School of Technology: Department of Civil Engineering
Post Graduate Program: M. Tech. Construction Engineering & Management
Curriculum Structure **Academic Year 2018-19**

Semester I									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
CEM501 (PC|ST) Version:1.0	Advanced Concrete Science and Technology	3	1	-	4	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM503 (PC|ST) Version:1.0	Concrete Processes	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM505 (PC|ST) Version:1.0	Construction Planning, Scheduling and Control	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM507. - (PE|ST) Version:1.0	Program Elective - I	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM509. - (DE|ST) Version:1.0	Department Elective- I	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM511 (UC|ST) Version:1.0	Research Methodology and IPR	3	1	-	4	Theory (100)	FET	20	40
							CAT	30	
							CAT II	15	
							ESE	50	40
CEM513 (PC|ST) Version:1.0	Cement Concrete Lab - I	-	-	2	1	Practical	FEP	50	40
							POE	50	
CEM515 (PC|ST) Version:1.0	Construction Planning Lab	-	-	2	1	Practical	FEP	50	40
							POE	50	
CEM517 (PW|ST) Version:1.0	Mini Project - I	-	-	2	1	Project	FEP	100	40
		18	**02**	**06**	**23**	Total Hours: **26**, Total Credits: **23**			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical; **POE** – Practical Oral Examination

Semester II									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
CEM502 (PC|SS) Version:1.0	Fracture Mechanics of Concrete Structures	3	1	-	4	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM504 (PC|SS) Version:1.0	Construction Project Management	3	1	-	4	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM506 (PC|SS) Version:1.0	Contract Laws and Regulations	3	1	-	4	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM508. - (PE|ST) Version:1.0	Program Elective - II	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM510. - (DE|ST) Version:1.0	Department Elective- II	3	-	-	3	Theory (100)	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
CEM512 (PC|ST) Version:1.0	Cement Concrete Lab - II	-	-	2	1	Practical	FEP	50	40
							POE	50	
CEM514 (PC|ST) Version:1.0	Construction Contracting Lab	-	-	2	1	Practical	FEP	50	40
							POE	50	
CEM516 (PW|ST) Version:1.0	Mini Project - II	-	-	2	1	Project	FEP	100	40
CEM518 (PC|ST) Version:1.0	NPTEL Online Courses	-	-	-	2	Online	FEP	100	40
		15	**03**	**06**	**23**	Total Hours: **24**, Total Credits: **23**,			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical; **POE** – Practical Oral Examination

Semester III									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
CEM601 (PW|ST) Version:1.0	Construction Industry Internship	-	-	-	4	Report and Presentation	FEP	50	50
							ESE	50	
CEM603 (PW|ST) Version:1.0	Dissertation Phase - I	-	-	-	4	Presentation	FEP	100	50
CEM605 (PW|ST) Version:1.0	Dissertation Phase - II	-	-	-	8	Presentation Report and Demo	ISE	100	50
							ESE	50	
		-	**-**	**-**	**16**	Total Hours: **-**, Total Credits: **16**,			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical; **POE** – Practical Oral Examination

Semester IV									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
CEM602 (PW|ST) Version:1.0	Dissertation Phase - III	-	-	-	8	Presentation & Demonstration	ISE	100	50
CEM604 (PW|ST) Version:1.0	Dissertation Phase - IV	-	-	-	8	Viva Voce Exam	ESE	50	50
CEM606 (PW|ST) Version:1.0	Dissertation outcome Dissemination	-	-	-	2	Publications and Patents	ESE	100	50
		-	**-**	**-**	**18**	Total Hours: **-**, Total Credits: **18**,			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical; **POE** – Practical Oral Examination

Total Credits: **80**

Program Elective

CEM507.1 Quality Control and Safety Management
CEM507.2 Resource Management
CEM507.3 Computer Applications in Construction Engineering
CEM508.1 Formwork for Concrete
CEM508.2 Repair and Rehabilitation of Concrete Structures
CEM508.3 Fiber Reinforced Concrete

Department Elective

CSE509.1 / CEM509.1 Structural Optimization
CSE509.2 / CEM509.2 Structural Health Monitoring
CSE509.3 / CEM509.3 Green Building Technology-
CSE510.1 / CEM510.1 Disaster Management
CSE510.2 / CEM510.2 Underwater Construction
CSE510.3 / CEM510.3 Environmental Impact Assessment and Management

CEM501: Advanced Concrete Science and Technology

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	1	-	4	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: The focus will be very much on calcium silicate cement, blended cements, which are formed by replacing some of the Portland cement with mineral admixtures such as silica fume, slag, and fly ash, are also discussed in detail. It also happens that the chemical reactions and reaction products associated with mineral admixtures are quite interesting and can be readily discussed in conjunction with those of Portland cement itself.

Course Outcomes: after the end of this course students will able to

- **CO1** Generalizes[5] microstructure of cement paste
- **CO2** Critisize[4] physical sate of water in cement paste
- **CO3** Examine[4] heat of hydration and its effect on strength of concrete
- **CO4** Evaluate[6] effect of chemical admixture on fresh concrete
- **CO5** Rate[6] need of sustainable concrete
- **CO6** Evaluate[6] shrinkage and creep of concrete

Syllabus (Theory)

Units	Description	Hours
I	**Microstructural Aspects of Cement Paste:** general features, overview of the hydration process, the hydration reactions, morphology of the main hydration products, interfacial transition zone (ITZ), phase composition of Portland cement paste.	06
II	**Pore Structure of Cement Paste:** pore system, classification of pores, physical state of water in cement paste, pore volume measurements.	06
III	**The Kinetics of Hydration of C_3S:** Overview of Kinetics, the heat of hydration and thermal calorimetry, Nucleation and Growth, Diffusion Controlled, Effect of Hydration Temperature, Effect of Particle Size, Strength development with time.	06

IV	**Chemical Admixtures**: Accelerator, retarder, water reducing elements, plasticizer and super-plasticizer, their functions and dosage. Self-curing admixture.	06
V	**Mineral Admixtures:** Pozzolanic Reaction, Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag, and Metakaoline and their effects on concrete properties	06
VI	**Shrinkage and Creep of Concrete:** Plastic Shrinkage, Drying Shrinkage, Autogenous Shrinkage and Self-desiccation, Creep of Cement Paste, factors affecting and how to measure shrinkage and creep of concrete.	06

Text Book

- Gupta B. L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
- Shetty M. S, "Concrete Technology", S. Chand and Company Ltd, New Delhi, 2003

References

- P.K. Mehta and Paulo J.M. Monteiro, "Concrete: microstructure, properties and materials", The McGraw, Hill Companies
- Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995
- Gambir. M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi

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CEM503: Concrete Processes

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To develop adequate understanding on concrete production process and properties and uses of concrete as a modern material of construction.

Course Outcomes: after the end of this course students will able to

CO1 Design[5] concrete mixes as per IS and ACI codes.
CO2 Critisize[4] the need for special concrete.
CO3 Integrate[5] Ready Mix Concrete (RMC)

CO4 Generalize[5] construction method for special concrete.
CO5 Evaluate[6] strength of existing structure by using NDT.
CO6 Evaluate[6] damage of structural elements and suggest repairing techniques.

Syllabus (Theory)

Units	Description	Hours
I	**Concrete Mix Design:** Principles of mix proportioning, probabilistic parameters, factors governing selection of mix. Road note, 4, DOE, ACI and IS method of concrete mix design, acceptance criteria.	06
II	**Special Concretes:** High strength, high performance concrete, reactive powder concrete, lightweight, heavyweight, and mass concrete; fibre reinforced concrete; self-compacting concrete; other special concretes.	06
III	**Ready Mixed Concrete:** RMC facility, general requirements of RMC, monitoring quality of ingredients, quality control, concrete pump, design of plumbable concrete, maintenance concrete pump.	06
IV	**Construction Methods:** shotcrete, roller compacted concrete, mass concrete, underwater concrete, vacuum dewatered concrete.	06
V	**Repairing Concrete:** Introduction to 'maintenance' of concrete structures, use of nondestructive testing, evaluation criteria.	06
VI	**Distress in Structure:** causes and precautions, damage assessment of structural elements, repairing techniques and repairing materials.	06

Text Book

- Gupta B. L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
- Shetty M. S, "Concrete Technology", S. Chand and Company Ltd, New Delhi, 2003

References

- Santhakumar. A.R; "Concrete Technology", Oxford University Press, New Delhi, 2007
- Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995
- Gambir. M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi.
- IS10262,1982 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998

CEM505: Construction Planning, Scheduling and Control

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: 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.

Course Outcomes: after the end of this course students will able to

- **CO1** Explain[4] basic concepts of construction planning
- **CO2** Summarized[5] elements of scheduling and to apply appropriate tools
- **CO3** Analyze[4] techniques like networks and coding systems in construction
- **CO4** Manage[5] projects through cost control
- **CO5** Examine[4] quality control and safety of construction projects
- **CO6** Compose[5] and study the concept of gathering and using project information

Syllabus (Theory)

Units	Description	Hours
I	**Construction Planning:** 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.	06
II	**Scheduling Procedures:** Construction Schedules, Critical Path Method, Scheduling Calculations, Float, Presenting Project Schedules, Scheduling for Activity, Node and with Leads, Lags, and Windows, Scheduling with Resource Constraints and Precedence's,	06
III	**Scheduling Techniques:** Use of Advanced Scheduling Techniques, Scheduling with Uncertain Durations, Calculations for Monte Carlo Schedule Simulation, Crashing and Time/Cost Tradeoffs, Improving the Scheduling Process.	06

IV	**Cost Control, Monitoring and Accounting:** 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.	06
V	**Quality Control and Safety During Construction:** 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.	06
VI	**Organization and Use of Project Information:** 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.	06

Text Book

- Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, McGraw Hill Publishing Company, New Delhi, 1998.

References

- Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.
- Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
- Halpin, D. W., Financial and Cost Concepts for Construction Management, John Wiley & Sons, New York, 1985.
- Willis, E. M., Scheduling Construction Projects, John Wiley & Sons, 1986.

CEM511: Research Methodology

(Ver 1.0, University Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	1	-	4	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To develop adequate understanding on basic concepts of research and its methodologies, select and define appropriate research problem, prepare a project proposal, write a research report and thesis, write a research proposal, process for filing patent.

Course Outcomes: after the end of this course students will able to

- **CO1** Design[5] research problem
- **CO2** Organize[5] research related information
- **CO3** Acept[7] research ethics
- **CO4** Compare[6] tomorrow world will be ruled by ideas, concept, and creativity
- **CO5** Criticize[5] IPR in growth of individuals & nation
- **CO6** Evaluate[4] research problem with economic growth and social benefits

Syllabus (Practical)

Units	Description	Hours
I	**Research:** Definition of research, Applications of research and types, Research process and steps in it, Deductive and inductive reasoning; Validity-conclusion, internal, construct and external; Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem-solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	06
II	**Single Factor Experiment**: Analysis of Variance (ANOVA) for fixed effect model; Total treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors. **Two factor Factorial Design:** Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two-factor factorial design; Models- Effects, means and regression	06
III	**Taguchi Techniques for Experimental Design:** Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting- methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects, Parameter Design- Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design.	06
IV	**Design of Experiments (DOE):** Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE, Simple Comparative Experiments- Basic statistical concepts, random	06

	variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample t test-value, Confidence intervals, Paired comparison.	
V	**Literature review:** Need, Procedure- Search for existing literature, Review the literature selected, develop a theoretical and conceptual framework, writing up the review, Formulating a research problem: Sources, Considerations, Steps in formulation of a problem, formulation of objectives, Definition of variables – Concepts, indicators and variables, Types of variables, Types of measurement scales, Constructing the Hypothesis- Null(Research) and alternative, one-tailed and two-tailed hypotheses, Hypothesis testing, errors in testing.	06
VI	**Research Modeling:** Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling, Data collection methods, Surveys-types and method selection. **Research Proposal:** Contents-Preamble, the problem, objectives, hypothesis to be tested, study design, setup, measurement procedures, analysis of data, organization of report; Displaying data- tables, graphs and charts, Writing a research report-Developing an outline, Key elements- Introduction, Methods, Measurement section, Design& procedure section, Results, conclusion section, Referencing of books and research papers, Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.	06

Text Book

- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"

References

- Krishnaswamy, K. N., Sivakumar, Appa Iyer and Mathirajan, M. (2006), Management Research Methodology: Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
- Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1
- Montgomery, Douglas C. & Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e, (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN:978-81-265-1424-3
- Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, Dreamtech Press, New Delhi), ISBN: 81-7722-372-0
- Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (New Age International, New Delhi)

CEM513: Cement Concrete Lab - I

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	50	40
					ESE	50	

Course Outcomes: after the end of this course students will able to

CO1 demonstrated the knowledge of a variety of laboratory procedures for concrete and aggregates.

CO2 perform, record, and report the results of a variety of laboratory procedures for concrete and aggregates.

Scope and Knowledge:

Certification as an **ACI Concrete Laboratory Testing Technician—Level 1** demonstrates a working knowledge of the following ASTM and/or AASHTO practices and test methods:

As an ACI Concrete Strength Testing Technician:

- C617/C617M—Capping Cylindrical Concrete Specimens
- C1231/C1231M—Unbonded Caps for Concrete Cylinders
- C39/C39M—Compressive Strength of Cylindrical Concrete Specimens
- C78/C78M—Flexural Strength of Concrete

As an ACI Aggregate Testing Technician:

- T2–91—Sampling Aggregates
- T248–11—Reducing Samples of Aggregate to Testing Size
- T11–05—Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
- T27–11—Sieve Analysis of Fine and Coarse Aggregates
- T85–10—Specific Gravity and Absorption of Coarse Aggregate
- T84–10—Specific Gravity and Absorption of Fine Aggregate
- T255–00—Total Moisture Content of Aggregate by Drying
- T21–05—Organic Impurities in Fine Aggregate for Concrete

CEM515: Construction Planning Lab

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	50	40
					ESE	50	

Course Description: To develop adequate understanding on basic concepts of research and its methodologies, select and define appropriate research problem, prepare a project proposal, write a research report and thesis, write a research proposal, process for filing patent.

Course Outcomes: after the end of this course students will able to

CO1 plan, control and monitor construction projects with respect to time and cost
CO2 construction projects are administered with respect to contract structures and issues
CO3 optimize construction projects based on costs

Syllabus (Practical)

Units	Description	Hours
I	Develop a WBD structure for the construction of one storeyed building; Develop a bar chart for the construction of this building, including finishing activities, assuming reasonable activity durations.	04
II	Develop a CPM chart for a 5-span bridge on open foundations. Develop a comparative table for a 10-storeyed building constructed by at least three different methods, listing their pros and cons.	04
III	Develop a Gantt Chart for the construction of a two storeyed precast framed structure, including open foundations, along with list of equipment resources, assuming reasonable quantities and productivities. Develop a bar chart for concreting 1500 sq.m. of a 15cm. thick slab using various equipment for production to place of concrete at 3m height above ground level; show all equipment resources required, along with a site layout	04

References

- Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
- National Building Code, Bureau of Indian Standards, New Delhi, 2017.
- Chudley, R., Construction Technology, ELBS Publishers, 2007.
- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006

- Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India.
- Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

CEM517: Mini Project - I

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	100	40

Course Outcomes: after the end of this course students will able to

CO1 Acquired[4] knowledge within the chosen area of technology for project development
CO2 Justify[6] the technical aspects of the chosen project with a comprehensive
CO3 Reproduce[5], improve and refine technical aspects for engineering projects
CO4 Work[4] as an individual in development of technical projects
CO5 Communicate[5] and report effectively project related activities and findings

Syllabus

Mini project may be carried out in one or more form of following:

- Product preparations, working/non-working models, prototype development, fabrication of setups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, survey, creating awareness in society.
- The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

CEM502: Fracture Mechanics of Concrete

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	1	-	4	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: Emphasis will be equally placed on sound theoretical coverage of fracture mechanics and its computational application in concrete structures, as well as on the practical application of those techniques in the analysis of structures.

Course Outcomes: after the end of this course students will able to

CO1 Compare[6] structural failure based on material performance.
CO2 Analyze[4] linear elastic fracture mechanics of concrete.
CO3 Analyze[4] non-linear elastic fracture mechanics of concrete.
CO4 Evaluate[6] fracture process zone on fracture behavior of concrete.
CO5 Compare[6] variation of plastic zone over thickness of concrete.
CO6 Evaluate[6] fracture in concrete by using different test

Syllabus (Theory)

Units	Description	Hours
I	**Introduction** Structural failure based on material performance; Concepts of linear elastic fracture mechanics; Fracture mechanics of concrete.	06
II	**Linear Elastic Fracture Mechanics:** Airy stress functions for problems in elasticity; Complex stress function; Elastic stress and displacement fields at crack tip; Stress intensity factors and crack opening displacements for useful geometries; Superposition of stress intensity factors; Plastic zone at crack tip; Griffith's fracture theory; Strain energy release rate for crack propagation; Relationship between stress intensity factor and strain energy release rate; Design based on linear elastic fracture mechanics.	06
III	**Nonlinear Fracture Mechanics:** Energy principles for crack propagation in non-linear materials; J-integral for nonlinear elastic materials; Fracture resistance (R curve); Crack tip opening displacement.	06
IV	**Fracture Process of Concrete:** Constituents and microstructure of concrete; Fracture behaviour and strain localization of concrete; Fracture process zone and toughening mechanisms; Experimental determination of fracture zone; Influence of fracture process zone on fracture behaviour of concrete.	06
V	**Fracture Behavior of Different Materials:** Variation of plastic zone over the thickness, slip planes in plane strain and plane stress, Experimental evidence, Minimum thickness for fracture toughness specimen based on plastic zone,	06
VI	**Concrete Fracture Properties:** Fracture testing – early attempts, Fracture toughness as a function of specimen thickness, Requirements of the test,	06

Candidate fracture toughness, Compact tension and three-point bend specimens, Chevron notch – visualization exercise.

Test Book

- Elements of fracture mechanics by Prashant Kumar, Wheeler Publishing, 1999
- Rock and Other Quasi,Brittle Materials by Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, Publisher: Wiley , 1995.
- David Broek, Elementary Engineering Fracture Mechanics, 3rd Rev Edition, Springer, June 1982.

References

- "Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock and Other Quasi,Brittle Materials" Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang
- "Fracture Mechanics: Fundamentals and Applications", Third Edition, CRC Press, Ted L. Anderson.
- "Fatigue of materials", Cambridge University Press, June 2012 by S. Suresh.
- "Deformation and Fracture Mechanics of Engineering Materials" by Rechard W Hertzberg.
- "Concrete fracture models and applications", Springer, ©2011, Shailendra Kumar; Sudhirkumar V Barai
- "Structural and Residual Stress Analysis by Nondestructive Methods" by V Hauk

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CEM504: Construction Project Management

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	1	-	4	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To study the various management techniques for successful completion of construction projects. To study the effect of management for project organization, design of construction process, Labour, material and equipment utilization, and cost estimation.

Course Outcomes: after the end of this course students will able to

CO1 Compare[6] various management techniques for successful completion projects
CO2 Organize[5] effect of management for project organization
CO3 Design[5] of construction process
CO4 Optimize[5] Labour, material and equipment utilization, and cost estimation
CO5 Evaluate[6] effective cost and control of project
CO6 Recommende[6] effective financial management in construction

Syllabus (Theory)

Units	Description	Hours
I	**The Owners' Perspective:** 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.	06
II	**Organizing for Project Management:** 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.	06
III	**Design and Construction Process:** Design and Construction as an Integrated System, Innovation and Technological Feasibility, Innovation and Economic Feasibility, Design Methodology, Functional Design, Construction Site Environment.	06
IV	**Labour, Material and Equipment Utilization:** Historical Perspective, Labour Productivity, Factors Affecting Job, Site Productivity, Labour 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.	06
V	**Cost Estimation:** 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.	06

VI	**Financial Management:** Working Capital Management, Compound Interest and Present Value methods, Discounted Cash Flow Techniques, Capital Budgeting.	06

Text Book

- Chitkara, K.K. Construction Project Management: Planning, Scheduling and Control, Tata McGraw Hill Publishing Company, New Delhi, 1998.

References

- Choudhury S, Project Management, McGraw Hill Publishing Company, New Delhi, 1988.
- Chris Hendrickson and Tung Au, Project Management for Construction – Fundamental Concepts for Owners, Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
- Frederick E. Gould, Construction Project Management, Wentworth Institute of Technology, Vary E. Joyce, Massachusetts Institute of Technology, 2000.
- George J.Ritz , Total Construction Project Management , McGraw Hill Inc, 1994.

CEM506: Contract Laws and Regulations

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	1	-	4	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To study the various types of construction contracts and their legal aspects and provisions. To study the of tenders, arbitration, legal requirement, and Labour regulations.

Course Outcomes: after the end of this course students will able to

CO1 Prepare[5] effective contact document for construction project
CO2 Evaluate[6] tender for construction project
CO3 Compare[6] actions and laws in construction project
CO4 Assess[6] laws related to construction project
CO5 Summarize[6] social security, welfare legislation, laws relating to wages

CO6 Integarte[5] safety measure and health condition in construction project

Syllabus (Theory)

Units	Description	Hours
I	**Construction Contracts:** Indian Contracts Act, Elements of Contracts, Types of Contracts, Features, Suitability, Design of Contract Documents, International Contract Document, Standard Contract Document, Law of Torts.	06
II	**Tenders:** 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, Maharashtra Transparency in Tenders Act.	06
III	**Arbitration:** 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.	06
IV	**Legal Requirements:** 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.	06
V	**Labour Regulations:** 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, Child Labour Act, Other Labour Laws.	06
VI	**Welfare Measures:** Compensation, Safety and health, GPF, EPF, Group Insurance, Housing, Pension, Laws related to welfare measures.	06

Text Book

- Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.

References

- Gajaria G.T., Laws Relating to Building and Engineering Contracts in India,
- Jimmie Hinze, Construction Contracts, McGraw Hill, 2001.
- Kwaku, A., Tenah, P.E. Jose M. Guevara, P.E., Fundamentals of Construction Management and Organisation, Printice Hall, 1985.M.M. Tripathi Private Ltd., Bombay, 1982.
- Patil. B.S, Civil Engineering Contracts and Estimates, Universities Press (India) Private Limited, 2006.

CEM512: Concrete Technology Lab 2

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	50	40
					ESE	50	

Course Description: A Concrete Field Testing Technician an individual who has demonstrated the knowledge and ability to properly perform and record the results of seven basic field tests on freshly mixed concrete.

Course Outcomes: after the end of this course students will able to

CO1 demonstrated the knowledge of a variety of laboratory procedures for concrete and aggregates.

CO2 properly perform, record, and report the results of a variety of laboratory procedures for concrete and aggregates.

Scope and Knowledge:

The program requires a working knowledge of the following ASTM test methods and practices:
C1064/C1064M—Temperature of Freshly Mixed Hydraulic-Cement Concrete
C172/C172M—Sampling Freshly Mixed Concrete
C143/C143M—Slump of Hydraulic-Cement Concrete
C138/C138M—Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
C231/C231M—Air Content of Freshly Mixed Concrete by the Pressure Method

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CEM514: Construction Contracting Lab

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	50	40
					ESE	50	

Course Outcomes: after the end of this course students will able to

CO1 Plan[5], control and monitor construction projects with respect to time and cost

CO2 Construction[6] projects are administered with respect to contract structures and issues

CO3 Optimize[5] construction projects based on costs

Syllabus (Practical)

Units	Description	Hours
I	For the construction of a typical 3 storeyed, framed structure with 400 sq.m. area per floor develop the histograms for the various resources required, showing all intermediate calculations; also, draw S-curves for concrete placing and blockwork done over the period.	04
II	Write a 500-word note on the advantages of Lean Construction method over conventional project management systems. Write a 500-word note on the Safety and Health precautions you would take for a typical 3 storeyed building with 400 sq. m. plinth area.	02
III	Assuming a 4-month delay in a construction contract of 24 months duration, form 3 groups for arguing the case for or against levying penalty on the contractor; Group A to formulate the contract conditions, Group B to act as Client and Group C to act as the Contractor. One person to act as Arbitrator/ Judge.	04
IV	Refer to a Standard Schedule of Rates of any PWD (available on the Net), develop the approximate cost of a 3 storey, 400 sqm plinth area building.	02

Text book

- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011

References

- Varghese, P.C., "Building Construction", Prentice Hall India, 2007.
- National Building Code, Bureau of Indian Standards, New Delhi, 2017.
- Chudley, R., Construction Technology, ELBS Publishers, 2007.
- Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
- Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
- Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
- Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

CEM516: Mini Project - II

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	2	1	Practical	FET	100	40

Course Outcomes: after the end of this course students will able to

CO1 Acquired[4] knowledge within the chosen area of technology for project development
CO2 Justify[6] the technical aspects of the chosen project with a comprehensive
CO3 Reproduce[5], improve and refine technical aspects for engineering projects
CO4 Work[4] as an individual in development of technical projects
CO5 Communicate[5] and report effectively project related activities and findings

Syllabus

Mini project may be carried out in one or more form of following:

- Product preparations, working/non-working models, prototype development, fabrication of setups, laboratory experiment development, process modification/development, simulation, software development, integration of software and hardware, statistical data analysis, survey, creating awareness in society.
- The student is required to submit a report based on the work. The evaluation of the project shall be on continuous basis.

CEM507.1: Quality Control and Safety Management

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To create a complete understanding on quality planning, quality assurance, quality control and safety management.

Course Outcomes: after the end of this course students will able to

CO1 Distinguish[4] the elements of quality planning and the implication

CO2 Developed[5] awareness of quality assurance
CO3 Exposed[5] to means of quality control
CO4 Compair[4] the relationship between quality and safety management
CO5 Setup[5] safety measure on construction site

Syllabus (Theory)

Units	Description	Hours
I	**Quality Management Systems:** Types of organizations, Inspection. control and enforcement, Quality Management Systems and method, Responsibilities and authorities, In quality assurances and quality Control, Quality circle.	06
II	**Quality Policy:** Objectives and methods In Construction Industry, Consumers satisfaction, Economics-Time of Completion -Statistical tolerance, Taguchi's concept of quality, Codes and Standards, Documents -Contract and construction programming, Inspection procedures, Processes and products, Total QA I QC programme and cost implication.	06
III	**Objectives:** Regularity agent, owner, design, contract and construction, oriented objectives, methods, Techniques and needs of QA/QC, Different aspects of quality - Appraisals, Factors Influencing construction quality.	06
IV	**Failure Aspects:** Critical, major failure aspects and failure mode analysis, Stability methods and tools, optimum design, Reliability testing, reliability coefficient and reliability prediction, Selection of new materials, Influence of drawings detailing, specification, standardization, bid preparation, Reliability Based Design.	06
V	**Construction Activity:** Construction activity, environmental safety. Social and environmental factors, Natural causes and speed of Construction, Life cycle costing, Reliability and Probabilistic Methods, Value engineering and value analysis	06
VI	**Safety:** Ability of systems to protect fire, Preventive systems, fire escape system design, Planning for pollution free construction environmental, Hazard free Construction execution.	06

Text Book

- James, J.O Brian, "Construction Inspection Handbook -Quality Assurance and:Quality Control", Van Nostrand, New York, 2009.

References

- Kwaku, A., Tenah, Jose. M. Guevara, "Fundamentals of Construction Management and Organization", Reston Publishing Co., Inc., Virginia, 2005.

- Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis", Tata McGraw Hill 2002.
- Clarkson H. Oglesby, "Productivity Improvement in Construction", McGraw-Hill, 2009.
- L. Ashford, "The Management of Quality in Construction", E & F.N, Spon. New York, 2009.
- Steven McCabe, "Quality Improvement Techniques in Construction", Addison Wesley Longman Ltd, England. 2008.

CEM507.2: Resource Management

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To create a complete understanding on quality planning, quality assurance, quality control and safety management.

Course Outcomes: after the end of this course students will able to

CO1 Manage[5] various resources involved in construction.
CO2 Evaluate[6] the labour resources involved in construction
CO3 Evaluate[6] the material & equipment resources involved in construction
CO4 Evaluate[6] the time resources involved in construction
CO5 Plan[5] and manage the resources using leveling critical path measurement.

Syllabus (Theory)

Units	Description	Hours
I	**Introduction to Resources:** Introduction to resources, Characteristics of resources, Types of resources, manpower, Equipment, Material, Money, Time, Tools for measurement of resources	06
II	**Resource Planning:** Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.	06

III	**Labour Management:** 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.	06
IV	**Materials and Equipment:** 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.	06
V	**Time Management:** 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.	06
VI	**Resource Allocation and Levelling:** Time-cost trade off, Computer application, Resource leveling, resource list, resource allocation, Resource loading, Cumulative cost, Value Management	06

Text Book

- James, A., Adrain, "Quantitative Methods in Construction Management", American Elsevier Publishing Co., Inc., 2003.

References

- Andrew, D. Szilagg, "Hand Book of Engineering Management", 2002.
- Glenn. A, Sea's and Reichard, Clough .H, "Construction Project Management", John Wiley and Sons, Inc, 2009.
- Harvey, A. Levine, "Project Management using Micro Computers", Obsome McGraw Hill C.A. Publishing Co., Inc. 2008.

CEM507.3: Computer Applications in Construction Engineering

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: To create a complete understanding on quality planning, quality assurance, quality control and safety management.

Course Outcomes: after the end of this course students will able to

CO1	Review3 the basics of computer hardware
CO2	Planning[5] various resources used in construction management
CO3	Manage[5] and optimize use of labour in construction
CO4	Optimize[5] use of inventory models and scheduling techniques applied to construction engineering.
CO5	Optimize[5] use of construction hardware and software requirements of computer, programming, optimization techniques

Syllabus (Theory)

Units	Description	Hours
I	Overview of IT Applications in Construction – Construction process – Computerization in Construction – Computer aided Cost Estimation – Developing application with database software	06
II	Linear, Dynamic and Integer programming - Branch and Bound Techniques - Application to production Scheduling, Equipment Replacement, Material Transportation and Work Assignment Problems - Software Development.	06
III	PERT and CPM - Advanced planning and scheduling concepts – Computer applications – Case study.	06
IV	Decision Making - Bayes Theory - Simulation - Models - Genetic Algorithm	06
V	Deterministic and Probabilistic Inventory Models - Software applications	06
VI	Sequencing problems – Simulation – Enterprises – Introduction to ERP systems.	06

Text Book

- C.S. Krishnamoorthy and S. Rajeev, Computer Aided Design, Narosa publishing house, New Delhi, 1991

References

- H.B. Harrison, Structural Analysis and Design, vol. I & II, Pergamon press, 1991
- Billy E.Giliet Introduction to Operation Research - Computer Oriented Algorithmic Approach, Tata McGraw Hill,1990
- Paulson. B.R., Computer Applications in Construction, McGraw Hill, 1995
- Feigenbaum.L., Construction Scheduling with Primavera Project Planner, Prentice Hall Inc., 1999

CEM508.1: Formwork for Concrete

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: The chapter addresses planning and design considerations for formwork. More specifically, the common design deficiencies, vertical and horizontal loads, safety factors for formwork accessories and shoring are discussed.

Course Outcomes: after the end of this course students will able to

- **CO1** Categorize[4] different material used for concrete formwork.
- **CO2** Design[5] concrete formwork for different site condition.
- **CO3** Differentiate[4] shoring material used in concrete work.
- **CO4** Plan[5] and schedule concrete formwork.
- **CO5** Design[5] formwork for different systems
- **CO6** Classify[5] advances in concrete formwork

Syllabus (Theory)

Units	Description	Hours
I	**Formwork Materials:** lumber, types, finish, sheathing ratio, working stresses, repetitive member stress, plywood, types and grades, textured surfaces and strength, reconstituted wood, steel, aluminum, form lining materials, hardware and fasteners, nails in plywood, bolts, lag screws and connectors, bolt loads.	06
II	**Design Considerations:** design considerations, live loads and wind pressure, concrete pressure on form work, rate of placing, consistency of concrete, vibration, hydrostatic pressure and pressure distribution, allowable stresses, check for deflection, bending and lateral stability	06
III	**Shoring Materials:** simple wood stresses, slenderness ratio, allowable load, tubular steel shores, patented shores, site preparation, size and spacing, steel tower frames, safety practices, horizontal shores, Ellis shores, Dayton sure grip and baker roof shores, Safeway Symons shores, dead shore,	06
IV	**Overall planning:** Overall planning, detailed planning, corner units, schedule, planning at tender stage, development of basic system, planning for maximum	06

	reuse, planning examples, site layout plan, crane arrangements, recheck plan details, planning for safety, transporting plant, wales and ties, vertical transportable form work.	
V	**Formwork for Different Systems:** location of job mill, storage, equipment, form for wall footings, column footings, slab on grade and paving work, highway and airport paving, external vibration, prefabricated panel systems, giant forms, curved wall forms, tolerance for walls, erections practices, column heads, beam or girder forms, suspended forms, flying system forms.	06
VI	**Design Considerations:** shell forms, design considerations, building forms, strength requirements, tunnel forming components, curb and gutter forms, invert forms, arch forms, concrete placement methods, cut and cover construction, slip forms, functions of various components and safety in slip forms, special structures built with slip form technique.	06

Text Book

- Hurd. M.K., "Formwork for Concrete", Special Publication No.4 Fifth Edition American Concrete Institute, Detroit, 2003.

References

- Robert L. Peurifoy and Garold D. Oberlender, "Formwork for Concrete Structures", McGraw, Hill, 2006.
- Michael P. Hurst, "Construction Press", London & New York.
- Austin. C.K., "Formwork for Concrete", Cleaver, Hume Press ltd., London 2006.
- Tudor Dinescu and Constantin Radulescu, "Slip Form Techniques", Abacus Press Tum Bridge Wells, Kent, 2002.
- Guide for Concrete Formwork, American Concrete Institute, Box No. 9150, Michigan 48219.
- Safety Requirements for Scaffolding, American National Standards Institute. Broadway, New York, 10018.
- http://www.siit.ca/programs/details/concrete,forming.html

CEM508.2: Repair and Rehabilitation of Structures

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	

					ESE	50	40

Course Description: To impart knowledge about different types of determination of structures testing the structures for the deter ration of structures testing the structures for the diagnosis defects and different types of repairing methods.

Course Outcomes: after the end of this course students will able to

CO1 Analyze[4] distress in structures
CO2 Critisize[4] corrosion of reinforcement and remedial measure for it
CO3 Evaluate[6] and diagnosis damage of existing structure
CO4 Classify[4] different repair techniques in concrete structure
CO5 Summatize[6] different innovative techniques of strengthening of structures
CO6 Rate[6] need of structural health monitoring

Syllabus (Theory)

Units	Description	Hours
I	**Introduction:** Deterioration of Structures, Distress in Structures, Causes and Prevention. Mechanism of Damage, Types of Damage	06
II	**Corrosion of Steel Reinforcement:** Causes, Mechanism and Prevention. Damage of Structures due to Fire, Fire Rating of Structures, Phenomena of Desiccation	06
III	**Inspection and Testing:** Symptoms and Diagnosis of Distress, Damage assessment, NDT.	06
IV	**Repair of Structure:** Common Types of Repairs, Repair in Concrete Structures, Repairs in Under Water Structures, Guniting, Shotcreate, Underpinning.	06
V	**Strengthening of Structures:** Strengthening Methods, Retrofitting, Jacketing, Fiber wrapping, innovative retrofitting technics – base isolation, dampers etc.	06
VI	**Health Monitoring of Structures:** Need, Use of Sensors, Building Instrumentation.	06

Text Book

- Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.

References

- Concrete Technology by A.R. Santakumar, Oxford University press
- Defects and Deterioration in Buildingts, E F & N Spon, London
- Non-Destructive Evaluation of Concrete Structures by Bungey, Surrey University Press

- Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)

CEM508.3: Fiber Reinforced Concrete

(Ver 1.0, Program Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: This course presents the general guidelines for using short fibers in concrete and reviews the historical aspects. Once the concrete cracks, these fibers do not necessarily fail.

Course Outcomes: after the end of this course students will able to

CO1 Appraise[4] the historical aspect of fibre reinforced concrete (FRC)
CO2 Collect[5] FRC characteristics and properties
CO3 Evaluate[6] effect of fibres on fresh and hardened properties of concrete
CO4 Rewrite[5] theoretical aspects and engineering applications of FRC
CO5 Evaluate[6] optimization of fibre in FRC.
CO6 Examine[4] effect of constituent materials on FRC.

Syllabus (Theory)

Units	Description	Hours
I	General guidelines for using short fibers in concrete are presented and the historical aspects are reviewed.	06
II	FRC characteristics and properties, fiber types, geometry, design, mixing, placement and finishing, and applications are introduced.	06
III	The testing techniques used for FRC including workability tests, mechanical tests, and durability tests.	06
IV	Theoretical aspects of FRC, the available design guidelines will be introduced, and engineering applications will be reviewed.	06
V	Variety of FRC applications. Benefits of using fibers are reviewed and various existing engineering applications are illustrated.	06

VI	Properties of constituent materials, Mechanics and properties of Fibre Reinforced Concrete, Applications of fibre Reinforced Concrete.	06

Text Book

- Shetty M. S, "Concrete Technology", S. Chand and Company Ltd, New Delhi, 2003

References

- R. N. Swamy, Natural fibre reinforced cement and concrete, Volume 5 of Concrete technology and design, Blackie, 1988
- Uddin, Nasim, Developments in fiber-reinforced polymer (FRP) composites for civil engineering,
- Gupta B. L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
- Santhakumar. A.R; "Concrete Technology", Oxford University Press, New Delhi, 2007
- Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London,1995

CEM509.1: Structural Optimization

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: Analytical and numerical methods for structural optimization. Optimization problem formulation; optimization using calculus of variations; linear programming; nonlinear optimization; global optimization; generalized optimality criteria and dual methods; sensitivity analysis; multilevel and decomposition techniques; shape and topology optimization. Course in structural analysis, Finite element analysis of structures are required for this course

Course Outcomes: after the end of this course students will able to

- **CO1** Formulate[3] mathematical statement for design optimization problems
- **CO2** Solve[3] optimization problems using optimality criteria
- **CO3** Understand[2] and apply[3] Linear Programming methods
- **CO4** Select[3] and apply[3] appropriate numerical techniques for optimization problems
- **CO5** Implement[4] or use evolutionary Algorithms for global optimization

Syllabus (Theory)

Units	Description	Hours
I	Introduction: Introduction of optimization, basic theory and elements of optimization, Terminology and definitions, Basic principles and procedure of optimization. Classical Methods of Optimization: Trial and error method, Monte-Carlo method, Lagrangian multiplier method, illustrative examples	06
II	Linear Programming: Introduction, terminology, formulation of LPP, graphical and algebraic methods of solving LPP, standard form and canonical form of linear programming, geometrical intepretation, illustrative examples.	06
III	Linear Programming: Simplex methods, Artificial variable techniques, solution of simultaneous equations, Dual formulations - illustrative examples. Network analysis: Modifications and improvements on CPM/PERT. Transportation and Assignment problem: Introduction, terminology, formulation and solution of mathematical models, illustrative examples.	06
IV	Non-Linear Programming: local and global optimum, problem formulation, Unconstrained and constrained methods of optimization-Kuhn Tucker conditions, Lagrangian Multiplier methods, graphical method, Univariate search method, Steepest Descent Methods, quadratic programming problem, Wolfs modified simplex method, illustrative examples.	06
V	Dynamic programming: Introduction, terminology, need and characteristics of dynamic programming, formulation, solution of LPP, applications, illustrative examples Decision theory: Introduction, types, decision trees. Simulation: Introduction, advantages, limitations, types, applications	06
VI	Structural Optimization: Optimum structural design of rectangular timber beam, reinforced concrete rectangular, T and L beams, concrete mix proportioning, reinforced concrete deep beams, planner trusses, Procedure of optimization for structural grid and slab.	06

Text Book

- Rao, S. S., "Engineering Optimization –Theory and Practice", fourth edition, John Willey & Sons, 2009.

References

- Vanderplaats, G.N., "Multidiscipline Design Optimization", 1st edition, Vanderplaats R&D, 2007.

- Rao, S. S., "Engineering Optimization –Theory and Practice", fourth edition, John Willey & Sons, 2009.
- Haftka, R.T. and Gurdal, Z., "Elements of Structural Optimization", Third edition, Kluwer Academic Publishers, 1992.
- Christensen, P. W. and Klarbing, A., "An Introduction to Structural Optimization", Springer Science and Media B.V., 2009.
- Fundamentals of Optimum Design in Engineering‖ S.S.Bhavikatti, New Age International Publishers.

CEM509.2: Structural Health Monitoring

(Ver 1.0, Department Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: By continuously monitoring one or more response quantities causing these changes, it is possible to assess the condition of the structure for its structural integrity. Such a monitoring of the structure is generally known as Structural Health Monitoring. Health monitoring application has received great deal of attention all over the world due to its signi? can't impact on safety and longevity of the structure. The course will broadly cover the overview of SHM, its interrelationship with smart material and the application of various smart sensors in SHM

Course Outcomes: after the end of this course students will able to

CO1 Criticize[4] fundamentals of maintenance and repair strategies.
CO2 Diagnose[6] for serviceability and durability aspects of concrete
CO3 Propose[5] materials and techniques used for repair of structures.
CO4 Propose[5] the appropriate repair, strengthening, rehabilitation and retrofitting technique
CO5 Optimize[6] appropriate health monitoring technique and demolition technique.

Syllabus (Theory)

Units	Description	Hours
I	Introduction to Structural Health Monitoring Definition of structural health monitoring (SHM), Motivation for SHM, SHM as a way of making materials	06

	and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM, SHM as a part of system management, Passive and active SHM, NDE, SHM and NDECS, Variety and multidisciplinary: the most remarkable characters of SHM, Birth of the SHM Community.	
II	Vibration-Based Techniques for SHM: Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State space description of mechanical systems, Modeling of damaged structural elements, Linking experimental and analytical data, Modal Assurance Criterion (MAC) for mode pairing, Modal Scaling Factor (MSF), Co-ordinate Modal Assurance Criterion (COMAC), Damping, Expansion and reduction, Updating of the initial model.	06
III	Neural network approach to SHM: The basic idea of neural networks, Neural networks in damage detection, localization and quantification, Multi-layer Perceptron (MLP), A simulation example, Description of the structure, Application of damage indicator methods, Application of the modal force residual method and inverse eigen sensitivity method, Application of the kinetic and modal strain energy methods, Application of the Multi-Layer Perceptron neural network, Time-domain damage detection methods for linear systems, Parity equation method, Kalman filters, AR and ARX models.	06
IV	Fiber-Optic Sensors Classification of fiber-optic sensors, Intensity-based sensors, Phase modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), The fiber Bragg grating as a strain and temperature sensor, Response of the FBG to uniaxial uniform strain fields, Sensitivity of the FBG to temperature, Response of the FBG to a non-uniform uniaxial strain field, Response of the FBG to transverse stresses, Photoelasticity in a plane stress state, Structures with embedded fiber Bragg gratings.	06
V	SHM with Piezoelectric Sensors The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, Available industrial AE systems, New concepts in acoustic emission, State-the-art and main trends in piezoelectric transducer-based acousto-ultrasonic SHM research, Lamb wave structure interrogation, Sensor technology.	06
VI	SHM Using Electrical Resistance Composite damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, 0° unidirectional	06

laminates, Multidirectional laminates, Randomly distributed fiber reinforced polymers, Damage localization.

Text Book

- Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley ISTE, 2006.

References

- Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.
- 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.
- Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.
- Smart Materials and Structures, Gandhi and Thompson
- Structural Health Monitoring: Current Status and Perspectives, Fu Ko Chang

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CEM509.3: Green Building Technology

(Ver 1.0, Department Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: The Green Building Technology courses will highlight building construction methods that include: conservation techniques, environmental awareness in material reuse and energy efficient mechanical systems

Course Outcomes: after the end of this course students will able to

CO1 Understand the fundamentals of energy use and energy processes in building.
CO2 identify the energy requirement and its management.
CO3 Know the Sun-earth relationship vis-a-vis its effect on climate.
CO4 Be acquainted with the end-use energy requirements.
CO5 Be familiar with the audit procedures of energy.

Syllabus (Theory)

Units	Description	Hours
I	Overview of the significance of energy use and energy processes in building - Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.	06
II	Indoor environmental requirement and management - Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.	06
III	Climate, solar radiation and their influences - Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of building.	06
IV	End-use, energy utilization and requirements - Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building. Heat gain and thermal performance of building envelope - Steady and non-steady heat transfer through	06
V	the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer	06
VI	Energy management options - Energy audit and energy targeting - Technological options for energy management.	06

Text Book

- Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.

References

- Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
- Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.

CEM510.1: Disaster Management

(Ver 1.0, Department Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	

					ESE	50	40

Course Description: This course is intended to provide fundamental understanding of different aspects of Disaster Management. It will expose the students to the concept and functions of Disaster Management and to build competencies of Disaster Management professionals and development practitioners for effective supporting environment as put by the government in legislative manner. It would also provide basic knowledge, skills pertaining to Planning, Organizing and Decision-making process for Disaster Risk Reduction

Course Outcomes: after the end of this course students will able to

CO1 Understand the fundamentals of disasters and its impacts.
CO2 Understand the cyclones, local storms and floods.
CO3 procedures to prevent, mitigate and prepare community-based disaster risk reduction.
CO4 Know the inter-relationship between disasters and development.
CO5 Know the disaster risk management in India and case studies on reducing disaster risks.

Syllabus (Theory)

Units	Description	Hours
I	Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).	06
II	Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc. Differential Impacts - in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change. Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India	06
III	Approaches to Disaster Risk Reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRis/ULBs), states, Centre, and other stake-holders.	06
IV	Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as	06

	darns, embankments, changes in Land-use etc. Climate change adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.	
V	Disaster Risk Management in India: Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)	06
VI	Field Work and Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.	06

Text Book

- Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.

References

- Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
- Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.

CEM510.2: Underwater Construction

(Ver 1.0, Program Core, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: This course deals with concepts of site preparation, drainage and shoring during excavation. It also teaches underwater construction activities. Pre-requisite for this course is basic of civil engineering, engineering mechanics, foundation engineering and soil exploration.

Course Outcomes: after the end of this course students will able to

CO1 Manage[5] problems in site preparation, drainage and shoring during excavation.

CO2 Implementation[5] of underwater construction
CO3 Apply[3] underwater tunnelling techniques
CO4 Design[5] of underwater foundation for structures

Syllabus (Theory)

Units	Description	Hours
I	Introduction: Site preparation, temporary roads, site drainage. Deep trench and deep basement excavations. Bulk excavation.	06
II	Coastal structures: Stability of slopes to open excavations. support of excavation by timbering and sheet piling.	06
III	Offshore Platforms: Retaining walls and sheet pile design, Requirements for shorting and underpinning. Methods of shoring of Underpinning.	06
IV	Dewatering and Groundwater Control for Soft Ground Tunneling: Tunneling in touch, mediumtough and soft rocks. Tunneling by borls shield tunneling.	06
V	Piping Systems: Culverts and conduits.	06
VI	Deep water foundations: Design of piles, pile load tests. Foundation design for dynamic conditions	06

Text Book

- Ben C. Gerwick Jr., "Construction of Marine and Offshore Structures", 3rd ed. CRC Press, 2007.

References

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

CEM510.3: Environmental Impact Assessment and Management

(Ver 1.0, Department Elective, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
3	-	-	3	Theory	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description: This course deals with concepts of site preparation, drainage and shoring during excavation. It also teaches underwater construction activities. Pre-requisite for this course is basic of civil engineering, engineering mechanics, foundation engineering and soil exploration.

Course Outcomes: after the end of this course students will able to

CO1 Identify[5] methods for prediction of impacts.
CO2 Identify[5] methodology and prepare EIA reports.
CO3 Identify[5] the environmental attributes for EIA study.
CO4 Formulate[6] environmental management plans.

Syllabus (Theory)

Units	Description	Hours
I	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	06
II	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	06
III	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.	06
IV	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	06

	Impact, Major Hazard/ Risk Assessment, Impact on Transport System, Integrated Impact Assessment.	
V	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.	06
VI	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.	06

Text Book

- David P. Lawrence, Environmental Impact Assessment: Practical Solutions to Recurrent Problems, John Wiley & Sons, 2003.

References

- Canter, L.W., Environmental Impact Assessment, McGraw Hill Pub. Co., 1997.
- Hosetti, B. B., Kumar Eds, A., Environmental Impact Assessment and Management, Daya Publishing House, 1998.
- UNESCO, Methodological Guidelines for the Integrated Environmental Evaluation of Water Resources Development, UNESCO/UNEP, Paris, 1987.
- Anjaneyulu. Y., and Manickam. V., Environmental Imapact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
- Wathern. P., Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.

CEM601: Dissertation Phase - I

(Ver 1.0, Project Work, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	-	4	Practical	FEP	100	40

Syllabus

A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest

specific to the domain in consultation with the dissertation supervisor and industry co- supervisor. The objectives and scope of the dissertation will be expected at a higher level.

A student is required to submit the dissertation synopsis duly signed by supervisor and co-supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPC (Departmental Program Committee).

The dissertation synopsis seminar presentation comprises of the following details:

- Dissertation titles
- General introduction to the area of the topic
- Relevance of the dissertation work
- Literature review/ prior work done in the area
- Dissertation objectives and scope
- Expected outcomes
- Methodology
- Phases of work and representation on a Gantt chart with deadlines
- Resources required to complete the work
- Commitment from the student (Ethical conduct)
- References

Based on the report and the presentation, the DPC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope, etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

CEM603: Dissertation Phase - II

(Ver 1.0, Project Work, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	-	4	Practical	FEP	50	40
					POE	50	

Syllabus

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis. Phase II evaluation consists of a progress review based

on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPC and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis. Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

This phase consists of both the In- semester evaluation by the supervisor and DPC and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

CEM602: Dissertation Phase - III

(Ver 1.0, Project Work, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	-	9	Practical	FEP	100	40

Syllabus

This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co- supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co- supervisor submit the same to the PG program coordinator of department.

The Program coordinator will schedule the presentation of student (Pre-submission) before the DPGC members once the student has completed all the academic requirements for the prescribed program.

1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III
5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal)

Based on the recommendation of DPC, the dissertation is processed further. Viva-Voce examination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

CEM604: Dissertation Phase - IV

(Ver 1.0, Project Work, School of Technology)

Lecture	Tutorial	Practical	Credits	Evaluation Scheme for (Theory and Practical)			
				Component	Exam	WT	Pass %
-	-	-	9	Practical	FEP	50	40
					POE	50	

Syllabus

If the DPC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the dissertation and a presentation is to be given to DPC. The DPC will take a final decision on whether to schedule the final exam or give additional extension of the work.

It is mandatory on the part of the student to

1. Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier Springer, Materials Today or any other reputed conferences.

2. A paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor

3. If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.

4. In case of NDA with company when student is pursuing his dissertation, publication may not be possible in public domain. These cases are to be treated as special cases. A rubric is developed for evaluation.

The evaluation of the dissertation work of a student shall be carried out in four phases: First and third phase being evaluated for ISE by Department Post Graduate Committee (DPC) while second and fourth phase by DPGC for ISE and by a panel of examiners for ESE. Except for phase I evaluation i.e. evaluation based on synopsis submission seminar, a student shall be evaluated for all other phases for his/her understanding, the work done and his/her presentation followed by demonstration.

A panel of examiners for ESE shall consist of Chairman (who shall be one of the DPC members and shall monitor the process as per norms), an Internal Examiner (who shall be the Guide) and an External Examiner (who shall be a subject expert from outside the institute).