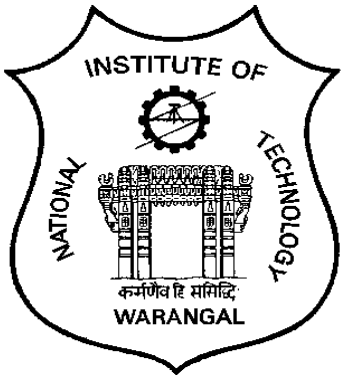
NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL



RULES AND REGULATIONS
SCHEME OF INSTRUCTION AND SYLLABI FOR
M.TECH. PROGRAM IN
CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Effective from 2016-17

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

VISION

Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship and Technological services to the society

MISSION

- Imparting total quality education to develop innovative, entrepreneurial and ethical future professionals fit for globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product oriented research for establishing a self-sustaining and wealth creating centre to serve the societal needs.

DEPARTMENT OF CIVIL ENGINEERING

VISION

To be a knowledge nerve centre in civil engineering education, research, entrepreneurship and industry outreach services for creating sustainable infrastructure and enhancing quality of life.

MISSION

- Generate a specialized cadre of civil engineers by imparting quality education and training
- Attain international standards in teaching, research and consultancy with global linkages

GRADUATE ATTRIBUTES

1. Scholarship of Knowledge: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.
2. Critical Thinking: Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.
3. Problem Solving: Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.
4. Research Skill: Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.
5. Usage of modern tools: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.
6. Collaborative and Multidisciplinary work: Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.
7. Project Management and Finance: Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.
8. Communication: Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.
9. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.
10. Ethical Practices and Social Responsibility: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.
11. Independent and Reflective Learning: Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

DEPARTMENT OF CIVIL ENGINEERING

M.TECH IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT

PROGRAM EDUCATIONAL OBJECTIVES

PEO1	Apply systems, methods, procedures, modern tools and techniques in construction projects.
PEO2	Identify and apply sustainable, alternative and cost effective construction materials and practices.
PEO3	Work in team environment and apply tools to optimise resources for achieving project objectives.
PEO4	Communicate effectively, demonstrate leadership qualities and exhibit professional ethics.
PEO5	Engage in lifelong learning for career enhancement and adapt to changing societal needs.

Mapping of Mission statements with program educational objectives

Mission Statement	PEO1	PEO2	PEO3	PEO4	PEO5
MS1	2	3	3	3	3
MS2	2	2	3	3	3

1: Slightly 2: Moderately 3: Substantially

Mapping of programme educational objectives with graduate attributes

PEO	GA 1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11
PEO 1	3	3	3	2	2	1	3	1	1	1	1
PEO 2	2	2	2	2	1	1	1	1	2	1	1
PEO 3	1	1	1	1	1	3	3	2	1	1	1
PEO 4	1	1	1	1	1	3	3	3	1	2	1
PEO 5	1	1	1	1	1	1	1	1	3	2	2

1: Slightly 2: Moderately 3: Substantially

PROGRAM OUTCOMES: At the end of the program, the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to solve problems related to contemporary issues in construction Industry.
PO2	Analyze, design, conduct numerical experiments, and interpret data of complex construction technology management problems.
PO3	Select materials and technologies for infrastructure development.
PO4	Employ sustainable technologies to protect environment and ecosystems.
PO5	Work in inter-disciplinary engineering teams with social responsibility and ethical values.
PO6	Communicate effectively and demonstrate leadership skills.
PO7	Engage in lifelong learning and demonstrate awareness of contemporary issues to meet the challenges and demand-driven needs of the society.
PO8	Use modern engineering tools, instrumentation and software in implementing construction projects.

Mapping of program educational objectives with graduate attributes

Programme outcomes	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8	GA9	GA10	GA11
PO1	3	3	3	2	2	2	3	2	2		
PO2	3	3	3	3	2	2	3	2	2	1	2
PO3	3	2	2	2	3	2	2	2	2	1	1
PO4	2	2	2	2	2	2	2	2	2	3	
PO5	2	2	3	2	2	3	3	3	1	3	2
PO6	2	1	1	1	1	3	2	3	1		2
P07	2	3	3	3	2	3	2	2	3	3	2
PO8	2	3	3	3	3	2	2	2	3	3	3

1: Slightly 2: Moderately 3: Substantially

Mapping of program outcomes with program educational objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	3	3	3
PO2	3	3	3	2	2
PO3	3	3	3	2	
PO4	3	3	2	2	2
PO5	3		3	2	2
PO6	3		2	3	2
PO7	3	3	3	3	3
PO8	2	2	3	3	3

1: Slightly 2: Moderately 3: Substantially

SCHEME OF INSTRUCTION

M. Tech. (Construction Technology and Management) Course Structure

M. Tech. I – Year I – Semester

S.No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5101	Construction Techniques	4	0	0	4	PCC
2	CE5102	Project Planning and Management	4	0	0	4	PCC
3	SM5011	Construction Economics and Finance	4	0	0	4	PCC
4		Elective – I	3	0	0	3	DEC
5		Elective – II	3	0	0	3	DEC
6		Elective – III	3	0	0	3	DEC
7	CE5103	Construction Management Software Laboratory	0	0	3	2	PCC
8	CE5104	Quality control Lab	0	0	3	2	PCC
9	CE5141	Seminar – I	0	0	2	1	PCC
		TOTAL	**21**	**0**	**8**	**26**	

M. Tech. I – Year II – Semester

S.No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE5151	Contract Management and Arbitration	4	0	0	4	PCC
2	CE5152	Quantitative Methods in Construction Management	4	0	0	4	PCC
3	CE5153	Construction Methods and Equipment	4	0	0	4	PCC
4		Elective – IV	3	0	0	3	DEC
5		Elective – V	3	0	0	3	DEC
6		Elective – VI	3	0	0	3	DEC
7	CE5154	Construction Project Studio	0	0	3	2	PCC
8	CE5155	Building Information Modelling Lab	0	0	3	2	PCC
9	CE5191	Seminar – II	0	0	2	1	PCC
		TOTAL	**21**	**0**	**8**	**26**	

M. Tech. II – Year I – Semester

S.No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1		Industrial Training (8-10 weeks; Optional)					
2	CE6142	Comprehensive Viva voce				2	PCC
3	CE6149	Dissertation Part – A				6	PCC
		TOTAL				**8**	

M. Tech. II – Year II – Semester

S.No.	Course Code	Course Title	L	T	P	Credits	Cat. Code
1	CE6199	Dissertation Part – B				12	PCC
		TOTAL				**12**	

List of Electives

Course No.	Subject	L	T	P	Credits
	For Electives I, II and III				
CE5111	Neo Construction Materials	3	0	0	3
CE5112	Infrastructure Valuation	3	0	0	3
CE5113	Building Services	3	0	0	3
CE5211	Analysis and Design of Bridges	3	0	0	3
CE5213	Structural Masonry	3	0	0	3
CE5312	Environmental Impact Assessment and Management	3	0	0	3
CE5416	Tunneling Technology	3	0	0	3
CE5511	Advanced Statistical Methods	3	0	0	3
SM5012	Human Resource Development for Construction	3	0	0	3
	For Electives IV, V and VI				
SM5061	Strategic Management in Construction	3	0	0	3
CE5161	Underwater Construction	3	0	0	3
CE5162	Timber and Formwork Design	3	0	0	3
CE5163	Quality and Safety Management	3	0	0	3
CE5263	Rehabilitation of Structures	3	0	0	3
CE5264	Tall Structures	3	0	0	3
CE5265	Structural Health Monitoring	3	0	0	3
CE5770	Climate Systems	3	0	0	3
CE5466	Offshore Foundations	3	0	0	3
ME5061	Critical Chain Management	3	0	0	3

DETAILED SYLLABUS

CE 5101	CONSTRUCTION TECHNIQUES	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the limitations of construction techniques.
CO2	Analyse productivity and economics in construction techniques.
CO3	Implement modular construction practices.
CO4	Understand reliable proportioning concepts in construction techniques.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3		2	1			1	
CO2	2		3	1			1	2
CO3			3				1	2
CO4			3	1			1	2

Detailed syllabus

Introduction: Introduction to Construction Techniques

Reinforced and Prestressed Concrete construction: Introduction, Mechanized methods of earthwork: Tractors and attachments, Dozers, Tippers, Scrapers, Shovels and Trenching machines, Dumpers, Rollers and Compactors, Estimation of quantities of earthwork in grading, Grading of sites with bulldozers and scrapers, Drilling, Blasting methods, Labor protection in drilling and blasting, Fabrication of reinforcement and transportation of erected reinforcement, Concreting, Special methods for concreting construction, Introduction to Prestressed concrete, Advantages of Prestressed concrete, Types of Pre-stressing, Methods of pre-stressing, Equipment for pre-stressing operation.

Prefabricated structures: Introduction to Prefabricated structures, Planning for pre-casting, Selection of equipment for fabrication, Transport and erection of prefabricated components, Quality measures, Design considerations of precast elements, Safety measure during erection

Ready mixed Concrete: Production of Ready Mixed Concrete, Site mixed vs. Ready Mixed Concrete, Equipment for RMC plant, IS code provision for RMC, Quality measures of Ready Mixed Concrete, RMC Productivity analysis, Productivity analysis-Case study

Modular Construction Practices: Introduction to Modular Construction, Modular coordination, Modular Standardization, Modular System Building, Limitation and Advantages of Modular Construction

Construction Chemicals, Admixtures, Water Proofing, Epoxy

Formwork: Requirements of Formwork, Loads carried by Formwork, Types of Formwork: Timber, Steel, Modular shuttering, Slip forms, Scaffolding.

Reading:

1. Allen E, Iano, J, Fundamentals of Building Construction subscription E Book, Material and Method, John Wiley and Sons, 2011.
2. Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8th Ed., Prentice Hall, 2009.

CE 5102	PROJECT PLANNING AND MANAGEMENT	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Prepare work break down plan and estimate resources requirements.
CO2	Solve problems of resource allocation and levelling using network diagrams.
CO3	Plan and develop management solutions to construction projects.
CO4	Understand the principles of project management, resource management and inventory.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	1				
CO2	3	3	2					2
CO3	2	3		1	2			2
CO4			3				2	2

Detailed syllabus

Introduction: Phase of project, project management and its relevance, stake holders of a project, structure of project organization, management levels, and traits of a project manager.

Construction Planning: Introduction, activities involved types of project plan, work breakdown structure. Planning terminologies, Critical path method, forward and backward pass, PERT, Ladder network, Precedence network, Line of balance.

Project scheduling and resource leveling: Introduction, Resource allocation and leveling for unlimited resources, Resource allocation for limited resources, Multi resource allocation, Optimal scheduling.

Contracts Estimation and Bidding Strategy: Introduction, Determination of bid price, Bidding models.

Project Monitoring and Control: Introduction, Project updating, Cost control.

Construction Management: Construction Equipment and Management, Construction Account Management, Construction Material management, Construction Quality Management, Construction Safety Management, Computer Application In Construction Management,

Workforce Motivation And Human Factors In Construction Management, Plant Management, Project Communication.

Reading:

1. Callahan, M. T., Quackenbush, D. G., and Rowings, J. E., Construction Project Scheduling, McGraw-Hill, New York, 1992.
2. Cleland, D. I. and Ireland, L. R., Project Management: Strategic Design and Implementation 4th Edition, McGraw-Hill, New York, 2002.

SM 5011	CONSTRUCTION ECONOMICS AND FINANCE	PCC	4 – 0 – 0	4 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Prepare income, profit and loss statements and implement construction accounting.
CO2	Evaluate construction project economics, cost-benefit analysis and breakeven analysis.
CO3	Analyze and evaluate construction risks and uncertainties.
CO4	Understand the importance of working capital management, budgeting and control.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2				1	2	
CO2	2	3	2			1	1	
CO3	1	3	1				1	
CO4	2	3	2				1	

Detailed syllabus

Construction accounting, Income statement, Depreciation and amortization, Engineering economics, Time Value of Money, Break even analysis.

Benefit-cost analysis, Replacement analysis

Capital Budgeting & Methods, Discounted Cash flow, NPV,IRR, PI,ARR,
Risks and uncertainties and management

Taxation and inflation, Cost Elements, bidding and award revision due to unforeseen causes, escalation. Financial plan, multiple sources of finance, Working capital Management. Budgeting and budgetary control, Project Appraisal and Project yield, Performance – appraisal and project yield.

Reading:

1. Danny Myers, Construction Economics: A New Approach, Taylor and Francis Publisher, 2004.
2. Ofori, G, The Construction Industry Aspects of its economics and Management, Singapore University Press, 1990.

3. Construction and Finance Management- Coombs W.E and W.J Palmer, Mc-Graw-Hill New York.
4. Financial and Cost concepts for construction Mangement, Halpin, D.W. John Wiley & sons, New York.
5. Construction Accounting and Finance, Vajrani and chandola, Dhanpat Rai Publications.

CE 5103	CONSTRUCTION MANAGEMENT SOFTWARE LABORATORY	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Prepare work break down plan and estimate resources required in a construction project.
CO2	Prepare precedence diagram and network diagrams.
CO3	Implement resource allocation and levelling using MSP.
CO4	Build architectural plan and material take-off.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	1				2
CO2	3	3	2					2
CO3	2	3					2	2
CO4		2						2

Detailed syllabus

Introduction to different software available for Construction Technology and Management

Introduction to network methods (CPM, PERT), Implementation in MSP

Introduction to Primavera software, case study

Introduction to REVET architecture

Reading:

1. Manual Of Rivet Architecture, Autodesk,2010

CE5104	QUALITY CONTROL LAB	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Apply quality control methods to various construction materials.
CO2	Verify whether materials are consistent with specifications in codal provisions
CO3	Identify potential sources of quality reduction and recommend control measures
CO4	Prepare detailed quality control report

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					3	3	1	
CO2			2					
CO3	2	2	2	1	3	2	2	2
CO4					2	2	2	1

Detailed syllabus

Quality control methods for different construction materials, Tolerance measurements as per IS code.

Reading:

IS Codes and related quality control manuals

CE 5141	Seminar-I	MDC	0 – 0 – 2	1 Credit

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify and chose appropriate topic of relevance.
CO2	Assimilate literature on technical articles of specified topic and develop comprehension.
CO3	Prepare technical report.
CO4	Design, develop and deliver presentation on specified technical topic.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1						3	2	2
CO2						3	2	2
CO3						3	2	2
CO4						3	2	2

Detailed syllabus

Student can choose any topic, of his choice, pertaining to Construction Technology and Management. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of Construction Technology and Management for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

Reading:

1. Construction Technology and Management Journals
2. Research Articles / Reports available on Internet
3. Construction Technology and Management Textbooks and Handbooks

CE 5111	Neo Construction Materials	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the structural, physical and long-term performance of building materials used in construction.
CO2	Understand mechanical and non-mechanical behaviour of neo- materials.
CO3	Understand the use of advanced materials in construction projects.
CO4	Identify crucial problem areas in manufacture and applications of building materials.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1			3				1	
CO2			3				1	
CO3			3	1			1	2
CO4			3	1			1	

Detailed syllabus

Aggregates: Introduction, Historical back ground of Light weight aggregate concrete, Artificial aggregates, Physical properties of aggregates, Light weight aggregate concrete, Applications of light weight aggregate concrete, Properties of green light weight aggregate concrete, Effect of size aggregate on the strength properties of LWAC made with palm oil shells, Recycled aggregate, Pre placed aggregate concrete.

Fibers in Concrete: Fiber reinforced concrete, Behavior of steel fibers in concrete, Glass fiber reinforced concrete, GFRC in construction, Natural fiber reinforced concrete, Polymer Fiber Reinforced Concrete.

Special Concretes: High strength concrete, Effect of RHA on the properties of HSC, High performance concrete –applications, Self-Compacting Concrete, Concrete made with waste rubber, Special Concretes, Sulfur Concrete, Ferro cement, Geo synthetics, Nano Concrete, Changes in concrete with respect to time.

Corrosion In Concrete: Corrosion in concrete and its protection, Corrosion of rebars in concrete, Influence of fly ash on the corrosion steel bar in concrete.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers.

Reading:

1. Adam M Neville, Properties of Concrete, 5th Edition, Longman Sc and Tech Publishers, 2011.
2. Kumar Mehta. P and Paulo J M Monteiro, Concrete Microstructure, Properties and Materials, McGraw Hill, 2006.

CE 5112	Infrastructure Valuation	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the importance of Infrastructure valuation in a business organization.
CO2	Apply special techniques in Infrastructure valuation.
CO3	Apply analytical and decision-making skills in the valuation job.
CO4	Understand structured phases of value engineering and build teams.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	1						
CO2	2	2				1		
CO3	3	2						1
CO4	2	2			2	1		1

Detailed syllabus

Concepts: Introduction, History of value engineering, Value, Function, Cost, Worth, Case Study Discussions.

General Techniques in Infrastructure Valuation: General Techniques -Brainstorming Technique, The Gordon Technique, Feasibility Ranking, The Morphological Analysis Technique, ABC Analysis, Probabilistic Approach, Make or Buy Technique, Case Study Discussions.

Special Techniques in Infrastructure Valuation: Special Techniques - Function – Cost – Worth Analysis, Function Analysis System Technique - Technically oriented FAST and Customer-oriented FAST, Weighted Evaluation Method - Equal Importance Method, Descending Order of Importance Method, Numeric Analysis - Forced Distribution Technique, Quantitative Method, Predetermined Minimum Method. Evaluation Matrix. Break-even Analysis. Life Cycle Cost (LCC), Case Study Discussions.

Applications of Infrastructure Valuation: Team Dynamics - Team Structure and Team Building, Definition of the creative and structured phases of value engineering, The workshop approach to achieving value, Target setting, Time management, Case Study Discussions.

Reading:

1. Anil Kumar Mukhopadhyaya, Value Engineering Concepts, Techniques and Applications, Response Books, 2013.
2. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind from Concept to Value Engineering Certification, Response Books, 2009.
3. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw-Hill Book Company, 2009.
4. M.R.S. Murthy, Cost Analysis for Management Decisions, Tata McGraw-Hill Publishing Company Ltd., 1988.

CE 5113	Building Services	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Design residential buildings from the point of view of grouping and circulation, lighting and ventilation and fire protection.
CO2	Design vertical transportation in buildings.
CO3	Analyse and design prefabrication systems in buildings.
CO4	Plan and design building services.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1			2	3				
CO2			2	1				
CO3	2	3	2	1			2	2
CO4	2	3	2					

Detailed syllabus

Orientation and Planning: Selection of site, Orientation of building, Design of residential buildings with particular reference to grouping and circulation.

General building requirements: Open spaces in and around buildings for lighting and ventilation, Minimum sizes and height of roofs, Rat and Termite proofing of buildings, Lightning protection of buildings.

Fire protection of buildings: Important considerations in fire protection, Fire resisting, Properties of common building materials, Fire safety and exit requirements.

Vertical transportation in buildings: Essential requirements and details of construction of stairs, lifts escalators and ramps.

Prefabrication systems in residential buildings: Planning and modules and sizes of components in prefabrication, Testing of components, Manufacturing and erection guide lines.

Miscellaneous structures: Shell structures, Domes, Folded plate structures, Skeletal and space frame structures, Grain storage structures, Earthquake resistant structures.

Building services: Lighting and Ventilation, Electrical installation, Air-conditioning and heating, Acoustics and Sound insulation, Plumbing services.

Reading:

1. National building code of India,BIS 2005
2. Building construction, Arora and Bindra, Dhanpatrai &Sons,2012
3. Hand book of Housing Statistics,NBO 2003

CE 5211	Analysis and Design of Bridges	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Design of RC Structures and Theory of Structures.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the codal provisions for loading and design standards of bridges.
CO2	Design the substructure including pier and pier cap and well elements.
CO3	Design the superstructure of bridge using different methods.
CO4	Design girder bridges and cable stayed bridges.
CO5	Understand, design and select materials suitable for bearings.

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1	3	-	-	2	2	3
CO2	3	2	3	2	-	-	-	-
CO3	3	2	3	3	1	2	1	3
CO4	3	3	3	2	-	2	1	2
CO5	3	3	3	-	-	-	-	-

Detailed Syllabus:

Introduction - Classification – Investigation for bridges - Loading standards – IRC and Railway loads – Impact.

Bridge substructure - Determination of maximum flood discharge - Determination of linear water way - Determination of maximum depth of scour - Loads acting on substructure - Design of pier and pier cap - Design well elements - Sinking of wells.

Bridge Superstructure - Pigeaud's curves method for design of slab - Analysis of beams– Courbon's Method – Hendry Jaeger Method – Guyon and Massonet Method - Box Girder Bridges - Grillage analogy.

Cable Bridges - Advantages - Arrangement of stay cables - types of towers - Linear analysis of cables and towers

Bridge Bearings and expansion joints - Functions, types and selection of bearings - Bearing materials - Design of elastomeric bearings for different conditions - Expansion joints – types of expansion joints.

Reading:

1. Swami Saran, “Analysis and Design of Substructures”, Oxford & IBH Publishing Co., 1996.

2. J.E. Long, “Bearings in Structural Engineering”, Newnes Butterworth & Co., 1974.

3. R.E. Rowe, “Concrete Bridge Design”, 1st Edition, Elsevier Science and Technology, 1962.

4. L.G. Hendry and A.W. Jaeger, “The Analysis of Grid Frameworks and Related Structures”, Chatto & Windus, 1958.

5. Jaeger & Bakht, “Bridge Analysis by Microcomputer”, Mc Graw Hill, 1989.

6. C.S Surana & R. Agarwal, “Grillage Analogy in Bridge Deck Analysis”, Narosa Publication, 1998.

7. Maisel and Roll, “Method of Analysis and Design of Concrete Box Beams with Side Cantilever”, Cement and Concrete Associations, 1974.

8. M.S. Troitsky, “Cable Stayed Bridges: An approach to Modern Bridge Design”, 2nd edition, Van Nostrand Reinhold Company, 1988.

9. T.R. Jagdeesh and M.A. Jayaram, “Design of Bridge Structures”, 2nd Edition, Prentice Hall of India Pvt. Ltd., 2003.

CE 5213	Structural Masonry	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand behavior of masonry structures under gravity and lateral loads.
CO2	Design masonry structures for gravity, wind and seismic loads.
CO3	Design masonry infill as shear walls for lateral action.
CO4	Apply strengthening techniques for repair and rehabilitation of masonry structures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	2				1	
CO2	1	2	3					
CO3	1	2	3					
CO4	1	2	2				1	2

Detailed syllabus

Introduction: Masonry construction-National and International perspective- Historical development, Modern masonry, Principles of masonry design, Masonry standards: IS 1905 and others.

Material Properties: Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

Masonry in Compression: Prism strength, Eccentric loading, Kern distance.

Masonry under Lateral loads: In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms.

Behavior of Masonry: Shear and flexure- Combined bending and axial loads-Reinforced and unreinforced masonry- Cyclic loading and ductility of shear walls for seismic design - Infill masonry.

Structural design of Masonry: Working and Ultimate strength design- In-plane and out-of-plane design criteria for load-bearing -and in fills, connecting elements and ties- Consideration of seismic loads-Code provisions.

Seismic evaluation and Retrofit of Masonry: In-situ and non-destructive tests for masonry-properties-Repair and strengthening of existing masonry- structures for seismic loads.

Reading:

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R. Masonry Structures: Behavior & Design, Prentice Hall (1994).
2. Hendry, A. W., Structural Masonry, Mc Millan, UK, 2nd edition. (1998)
3. Hendry, A. W., Sinha, B. P. and Davies, S. R.. Design of Masonry Structures, E&FN Spon, UK, (1997)
4. Schneider, R. S. and Dickey, W. L.. Reinforced Masonry Design, Prentice Hall, 3rdedn. (1994)
5. Paulay, T. and Priestley, M. J. N.. Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley. (1992)

CE 5312	Environmental Impact Assessment and Management	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify the environmental attributes for EIA study.
CO2	Identify methodology and prepare EIA reports.
CO3	Identify methods for prediction of impacts.
CO4	Formulate environmental management plans.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				3	1	1	2	1
CO2				3	1	2	2	1
CO3				3	1	1	2	1
CO4				3	1	2	2	2

Detailed syllabus

Introduction: The Need for EIA, Indian Policies Requiring EIA , The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Identifying the Key Issues: Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection: Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

EIA Methodologies: Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods,

Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods. Rapid assessment of Pollution sources method, predictive models for impact assessment, Applications for RS and GIS.

Reviewing the EIA Report: Scope, Baseline Conditions, Site and Process alternatives, Public hearing. Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System,Integrated Impact Assessment.

Review of EMP and Monitoring: Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Case Studies: Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Reading:

1. Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997.
2. David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003.
3. Hosetti, B. B., Kumar Eds, A., Environmental Impact Assessment and Management, Daya Publishing House, 1998.
4. UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987.
5. Anjaneyulu.Y., and Manickam. V., Environmental Imapact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
6. Wathern.P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

CE 5416	Tunnelling Technology	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify tunnel driving methods for a given ground conditions.
CO2	Design tunnel excavation.
CO3	Identify and design tunnel support systems.
CO4	Identify difficulties and remedies during tunnelling.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1						
CO2		2	3					
CO3		2	3					1
CO4			1	2			1	2

Detailed syllabus

Tunnels in Soils and Rocks: Benefits of tunnelling, Tunnels for different purposes, Site investigation and geophysical methods adopted for tunnelling purposes, Rock rating and classification, Instrumentation on tunnels.

Tunnelling methods: Drill and blast method, Tunnel boring machine, NATM, Shield tunnelling, Earth pressure method, Application of compressed air.

Tunnel lining and supports: Different types of support measures adopted in tunnelling, Analysis of stresses on the tunnel lining, Design of tunnel lining and support measures.

Tunnelling Mechanics: Behaviour of soils and rocks, Stress and deformation fields around tunnels, Analytical equations used and derivations, Stability problems in tunnels.

Numerical Analysis of Tunnelling: Finite element analysis of tunnelling process, Constitutive models used, Development of longitudinal displacement curves and ground reaction curves, Ground surface settlement due to tunnelling in soft grounds.

Reading:

1. Kolymbas D. Tunnelling and Tunnel Mechanics, A rational approach to tunnelling, Springer, 2005.
2. Singh B. And Goel R. K. Tunelling through weak rocks, Elsevier, 2006.

CE 5511	Advanced Statistical Methods	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand moment generating functions and expectations.
CO2	Understand correlation, regression and multivariance.
CO3	Estimate parameters and conduct statistical tests of significance.
CO4	Apply the statistical methods to Construction Technology and Management Problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2					1	1
CO2	3	2					1	1
CO3	3	2					1	1
CO4	3	2					1	2

Detailed syllabus

Basic Statistics: Sources of Data, Organization of Data, The Histogram, Measures of central tendency, Mean Deviation, Standard Deviation, Correlation, Coefficient of correlation, Rank correlation, Regression.

Multivariate Data: Vector random variables, sample estimate of centroid, standard deviation, SSCP, dispersion, variance, covariance, correlation matrices.

Multiple Regression: Multiple parameter estimation by method of least squares, tests of significance use of dummy variables, problems associated with multi co-linearity, heteroscadasticity

Probability: Equally likely, mutually exclusive events, definitions of probability, additions & multiplication theorems of probability and problems based on them.

Bayesian approach, distributions; Poisson, normal, Erlang, Gamma and Weibull probability distributions.

Geostatistics: Pattern Analysis, Measures of Arrangements & dispersion, Auto Correlation, Semiveriogram, Kriging.

Reading:

1. Gupta, S.C. and Kapoor, V.K., “Fundamentals of Mathematics Statistics”, Sultan Chand and Sons, 2001.
2. Johnson, R.J., “Miller and Freund’s Probability and Statistics for Engineers” 6th Edition, Prentice Hall of India, 2002.
3. Jay L.Devore, “Probability and statistics for Engineering and the Sciences”, Thomson and Duxbbury, 2002.
4. Sarma, D.D. “Geostatistics with Applications in Earth Sciences”, Capital Publishing Company, 2002.
5. Cooley W.W and Lohnes P.R . - Multivariate Data Analysis**,** John Wiley and Sons.

SM 5012	HUMAN RESOURCE DEVELOPMENT FOR CONSTRUCTION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Plan and manage key human resource functions within organizations.
CO2	Understand current issues, trends, practices, and processes in HRM.
CO3	Contribute to employee performance management and organizational effectiveness.
CO4	Develop employability skills.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1			3		2	1
CO2		1			3		2	1
CO3		1			3	1	2	1
CO4		1			3	1	2	1

Detailed syllabus

Organization and management theory: Challenges of managing people in construction, Contemporary management Theory, Production efficiency: the Classical Approach, Human Behavior theory, Manager's attitude towards people in construction, Expectations of the employment relationship.

Strategic HRM approaches and operational HRM approaches: Models of HRM, Employee resourcing, Recruitment & Selection, Case Study Discussion, Training & Development, Appraisal Systems, Reward management, Case Study Discussion, Mentoring, Career in Construction Management.

Employee relations and empowerment: Employees relations, The changing role of trade unions, The effect of unions, Collective bargaining, Case Study Discussion, The evolution of empowerment within HRM.

Diversity and work/life balance: Workforce Diversity, Equal Opportunities in construction, Work-life Balance.

Employee welfare and Employment legislations: Workplace health and safety hazards, employment legislations.

Strategic human resource development: Relationship between HRM and Business Performance, Case Study Discussion, Current industry issues and the role of HRM, Future improvements construction HRM, Measuring the Performance of HRM.

Reading:

1. Langfor D.A, Human Resource Management in Construction, Longman, 1995.
2. Martin Loosemore, Andrew Dainty, Helen Lingard, Human Resource Management in Construction Projects: Strategic and Operational Approaches, Taylor and Francis, 2010.
3. Human Resource Management – Aswathappa – TMH, 2010.
4. Human Resource Management, Garry Dessler, and Biju Varkkey, PEA, 2011.

CE5151	CONTRACT MANAGEMENT AND ARBITRATION	PCC	4 – 0 – 0	4 Credits

Pre-requisites: Project Planning and Management, Construction Techniques

Course Outcomes: At the end of the course, the student will be able to:

CO1	Prepare contract schedules, notice inviting tender and contract documents.
CO2	Understand laws of construction contract.
CO3	Implement dispute resolution.
CO4	Prepare contract management plan as per standards.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	2		2		1	
CO2	2	3	1		2		1	
CO3	2	2	3		2		1	
CO4	2	2	1		2		1	

Detailed syllabus

Construction Laws: Public law, Government Department and Local authorities, Private law, contracts, Tort, property law and building law.

Construction contracts: Contract specification, types of contract documents used for construction.

Contract procurement: Selecting a contractor

Contract procedure: Disputes, arbitration and litigation procedure-preparation, settlement, evidence.

Building formulae: Price adjustment-need for formulae, comparison with previous system, civil engineering and building formulae, practical implication.

Reading:

1. Allen E, Iano, J, Fundamentals of Building Construction subscription E Book, Material and Method, John Wiley and Sons, 2011.

Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8th Ed., Prentice Hall, 2009.

CE5152	QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT	PCC	4 – 0 – 0	4 Credits

Pre-requisites: Construction Economics and Finance, Project Planning and Management

Course Outcomes: At the end of the course, the student will be able to:

CO1	Formulate and solve deterministic optimization problems.
CO2	Model risk and uncertainty in construction industry.
CO3	Apply stochastic optimization techniques for decision making under uncertainty.
CO4	Plan and manage activities using simulation, queuing and game theory.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3						2
CO2	3	3						2
CO3	3	3			2			3
CO4	3	3			2			3

Detailed syllabus

Introduction and concepts of probability and statistics: Probability: Conditional probability, Probability distributions (Normal, Bayesian, Poisson, Exponential), Probability density functions.

Linear programming: Formulation of LP problems: Basic variables, constrains, corner points, augmented form, maximization and minimization problems. Solution methods: Graphical method, Algebraic method, Simplex method (Tabular and Matrix form). Integer linear programming.

Transportation and assignment problems: Transportation problem: Basic feasible solutions using N-W Corner rule, Minimum cost method, Vogel's approximation method.

Optimal solutions using Stepping Stone Method, Modified distribution method.

Assignment problems: Hungarian algorithm.

Dynamic programming: Stage coach problem, Reliability problem, Continuous variables, Oil exploration problem, Manpower planning problem.

Queuing theory: Single server infinite queue length model,Single server finite queue length model, multiple server infinite queue length model,multiple server infinite queue length model.

Decision theory: Decision in certainity: Analytical hirearchy approach, Comparison Matrix, Consistency test,
Probabilistic decision making: Expected value approach, sensitivity analysis on payoffs, Optimal decision strategy.

Forecasting: Quantitative methods-Time series (average method, moving average method, exponential smoothing, mean square error), Regression analysis. Qualitative methods.

Games theory simulations applied to construction: n x m person zero sum games with finite strategies, Maximin & Minimax strategies, Saddle points, Rule of dominance.

Solution methodologies: Algrbraic method, Graphical method, Method of matrices, LP method, Iterative method of approximate solution.

Modifications and improvement on CPM/PERT techniques: Beyond CPM/PERT: Overview of the pitfalls of making traditional CPM/PERT assumptions. PERT technique extended to Monte-Carlo simulation analyses.

CPM: advantages of circle notation diagram for the presentation of CPM project plans. Concept of dependent operations overlapping in time.

Reading:

1. Freund, J.E. and Miller, I.R., Probability and Statistics for Engineers, Prentice - Hall of India, 5th edition, New Delhi, 1994.
2. Goel B.S. and Mittal, S.K., Operations Research, Pragati Prakashan, Meerut, 2000.
3. Gupta, S.C. and Kapur, V.K., Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 1999
4. Taha, H.A.., Operations Research: An Introduction, Prentice - Hall of India, 8th Ed., New Delhi, 2010.

CE5153	CONSTRUCTION METHODS AND EQUIPMENT	DEC	4 – 0 – 0	4 Credits

Pre-requisites: Construction Techniques

Course Outcomes: At the end of the course, the student will be able to:

CO1	Select construction equipment appropriate to tasks.
CO2	Estimate equipment ownership and operating costs.
CO3	Estimate and schedule activities using equipment productivity and cost data.
CO4	Understand contemporary issues pertaining to construction methods, equipment usage and management.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	2	3					
CO2	1	3	2					
CO3	1	3	2					1
CO4	3	2	2				2	2

Detailed syllabus

Equipment Economics: Equipment records, Cost of Capital, Elements of ownership Cost, Operating Cost, Replacement Decisions, Rent and Lease Considerations.

Planning for Earthwork Construction : Planning, Graphical Presentation of Earthwork, Earthwork Quantities, Mass Diagram, Pricing Earthwork Operations.

Compaction and Stabilization Equipment : Compaction of Soil and rock, Types of Compacting Equipment, Dynamic Compaction, Stabilizing soils with Lime, Cement Soil Stabilization.

Mobile Equipment Power Requirements: Required Power, Available power, Usable power, Performance Charts.

Dozers, Scrapers, Excavators: Introduction, Performance Characteristics of Dozers, Pushing Material, Land Clearing, Scraper types, operation, Performance Charts, Production cycle, Hydraulic Excavators, Shovels, Hoes.

Trucks and Hauling Equipment, Finishing Equipment : Trucks, productivity, Performance Calculations, Gaders, Trimmers.

Concrete and Concrete Equipment, Cranes, Piles and Pile-Driving Equipment, Planning for Building Construction: Concrete Mixtures, Batching of Concrete, Placing of Concrete.

Reading:

1. Peurifoy, R.L., Ledbetter, W.B.and Schexnayder, C , " Construction Planning Equipment and Methods ", 5th Edition, McGraw Hill, Singapore,
2. Sharma S.C. “Construction Equipment and Management ", Khanna Publishers New Delhi.

CE5154	CONSTRUCTION PROJECT STUDIO	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Prepare contract drawings and estimates for highway, building and bridge Projects.
CO2	Prepare detailed item wise specification of the project.
CO3	Identify and estimate resources for the items of the project and prepare detailed project schedule.
CO4	Prepare notice inviting tender and contract document.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					3	3	1	
CO2			2					
CO3	2	2	2	1	3	2	2	2
CO4					2	2	2	1

Detailed syllabus

Scheduling: Detailed construction Project scheduling
Valuation: Valuation, Specification writing
Contract: Contract document-highway projects, Buildings, Bridges

Reading:

1. Project Scheduling with Primavera P6, Training Manual,2006.

CE5155	BUILDING INFORMATION MODELING LAB	PCC	0 – 0 – 3	2 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand and apply the fundamental concepts of building information modeling (BIM)
CO2	integrate construction processes through Building Information Modelling (BIM)
CO3	Understand and manage information delivery cycle using BIM and related digital technologies
CO4	Model a structure with building information modeling(BIM) software.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1					3	3	1	
CO2			2					
CO3	2	2	2	1	3	2	2	2
CO4					2	2	2	1

Detailed syllabus

- Level of Detail (LOD) BIM Concepts
- Detailed Architectural BIM Modeling
- Basic Introduction to Structural / MEP BIM Concepts
- 3D Spatial Interference Analysis
- Generating Good for Construction (GFC) Documentation
- Material Take-Off(MTO)
- Bill of Quantity (BOQ) Generation
- Project Scheduling with BIM
- 4D Simulation
- Project work

Reading:

(1) BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors 2nd Edition, by Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston.
(2) BIM and Construction Management: Proven Tools, Methods, and Workflows by Brad Hardin
(3) Building Information Modeling: BIM in Current and Future Practice by Karen Kensek

CE5191	Seminar-II	MDC	0 – 0 – 2	1 Credit

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify and chose appropriate topic of relevance.
CO2	Assimilate literature on technical articles of specified topic and develop comprehension.
CO3	Prepare technical report.
CO4	Design, develop and deliver presentation on specified technical topic.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1						3	2	2
CO2						3	2	2
CO3						3	2	2
CO4						3	2	2

Detailed syllabus

Student can choose any topic, of his choice, pertaining to Construction Technology and Management. Topic should be a relevant and currently researched one. Students are advised to refer articles published in current journals in the area of Construction Technology and Management for choosing their seminar topics. Student should review minimum of 5 to 6 research papers relevant to the topic chosen, in addition to standard textbooks, handbooks, etc. Students are required to prepare a seminar report, in the standard format and give presentation to the Seminar Assessment Committee (SAC) in the presence of their classmates. It is mandatory for all the students to attend the presentations of their classmates.

Reading:

1. Construction Technology and Management Journals
2. Research Articles / Reports available on Internet
3. Construction Technology and Management Textbooks and Handbooks

SM 5061	STRATEGIC MANAGEMENT IN CONSTRUCTION	PCC	3 – 0 – 0	3 Credits

Pre-requisites: Construction Economics and Finance

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand the importance of Strategic Management in a business organization.
CO2	Identify environmental factors which influence business firm.
CO3	Understand the effect of competition on the business environment.
CO4	Understand different models and strategies used by organizations.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3			2		1	
CO2	2	2			2		1	
CO3	3	3		1			1	
CO4	3	3					1	

Detailed syllabus

Introduction to Strategic Management Concepts: Introduction to strategy, Purpose, Objectives, goals, Policies and programs,7-S frame work, Board of Directors-Roles, Responsibilities, Structure and composition Role of top management.

External and Internal Environment Analysis: Strategic Management process, SWOT Analysis Macro and Micro environmental factors. Importance of value chain.

Decision and Analytical Tools: Competitive Environment-five forces model, Factors driving industry change. Key factors for success in organization, overall cost Leadership, focus and differentiation strategies.

Financial Strategies: Growth strategy, stabilization strategy and retrenchment strategy. Portfolio strategies G.E, B.C.G & Arthur D.Little’s model.

Corporate Strategic Events: Corporate parenting strategy, Ansoffs product market Grid-Product Development, Market Development and Market penetration and diversification strategies.

Strategic Management Evaluation and control: Strategy implementation and evaluation control of strategic performance-performance gap, ROI, Budget and Financial Ratios, Strategy Audit.

Reading:

1. David Langford, Steven Male, Strategic Management in Construction, 2nd Edition, John-Wiley and Sons, 2008.
2. Richard Fellows, Construction Management in Practice, 2nd Edition, Blackwell Science, 2001.

CE5161	UNDERWATER CONSTRUCTION	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Construction Techniques

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand problems in site preparation, drainage and shoring during excavation.
CO2	Understand Implementation of underwater construction.
CO3	Apply underwater tunnelling techniques.
CO4	Design of underwater foundation for structures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	1	2	1			1	
CO2			3	1			1	
CO3		3	3				1	
CO4		3	2				1	1

Detailed syllabus

Introduction: Site preparation, temporary roads, site drainage. Deep trench and deep basement excavations. Bulk excavation.

Coastal structures: Stability of slopes to open excavations. support of excavation by timbering and sheet piling.

Offshore Platforms: Retaining walls and sheet pile design, Requirements for shorting and underpinning. Methods of shoring of Underpinning.

Dewatering and Groundwater Control for Soft Ground Tunneling: Tunneling in touch, medium-tough and soft rocks. Tunneling by borls shield tunneling.

Piping Systems: Culverts and conduits.

Deep water foundations: Design of piles, pile load tests. Foundation design for dynamic conditions.

Reading:

1. Ben C. Gerwick Jr., Construction *of* Marine and Offshore Structures, 3rd ed. CRC Press, 2007.
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley and Sons.1992.

CE 5162	Timber and Formwork Design	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Design decking, form work and false work.
CO2	Understand the sequence of construction of civil engineering structures.
CO3	Understand the safety steps involved in the design of form work and false work.
CO4	Select a right material for manufacturing false work and form work suiting specific requirements.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	1				1	1
CO2	1	3					1	
CO3	1	3	1					
CO4		3	3	1			1	1

Detailed syllabus

Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms.

Formwork – Design: Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork.

Design of Decks and False works: Types of beam, decking and column formwork, Design of decking, False work design, Effects of wind load, Foundation and soil on false work design.

Special Forms: The use and applications of special forms.

Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and false work.

Reading:

1. Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996
2. Michael P. Hurst, Construction Press, London and New York., 2003
3. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996.
4. Tudor Dinescu and Constantin Radulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.

CE5163	QUALITY AND SAFETY MANAGEMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand different aspects of quality and related tools.
CO2	Apply techniques of total quality assurance and quality control programme and cost implication.
CO3	Understand importance of various aspects of safety during construction activity.
CO4	Apply principles of environmental safety to construction projects.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	1	3					1
CO2	3	1	2				1	1
CO3	3	1			1			
CO4	3	1		2			1	

Detailed syllabus

Quality Management: Quality policy in construction industry-Consumer satisfaction-Ergonomics ,Time of Completion-Statistical Tolerance-Taguchi's concept of quality- Contract and construction programming-Inspection procedures.

Quality Assurance and Control: Total QA/QC Program and cost implication. Different aspects of quality-Appraisals, failure mode analysis, Stability methods and tools, Influence of drawings, detailing, specification.

Standardization: Standardization-Bid preparation-Construction activity.

Safety Programmes and organization: Environmental safety, Social and environmental factors.

Reading:

1. Clarkson H. Oglesby, Productivity Improvement in Construction, McGraw Hill, 2000

2. James, J.O Brian, Construction Inspection Handbook – Quality Assurance and Quality Control, Van Nostrand, New York,1989
3. Juran Frank, J.M. and Gryna, F.M. Quality planning and Analysis, Tata McGraw Hill, 1982
4. Kwaku A., Tenah and Jose M.Guevera, Fundamental of Construction Management and Organization, PHI 1995

CE5263	REHABILITATION OF STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Neo Construction Materials

Course Outcomes: At the end of the course the student will be able to:

CO1	Estimate causes for distress and deterioration of structures.
CO2	Understand NDT techniques for condition assessment of structures for identifying damages in structures.
CO3	Select repair material and retrofitting strategy suitable for distress.
CO4	Formulate guidelines for repair management of deteriorated structures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		2	3	2			2	1
CO2		2	3				1	2
CO3		1	3	2			1	1
CO4		2	3	2			1	1

Detailed syllabus

Introduction to Rehabilitation: An overview of present repair practices, distress identification and repair management, Causes of distress in concrete structures-Holistic Models for deterioration of concrete, Permeability of concrete, aggressive chemical agents, durability aspects, Condition Survey- Definition, objectives, different stages-Preliminary inspection, planning stage, visual inspection, field laboratory testing stage, consideration for repair strategy.

Non Destructive and Destructive Testing Methods: Non-Destructive evaluation tests - Concrete strength assessment - Rebound hammer test - Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing, Chemical tests - Carbonation tests and chloride content, Corrosion potential assessment - cover meter survey, half cell potentiometer test, resistivity measurement, Discussion of case studies of RCC buildings subjected to distress - Identification and estimation of damage.

Evaluation of Structural properties: Fire damage assessment, structural integrity and soundness assessment, interpretation and evaluation of results, Evaluation of reserve strength of existing structures, analysis necessary to identify critical sections, active and passive repairs, modeling of repaired composite structures .

Repair materials and case studies: Selection of repair materials for concrete-Essential parameters for repair materials-Strength and durability aspects, cost and suitability aspects, Materials for repair-Premixed cement concrete and mortars, polymer modified mortars and concrete, epoxy and epoxy systems including epoxy mortars and concrete, polyester resins, coatings, Discussion of case studies-RCC buildings, water tanks, industrial structures-Identifying a suitable repair option for certain damage in a structure.

Repair/ Rehabilitation methods and strategies: Rehabilitation and retrofitting methods-repair options, performance requirements of repair systems, important factors to be considered for selection of repair methods, Repair stages, Guniting, shotcreting, polymer concrete system, reinforcement replacement, strengthening concrete by surface impregnation, polymer and epoxy overlays, Resin/polymer modified slurry injection, plate bonding technique, ferrocement jacketing, RCC jacketing, propping and supporting, fiber wrap technique, foundation rehabilitation methods, chemical and electrochemical method of repair, Repair/Rehabilitation strategies- Stress reduction technique, repair and strengthening of columns and beams, Compressive strength of concrete, cracks/joints, masonry, foundation, base isolation.

Guidelines for repair and rehabilitation works: Guidelines for framing terms and conditions for repair and rehabilitation works contracts- engagement of consultants, contractors, execution of work, post repair inspection

Reading:

1. Raikar, R.N., “Learning from failures - Deficiencies in Design, Construction and Service” RandD Centre (SDCPL), RaikarBhavan, Bombay, 1987.
2. Santhakumar A.R., “Concrete Technology” Oxford University Press, 2007, New Delhi
3. CPWD Handbook on Repair and Rehabilitation of RCC buildings, Govt of India Press, New Delhi

CE5264	TALL STRUCTURES	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand structural systems of tall buildings.
CO2	Implement latest construction practices and processes for structural systems.
CO3	Analyse and design high rise structures.
CO4	Design fire protection systems in tall buildings.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3						
CO2	1	3		2			2	1
CO3		3	3				1	
CO4		3	2	2			2	1

Detailed syllabus

Evolution of Tall buildings: Introduction, Design criteria for structural design of Tall building, Concept of premium for height, Development of high rise architecture.

Assembly of Building and site investigation: Building performance –cost, quality and time, Environmental requirements, Industrialization& Robotics in Construction, Introduction to safety and Health Management System, Stages of site Investigation, Site Reconnaissance & Ground investigation-Field tests & Laboratory tests.

Foundation systems: Foundation systems.

Material handling and Mechanization: Material handling considerations, Earthmoving equipment's, Horizontal and vertical movements, Selection & Utility of Cranes (Tower Cranes & Climbing Cranes).

Wind & seismic effects on behavior of Tall Structures: Outlook of Design considerations and Characteristics of wind, Codal wind loads and cladding pressures on behavior of tall buildings, Introduction to Tall building behavior during earthquakes and seismic design philosophy.

Structural Forms & Flooring Systems: Introduction of Various structural forms and their importance to high rise architecture, Introduction to various Flooring Systems in concrete & steel.

Modeling for analysis: Approaches for analysis, Assumptions involved in modeling, Reduction techniques, Application using Structural engineering Software.

Reading:

1. Taranath, B, Steel, Concrete and Composite Design of Tall Buildings, 2nd Edition, McGraw Hill, 1998.
2. White and Salmon, Building Structural Design Handbook, John Wiley & Sons, 1987.
3. Wolfgang Schueller, the Design of Building Structures, Prentice Hall, New Jersey, 1996.

CE 5265	Structural Health Monitoring	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Seismic Resistant Design.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Understand types of static field testing and loading methods
CO2	Perform Dynamic field testing
CO3	Perform Continuous and periodic monitoring
CO4	Identify Hardware required for remote data acquisition system for health monitoring

Mapping of course outcomes with program outcomes:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	-	3	-	2	-	-
CO2	2	3	-	3	-	3	-	-
CO3	1	2	-	3	-	-	1	1
CO4	1	2	-	2	-	3	-	1

Detailed Syllabus:

Introduction - Definition of SHM - Motivation for structural health monitoring - Assessment by NDT equipment's.

Static Testing - Static field testing- types of static tests- loading methods - Behavioural / Diagnostic tests - Proof tests - Static response measurement – strain gauges, LVDTs, dial gauges - case study.

Dynamic field testing - Types of dynamic tests - Stress history data - Dynamic load allowance tests - Ambient vibration tests - Forced Vibration Method - Dynamic response methods - Impact hammer testing - Shaker testing - Periodic and continuous monitoring.

Data Acquisition - Static data acquisition systems - Dynamic data acquisition systems - Components of Data acquisition system - Hardware for Remote data acquisition systems.

Remote Structural health monitoring - Remote Structural Health Monitoring - Importance and Advantages – Methodology - RF/PSTN/GSM/Satellite Communications - Networking of sensor - Data compression technique - Case Studies

Reading:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 2006.

2. Douglas E Adams, "Health Monitoring of Structural Materials and Components - Methods with Applications", John Wiley and Sons, 2007.

3. J.P. Ou, H. Li and Z.D. Duan, “Structural Health Monitoring and Intelligent Infrastructure Vol-1”, Taylor and Francis Group, London, U.K, 2006.

4. Victor Giurglutiu, “Structural Health Monitoring with Wafer Active Sensors”, Academic Press Inc., 2007.

CE5770	CLIMATE SYSTEMS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: Environmental Impact assessment

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify the factors influencing the global climate systems.
CO2	Assess the impacts of climate change on global, regional and local scales.
CO3	Develop strategies for adaptation and mitigation measures.
CO4	Identify clean technologies for sustainable development.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	3	1	3			1	1
CO2	2	2	1	3			1	2
CO3	3	3	2	3	2		1	2
CO4	1	1	3	3			2	2

Detailed syllabus

Earth's Climate System: Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation –The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

Observed Changes And Its Causes: Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC –Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

Impacts Of Climate Change: Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Climate Change Adaptation And Mitigation Measures: Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human

Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

Clean Technology And Energy: Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydropower – Mitigation Efforts in India and Adaptation funding.

Reading:

1. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998
3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998
4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996
5. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

CE5466	OFFSHORE FOUNDATIONS	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Analyze the index and engineering properties of marine clays.
CO2	Adopt suitable investigation method and sampling techniques for marine deposits.
CO3	Analyze loads on offshore structures and select appropriate foundation for structures.
CO4	Implement the required ground improvement technique for structures.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	3	2					
CO2	2	3	2					
CO3	1	3	3					
CO4	1		2				2	2

Detailed syllabus

Introduction: Key challenges of offshore engineering design

Architecture and Marine Environment: Common components of field architecture and describe the drivers during concept selection, aspects of the marine environment that feed into offshore engineering design

Site Investigation and geotechnical aspects: Main components of an offshore site investigation, geotechnical site investigation data

Offshore Foundations: Main types of offshore foundation systems and describe the drivers during foundation design, foundation design calculations to illustrate the interplaying mechanisms

Loads on Offshore Structures: Aspects of geotechnical pipeline design and perform selected design calculations to illustrate the interplaying mechanisms. loads acting on the offshore structures

Reading:

1. Ben C. Gerwick, Construction of Marine and Offshore Structures, CRC Press, 1999.
2. Gou B., Song S., Chacko J. and Ghalambor A., Offshore Pipelines, GPP Publishers, 2006.
3. Hakrabarti, S. K., Handook of Offshore Engineering, Elsevier, 2005.
4. Tomlinson, M. J., Pile Design and Construction, E and F Spon, 1994.

ME5061	CRITICAL CHAIN MANAGEMENT	DEC	3 – 0 – 0	3 Credits

Pre-requisites: None

Course Outcomes: At the end of the course, the student will be able to:

CO1	Identify resource dependencies in the project network.
CO2	Understand importance of search for an optimum solution.
CO3	Provide buffers for efficient project management.
CO4	Monitor project progress by considering the consumption rate of the buffers.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2				2	1	3	3
CO2		2	3				3	3
CO3	2			2		1	3	3
CO4	2		2				3	3

Detailed syllabus

Overview of Theory of Constraints (TOC): The troughput world, The production solution, Five focussing steps, The thinking process, Resistance to Change.

Concept of critical chain in projects: Project initiation process, Stake holder endorsement, The work breakdown structure, Responsibility assignment, Milestone sequencing, work packages

Developing single-project critical chain plan: The process, good-enough concept, Buffer and Threshold sizing, Cost buffer, Methods to create the plan, External constraints, Reducing Planned time, Enterprise wide resource planning

Developing multi-project critical chain plan: Identifying the multi project Constraints, Exploiting the Multi project constraint, Features of multi project critical chains.

Measurement and control, Project risk management: Buffer Management, The cost buffer, Quality Measurement, Response to buffer signals, The cost world, Change control actions.

TOC's thinking process applied to project management.: Goldratt's Thinking process, Current-reality tree, Future reality tree, Prerequisite tree, Transition tree, The multiproject Process, Future directions

Reading:

1. Dettmer HW, The Logical Thinking Process: A Systems Approach to Complex Problem Solving, ASQ Quality Press, 2007.
2. Leach LP, Critical Chain Project Management, Artech House, 2004.

CE6142	COMPREHENSIVE VIVA VOCE	PCC	0 – 0 – 0	2 Credits

Pre-requisites: Both I & II Semester course work of I Year should be completed**.**

Course Outcomes: At the end of the course, the student will be able to:

CO1	Assimilate knowledge of different courses studied.
CO2	Develop overall comprehension about Construction Technology and Management.
CO3	Analyse real life engineering problems with theoretical knowledge learned.
CO4	Interpret and articulate solutions to real life structural engineering problems.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	2				
CO2	3	3	3	2				
CO3	3	3	3	2				
CO4	3	3	3	2				

Detailed syllabus

All the subjects studied in I year I semester and II semesters.

Reading:

1. Reading Material of all the courses
2. Case Studies / Consultancy Reports

CE6149	DISSERTATION PART- A	PCC	0 – 0 – 0	6 Credits

Pre-requisites: Both I & II Semester course work of I Year should be completed**.**

Course Outcomes: At the end of the course, the student will be able to:

CO1	Define Research Problem Statement.
CO2	Critically evaluate literature in chosen area of research & establish scope of work.
CO3	Develop study / experimental methodology.
CO4	Carryout pilot theoretical study/experiment.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	2	3	3	3	3
CO2	2	2	2	2	3	3	3	3
CO3	2	2	2	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3

Detailed syllabus

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest and the available facilities at the commencement of dissertation work. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Reading:

1. Journal Publications
2. Conference / Seminar Proceedings
3. Handbooks / Research Digests

CE6199	DISSERTATION PART- B	PCC	0 – 0 – 0	12 Credits

Pre-requisites:

1. Both I & II Semester course work of I Year should be completed.
2. CE6149: Dissertation Part A

Course Outcomes: At the end of the course, the student will be able to:

CO1	Expand on the defined research problem in dissertation Part-A.
CO2	Critically evaluate literature in the well defined research & clearly establish scope of work.
CO3	Conduct Laboratory studies.
CO4	Analyse data, develop models and offer solutions.

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	2	2	3	3	3	3
CO2	2	2	2	2	3	3	3	3
CO3	2	2	2	2	3	3	3	3
CO4	2	2	2	2	3	3	3	3

Detailed syllabus

Students are required to search, collect and review various research articles published in chosen area of research. A student has to select a topic for his dissertation, based on his/her interest and the available facilities at the commencement of dissertation work. A student shall be required to submit a dissertation report on the research work carried out by him/her.

Reading:

4. Journal Publications
5. Conference / Seminar Proceedings
6. Handbooks / Research Digests