO		Course Outcome	Overall Correlation of COs to POs
		CO1	
PO1	Knowledge of Engineering Sciences	M	M
PO2	Problem analysis	H	H
PO3	Design / development of solutions	H	H
PO4	Investigation	M	M
PO5	Modern Tool Usage	M	M
PO6	Individual and Team work	M	M
PO7	Communication	M	M
PO8	Engineer and Society	L	L
PO9	Ethics	M	M
PO10	Environment and Sustainability	L	L
PO11	Project Management and Finance	M	M
PO12	Life Long Learning	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	H
PSO2	Critical analysis of Construction management problems and innovation	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	M	M

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS**OUTCOME:**

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

PO/PSO		Overall Correlation of COs to POs
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	H
PO5	Modern Tool Usage	H
PO6	Individual and Team work	H
PO7	Communication	H
PO8	Engineer and Society	H
PO9	Ethics	L
PO10	Environment and Sustainability	H
PO11	Project Management and Finance	M
PO12	Life Long Learning	H
PSO1	Knowledge of Construction Engineering & Management discipline	M
PSO2	Critical analysis of Construction management problems and innovation	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H

CN5411**PROJECT PHASE II****L T P C
0 0 24 12****OBJECTIVES:**

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS**OUTCOME:**

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

PO/PSO		Overall Correlation of COs to POs
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	M
PO5	Modern Tool Usage	H
PO6	Individual and Team work	M
PO7	Communication	L
PO8	Engineer and Society	H
PO9	Ethics	L
PO10	Environment and Sustainability	H
PO11	Project Management and Finance	H
PO12	Life Long Learning	H
PSO1	Knowledge of Construction Engineering & Management discipline	H
PSO2	Critical analysis of Construction management problems and innovation	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H

CN5071

ADVANCED CONCRETE TECHNOLOGY

**L T P C
3 0 0 3**

OBJECTIVE:

- To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS 9

Aggregates classification IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates. Cement, Grade of cement, Chemical composition, Testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT II MIX DESIGN 9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Mix design for special concretes- changes in Mix design for special materials.

UNIT III CONCRETING METHODS 9

Process of manufacturing of concrete, methods of transportation, placing and curing, Extreme weather concreting, special concreting methods. Vacuum dewatering – Underwater Concrete

UNIT IV SPECIAL CONCRETES 9

Light weight concrete Fly ash concrete, Fiber reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self-Compacting-Concrete, Geo Polymer Concrete, Waste material-based concrete – Ready mixed concrete.

UNIT V TESTS ON CONCRETE 9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage – Durability of concrete. Non-destructive Testing Techniques microstructure of concrete

TOTAL: 45 PERIODS

CO – PO Mapping - HUMAN RESOURCES MANAGEMENT IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	-	-	-	-	M	M
PO2	Problem analysis	M	H	M	M	L	M
PO3	Design / development of solutions	M	M	H	M	L	M
PO4	Investigation	H	H	H	M	H	H
PO5	Modern Tool Usage	L	L				L
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	H	H	H	H	M	H
PO8	Engineer and Society	M	H	M	M	M	M
PO9	Ethics	M	M	H	M	M	M
PO10	Environment and Sustainability	-	-	-	-	M	M
PO11	Project Management and Finance	M	H	H	H	L	H
PO12	Life Long Learning	M	H	H	H	H	H
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	L	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	L	M	L	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	L	L	L	L	M	L

CN5002

CONSTRUCTION PROJECT MANAGEMENT

**L T P C
3 0 0 3**

OBJECTIVE:

- To study the various management techniques for successful completion of construction projects.

UNIT I THE OWNERS' PERSPECTIVE

9

Introduction - Project Life Cycle - Types of Construction - Selection of Professional Services - Construction Contractors - Financing of Constructed Facilities - Legal and Regulatory Requirements - Changing Environment of the Construction Industry - Role of Project Managers.

UNIT II ORGANIZING FOR PROJECT MANAGEMENT

9

Project Management – Modern trends - Strategic Planning - Effects of Project Risks on Organization - Organization of Project Participants -Traditional Designer-Constructor Sequence - Professional Construction Management - Owner-Builder Operation - Turnkey Operation - Leadership and Motivation for the Project Team.

UNIT III DESIGN AND CONSTRUCTION PROCESS

9

Design and Construction as an Integrated System - Innovation and Technological Feasibility - Innovation and Economic Feasibility - Design Methodology - Functional Design - Construction Site Environment.

UNIT IV LABOUR, MATERIAL AND EQUIPMENT UTILIZATION 9

Historical Perspective - Labour Productivity - Factors Affecting Job-Site Productivity - Labor Relations in Construction - Problems in Collective Bargaining - Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management - Construction Equipment - Choice of Equipment and Standard Production Rates - Construction Processes Queues and Resource Bottlenecks.

UNIT V COST ESTIMATION 9

Costs Associated with Constructed Facilities - Approaches to Cost Estimation - Type of Construction Cost Estimates - Effects of Scale on Construction Cost - Unit Cost Method of Estimation - Methods for Allocation of Joint Costs - Historical Cost Data - Cost Indices - Applications of Cost Indices to Estimating - Estimate Based on Engineer's List of Quantities - Estimation of Operating Costs.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Identify the stages involved in a project and analyze the obligatory services to be taken up while performing a construction activity.
CO2	Apply the professional skills acquired in managing a construction project.
CO3	Develop the ability to attain an equilibrium among Innovation, Technology and Economic feasibility.
CO4	Cultivate an idea on effective resource utilization and identify factors affecting job productivity.
CO5	Estimate the cost of construction project.

REFERENCES:

- Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw-Hill Publishing Company, New Delhi, 3rd Edition, 2014.
- Choudhury S, Project Management, McGraw-Hill Publishing Company, New Delhi, 2017.
- Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2nd edition, 2000.
- Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 4th Edition, 2013.
- Prasanna Chandra Project Planning, Analysis, Selection, Implementation and review, Tata McGrawHill, 8th Edition, 2017

CO – PO Mapping - CONSTRUCTION PROJECT MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	-	-	H	-	M	H
PO2	Problem analysis	H	L	-	L	-	L
PO3	Design / development of solutions	-	-	H	-	-	H
PO4	Investigation	-	M	-	H	-	H
PO5	Modern Tool Usage	-	-	M	M	-	M
PO6	Individual and Team work	-	M	M	-	-	M
PO7	Communication	H	H	M	-	M	H
PO8	Engineer and Society	M	M	H	-	M	M
PO9	Ethics	M	-	-	M	-	M
PO10	Environment and Sustainability	-	-	-	-	-	-

PO11	Project Management and Finance	H	M	-	-	H	H
PO12	Life Long Learning	-	-	H	L	L	L
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	H	-	-	H
PSO2	Critical analysis of Construction management problems and innovation	M	-	H	M	-	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	M	-	-	M

CN5003

SUSTAINABLE CONSTRUCTION

**L T P C
3 0 0 3**

OBJECTIVE:

- To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

UNIT I INTRODUCTION

9

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO2 contribution from cement and other construction materials.

UNITII MATERIALS USED IN SUSTAINABLE CONSTRUCTION

9

Construction materials and indoor air quality - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

UNITIII ENERGY CALCULATIONS

9

Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use

UNITIV GREEN BUILDINGS

9

Control of energy use in building - ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations – Features of LEED and TERI – Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling - Performance ratings of green buildings - Zero energy building

UNITV ENVIRONMENTAL EFFECTS

9

Non-renewable sources of energy and Environmental aspects – energy norm, coal, oil, natural gas - Nuclear energy - Global temperature, Green house effects, global warming - Acid rain: Causes, effects and control methods - Regional impacts of temperature change.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Describe the various sustainable materials used in construction.
CO2	Explain the method of estimating the amount of energy required for building.
CO3	Describe the features of LEED, TERI and GRIHA ratings of buildings.
CO4	Explore the concept and performance of zero energy buildings.
CO5	Select less carbon emission materials for construction.

REFERENCES:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.
5. New Building Materials and Construction World magazine

CO – PO Mapping - SUSTAINABLE CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	H	M	H	H	H
PO2	Problem analysis	-	L	M	L	L	L
PO3	Design / development of solutions	L	H	H	H	M	H
PO4	Investigation	L	M	L	M	M	M
PO5	Modern Tool Usage	-	L	L	M	M	M
PO6	Individual and Team work	L	L	-	L	-	L
PO7	Communication	-	L	-	L	L	L
PO8	Engineer and Society	M	M	L	L	M	M
PO9	Ethics	L	-	-	L	L	L
PO10	Environment and Sustainability	H	M	L	H	H	H
PO11	Project Management and Finance	M	L	L	L	L	L
PO12	Life Long Learning	L	M	L	M	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	L	M	L	M	M	M
PSO2	Critical analysis of Construction management problems and innovation	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	L	M	L	M	M	M

CN5004 ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION**L T P C
3 0 0 3****OBJECTIVE:**

- To study the concepts of Construction Economic and Finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, and management of accounting.

UNIT I BASIC PRINCIPLES 9

Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest . Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient(G), Geometric Gradient (C).

UNIT II COMPARING ALTERNATIVES PROPOSALS 9

Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR)Analysis, Benefit/Cost Analysis, Break Even Analysis.

UNIT III EVALUATING ALTERNATIVE INVESTMENTS 9

Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.

UNIT IV FUNDS MANAGEMENT 9

Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management-foreign currency management.

UNIT V FUNDAMENTALS OF MANAGEMENT ACCOUNTING 9

Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.

TOTAL : 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Describe the basic principles of Economic in construction
CO2	Evaluate alternate proposals
CO3	Evaluate alternative investments
CO4	Select best source of finance for a project
CO5	Manage the finance and accounting

REFERENCES:

- Blank, L.T., and Tarquin,a.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co., 1988
- Collier C and GlaGola C Engineering Economics & Cost Analysis, 3rd Edn. Addison Wesley Education Publishers.,1998.
- Patel, B M Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000
- Shrivastava,U.K., Construction Planning and Management,2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi., 2001.
- Steiner, H.M. Engineering Economic principles, 2nd Edn. McGraw Hill Book, 1996

CO – PO Mapping - ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of COs to Pos
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	M	H	M	L	M
PO2	Problem analysis	H	M	H	M	L	M
PO3	Design / development of solutions	-	-	-	-	-	-
PO4	Investigation	L	L	M	-	M	M
PO5	Modern Tool Usage	L	-	L	-	M	L
PO6	Individual and Team work	-	-	-	-	-	-
PO7	Communication	-	-	-	-	-	-

PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	H	M	H	M	L	M
PO12	Life Long Learning	-	L	-	L	-	L
PSO1	Knowledge of Construction Engineering & Management discipline	H	M	H	M	L	M
PSO2	Critical analysis of Construction management problems and innovation	H	M	H	M	L	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	L	L	M	-	M	M

CN5005

DESIGN OF ENERGY EFFICIENT BUILDINGS

L T P C

3 0 0 3

OBJECTIVE:

- This course aims to provide an understanding of the concept of energy consumption in buildings and design a energy efficient building

UNIT I INTRODUCTION

9

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies.

UNIT II PASSIVE SOLAR HEATING AND COOLING

9

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds – Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odor removal.

UNIT III DAYLIGHTING AND ELECTRICAL LIGHTING

9

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV HEAT CONTROL AND VENTILATION

9

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT IV DESIGN FOR CLIMATIC ZONES**9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL: 45 PERIODS**OUTCOME:**

On completion of this course, the student is expected to be able to

CO1	Explain environmental energy supplies on buildings
CO2	Explain the passive solar heating, cooling system
CO3	Discuss the various aspects of day-lighting and electrical lighting in a building
CO4	Predict and design building ventilation and heat control for indoor comfort
CO5	Design a building for climatic zone and apply simulation programs of buildings to perform energy calculations

REFERENCES

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2018.
2. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 (S and T) 1995
3. Residential Energy: Cost Savings and Comfort for Existing Buildings by John Krigger and Chris Dorsi, Published by Saturn Resource Management, 2013.
4. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 3rd Edition, 2014
5. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non-Conventional Energy Sources, 2009.

CO – PO Mapping - DESIGN OF ENERGY EFFICIENT BUILDINGS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	-	-	-	H	H	M
PO3	Design / development of solutions	M	M	M	H	H	H
PO4	Investigation	-	-	-	-	L	M
PO5	Modern Tool Usage	-	-	-	-	M	L
PO6	Individual and Team work	L	-	-	-	-	L
PO7	Communication	-	-	-	L	L	L
PO8	Engineer and Society	H	H	H	H	H	M
PO9	Ethics	M	-	-	-	M	L
PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance	-	-	-	-	-	L
PO12	Life Long Learning	H	-	-	-	-	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	H	H	M	H
PSO2	Critical analysis of Construction management problems and innovation	M	M	M	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	L	L	M	H	H	H

OBJECTIVES:

- To study and understand the various safety concepts and requirements applied to construction projects.

UNIT I CONSTRUCTION ACCIDENTS 9

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

UNIT II SAFETY PROGRAMMES 9

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

UNIT III CONTRACTUAL OBLIGATIONS 9

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

UNIT IV DESIGNING FOR SAFETY 9

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

UNIT V OWNERS' AND DESIGNERS' OUTLOOK 9

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

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Develop the knowledge on accidents and their causes
CO2	Develop the knowledge about safety programmes safety programme job-site safety assessment
CO3	Apply the knowledge contractual obligations
CO4	Explain about designing for safety and safety procedures
CO5	Develop the knowledge owners' and designers responsibility

REFERENCES:

- Patrick X.W. Zou ,Riza YosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd 2015
- Jimmy W. Hinze, Construction Safety, Prentice Hall Inc., 1997.
- Richard J. Coble, Jimmie Hinze and Theo C. Haupt, Construction Safety and Health Management, Prentice Hall Inc., 2001.
- Tamilnadu Factory Act, Department of Inspectorate of factories, Tamilnadu. Health Management, Prentice Hall Inc., 2001.
- Bhattacharjee S.K. Safety Management in Construction (Principles and Practice), Khanna Publishers, New Delhi 2011

CO – PO Mapping - PROJECT SAFETY MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	-	M	-	M
PO2	Problem analysis	H	H	-	M	-	H
PO3	Design / development of solutions	-	M	-	M	M	M
PO4	Investigation	M	M	-	-	-	M

CO3	Apply Deterministic and Probabilistic Inventory Models.
CO4	Analyze the scheduling concepts.
CO5	Solve problems using simulation and ERP systems.

REFERENCES:

1. Billy E. Gillet., Introduction to Operations Research – A Computer Oriented Algorithmic Approach, McGraw Hill, 2008.
2. Feigenbaum, L., Construction Scheduling with Primavera Project Planner Prentice Hall Inc., 2002.
3. Ming Sun and Rob Howard, "Understanding I.T. in Construction, Spon Press, Taylor and Francis Group, 2004.
4. Paulson, B.R., Computer Applications in Construction, McGraw Hill, 1995.
5. Tarek Hegazy, Computer-Based Construction Project Management, Pearson New International Edition, 2013.

CO – PO Mapping - COMPUTER APPLICATIONS IN CONSTRUCTION ENGINEERING AND PLANNING

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	L	L	H
PO2	Problem analysis	M	M	H	L	L	M
PO3	Design / development of solutions	M	-	M	-	M	M
PO4	Investigation	M	-	M	-	L	M
PO5	Modern Tool Usage	H	H	H	M	M	H
PO6	Individual and Team work	M	-	-	M	M	M
PO7	Communication	-	-	-	-	-	-
PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	M	-	M	-	-	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	M	M	H	M	M
PSO2	Critical analysis of Construction management problems and innovation	M	-	M	-	L	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	M	L	L	L

OBJECTIVE:

- To study the various quantitative methods applied to the elements of management, effect of production management, finance management, decision theory and managerial economics.

UNIT I OPERATIONS RESEARCH**9**

Introduction to Operations Research - Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems.

UNIT II PRODUCTION MANAGEMENT**9**

Inventory Control - EOQ Model - Quantity Discounts - Safety Stock – Replacement Theory–PERT and CPM – Simulation Models– Quality Control.

UNIT III FINANCIAL MANAGEMENT**9**

Working Capital Management – Compound Interest and Present Value methods – Discounted Cash Flow Techniques – Capital Budgeting.

UNIT IV DECISION THEORY**9**

Decision Theory – Decision Rules – Decision making under conditions of certainty, risk and uncertainty – Decision trees – Utility Theory.

UNIT V MANAGERIAL ECONOMICS**9**

Cost Concepts – Break-even analysis – Pricing Techniques – Game theory - Applications.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Apply the knowledge of science and engineering fundamentals in learning the concept of operations research and its practical applicability for solving challenges in construction.
CO2	Identify, formulate, plan and schedule construction engineering projects.
CO3	Apply the knowledge of financial management and cost concepts.
CO4	Design the required man, material, equipment, cost and time as per needs by proper decision rules.
CO5	Analyze the cost by break-even analysis and modern construction management software.

REFERENCES:

- Frank Harrison, E., The Managerial Decision-Making Process, Houghton Mifflin Co., Boston, 1999.
- Hamdy A. Taha, Operations Research: An Introduction, Prentice Hall, 2010.
- Levin, R.I, Rubin, D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill College, 1993.
- Tang S.L., Irtishad U. Ahmad, Syed M. Ahmed, Ming Lu, Quantitative Technique for Decision making in Construction, Hongkong University Press, HKU, 2004.
- Vohra, Nd., Quantitative Techniques in Management, Fifth Edition, Tata McGraw-Hill Company Ltd, 2017.

CO – PO Mapping - QUANTITATIVE TECHNIQUES IN MANAGEMENT

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	-	H	-	-	H
PO2	Problem analysis	H	M	M	H	H	H
PO3	Design / development of solutions	-	-	M	H	M	M
PO4	Investigation	-	-	-	M	-	M
PO5	Modern Tool Usage	-	M	M	M	-	M
PO6	Individual and Team work	-	-	-	-	M	M
PO7	Communication	-	-	-	-	L	L
PO8	Engineer and Society	H	-	-	-	-	H
PO9	Ethics	-	-	-	-	L	L
PO10	Environment and Sustainability	L	-	-	-	L	L
PO11	Project Management and Finance	-	H	H	-	H	H
PO12	Life Long Learning	-	-	M	-	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	M	H	H	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	M	H	H	M	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	H	M	H	M	M

**CN5009 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION L T P C
3 0 0 3**

OBJECTIVE:

- To study the effect of resource planning, labor management, material and equipment, time management, and resource allocation and resource leveling in construction.

UNIT I RESOURCE PLANNING 9

Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.

UNIT II LABOUR MANAGEMENT 9

Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.

UNIT III MATERIALS AND EQUIPMENT 9

Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

UNIT IV TIME MANAGEMENT 9

Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control.

UNIT V RESOURCE ALLOCATION AND LEVELLING**9**

Time-cost trade off, Computer application – Resource levelling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management.

TOTAL : 45 PERIODS**OUTCOME:**

- On completion of this course, the student is expected to be able to

CO1	Identify the different types of resources in a construction industry
CO2	Evaluate the labour productivity and the influencing factors
CO3	Calculate the equipment output and its operation condition of construction equipment
CO4	Describe the terms of cash inflow, cash outflow and balance sheet
CO5	Categorize the time and cost related informations in a construction sector.

REFERENCES:

- Sharma , S C., Construction equipment managaemnt , Khanna publishers, Delhi, 2016.
- Kumar NeerajJha Construction project management , Pearson publishers, 2015.
- Andrew,D., Szilagg, Hand Book of Engineering Management, 1982.
- Oxley Rand Poslciit, Management Techniques applied to the Construction Industry,Granda Publishing Ltd., 1980.
- Paul Netscher, Construction Project Management: Tips and Insights, Panet Publications, 2017.

CO – PO Mapping - RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	-	-	H	-	-	H
PO2	Problem analysis	-	M	H	H	-	H
PO3	Design / development of solutions	M	H	-	-	M	M
PO4	Investigation	H	L	-	-	H	H
PO5	Modern Tool Usage	-	H	-	H	-	H
PO6	Individual and Team work	L	-	L	-	L	L
PO7	Communication	M	M	-	-	M	M
PO8	Engineer and Society	-	-	L	L	-	L
PO9	Ethics	-	M	-	-	-	M
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	-	-	-	H	H	H
PO12	Life Long Learning	L	L	-	-	-	L
PSO1	Knowledge of Construction Engineering & Management discipline	M	M	H	M	M	M
PSO2	Critical analysis of Construction management problems and innovation	-	H	H	-	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	-	-	L	L

OBJECTIVE:

- To disseminate knowledge about detailed planning, design and erection of formwork for various elements such as slabs, beams, columns, walls, shells and tunnels.

UNIT I PLANNING, SITE EQUIPMENT & PLANT FOR FORM WORK 9

Introduction - Forms for foundations, columns, beams walls etc., General objectives of formwork building - Planning for safety - Development of a Basic System - Key Areas of cost reduction - Planning examples. Overall Planning - Detailed planning - Standard units - Corner units - Pass units - Calculation of labour constants - Formwork hours - Labour Requirement - Overall programme - Detailed programme - Costing - Planning crane arrangements - Site layout plan - Transporting plant - Formwork beams - Scaffold frames - Framed panel formwork - Formwork accessories.

UNIT II MATERIALSACCESSORIESPROPRIETARYPRODUCTS&PRESSURES 9

Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel - Aluminum - Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

UNIT III DESIGN OF FORMS AND SHORES 9

Basic simplification - Beam formulae - Allowable stresses - Deflection, Bending - Lateral stability - Shear, Bearing - Design of Wall forms - Slab forms - Beam forms - Column forms - Examples in each. Simple wood stresses - Slenderness ratio - Allowable load vs length behaviour of wood shores - Form lining Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

UNIT IV BUILDING AND ERECTING THE FORM WORK 9

Carpentry Shop and job mill - Forms for Footings - Wall footings - Column footings - Sloped footing forms - Strap footing - Stepped footing - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

UNIT V FORMS FOR DOMES AND TUNNELS, SLIP FORMS AND SCAFFOLDS 9

Hemispherical, Parabolic, Translational shells - Typical barrel vaults Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Building the forms - Placing concrete - Form removed -Strength requirements -Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts. Slip Forms - Principles -Types - advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course, the student is expected to be able to

CO1	Explain detail planning of formwork, plant and site equipment.
CO2	Select material accessories for formwork connection and analyze pressures on formworks.
CO3	Design the forms and shores.
CO4	Apply the knowledge of erecting forms for beams,slabs, columns, walls and causes of failures.
CO5	Apply the knowledge of forms and its erection for domes and tunnels, types of slip forms and scaffolds.

REFERENCES:

1. Austin, C.K., Formwork for Concrete, Cleaver -Hume Press Ltd., London, 1996.
2. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996
3. Michael P. Hurst, Construction Press, London and New York, 2003.
4. Robert L. Peurifoy and Garold D. Oberlender, Formwork For Concrete Structures, McGraw - Hill, 1996.
5. Kumar NeerajJha, Formwork for Concrete Structures, 2017

CO – PO Mapping - SHORING, SCAFFOLDING AND FORMWORK

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	-	-	H	M	M	M
PO3	Design / development of solutions		-	H	M	M	M
PO4	Investigation	H	H	M	M	M	M
PO5	Modern Tool Usage		-	H	M	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	M	M	M	H	H	M
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	H	H	H	H	H	H
PO10	Environment and Sustainability	H	H	-	-	-	H
PO11	Project Management and Finance	H	-	-	-	-	H
PO12	Life Long Learning	H	H	-	-	H	H
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	H	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	M	M	H	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H	H	H	H	H

CN5011**SYSTEM INTEGRATION IN CONSTRUCTION**

L	T	P	C
3	0	0	3

OBJECTIVE:

- To understand how the various systems that constitute a building design (site, structure, skin, building services and environmental controls, space and finishes, etc.) are interwoven and integrated with a view to achieving a high-performance building;

UNIT I STRUCTURAL INTEGRATION**9**

Structural System, Systems for enclosing Buildings, Functional aesthetic system, Materials Selection and Specification.

UNIT II ENVIRONMENTAL FACTORS**9**

Qualities of enclosure necessary to maintain a specified level of interior environmental quality – weather resistance – Thermal infiltration – Acoustic Control – Transmission reduction – Air quality – illumination – Relevant systems integration with structural systems.

UNIT III SERVICES**9**

Plumbing – Electricity – Vertical circulation and their interaction – HVAC.

UNIT IV MAINTENANCE**9**

Component longevity in terms of operation performance and resistance to deleterious forces - Planning systems for least maintenance materials and construction – access for maintenance – Feasibility for replacement of damaged components – equal life elemental design – maintenance free exposed and finished surfaces.

UNIT V SAFETY**9**

Ability of systems to protect fire – Preventive systems – fire escape system design – Planning for pollution free construction environmental – Hazard free Construction execution.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Integrate the various construction techniques and incorporate into the building process
CO2	Appreciate the requirements and elements of HVAC, mechanical, electrical, hydraulic and transportation services in buildings
CO3	Design and integrate services into high-rise buildings
CO4	Interpret the intricacies of physical installation of services and their critical sequence in the construction process.
CO5	Adopt an approach relating systems to aim for a high performance building in various categories of major use

REFERENCES

- A.J. Elder and MartizVindenBarg, Handbook of Building Enclosure, McGraw-Hill Book Company, 1983.
- David V.Chadderton, Building Services Engineering, Taylor and Francis, 2007.
- Jane Taylor and Gordin Cooke, The Fire Precautions Act in Practices, 1987.
- Peter R. Smith and Warren G. Julian, Building Services, Applied Science Publishers Ltd., London, 1993.
- William T. Mayer, Energy Economics and Building Design, McGraw-Hill Book Company, 1983.

CO – PO Mapping - SYSTEM INTEGRATION IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	-	-	M	M	-	M
PO2	Problem analysis	M	M	H	M	M	M
PO3	Design / development of solutions	M	M	H	M	M	M
PO4	Investigation	M	M	H	M	M	M
PO5	Modern Tool Usage	H	L	M	M	M	M
PO6	Individual and Team work	H	L	M	L	L	L
PO7	Communication	H	L	L	L	L	L
PO8	Engineer and Society	H	M	M	-	-	M
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	M	L	M	-	-	M
PO11	Project Management and Finance	H	M	-	H	-	H
PO12	Life Long Learning	H	L	-	-	L	L
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	M	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	H	M	M	M	H	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	M	H	H	M	H

OBJECTIVE:

- To learn various multivariate data analysis techniques for construction management.

UNIT I STATISTICAL DATA ANALYSIS 9

Data and Statistics- Review of Basic Statistical Measures-Probability Distributions-Testing of Hypotheses-Non-Parametric Tests.

UNIT II BASIC CONCEPTS 9

Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques – Types of multivariate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation – Approaches to multivariate model building.

UNIT III REGRESSION AND FACTOR ANALYSIS 9

Simple and Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function – Validation of the model. Factor Analysis: Definition – Objectives – Approaches to factor analysis – methods of estimation – Factor rotation – Factor scores - Sum of variance explained – interpretation of results. Canonical Correlation Analysis - Objectives – Canonical variates and canonical correlation – Interpretation of variates and correlations.

UNIT IV DISCRIMINANT AND CLUSTER ANALYSIS 9

Discriminant Analysis - Basic concepts – Separation and classification of two populations - Evaluating classification functions – Validation of the model. Cluster Analysis – Definitions – Objectives – Similarity of measures – Hierarchical and Non – Hierarchical clustering methods – Interpretation and validation of the model.

UNIT V ADVANCED TECHNIQUES 9

Conjoint Analysis – Definitions – Basic concepts – Attributes – Preferences – Ranking of Preferences – Output of Conjoint measurements – Utility - Interpretation. Multi-Dimensional Scaling – Definitions – Objectives – Basic concepts – Scaling techniques – Attribute and Non-Attributes based MDS Techniques – Interpretation and Validation of models. Advanced Techniques – Structural Equation modeling

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Describe the different statistical analysis techniques.
CO2	Students will be able to formulate hypothesis
CO3	Explore the basic concepts of statistical analysis
CO4	Develop regression and factor analysis model and its interpretation
CO5	Create discriminant and cluster analysis model and its interpretation

REFERENCES:

- Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.
- Barbara G. Tabachnick, Linda S. Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.
- Richard A Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.
- David R Anderson, Dennis J Sweeney and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002.
- Howard E.A. Tinsley & Steven D. Brown, Handbook of Applied Multivariate Statistics & Mathematical modeling, Academic Press, 2000.

CO – PO Mapping - ADVANCED DATA ANALYSIS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	L	L	M	M	M
PO2	Problem analysis	-	M	H	H	H	H
PO3	Design / development of solutions	M	L	-	L	L	L
PO4	Investigation	M	L	M	L	L	L
PO5	Modern Tool Usage	-	L	H	H	H	H
PO6	Individual and Team work	L	L	M	L	L	L
PO7	Communication	L	M	L	M	L	L
PO8	Engineer and Society	L	M	L	M	M	M
PO9	Ethics	-	-	L	L	L	L
PO10	Environment and Sustainability	-	L	L	L	-	L
PO11	Project Management and Finance	-	L	H	H	H	H
PO12	Life Long Learning	L	M	H	H	H	H
PSO1	Knowledge of Construction Engineering & Management discipline	M	H	M	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	L	H	M	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	L	H	H	H	H

CN5013 LEAN CONSTRUCTION CONCEPTS, TOOLS AND PRACTICES L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about the basics of lean construction, principles, tools and techniques, and implementation in the construction industry.

UNIT I INTRODUCTION 9

Introduction and overview of the construction project management -Review of Project Management& Productivity Measurement Systems – Productivity in Construction– Daily Progress Report-The state of the industry with respect to its management practices –construction project phases - Essential features of contemporary construction management techniques - The problems with current construction management techniques– Current production planning.

UNIT II LEAN MANAGEMENT 9

Introduction to lean management – Toyota’s management principle-Evolution of lean in construction industry - Production theories in construction –Lean construction value - Value in construction - Target value design – Lean project delivery system- Forms of waste in construction industry – Waste Elimination.

UNIT III CORE CONCEPTS IN LEAN 9

Concepts in lean thinking – Principles of lean construction – Variability and its impact – Traditional construction and lean construction – Traditional project delivery - Lean construction and workflow reliability – Work structuring – Production control.

UNIT IV LEAN CONSTRUCTION TOOLS AND TECHNIQUES**9**

Value Stream Mapping – Work sampling – Last planner system – Flow and pull based production – Last Planner System – Look ahead schedule – constraint analysis – weekly planning meeting- Daily Huddles – Root cause analysis – Continuous improvement – Just in time.

UNIT V LEAN CONSTRUCTION IMPLEMENTATION**9**

Lean construction implementation- Enabling lean through information technology – Lean in design - Design Structure Matrix Location Based Management System-BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach

TOTAL : 45 PERIODS**OUTCOME:**

On completion of this course, the student is expected to be able to

CO1	Explains the contemporary management techniques and the issues in present scenario.
CO2	Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.
CO3	Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.
CO4	Apply lean techniques to achieve sustainability in construction projects.
CO5	Apply lean construction techniques in design and modeling

REFERENCES:

1. Corfe, C. and Clip, B., Implementing lean in construction: Lean and the sustainability agenda, CIRIA, 2013.
2. Shang Gao and Sui Pheng Low, Lean Construction Management: The Toyota Way, Springer, 2014.
3. Dave, B., Koskela, L., Kiviniemi, A., Owen, R., and Tzortzopoulos, P., Implementing lean in construction: Lean construction and BIM, CIRIA, 2013.
4. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., Lean construction tools and techniques, 2002.
5. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

CO – PO Mapping - LEAN CONSTRUCTION CONCEPTS, TOOLS & PRACTICES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	-	-	-	H	H	H
PO3	Design / development of solutions	-	-	H	M	H	H
PO4	Investigation	-	-	H	H	H	H
PO5	Modern Tool Usage	-	-	H	-	H	H
PO6	Individual and Team work	-	-	M	H	H	H
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	-	-	M	M	M	M
PO10	Environment and Sustainability	-	-	-	H	-	H
PO11	Project Management and Finance	-	-	-	-	H	H
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	H	H	H	H

PSO2	Critical analysis of Construction management problems and innovation	-	-	H	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H	H	H	H	H

CN5014 ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION ENGINEERS L T P C 3 0 0 3

OBJECTIVE:

- To impart the knowledge and skills required for understanding the various impacts of infrastructure projects on the environment and expose the students to the various methodologies available to predict the impacts, assess and to develop the skill to prepare Environmental Impact Assessment report

UNIT I INTRODUCTION 9

Sustainable Development challenges and need - Key approaches for Impact Assessment – EIA approach: historical development - Legal and Regulatory aspects in India - Types and Objectives, Components, Process of EIA.

UNIT II PREDICTION AND ASSESSMENT 9

Prediction and Assessment: tools - impact on air, water, soil & Noise - Role of Biodiversity impact Assessment - Identification, Prediction and Evaluation of Impacts on Biodiversity - Techniques of Biodiversity impact assessment - EIA Report Preparation - Environmental Management Plan: Preparation and implementation - Mitigation and Rehabilitation plans - Post Project Audit.

UNIT III HEALTH AND SOCIO-ECONOMIC IMPACT ASSESSMENT 9

Health Assessment: Impact of Environment on Health - Developing framework for Health impact analysis, tools and techniques - Socio-Economic Impact Assessment: Overview and Scope of Social Impact Assessment - SIA model and the planning process - Land acquisition: Legal aspects, Resettlement & Rehabilitation and Development.

UNIT IV INTEGRATED ANALYSIS 9

Integrated Analysis of Environmental, Social and Health Impacts - Challenges for Integrated Approach - Scope for Integrated approach in economic analysis - CBA , Social CBA ,and Cost effectiveness Analysis - Analytic Hierarchy process based Approach - Emerging Dimensions and future Directions.

UNIT V IMPACT OF INFRASTRUCTURE AND ENVIRONMENTAL SERVICES 9

Case Studies: EIA for Mining, extraction of natural resources and power generation - Primary Processing and Material production - Material Processing, Manufacturing/Fabrication - Service Sectors - Physical Infrastructure including Environmental Services - Building and Construction Projects - Area Development Projects and Townships - Strategic Environmental Assessment, Technological Assessment and Risk Assessment.

TOTAL: 45 PERIODS

OUTCOME:

On completion of the course, the student is expected to be able to

CO1	Apply the knowledge of science and engineering fundamentals in sustainable development challenges.
CO2	explain the identification, prediction and evaluation of impacts that will be caused by projects or industries on biodiversity.
CO3	Identify the legal requirements of environmental impact assessment for projects.

CO4	develop the ability to perform integrated analysis by considering environmental, social and health impacts.
CO5	select appropriate methods for environmental impact assessment for Infrastructure and environmental service.

REFERENCES

1. Canter, L.W., "Environmental Impact Assessment", McGraw Hill, New York, 1996.
2. Anjaneyulu, Yerramilli, and ValliManickam, "Environmental impact assessment methodologies", Hyderabad: BS Publications, 2007.
3. Lawrence, D.P., "Environmental Impact Assessment – Practical Solutions to recurrent problems", Wiley-Interscience, New Jersey, 2003.
4. Petts, J., "Handbook of Environmental Impact Assessment", Vol., I and II, Blackwell science, London, 1999.
5. World Bank – Source Book on Environmental Impact Assessment, 2010

CO – PO Mapping - ENVIRONMENTAL IMPACT ASSESSMENT FOR CONSTRUCTION ENGINEERS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	-	-	-	-	H
PO2	Problem analysis	-	M	M	H	-	M
PO3	Design / development of solutions	-	-	-	H	M	M
PO4	Investigation	-	M	M	-	M	M
PO5	Modern Tool Usage	-	-	-	M	-	M
PO6	Individual and Team work	-	-	-	M	H	M
PO7	Communication	-	-	-	-	L	L
PO8	Engineer and Society	M	-	-	-	-	M
PO9	Ethics	-	-	-	-	M	M
PO10	Environment and Sustainability	H	M	M	M	-	M
PO11	Project Management and Finance	-	-	-	M	M	M
PO12	Life Long Learning	-	-	-	-	L	L
PSO1	Knowledge of Construction Engineering & Management discipline	L	M	M	-	M	M
PSO2	Critical analysis of Construction management problems and innovation	-	M	-	M	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	M	M	M	M

ST5071 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures Facets of Maintenance, importance of Maintenance, routine and preventive maintenance, causes of deterioration. Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength and Durability - Thermal properties, microstructure of concrete – packing density- Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Health and safety precautions for handling and applications of repair materials, Special mortars and concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gas forming grouts, Salfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9

Concrete protection methods – reinforcement protection methods- Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, cathodic protection. Structural health monitoring.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRP jacketing, Strengthening, Beam shear strengthening, Flexural strengthening

TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

CO1	Students will explain the importance of maintenance assessment of distressed structures
CO2	Students will apply the knowledge on Quality assurance for concrete based on Strength and Durability
CO3	Students will identify various repair materials and advancements in concrete
CO4	Students will explain the knowledge on Concrete protection methods Structural health monitoring
CO5	Students will select Various strengthening and repair methods for different cases

REFERENCES

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann,Elsevier,New Delhi 2012
2. DovKominetzky.M.S., - Design and Construction Failures, Galgotia Publications Pvt.Ltd., 2001
3. Ravishankar.K., Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
5. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD ,Govt of India , New Delhi – 2002

CO – PO Mapping - MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	M	M	-	-	M	M
PO2	Problem analysis	M	M	-	-	-	M
PO3	Design / development of solutions	-	-	H	M	H	H
PO4	Investigation	H	H	-	-	-	H
PO5	Modern Tool Usage	-	-	H	H	M	H
PO6	Individual and Team work	M	M		-	-	M
PO7	Communication	-	L	-	-	-	L
PO8	Engineer and Society	-		M	H	M	M
PO9	Ethics	-	M	M	M		M
PO10	Environment and Sustainability	-	H	-	H	M	H
PO11	Project Management and Finance	L	-	-	-	-	L
PO12	Life Long Learning	-	-	M	M	M	M
PSO1	Knowledge of Construction Engineering & Management discipline	M	M	-	-	-	M
PSO2	Critical analysis of Construction management problems and innovation	-	-	H	H	M	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	-	-	M	H	M	M

CN5015

QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION

L T P C

3 0 0 3

COBJECTIVE:

- To study the concepts of quality assurance and control techniques in construction.

UNIT I QUALITY MANAGEMENT

9

Introduction – Definitions and objectives – Dimensions of quality - Factors influencing construction quality – Responsibilities and authority – Methods to improve quality – Quality Process - Quality plan – Quality Management Guidelines – Quality circles.

UNIT II QUALITY SYSTEMS

9

Introduction – History of standards - Quality system standard – ISO 9000 family of standards – Requirements – Preparing Quality System Documents – Quality related training – Implementing a Quality system – Third party Certification – Emission Norms – BS Norms.

UNIT III QUALITY PLANNING**9**

Quality Policy, Objectives and methods in Construction industry - Consumers satisfaction, Ergonomics - Time of Completion - Statistical tolerance – TQM – Traditional approach vs. Modern approach – Principles of TQM - Taguchi's concept of quality – Quality function deployment - Codes and Standards – Documents – Contract and construction programming – Inspection procedures - Processes and products – Total QA / QC programme and cost implication.

UNIT IV QUALITY ASSURANCE AND CONTROL**9**

Objectives – Regularity agent, owner, design, contract and construction oriented objectives, methods – Techniques and needs of QA/QC – Different aspects of quality – Appraisals – Sampling techniques – Sampling plan – Sampling Terms – AQL, LTPD, AOL - Factors influencing construction quality – Critical, major failure aspects and failure mode analysis, – Stability methods and tools, optimum design – Reliability testing, reliability coefficient and reliability prediction – Failure rate – Mean time to failure – Mean time to repair – Mean time between failures.

UNIT V QUALITY IMPROVEMENT TECHNIQUES**9**

Selection of new materials – Influence of drawings, detailing, specification, standardization – Bid preparation – Construction activity, environmental safety, social and environmental factors – Natural causes and speed of construction – Life cycle costing – Value engineering and value analysis.

TOTAL: 45 PERIODS**OUTCOME:**

- On completion of the course, the student is expected to be able to

CO1	Achieve the knowledge of quality management guidelines, quality circles.
CO2	Apply the quality standards for preparing Quality system documents.
CO3	Explain the skill of preparing inspection procedures for quality planning.
CO4	Select the techniques and tools for Quality Assurance and Control in Construction Industry.
CO5	Achieve the knowledge of quality improvement techniques

REFERENCES:

1. Hutchins.G, ISO 9000: A Comprehensive Guide to Registration, Audit Guidelines and Successful Certification, Viva Books Pvt. Ltd., 1994.
2. James, J.O' Brian, Construction Inspection Handbook – Total Quality Management, Van Nostrand, 1997
3. John L. Ashford, the Management of Quality in Construction, E &F.N.Spon, 1989.
4. Juran Frank, J.M. and Gryna, F.M. Quality Planning and Analysis, McGraw Hill, 2001
5. Steven McCabe, Quality Improvement Techniques in Construction, Addison Wesley Longman Ltd, 1998.

CO – PO Mapping - QUALITY CONTROL AND ASSURANCE IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	-	-	H	H	-	H
PO3	Design / development of solutions	-	-	H	M	-	H
PO4	Investigation	H	H	H	H	H	H
PO5	Modern Tool Usage		H		H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	H	H	H	H	H	H

PO10	Environment and Sustainability	H	H	H	H	H	H
PO11	Project Management and Finance	-	-	H	H	M	H
PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Construction Engineering & Management discipline	H	H	H	H	H	H
PSO2	Critical analysis of Construction management problems and innovation	-	-	H	H	H	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	H	H	M	M	M	M

CN5016

ORGANIZATIONAL BEHAVIOUR

**L T P C
3 0 0 3**

OBJECTIVE:

- To gain a solid understanding of human behavior in the workplace from an individual, group, and organizational perspective and frameworks and tools to effectively analyze and approach various organizational situations.

UNIT I FOCUS AND PURPOSE

9

Definition, need and importance of organizational behaviour –Nature and scope –Frame work – Organizational behaviour models.

UNIT II INDIVIDUAL BEHAVIOUR

9

Personality : types –Factors influencing personality, theories–Types of learners –The learning process –Learning theories –Organizational behaviour modification –Misbehaviour: Types and Management Intervention - Emotions: Emotional Labour –Emotional Intelligence –Theories – Attitudes: Characteristics, Components, Formation, Measurement and Values - Perceptions : Importance , Factors influencing perception –Interpersonal perception –Impression Management Motivation –importance –Types –Effects on work behavior.

UNIT III GROUP BEHAVIOUR

9

Organization structure –Formation –Groups in organizations –Influence –Group dynamics – Emergence of informal leaders and working norms –Group decision making techniques –Team building -Interpersonal relations –Communication –Control.

UNIT IV LEADERSHIP AND POWER

9

Meaning –Importance–Leadership styles –Theories –Leaders Vs Managers –Sources of power – Power centers –Power and Politics.

UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR

9

Organizational culture and climate –Factors affecting organizational climate –Importance of Job satisfaction –Determinants–Measurements – Influence on behavior - Organizational change – Importance –Stability Vs Change – Proactive Vs Reaction change– The change process – Resistance to change – Managing change - Stress - Work Stressors–Prevention and Management of stress – Balancing work and Life - Organizational development –Characteristics and objectives –.Organizational effectiveness.

TOTAL : 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Identify the need and importance of organizational behavior and the framework of organizational models
CO2	Explain the various learning theories and develop alternative organizational behavior approaches in the workplace
CO3	Describe the importance of group dynamics and team building.
CO4	Explore the various leadership styles and politics.
CO5	Explain the dynamics of organization behaviour with balance of work life.

REFERENCES:

- Stephen P. Robins, "Organisational Behavior", PHI Learning / Pearson Education, 15th edition, 2012.
- Fred Luthans, "Organisational Behavior", McGraw Hill, 12th Edition, 2005.
- Schermerhorn, Hunt and Osborn, "Organisational Behavior", John Wiley, 12th Edition, 2011.
- Udai Pareek, "Understanding Organisational Behaviour", 2nd Edition, Oxford Higher Education, 2008.
- Mc Shane & Von Glinov, "Organisational Behaviour", 6th Edition, Tata McGraw Hill, 2012.

CO – PO Mapping - ORGANIZATIONAL BEHAVIOUR

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	-	-	-	-	-	-
PO2	Problem analysis	-	-	-	-	-	-
PO3	Design / development of solutions	-	-	-	-	-	-
PO4	Investigation	-	-	-	-	-	-
PO5	Modern Tool Usage	-	-	-	-	-	-
PO6	Individual and Team work	H	M	H	M	H	H
PO7	Communication	H	M	H	M	H	H
PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	H	M	H	M	H	H
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	-	-	-	-	-	-
PSO1	Knowledge of Construction Engineering & Management discipline	-	-	-	-	-	-
PSO2	Critical analysis of Construction management problems and innovation	-	-	-	-	-	-
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	L	-	M	-	L	L

CN5017**MANAGEMENT INFORMATION SYSTEMS****L T P C
3 0 0 3****OBJECTIVE:**

- To study the concepts of information systems and their applications, system development and information systems, implementation and control, and system audit.

UNIT I	INTRODUCTION	9
Information Systems – Establishing the Framework – Business Models – Information System Architecture – Evolution of Information Systems.		
UNIT II	SYSTEM DEVELOPMENT	9
Modern Information System – System Development Life Cycle – Structured Methodologies- Designing Computer Based Methods, Procedures, Control – Designing Structured Programs		
UNIT III	INFORMATION SYSTEMS	9
Integrated Construction Management Information System – Project Management Information System – Functional Areas, Finance, Marketing, Production, Personnel – Levels, DSS, EIS, and ES – Comparison, Concepts and Knowledge Representation – Managing International Information System.		
UNIT IV	IMPLEMENTATION AND CONTROL	9
Control – Testing Security – Coding Techniques – Defection of Error – Validating – Cost Benefit analysis – Assessing the value and risk of Information System.		
UNIT V	SYSTEM AUDIT	9
Software Engineering qualities – Design, Production, Service, Software specification, Software Metrics, Software quality assurance – Systems Methodology – Objectives – Time and Logic, Knowledge and Human Dimension – Software life cycle models – Verification and Validation.		

TOTAL: 45 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to

CO1	Apply the knowledge of engineering fundamentals in various information systems in management.
CO2	Design the structured programs by computer-based methods.
CO3	Explain management information system for projects.
CO4	Perform the validation of the computer model and assess the risk of information system.
CO5	Perform software quality assurance, verification and validation.

REFERENCES:

1. Card and Glass, Measuring Software Design Quality , Prentice Hall, 1990.
2. Gordon B. Davis, Management Information System: Conceptual Foundations, Structure and Development, McGraw Hill, 1985.
3. Joyce J Elam, Case series for Management Information Systems , Simon and Schuster, Custom Publishing, 1996.
4. Kenneth C Laudon and Jane Price Laudon, Management Information Systems - Organisation and Technology, Prentice Hall, 2015.
5. Michael W. Evans and John J Marciniak, Software Quality assurance and Management, John Wiley and Sons, 1987.

CO – PO Mapping - MANAGEMENT INFORMATION SYSTEMS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	-	-	-	-	H
PO2	Problem analysis	-	M	H	M		M
PO3	Design / development of solutions	-	H	-	-	-	H

OUTCOME:

- On completion of this course, the student is expected to be able to

CO1	Describe the conceptual and theoretical backgrounds of Supply Chain Management and logistics
CO2	Apply the strategy in logistics function ranging from planning to execution and control.
CO3	Identify the Impact of BIM and new data management capabilities on supply chain management in construction.
CO4	Analyse the implications of various strategic choices and decide a better course of action.
CO5	Understand the role of construction logistic Managers and Delivery management systems.

REFERENCES:

- GregerLundesjö, Supply Chain Management and Logistics in Construction: Delivering Tomorrow's Built Environment, Kogan Page Publishers, 2015.
- Supply Chain Management, Strategy, Planning, and operation – Sunil Chopra , Peter Meindl and Kalra, Pearson Education, 2011
- A. Ravi Ravindran, Donald P. Warsing, Supply Chain Engineering: Models and Applications, CRC Press, 2012.
- G Srinivasan, Quantitative Models in Operations and Supply Chain Management, PHI Learning (P) Ltd, New Delhi, 2010
- David J.Bloomberg, Stephen Lemay and Joe B.Hanna, Logistics, PHI 2010

CO – PO Mapping - SUPPLY CHAIN MANAGEMENT AND LOGISTICS IN CONSTRUCTION

PO/PSO		Course Outcome					Overall Correlation of CO s to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	L	M	M	L	M	M
PO2	Problem analysis	-	M	M	M	L	M
PO3	Design / development of solutions	L	M	M	M	L	M
PO4	Investigation	-	M	L	L	L	L
PO5	Modern Tool Usage	L	L	L	-	-	L
PO6	Individual and Team work	-	L	M	M	M	M
PO7	Communication	L	-	M	M	M	M
PO8	Engineer and Society	M	M	M	L	L	M
PO9	Ethics	-	L	L	-	L	L
PO10	Environment and Sustainability	L	M	M	L	M	M
PO11	Project Management and Finance	L	M	H	H	H	H
PO12	Life Long Learning	L	M	M	M	L	M
PSO1	Knowledge of Construction Engineering & Management discipline	M	H	H	H	M	H
PSO2	Critical analysis of Construction management problems and innovation	L	H	H	H	M	H
PSO3	Conceptualization and evaluation of engineering solutions to Construction Issues	M	H	H	M	H	H

OPEN ELECTIVE COURSES (OEC)

OE5091

BUSINESS DATA ANALYTICS

L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE

9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, "Business Analytics Using R – A Practical Approach", Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, "Essentials of Business Analytics", Cengage Learning, second Edition, 2016.

5. U. Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making", Wiley, 2017.
6. A. Ohri, "R for Business Analytics", Springer, 2012
7. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publication, 2015.

Business Data Analytics

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092

INDUSTRIAL SAFETY

LT P C

3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION

9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING

9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION

9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING

9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE**9**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS**OUTCOMES:**

- CO1: Ability to summarize basics of industrial safety
- CO2: Ability to describe fundamentals of maintenance engineering
- CO3: Ability to explain wear and corrosion
- CO4: Ability to illustrate fault tracing
- CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P, Maintenance Engineering, S. Chand and Company, 1987.
3. Hans F. Winterkorn, Foundation Engineering Handbook, Chapman & Hall London, 2013.
4. Higgins & Morrow, Maintenance Engineering Handbook, Eighth Edition, 2008

OE5093**OPERATIONS RESEARCH****LT P C****3 0 0 3****OBJECTIVES:**

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING**9**

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING**9**

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I**9**

Transportation problems -Northwest corner rule, least cost method, Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9
Shortest path problem: Dijkstra’s algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

- CO1: To formulate linear programming problem and solve using graphical method.
- CO2: To solve LPP using simplex method
- CO3: To formulate and solve transportation, assignment problems
- CO4: To solve project management problems
- CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS LT PC 3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS 9
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS**OUTCOMES**

- CO1 – Understand the costing concepts and their role in decision making
- CO2– Understand the project management concepts and their various aspects in selection
- CO3– Interpret costing concepts with project execution
- CO4– Gain knowledge of costing techniques in service sector and various budgetary control techniques
- CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095**COMPOSITE MATERIALS****L T P C
3 0 0 3****OBJECTIVES:**

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096

WASTE TO ENERGY

**L T P C
3 0 0 3**

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I	INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE	9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors		
UNIT II	BIOMASS PYROLYSIS	9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.		
UNIT III	BIOMASS GASIFICATION	9
Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.		
UNIT IV	BIOMASS COMBUSTION	9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.		
UNIT V	BIO ENERGY	9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.		

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 – Understand the various types of wastes from which energy can be generated
- CO2 – Gain knowledge on biomass pyrolysis process and its applications
- CO3 – Develop knowledge on various types of biomass gasifiers and their operations
- CO4 – Gain knowledge on biomass combustors and its applications on generating energy
- CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990

AUDIT COURSES (AC)

AX5091

ENGLISH FOR RESEARCH PAPER WRITING

**L T P C
2 0 0 0**

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6
 Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6
 Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 6
 Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6
 Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6
 Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

- CO1 – Understand that how to improve your writing skills and level of readability
 CO2 – Learn about what to write in each section
 CO3 – Understand the skills needed when writing a Title
 CO4 – Understand the skills needed when writing the Conclusion
 CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

OUTCOMES

- CO1: Ability to summarize basics of disaster
- CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies”, Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company, 2007.
3. Sahni, Pardeep Et. Al. ,” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi, 2001.

AX5093

SANSKRIT FOR TECHNICAL KNOWLEDGE

L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic Sanskrit language.
- Recognize Sanskrit, the scientific language in the world.
- Appraise learning of Sanskrit to improve brain functioning.
- Relate Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS

6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES

6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS

6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE

6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING

6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. “Abhyasustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

OBJECTIVES

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.

Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS**OUTCOMES**

Students will be able to

- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

Suggested reading

1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX5096

PEDAGOGY STUDIES

L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do's and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Training-Part-I':Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

**L T P C
2 0 0 0**

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2- Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.