

Department of Civil Engineering
Indian Institute of Technology Delhi

***Revised curriculum for
Master of Technology in Construction Engineering and
Management (CET)
programme***

This document summarises the proposed revision in the curriculum of the Master of Technology in Construction Engineering and Management (CET) programme in the Department of Civil Engineering, IIT Delhi.

The proposed revised programme is shown in the table below.

Table 1: Breakup of credit structure in the proposed M.Tech. programmes

	Core (course)	Core (project)	Programme Elective	Total
Proposed	21	21	12	54

*Table 2: Semester-wise distribution of courses and credits in the proposed CET M.Tech. programme
(credits in brackets)*

Semester I (13.5 credits)	Semester II (13.5 credits)
Construction Project Management (3) Quantitative Methods in Construction Management (3) Advanced Concrete Technology (3) Computational Laboratory for Constr. Management (1.5) Programme Elective I (3)	Construction Economics and Finance (3) Construction Practices and Equipments (3) Construction Contract Management (3) Construction Engineering Lab. (1.5) Programme Elective II (3)
Semester III (15 credits)	Semester IV (12 credits)
Major Project Part I (9) Programme Electives III and IV (3 + 3)	Major Project Part II (12)

The proposed list of core courses for the CET students are as listed below.

- CVL 771 Advanced Concrete Technology (3 credits)
- CVL 772 Construction Project Management (3 credits)
- CVL 773 Quantitative Methods in Construction Management (3 credits)
- CVL 774 Construction Contract Management (3 credits)
- CVL 775 Construction Economics and Finance (3 credits)
- CVL 776 Construction Practices and Equipment (3 credits)
- CVP 771 Construction Technology Laboratory (1.5 credits)
- CVP 772 Computational Laboratory for Constr. Management (1.5 credits)
- CVD 777 Major Project Part-I (CET) (9 credits)
- CVD 778 Major Project Part-II (CET) (12 credits)

The proposed list of programme electives for the CET programme.

- CVL777 Building Science (3 credits)
- CVL778 Building Services and Maintenance Management (3 credits)
- CVL765 Concrete Mechanics (3 credits)
- CVL871 Durability and Repair of Concrete Structures (3 credits)
- CVL 779 Formwork for Concrete Structures (3 credits)
- CVL873 Fire Engineering and Design (3 credits)
- CVL872 Infrastructure Development and Management (3 credits)

- CVL874 Quality and Safety in Construction (3 credits)
- CVL875 Sustainable Materials and Green Buildings (3 credits)
- CVS 776 Independent Study (CET) (3 credits)
- CVD 776 Minor Project (CET) (3 credits)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Civil Engineering
2.	Course Title (< 45 characters)	ADVANCED CONCRETE TECHNOLOGY
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL771
6.	Status (category for program)	Core for CET and CEC, Programme elective for CES

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	10% with CVL141, 15% with Durability
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course	

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Dr. S. Bishnoi, Prof. B. Bhattacharjee, Dr. S. Gupta	
12.	Will the course require any visiting faculty?	No

13.	Course objective (about 50 words): This course will cover: Advanced aspects of concrete technology building the knowledge of the student beyond what is taught at the undergraduate level.	
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14.	Course contents (about 100 words) (Include laboratory/design activities): Hydration of cements and microstructural development, Mineral additives, Chemical admixtures, Rheology of concrete, Creep and relaxation, Shrinkage, cracking and volume stability, deterioration processes, special concretes,	
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	Advanced characterisation techniques, sustainability issues in concreting, Modelling properties of concrete
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to cement and concrete	1
2	Composition of cement and hydration of cement phases	3
3	Microstructural development	4
4	Supplementary cementitious materials and chemical admixtures	6
5	Rheology of concrete	3
6	Creep, relaxation and volume stability of concrete	4
7	Deterioration processes	6
8	Special concretes	4
9	Advanced characterisation techniques	4
10	Sustainability issues in concreting	3
11	Modelling properties of concrete	4
12		
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

No tutorials planned

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	No laboratories planned.	
2		
3		
4		
5		
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7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

Mehta P.K. and Monteiro P.J.M., Concrete Microstructure Properties and Materials, Third Edition, Tata McGraw Hill, 2006
 HFW Taylor, Cement Chemistry, Thomas Telford, 1997
 Bensted J. and Barnes P. (Ed.), "Structure and Performance of Cements", Second Edition, Spon Press, 2002

Newman J. and Choo B.S., Advanced Concrete Technology - Processes, Elsevier, 2003
 Newman J. and Choo B.S., Advanced Concrete Technology - Testing and Quality, Elsevier, 2003
 Neville A.M., Properties of Concrete, Fourth Edition, Pearson, 2006
 Reference material:
 Jahren P. and Tongbo S., Concrete and Sustainability, CRC Press, 2014
 Sarja A. and Vesikari, E., Durability Design of Concrete Structures E & FN Spon. 1996.
 Brandt, A. M., Cement-Based Composites: Materials, Mechanical Properties and Performance, E & FN SPON. 1995
 Bentur, A. and Mindes, S., Fibre Reinforced Cementitious Composites, E & FN Spon 1990

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD Projector
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	10%
20.2	Open-ended problems	0%
20.3	Project-type activity	0%
20.4	Open-ended laboratory work	0%
20.5	Others (please specify)	None

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	BUILDING SCIENCE
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL777
6.	Status (<i>category for program</i>)	PE for CET & CEC, OE for others

7.	Pre-requisites (<i>course no./title</i>)	120 Credits for UG Students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	nil
8.2	Overlap with any UG/PG course of other Dept./Centre	15% WITH SOLAR ARCHITECTURE (EXISTING ESL840)
8.3	Supercedes any existing course	CEL777

9.	Not allowed for (<i>indicate program names</i>)	NONE
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course 1. B. BHATTACHARJEE, 2.K.N.JHA, 3. S. BISHNOI	
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12.	Will the course require any visiting faculty?	NO
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13.	Course objective (<i>about 50 words</i>): To expose the students to • Concepts of functional design of buildings for thermal aspects and energy efficiency • External and internal noise control and acoustic design of auditoriums • Fenestration design for natural ventilation and • Daylighting & design of space for illumination requirement	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction to environmental features relevant to functional design. their measures description and quantification. Periodic nature of variation of environmental descriptors. Heat exchange of building with environment under diurnal periodic variation temperature and modelling. Estimation of hourly	
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	internal temperature through CIBS method. Thermal Design philosophy and optimization for decision variables such as shape, orientation, envelope properties etc. Purpose of ventilation, wind and stack effect as driving force. Design for desired flow and indoor velocity. Fundamentals of acoustics, Sound ion free field and enclosure. External and Internal air borne noise control. Protection against structure borne noise. Lighting principles and daylighting. Day light factor, and design for desired illumination and glare free lighting.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Environmental Factors: Factors and their representation, tropical environments and site environments, etc.	3
2	Human response to environment: Factors affecting human comfort, Human response to thermal environment, noise, visual environment etc.; Comfort indices.	3
3	Response of building to thermal environment: Processes of heat exchange of building with environment; Effect of solar radiation; Thermal properties of material and sections and their influence; Steady and periodic heat transfer in buildings.	6
4	Heat flow computations: Estimation of internal temperature within unconditioned space. computation of cooling/heating load	4
5	Structural control and design: Selection of envelope elements, Orientations, Glasses and shading devices, Selection of shape of building etc., Optimization.	4
6	Natural ventilation: Purpose of ventilation, Mechanisms, Ventilation Design	3
7	Noise and Building: Basic acoustics and noise, Planning, Sound in free field, protection against external noise.	3
8	Acoustics of enclosures, Internal noise sources and behaviour of room against air borne noise. Protection against internal noise.	3
9	Impact noise and protection against structure borne noise; isolation design, floating constructions.	3
10	Acoustic design of auditorium	3
11	Day lighting: Lighting principles and fundamentals.	3
12	Indian sky, daylight prediction and design of fenestration, supplementary and artificial illumination design.	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Nil	
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

Bureau of Indian Standards, " HAND BOOK OF FUNCTIONAL REQUIREMENTS OF BUILDINGS, (SP-41 & SP- 32)", BIS 1987 and 1989.

Clarke, J.A., "ENERGY SIMULATION IN BUILDING DESIGN" Adam Hilger Ltd. 1985.

Foreman, J.E.K., "SOUND ANALYSIS AND NOISE CONTROL". Van Nostrand Reinhold. 1990

Reference material:

Koenigsberger, O.H. et al, "MANUAL OF TROPICAL HOUSING AND BUILDING PART-I CLIMATIC DESIGN", Orient Longman. 1973.

Markus, T.A. & Morris, E.N., "BUILDING CLIMATE AND ENERGY" Pitman publishing limited. 1980.

Croome, J.D. & Roberts, B.M., "AIRCONDITIONING AND VENTILATION OF BUILDINGS VOL-1". Pergamon press.

Croome, J.D. "NOISE BUILDING AND PEOPLE" Pergamon press.

Clarke, J.A., "ENERGY SIMULATION IN BUILDING DESIGN" Adam Hilger Ltd. 1985.

Foreman, J.E.K., "SOUND ANALYSIS AND NOISE CONTROL". Van Nostrand Reinhold. 1990.

Maekawa, Z. and Lord, P. "ENVIRONMENTAL AND ARCHITECTURAL ACOUSTICS" E&FN Spon. 1994.

IS 2526, IS 4954 and NBC 2005 etc

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Open source Building Energy Simulation softwares; e.g., Equest.
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Nil
19.4	Laboratory	None
19.5	Equipment	None
19.6	Classroom infrastructure	LCD projection etc
19.7	Site visits	None

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	40-50%, Design of envelope for least operational energy and maximum thermal comfort. Design of fenestration in building for natural ventilation Design of external noise control elements such as barrier. Design of space for noise insulation. Acoustic design of auditorium. Fenestration design for daylighting.
20.2	Open-ended problems	Nil
20.3	Project-type activity	20%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	10% self study

Date: 12/2/2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	BUILDING SERVICES & MAINTENANCE MANAGEMENT
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL778
6.	Status (<i>category for program</i>)	PE for CET & CEC, OE for others

7.	Pre-requisites (course no./title)	120 Credits for UG Students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	nil
8.2	Overlap with any UG/PG course of other Dept./Centre	NIL
8.3	Supercedes any existing course	No

9.	Not allowed for (indicate program names)	NONE
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course 1. B. BHATTACHARJEE, 2.K.N.JHA, 3. S. BISHNOI	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): To expose the students to: • Concepts of building design for fire protection, • Design of fire-system, lifts, HVAC and other services • Maintenance management of buildings	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Concepts of functional design of building for fire protection, design of lift systems for optimum service. Building service system design. Control and intelligent buildings, HVAC, hot and cold water services, waste water handling system, electrical services, building maintenance management	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Fire Protection: Process of combustion in fire, Effect of fire load & ventilation condition on enclosure fire, growth and decay of fire in enclosure	2
2	Concepts of fire resistant and severity, Effect of fire on materials. Design of elements for given fire resistance, structural fire protection.	5
3	Site Planning, Internal planning for Escape and refuges, Fire detection & suppression systems, Smoke venting	4
4	Lifts & Vertical Transportation: arrangement of lifts and Design for optimum service condition	4
5	Building Services as a system, Capacity of storage and sizing, diversity of usage, control system etc,	3
6	HVAC System: Design Consideration. Basic psychrometry, Air conditioning process & system. Methods of Air Conditioning, Problems.	5
7	Water Supply, Hydraulic design, Storage Distribution, Component of cold & hot water supply system Waste water & Drainage systems: Fixture units & Design of system	3
8	Element of Electrical Services in building, Illumination & intelligent building	4
9	Definition, Role of building maintenance in construction process Maintenance generators, Expression of Standards, selection of level of maintenance and fixing standards	2
10	Planned maintenance: Planning vis-a-vis adhoc maintenance, schedule & contingency maintenance, levels of planning, planned inspection, etc	4
11	Maintenance cycle, maintenance profile, repair & replacement models, statistical methods, decision models, optimal renewal cycle, budgeting etc	4
12	Effect of design on maintenance, Diagnosis, appraisal, structural defects & various methods of repair.	2
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Nil	
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text book:

1. Maver T.W., Building Services Design, RIBA Publications Ltd., 1971

Building Maintenance Management - R.LEE

Concept of building fire safety – D.EGAN

Reference material:

2. Markus, T.A. & Morris, E.N., "Building Climate And Energy" Pitman publishing limited. 1980.

3. Building Engineering & System Design - F.S.MERRIT & J. AMBROSE

4. SP-35 (1987): Handbook of Water supply & drainage-BIS

5. N.B.C.-2005 BIS

6. Airconditioning & Ventilation of building - D.J. CROOME & B.M.ROBERTS.

8. Design of fire resisting structures - H.L. MALHOTRA.

9. An introduction to fire dynamics -D.DRYSDALE

10. Structural fire protection Edt by T.T.LIE

11. Elevator technology - G.C.BARNEY

12. HEATING VENTILATING AND AIR CONDITIONING Analysis and Design - Faye C. McQuiston and Jerald D. Parker.

14. Developments In Building Maintenance - I.EJ. GIBSON

15. Concrete Structures: materials, Maintenance And Repair By D.CAMPBELL, ALLEN & H.ROPER

16. Fire Safety Engineering Design of Structures John A. Purkis Elsevier

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Nil
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Nil
19.4	Laboratory	None
19.5	Equipment	None
19.6	Classroom infrastructure	LCD projection etc
19.7	Site visits	None

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	30-40%, Design of structural elements for fire resistance. Design of escape and refuges for fire protection. Storage design for services. Design of distribution accounting diversity of usage. Design of lift system for optimum service. Pipe sizing design for hot cold water supply & waste water disposal in building. Planning and Design of building maintenance system for intended design period.
20.2	Open-ended problems	Nil
20.3	Project-type activity	20%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	10% presentations

Date: 12/2/2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	FORMWORK FOR CONCRETE STRUCTURES
3.	L-T-P structure	3 – 0 – 0
4.	Credits	3
5.	Course number	CVL779
6.	Status (<i>category for program</i>)	PE for CET, CEC & CES students

7.	Pre-requisites (course no./title)	NO
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Yes, about 15% overlap with Construction Practices and Equipment (PG Course)
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	Students outside Civil Engineering Department
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course K N Jha, B Bhattacharjee, and A K Jain	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): To impart knowledge of: • Designing formwork for foundations, wall, column, beam, and slab elements, • planing and estimation of the cost of formwork and scaffolding for various applications.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Requirements and selection for Formwork , Formwork Materials, such as Timber, Plywood, Steel, Aluminum Form, Plastic Forms, and Accessories, Horizontal and Vertical Formwork Supports; Formwork Design Concepts, Illustration of Formwork system for Foundations, walls, columns, slab and	
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	beams and their design, Formwork for Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower. Formwork for Bridge Structures, Flying Formwork such as Table form, Tunnel form. Slipform, Formwork for Precast Concrete, Formwork Management Issues pre award and post award, Formwork failures-causes and Case Studies in Formwork Failure, Formwork issues in multi-story building construction.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Formwork as a Temporary Structure , Requirements, Selection, and Classification (Types) of Formwork	02
2	Formwork Materials, Shoring Towers, and Scaffolds	04
3	Formwork Design Concepts	04
4	Conventional and Proprietary Foundation Formwork	02
5	Conventional and Proprietary Wall Formwork	03
6	Conventional and Proprietary Column Formwork ,	03
7	Slab and Beam Formwork	03
8	Formwork for Special Structures such as Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, and Lift Shaft.	02
9	Formwork for Bridge Structures, Cases in Failure of Temporary Support Structures of Bridges	02
10	Flying Formworks such as Table Forms, Tunnel Formwork System, Column Mounted Shoring System, Gang Forms	03
11	Slipform, Formwork for Precast Concrete, Formwork Failure	07
12	Pre-Award and Post –award Formwork Management Issues, Formwork Issues in Multi-Story Building Construction	07
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Not Applicable

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
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8		
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COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

- 1 Jha, K.N., Formwork for Concrete Structures, First Edition, McGraw Hill. 2012.
- 2 Peurifoy, R.L. and Oberlender,G.D. , Formwork for concrete structures, McGraw Hill. 2011.
- 3 Robinson, J.R., Piers, abutments, and formwork for bridges. Library Accn No. 29797
- 4 Austin, C.K., Formwork to concrete, Cleaver - Hume Press, London, 1960.
- 5 Moore, C.E., Concrete Form Construction, Delmar Cengage Learning, 1977.

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19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	POWERPOINT, VIDEO
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD PROJECTOR
19.7	Site visits	YES

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	up to 40%
20.2	Open-ended problems	up to 30%
20.3	Project-type activity	up to 30%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Nil

Date: 10 Mar 2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department/Centre proposing the course	Civil Engineering
2.	Course Title (<i>< 45 characters</i>)	CONCRETE MECHANICS
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL765
6.	Status (<i>category for program</i>)	Programme Elective for CES, CET and CEC

7.	Pre-requisites (<i>course no./title</i>)	None
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
	8.1	Overlap with any UG/PG course of the Dept./Centre nil
	8.2	Overlap with any UG/PG course of other Dept./Centre nil
	8.3	Supercedes any existing course nil

9.	Not allowed for (<i>indicate program names</i>)	nil
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course Dr. Shashank Bishnoi, Dr. A. Ganguli, Dr. Gurmail Benipal
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12.	Will the course require any visiting faculty?	no
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13.	Course objective (<i>about 50 words</i>): The objective of this course is: • To develop the concepts of the continuum mechanical behaviour of fresh and hardened concrete. • To build upon the macroscopic mechanical and physical properties of concrete from the microstructural level. • Achieving a deeper understanding of the physical, mechanical and the long term performance of concrete structures.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction; Rheological modelling of fresh concrete; Flowing concrete;	
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	Mechanics of hardened concrete: Failure criteria; Constitutive equations; Elasto- plasticity, visco-elasticity, fatigue, damage mechanics and fracture; Mechanics of hydrating concretes, Durability Mechanics, Transport processes; Drying shrinkage; Micromechanics , Numerical and analytical homogenisation, poromechanics , Crystalline growths and internal microstresses
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction	2
2	Rheological modelling of fresh concrete; Flowing concrete	4
3	Failure criteria	3
4	Constitutive equations, Elasto-plasticity	6
5	Visco-elasticity and fatigue	3
6	Damage mechanics and fracture	3
7	Mechanics of hydrating concrete	3
8	Durability mechanics	3
9	Transport processes, Drying shrinkage	6
10	Micromechanics	3
11	Numerical and analytical homogenisation, Poromechanics	3
12	Crystalline growths and internal microstresses	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

NIL

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Sonntag, R. E., Borgnakke, C., and Van Wylen, G. J., *Fundamentals of Thermodynamics*, 5th Ed., John Wiley, 2000.

Text books:

Benipal, G. S., Theoretical Concrete Mechanics, Ready for publication.
 Chen, W. F. Constitutive Equations for Engineering Materials Vol. I: Elasticity and Modelling, Elsevier Publications, 1994
 Chen, W. F. and Saleeb, A.F. Constitutive Equations for Engineering Materials Vol. II: Plasticity and Modelling, Elsevier Publications, 1994
 Neville, A. M. Creep of Concrete: Plain, Reinforced and Prestressed, Construction Press, London, 1983.

Hauggard, A. B. Mathematical Modelling and Analysis of Early Age Concrete, Department of Structural Engineering and Materials, Technical University of Denmark, Dk-2800 Lyngby, Denmark, 1997

Reference material:

Tattersall, G. H. and Banfill, P. F. G. Rheology of Fresh Concrete, Pitman Adv. Pub. Program, 1983

Singh, Arbind K., Mechanics of Solids, Prentice Hall of India Pvt. Ltd., New Delhi, 2007

Biot M.A., Poroelasticity, Pergamon 1998

Bower A.F., Applied Mechanics of Solids, CRC Press 2010

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	
19.7	Site visits	

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	0%
20.2	Open-ended problems	0%
20.3	Project-type activity	0%
20.4	Open-ended laboratory work	0%
20.5	Others (please specify)	15% Theoretical and computer based assignments.

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	CONSTRUCTION PRACTICES AND EQUIPMENT
3.	L-T-P structure	3 – 0 – 0
4.	Credits	3
5.	Course number	CVL776
6.	Status (<i>category for program</i>)	CORE

7.	Pre-requisites (course no./title)	NO
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Prof K C Iyer, Prof B Bhattacharjee, Prof A K Jain, Dr. S Gupta, Dr. K N Jha, Dr. J Uma	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): This course aims to make the student well versed: • Various aspects of construction practices • Planning of construction equipment	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Form work design and scaffolding, slipform and other moving forms, Shoring, Reshoring, and Backshoring in multistoreyed Building construction. Prestressing, Steel and composites construction methods: Fabrication and erection of structures including heavy structures, Prefab construction, Industrialized construction, Modular coordination. Special construction methods: High rise construction, Bridge construction including segmental construction, incremental construction and push launching techniques. Factors affecting selection of equipment - technical and economic, Analysis of	
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	production outputs and costs, Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering, and Concreting.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Form work design	04
2	Scaffolding	02
3	Slipform and other moving forms	04
4	Shoring, Reshoring, and Backshoring in multistoreyed building construction- Estimating construction loads and strength of slabs	04
5	Prestressing in building and bridge construction	03
6	Steel and composite construction methods, fabrication and erection of structures including heavy structures	03
7	Prefab construction, industrialized construction, modular coordination	03
8	Special construction methods: high rise construction, bridge construction including segmental construction, incremental construction and push launching techniques	05
9	Factors affecting selection of equipment - technical and economic	03
10	Analysis of production outputs and costs,	03
11	Characteristics and performances of equipment for major civil engineering activities such as Earth moving, erection, material transport, pile driving, Dewatering, and Concreting.	08
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Not Applicable

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

1. Jha, K.N. 2012 Formwork for Concrete Structures, Tata McGraw Hill, New Delhi.
2. Jha, K.N. (2015), Construction Project Management: Theory and Practice (2015), Second Edition, Pearson Publishers, New Delhi.
3. Day, K.W., "Concrete Mix Design, Quality Control and Specification, E & FN Spon.1995.
4. Pourifoy R.C., Form Work For Concrete Structures

Reference material:

1. Raina V.K., Concrete Bridges Hand Book

2. Waraszawski A., Industrialization and Robotics in Building: A Managerial Approach.
3. Harris, F., Modern Construction Equipment and Methods
4. Smith R.C. & Andres C.K., Principles of Heavy Construction

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	POWERPOINT, VIDEO
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD PROJECTOR
19.7	Site visits	YES

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	40%
20.2	Open-ended problems	Nil
20.3	Project-type activity	60%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Nil

Date: 13 FEB 2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	CONSTRUCTION ECONOMICS AND FINANCE
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL775
6.	Status (<i>category for program</i>)	PC

7.	Pre-requisites (<i>course no./title</i>)	NIL
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	20% with "Construction Management"
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course	No

9.	Not allowed for (<i>indicate program names</i>)	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Prof K C Iyer, Dr. J. Uma Maheswari, Dr. K N Jha	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): This course is intended to provide a brief background for comparison of alternatives for financial investments. After studying the course the students would - (a) have learnt to choose best alternatives for financial investments and assess financial health of organisation in a given environment. (b) have also understood capital budgeting and working capital management parameters, risks, financial ratios, international finance	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Engineering economics, Time value of money, discounted cash flow, NPV, ROR, PI. Basis of comparison, Incremental rate of return, Benefit-cost analysis, Replacement analysis, Break even analysis. Depreciation and amortization. Taxation and inflation, Evaluation of profit before and after tax.	
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	Risks and uncertainties and management decision in capital budgeting. Working capital management, financial plan and multiple source of finance. Budgeting and budgetary control, Performance budgeting. Profit & Loss, Balance Sheet, Income statement, Ratio analysis, Appraisal through financial statements, International finance, forward, futures and swap. Practical problems and case studies
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction and time value of Money	4
2	Comparison of alternatives using NPV, NAV, Rate of Return, Break even analysis and social benefit cost analysis	6
3	Depreciation, depletion and amortisation	3
4	Replacement analysis	2
5	Taxation and inflation; Profit before and after tax	6
6	Working capital management	2
7	Construction accounting; Profit and loss accounts, Balance sheet preparation	4
8	Ratio analysis	4
9	Risks and uncertainties	3
10	Conventional Budgeting, Performance Budgeting and Zero-based budgeting	2
11	International finance	3
12	Futures, Forward, Swap	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

TEXT BOOKS

Blank, L.T. and Tarquin, A.J. Engineering Economy (Seventh Edition) McGraw Hill Book Company, ISBN 978-0-07-337630-1, 2012
 Van Horne, J.C. and Wachowicz J., J.M. Fundamentals of Financial Management (Thirteenth Edition) Prentice-Hall of India Ltd, 2009
 Jain, P.K., Peyrard, J. and Yadav, S.S. International Financial Management (First Edition) Macmillan India Limited 2012
 Jha K.N., Construction Project Management, Theory and Practice, Pearson Publishers, 2014

REFERENCE BOOKS

Van Horne, J.C. Financial Management and Policy, (Second Edition) Prentice-Hall of India Ltd 1990

Harris, F. and McCaffer, R. Modern Construction Management. (Sixth Edition) Blackwell Publishing 2006

Taylor, G.A.. Managerial and Engineering Economy. (Fifth Edition) East-West Edition, 1968.

Thuesen, H.G. Engineering Economy, (Second Edition) Prentice-Hall, Inc. 1959

Brigham, E.F. Fundamentals of Financial Management, (First Edition) The Dryden Press, Hinsdale, Illinois, 1978.

Kolb, R.W. and Rodriguez, R.J. Financial Management. (First Edition) D.C. Heath & Co., 1992

Walker, E.W. Essentials of Financial Management, (Second Edition) Prentice Hall of India Private Limited, New Delhi, 1974

Collier, C.A. and Ledbetter, W.B. (1982). Engineering Cost Analysis, Harper & Row Publishers, New York, 1982

Wilfred, N. Accounting for the Building Trade, Hutchinson Educational, London, 1971

Pilcher R. Principles of Construction Management. (First Edition) McGraw Hill Publishing Co Ltd, 1966

Lifson, N.W. and Shaifer, E.F. Decision and Risk Analysis for Construction Management, John Wiley & Sons, 1982

Degoff, R.A. and Friedman, H.A. Construction Management, John Wiley & Sons, 1985

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Optional
19.2	Hardware	Available
19.3	Teaching aides (videos, etc.)	Available
19.4	Laboratory	Not required
19.5	Equipment	Not required
19.6	Classroom infrastructure	LCD Projector and video playing facilities
19.7	Site visits	Yes

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	No
20.2	Open-ended problems	No
20.3	Project-type activity	10% from open source
20.4	Open-ended laboratory work	No
20.5	Others (please specify)	20% Case study and literature reading

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	CONSTRUCTION PROJECT MANAGEMENT
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL772
6.	Status (<i>category for program</i>)	PC

7.	Pre-requisites (course no./title)	NIL
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	10% with CVL245
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Dr. Uma Maheswari, Prof K C Iyer, Dr. K N Jha	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): After studying the course the students would- • have learnt the different challenges faced at various stages of a project • have also understood the methodology, tools and techniques for project management in construction	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction to construction project management - CPM, PERT, PDM, LOB. Scope management, WBS, PDRI. Time and cost management, material related management - purchase & inventory control, time-cost-resource optimization, quality, safety - planning & control. Labor productivity variations, productivity improvement - work study. Measuring project progress & performance - EVA & ES. Identification of risks and impact. Management Information systems.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Knowledge areas of construction project management CPM, PERT, PDM, LOB	7
2	Scope definition, WBS & PDRI	3
3	Estimating time and cost, develop a STRATEGIC project plan	5
4	Labour variations - skill, productivity & efficiency	2
5	Work study - productivity improvement in construction processes	4
6	Time, cost, resource optimization	3
7	Update, measuring project progress & performance - EVA, ES	5
8	Material related purchase & inventory control	4
9	Quality, safety & productivity - planning & control	3
10	Risk identification, assessment & impact in construction project	2
11	Management Information Systems	2
12	Project close-out	2
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
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8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text book

Baldwin, A. & Bordoli, D., A Handbook for Construction Planning and Scheduling, Blakwell Publishers, 2014.

Jha, K.N., Construction Project Management, First Edition, Pearson Publishers, 2011.

Reference book

Harris, F., McCaffer, R. & Edum-Fotwe, F., Modern Construction Management, sixth edition, Blackwell Publishers, 2006.

Knutson, K., Schexnayder, C. J., Fiori, C. & Mayo, R.E., Construction Management Fundamentals, McGraw Hill Publishers, 2013.

Whyte, A., Integrated Design and cost for civil Engineers, CRC Press, Taylor & Francis Group, 2015.

Mubarak, S., Construction project scheduling & control, second edition, John Wiley & sons, 2010.

Harris, R.B., Precedence and Arrow Networking techniques for construction, John Wiley & sons, 1978.

Drewin, F.J., Construction productivity, Elsevier, 1982.

Fewings, P., Construction Project Management - An integrated approach, Taylor & Francis, 2011.

Goetsch, D.L., Project Management for construction, Pearson publishers, 2015.

Ottoson, H., Practical project management for building and construction, CRC Press, Taylor & Francis, 2013.

Richardson, G.L., Project management Theory & Practice, CRC Press, Taylor & Francis, 2011.

McCarthy, J.F., Construction project management - A managerial approach, Pareto publishers, 2010.

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	No
19.2	Hardware	Available
19.3	Teaching aides (videos, etc.)	Available
19.4	Laboratory	Not required
19.5	Equipment	Not required
19.6	Classroom infrastructure	LCD Projector and video playing facilities
19.7	Site visits	No

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	Up to 30%
20.2	Open-ended problems	Nil
20.3	Project-type activity	Nil
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	20% for data collection and analysis

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Civil Engineering
2.	Course Title (< 45 characters)	CONSTRUCTION TECHNOLOGY LABORATORY
3.	L-T-P structure	0 - 0 - 3
4.	Credits	1 . 5
5.	Course number	CVP771
6.	Status (category for program)	Core for CEC and CET and Programme elective for CES

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	None
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course	No

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Dr. S. Bishnoi, Dr. A. Ganguli, Dr. S. Gupta	
12.	Will the course require any visiting faculty?	No

13.	Course objective (about 50 words): This laboratory course will offer knowledge on: • The use and testing of construction materials and • Site tests for quality control.	
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14.	Course contents (about 100 words) (Include laboratory/design activities): Tests related to quality control at site, in-situ tests, tests related to damage and deterioration assessment, performance monitoring of structures.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1		
2		
3		
4		
5		
6		
7		
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9		
10		
11		
12		
COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

No tutorials planned

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	Testing of cements and supplementary cementitious materials	6
2	Testing of chemical admixtures	3
3	Mixture design of special concretes	6
4	Moisture profile and acoustic measurements	3
5	Non destructive tests, half-cell potential, pH measurement, carbonation depth, water and air permeability	6
6	Effect of high temperature on concrete	3
7	Calorimetry and shrinkage	6
8	Alkali Silica Reaction	3
9	Advanced characterisation of construction materials	3
10	Behaviour of construction joints, water-proofing and precast joints	3
COURSE TOTAL (14 times 'P')		42

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

No text books. Reference material: Richardson M.G., Fundamentals of Durable Reinforced Concrete, First Edition, Spon Press, 2002 Comite Euro-international du Beton, Durable concrete structures: design guide, Second Edition, Thomas Telford Services Ltd., 1989
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Mehta P.K. and Monteiro P.J.M., Concrete Microstructure Properties and Materials, Third Edition, Tata McGraw Hill, 2006
 Bohni H (Ed.), Corrosion in reinforced concrete structures, CRC Press, 2005
 Bensted J. and Barnes P. (Ed.), "Structure and Performance of Cements", Second Edition, Spon Press, 2002
 Newman J. and Choo B.S., Advanced Concrete Technology - Processes, Elsevier, 2003
 Newman J. and Choo B.S., Advanced Concrete Technology - Testing and Quality, Elsevier, 2003
 Neville A.M., Properties of Concrete, Fourth Edition, Pearson, 2006
 Relevant IS, EN and ASTM standards

19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD Projector
19.7	Site visits	

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	0%
20.2	Open-ended problems	0%
20.3	Project-type activity	0%
20.4	Open-ended laboratory work	0%
20.5	Others (please specify)	100% Laboratory Activity

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	CONSTRUCTION CONTRACT MANAGEMENT
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL774
6.	Status (<i>category for program</i>)	PC

7.	Pre-requisites (course no./title)	NIL
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	15% with CEL245
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Prof K C Iyer, Dr. J. Uma Maheswari, Dr. K N Jha	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): After studying the course the students would - • have learnt to draft a complete contract, award works contracts, administer contracts, manage claims and resolve disputes. • have also understood the domestic and international practices in contract management through case study.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Professional Ethics, Duties and Responsibilities of Parties. Owner's and contractor's estimate, Bidding Models and Bidding Strategies, Qualification of Bidders. Tendering and Contractual procedures, Indian Contract Act 1872, Definition of Contract and its Applicability, Types of Contracts, Clauses in Domestic and International Contracts - CPWD, MES, FIDIC, AIA, NEC, JCT, etc. Contract Administration, Delay Protocol, Change Orders Analysis, Claim Management and Compensation, Disputes and Resolution Techniques,	
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	Arbitration and Conciliation Act 1996, Arbitration Case Studies.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction of business law and contract	2
2	Detailed project report and understading nature, specification, scope, timeline, cost and other salient points of projects for contact drafting	3
3	Professional Ethics, Duties and Responsibilities of Parties	1
4	Types of contracts	2
5	Indian Contract Act 1872 and standard contract clauses	8
6	Contract procurement: Prequalification and enlistment of contractor; Bidding strategies, Bidding Models, Negotiation and acceptance of contracts	4
7	Contract administration: site documents; interpretation of contracts; General contractual issues; notices and claims management	6
8	International contracts: FIDIC, NEC, JCT and AIA	3
9	Relationship contracts	1
10	Disputes - avoidance and resolution; Dispute prone clauses and situations, Delay analysis and delay protocol, Change order analysis	4
11	Arbitration and Conciliation Act 1996	4
12	Case study on Arbitration and International Best Practices	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

Gajria, K. Law relating to Building and Engineering Contracts in India, Butterworths India, 2000

Ramaswamy, B.S. Contracts ad their Management, Lexis Nexis Butterworths, 2005

Murdoch, J. and Hughes, W. Construction Contracts, Spon Press, 2002

Collier K. Construction Contracts, Beston Publishing Company, Inc., 1979

Patil, B.S. Building and Engineering Contracts, B.S. Patil, 1994

Reference material:

Ross, A and Williams, P. Financial Management in Construction Contracting, Wiley-

Blackwell, 2013
 Ndekugri, I. and Rycroft, M. The JCT Standard Building Contract: Law and Administration, Elsevier, 2009
 Fenn, P. Commercial Conflict Management and Dispute Resolution, Spon Press, 2012
 Atkinson, D. Causation in Construction Law – Principles and Methods of Analysis, Daniai Atkinson Limited, 2007
 Roy Chowdhury, S.K., Saharay, H.K. Law of Arbitration and Conciliation, Eastern Law House, 1996
 Lupton, S. Cornes and Lupton's Design Liability in the Construction Industry, Wiley-Blackwell, 2013

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	No
19.2	Hardware	Available
19.3	Teaching aides (videos, etc.)	Available
19.4	Laboratory	Not required
19.5	Equipment	Not required
19.6	Classroom infrastructure	LCD Projector and video playing facilities
19.7	Site visits	Yes

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	No
20.2	Open-ended problems	No
20.3	Project-type activity	No
20.4	Open-ended laboratory work	No
20.5	Others (please specify)	Case study and literature reading

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Department of Civil Engineering
2.	Course Title (< 45 characters)	DURABILITY AND REPAIR OF CONCRETE STRUCTURES
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL871
6.	Status (category for program)	PE for CEC, CET and CES

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (give course number/title)	
8.1	Overlap with any UG/PG course of the Dept./Centre	115% with Advanced Concrete Technology.
8.2	Overlap with any UG/PG course of other Dept./Centre	No
8.3	Supercedes any existing course	No

9.	Not allowed for (indicate program names)	None
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course Dr. S. Bishnoi, Prof. B. Bhattacharjee, Dr. S. Gupta	
12.	Will the course require any visiting faculty?	No

13.	Course objective (about 50 words): - This course will cover aspects of constructing and maintaining durable concrete structures. - Mechanisms of various deterioration processes, tests to determine the existence of these processes and measures to be taken to repair the damage or relieve the problems will be studied.	
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14.	Course contents <i>(about 100 words) (Include laboratory/design activities):</i> Chemical composition of concrete, permeability and transport processes, corrosion of reinforcement and prestressing steel in concrete, carbonation, chloride attack, alkali-silica reaction, freeze-thaw attack, sulphate attack, acid attack, effect of fire and high temperatures and seawater attack, cracking, weathering, biological processes, non-destructive testing, repairs, protection and retrofitting, durability based design of structures
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to cement and concrete microstructure, transport through cement microstructure	4
2	Corrosion of steel reinforcement, carbonation, chloride ingress, corrosion of prestressing steel	5
3	Aggregates and durability of concrete	2
4	Freeze-thaw attack and salt-scaling	2
5	Sulphate attack and delayed ettringite formation, physical salt attack	3
6	Effect of fire, acid attack, abrasion and cavitation	3
7	Quality control, workmanship and choice of materials	2
8	Autogenous, drying and plastic cracking in concrete	4
9	Biological processes	2
10	Non-destructive and laboratory test-methods	5
11	Inspection, repair and protection of structures	6
12	Durability based design of structures	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

No tutorials planned

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1	No laboratories planned.	
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books: Perkins P, Repair, Protection and Waterproofing of Concrete Structures, Third Edition, E&FN Spon, 1997 Richardson M.G., Fundamentals of Durable Reinforced Concrete, First Edition, Spon Press, 2002 Comite Euro-international du Beton, Durable concrete structures: design guide, Second Edition, Thomas Telford Services Ltd., 1989
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Matthews S., Design of durable concrete structures, IHS BRE Press, 2014

Reference material:

Mehta P.K. and Monteiro P.J.M., Concrete Microstructure Properties and Materials, Third Edition, Tata McGraw Hill, 2006

Bohni H (Ed.), Corrosion in reinforced concrete structures, CRC Press, 2005

HFW Taylor, Cement Chemistry, Thomas Telford, 1997

Bensted J. and Barnes P. (Ed.), "Structure and Performance of Cements", Second Edition, Spon Press, 2002

Newman J. and Choo B.S., Advanced Concrete Technology - Processes, Elsevier, 2003

Newman J. and Choo B.S., Advanced Concrete Technology - Testing and Quality, Elsevier, 2003

Neville A.M., Properties of Concrete, Fourth Edition, Pearson, 2006

Tazawa E, Autogenous Shrinkage of Concrete, E&FN Spon, 1999

Maekawa, Chaube and Kishi, Modelling of Concrete Performance, Hydration, Microstructure Formation and Mass Transport, E&FN Spon, 1999

Grantham M.G. (Ed.), Concrete Repair, A Practical guide, Taylor and Francis, 2011

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD Projector
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Up to 20% Software based problems on durability based design to be covered
20.2	Open-ended problems	Nil
20.3	Project-type activity	Nil
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Term papers on specific subjects - 10% of class time

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	Civil Engineering
2.	Course Title (<i>< 45 characters</i>)	FIRE ENGINEERING AND DESIGN
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL873
6.	Status (<i>category for program</i>)	PE for CES, CET, and CEC programmes

7.	Pre-requisites (course no./title)	None
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	Nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	Nil

9.	Not allowed for (indicate program names)	Not Applicable
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course Dr. Vasant Matsagar, Dr. Shashank Bishnoi, Prof. B. Bhattacharjee	
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12.	Will the course require any visiting faculty?	No
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13.	Course objective (<i>about 50 words</i>): Teaching theoretical and practical aspects of fire engineering and safety including recent technological advancements. Essentials of fire engineering; structural fire engineering; mechanics of structures under fire. Fundamentals of heat transfer in solids and structures; heat transfer mechanisms, thermo-mechanical properties of construction materials and fire growth. Analyzing thermal effects of fires on buildings and designing members for adequate strengths, protection measures, and hazard mitigation. Response evaluation of members such as beams, columns etc. and structures such as frames under simultaneous mechanical and fire loads.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): (A) Fire engineering: fundamentals of fire science, fire dynamics, hazard mitigation, and safety; codes, standards, rules and fire safety regulations; thermodynamics, thermofluids, heat and mass transfer; human behavior in fire and urban planning; fire testing methods for materials; large-scale fire testing.	
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	"Fire protection" - current methods in fire safety engineering; mechanics of repair; mitigation of fire damage by due design, and construction; industrial fire safety. Passive fire protection: analyzing the thermal effects of fires on buildings and designing structural members. Introduction to active fire protection. (B) Structural fire engineering: fire behavior and scenarios, heat transfer to the structure, structural response and stability under thermo-mechanical loads; fire safety design; mechanical properties of structural materials at elevated temperatures; fire response of steel, concrete, fiber reinforced polymers, high-performance materials etc.; computational procedures to predict structural behavior under fire conditions; structural fire resistance based on theoretical/empirical relationships; performance-based fire engineering; strengthening/repair of structures.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Fire engineering: fundamentals of fire science, fire dynamics.	4
2	Thermodynamics, thermofluids, heat and mass transfer. Human behavior in fire and urban planning.	4
3	Fire hazard mitigation, and safety provisions; codes, standards, rules, fire safety regulations.	3
4	Fire protection: current methods in fire safety engineering; mechanics of repair; mitigation of fire damage by due design, and construction; industrial fire safety.	4
5	Passive fire protection: analyzing thermal effects of fires on buildings and designing structural members. Introduction to active fire protection.	3
6	Fire testing methods for materials; large-scale fire testing; mechanical properties of the construction materials at elevated temperatures.	3
7	Structural fire engineering: fire behavior and scenarios, heat transfer to the structure.	4
8	Fire safety design; fire response of steel, concrete, fiber reinforced polymers, high performance materials etc.	3
9	Structural response and stability under fire with other loads; member and structure behaviors.	3
10	Computational procedures to predict structural behavior under fire conditions and scenarios.	4
11	Structural fire resistance based on the theoretical/ empirical relationships.	3
12	Performance-based fire engineering; strengthening/ repair of structures against fire.	4
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
3		
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COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

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|--|
| 1. Buchanan, Andrew H. (2001) "Structural Design for Fire Safety", John Wiley and Sons", |
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New York (NY), USA, ISBN 0-471-89060.

2. Kodur, Venkatesh; Franssen, Jean-Marc; Zaharia, Raul (2009) "Designing Steel Structures for Fire Safety", CRC Press, New York (NY), USA.
3. Wang, Yong; Burgess, Ian; Wald, Frantisek; Gillie, Martin (2014) "Performance-Based Fire Engineering of Structures", CRC Press, Taylor and Francis Group.
4. Purkiss, John A. (2007) "Fire Safety Engineering - Design of Structures", Butterworth-Heinemann Publications, Oxford, UK.
5. Malhotra, H.L. (1982) "Design of Fire-Resisting Structures", Surrey University Press, UK.
6. Li, Guo Qiang; Wang, Peijun (2013) "Advanced Analysis and Design for Fire Safety of Steel Structures", Springer, USA.
7. Wang, Y.C. (2002) "Steel and Composite Structures - Behaviour and Design for Fire Safety", Spon Press, UK.
8. Jain, V.K. (2007) "Fire Safety in Buildings", Taylor & Francis, UK.
9. Proceedings of the "Structures in Fire (SiF)" Conferences.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	SAFIR, Abaqus, Vulcan
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Microsoft (MS) Powerpoint and Videos
19.4	Laboratory	Nil
19.5	Equipment	Computer Systems/ Workstations
19.6	Classroom infrastructure	LCD Projector and PA System
19.7	Site visits	Nil

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	50%
20.2	Open-ended problems	10%
20.3	Project-type activity	15%
20.4	Open-ended laboratory work	10%
20.5	Others (please specify)	15% (Design problems and simulation)

Date: 16th February 2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	COMPUTATIONAL LABORATORY FOR CONSTRUCTION MANAGEMENT
3.	L-T-P structure	0 - 0 - 3
4.	Credits	1 . 5
5.	Course number	CVP772
6.	Status (<i>category for program</i>)	PC

7.	Pre-requisites (course no./title)	NIL
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Dr. J. Uma Maheswari, Dr. Vasant Matsagar, Dr. K N Jha	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): After completing this laboratory, the students would be able to- • develop on their own simple algorithms for any construction software • integrate software applications for complex problems	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction to construction project models - analytical and numerical. Application software for project planning, scheduling & control. Programming exercises for estimation, network planning and control, LP in construction. MATLAB Programming in linear and non-linear programming.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
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COURSE TOTAL (14 times 'L')		

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Introduction to construction project models	6
2	Network planning using Primavera, Project planner and MS Project	6
3	Database management	6
4	MATLAB differential functions	6
5	MATLAB linear programming	6
6	Exposure to Operations Research Software	3
7	NETwork computational exercise	6
8	Exposure to estimation software	3
9		
10		
COURSE TOTAL (14 times 'P')		42

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text book

Paulson, B.R., Computer Applications in Construction, McGraw Hill, 1995.

Reference books

Chatfield, C. & Johnson, T., Microsoft Project 2007 step-by-step, Prentice Hall of India, 2007.

Dayal, S., Earned value Management using Microsoft Project, J. Ross publishers, 2008.

Milosevic, D.Z., Project Management toolbox- tools and techniques for the practicing project manager, John Wiley & sons, 2013.

Khan, R.M., Problem solving and data analysis using minitab, John Wiley & sons, 2013.

Albright, S.C., VBA for Modelers - Developing decision support systems with MS Excel, Cengage learning, 2012.

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19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Required
19.2	Hardware	Available
19.3	Teaching aides (videos, etc.)	Available
19.4	Laboratory	Available
19.5	Equipment	Available
19.6	Classroom infrastructure	Available
19.7	Site visits	No

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Nil
20.2	Open-ended problems	Nil
20.3	Project-type activity	Nil
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	100% computational laboratory activity

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	INFRASTRUCTURE DEVELOPMENT AND MANAGEMENT
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3 (Three)
5.	Course number	CVL872
6.	Status (<i>category for program</i>)	PE for CEC & CET

7.	Pre-requisites (course no./title)	PG courses on "Fin. Mgmnt" and "Proj. Mgmnt" of any dept
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	25% Overlap with UG course in Infrastructure Planning and management
8.2	Overlap with any UG/PG course of other Dept./Centre	
8.3	Supercedes any existing course	

9.	Not allowed for (indicate program names)	Outside CE Department
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course Prof. K.C. Iyer / Dr. K.N. Jha / Dr. J. Uma Maheshwari	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): To make students aware of: • Importance of infrastructure for economic growth and development of the nation • Government's initiatives in infrastructure; • Planning and implementation methodology in infrastructure projects - problems and risks; • Policies and regulations; • National and international experiences • Models on infrastructure development	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>):	
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	• Introduction to Indian Infrastructure. Govt. initiatives through various five year plans. • Overview of various sectors of infrastructure and SEZ. • Infrastructure procurement through Public-Private-Partnership. Sector-wise differences in policies, Concession agreement, Selection procedure of concessionaires, Issues in financial closure, Stakeholder management. • Financial Models, Risk management, Environmental Impact Assessment, Case studies
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Indian Infrastructure & Economic impact of physical infrastructure	3
2	Five year plans: government's initiatives	3
3	Overview of various sectors of infrastructure	3
4	Financial analysis of infrastructure projects	3
5	Economic considerations infrastructure projects	2
6	Introduction to PPP - comparison with conventional form	3
7	Conventional forms of contracts and concession agreements	8
8	RFQ and RFP	3
9	Risk Management Issues in Infrastructure Projects	3
10	Environmental impact assessment	2
11	Problems in Infrastructure Development and Management	4
12	Case Studies	5
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Module no.	Experiment description	No. of hours
1		
2		
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COURSE TOTAL (14 times 'P')		Nil

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

No text books

Reference material:

1. R.N. Joshi. Public Private Partnership in Infrastructure: Perspectives-Principles-Practices, Vision Books 2010 (ISBN 978-81-7004-796-7)
2. Jeffrey Delmon, Public-Private Partnership Projects in Infrastructure: An Essential Guide for Policy Makers, Cambridge University Press 2011 (ISBN: 9780521152280)
3. Sidney M. Levy. Public-Private Partnerships Case Studies on Infrastructure Development ASCE Press, 2011
4. Carlos Oliveira Cruz and Rui Cunha Marques. Infrastructure Public-Private Partnerships: Decision, Management and Development, Springer 2013
5. Carl D. Martland. Toward More Sustainable Infrastructure, John Wiley and Sons (ISBN 978-0-470-44876-2), 2012
6. Ole Helby Petersen. Public-Private Partnerships: Policy and Regulation – With

- Comparative and Multi-level Case Studies from Denmark and Ireland, Copenhagen Business School (2011)
7. Alvin Goodman and Makarand Hastak. Infrastructure Planning Handbook: Planning, Engineering, and Economics, McGraw Hill/ASCE Press 2006 (ISBN 978-0-07-147494-8),.
 8. Delmon, Jeffrey. Private Sector Investment in Infrastructure, Wolters Kluwer, Second Edition, 2009
 9. Willie Tan. Principles of Project and Infrastructure Finance, Taylor and Francis, 2007
 10. Darrin Grimsey and Mervyn K. Lewis. Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance, Edward Elgar Publishing Limited, UK, 2004
 11. Ioannis N. Kessides, Reforming Infrastructure Privatization, Regulation, and Competition, A World Bank Policy Research Report, A copublication of the World Bank and Oxford University Press, 2004
 12. Gómez-Ibáñez, J.A. Regulating Infrastructure: Monopoly, Contracts, and Discretion, The Harvard University Press, 2003
 13. <http://3inetwork.org/reports/reports1.shtml> for PDF files of Indian Infrastructure Reports for the years 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009
 14. <http://infrastructure.gov.in/>

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	Yes
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	Yes
19.7	Site visits	

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Nil
20.2	Open-ended problems	20%
20.3	Project-type activity	20%: It will be term project type activity wherein students will be expected to understand and present a case of an infrastructure project from any sector right from its inception to commissioning including observations of experts, audit, etc.
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Nil

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	QUALITY & SAFETY IN CONSTRUCTION
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL874
6.	Status (<i>category for program</i>)	PE

7.	Pre-requisites (course no./title)	NIL
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☒ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Dr. J. Uma Maheswari, Dr. K N Jha, Prof. K C Iyer	
12.	Will the course require any visiting faculty?	No

13.	Course objective (<i>about 50 words</i>): This course is intended to provide a basic background on quality management and safety management. After attending this course, the students would be able to - plan and manage the quality related project using the tools, techniques and methodology which they were taught - plan, quantify, analyze and manage the hazardous construction project	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction to safety. Types of injuries, Factors affecting safety, Strategic Planning for safety provisions. Personal & Structural safety - Safety consideration during construction, demolition and during use of equipment. Recording injuries and accident indices. Method statement, SOPs, PPE, Inspections, Investigations. Site safety programmes - JSA, JHA, Root cause analysis, meetings, safety policy, manuals, training & orientation. Safety	
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	legislation regard to violation. Introduction to quality, assurance, control and audit. Regulatory agent - owner, designer, contractor. Strategic Planning and control of quality during design and construction, Quality tools in construction projects, Customer satisfaction and QFD, Quantitative techniques in quality control, Quality assurance during construction, Inspection of materials and machinery. Assessing quality. Teachings/findings of Gurus - Concept and philosophy of TQM, 6Sigma, ISO Certification. IS codes and standards regard to quality & safety.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Terminologies related to safety, strategic planning for safety	4
2	Factors affecting safety, personnel & structural safety during construction, demolition and during equipment handling	6
3	Recording injuries, accident statistics, violation	3
4	Method statement, SOPs, PPE, Inspections, investigations	4
5	Site safety programs	4
6	Quality related terms, regulatory agent	3
7	Strategic planning for quality	3
8	Quality tools in construction projects, QFD	6
9	Techniques in quality control, inspection, testing	5
10	Concept of TQM, 6sigma, ISO certification	4
11		
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

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17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
2		
3		
4		
5		
6		
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8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text book

Hinzie, J.W., Construction safety, Prentice Hall, 1997.

Rumane, A.R., Quality management in construction projects, CRC Press, T&F, 2011.

Reference books

MacCollum, D.V., Construction safety planning, John Wiley & sons, 1995.

Li, R.Y.M. & Poon, S.W., Construction safety, Springer, 2013.

Reese, C.D., Accident/Incident prevention techniques, CRC Press, T&F, 2012.

MacCollum, D.V., Construction safety engineering principles - designing and managing safer job sites, Tata McGraw Hill, 2007.

Holt, A.S.J., Principles of construction safety, Blackwell Publishers, 2005.

Bhattacharjee, S.K., Safety management in construction - principles and practices, Khanna publishers, 2011.

McCabe, S., Quality improvement techniques in construction, Pearson Education, 1998.
 Ashford, J.L., The Management of quality in construction, 1989.
 O'Brian, Construction inspection handbook- quality assurance & quality control.
 Rumane, A.R., Quality tools for managing construction projects, CRC Press, T&F, 2013.
 Yang, K. & El-Haik, B.S., Design for Six Sigma, Tata McGraw Hill, 2009.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	No
19.2	Hardware	Available
19.3	Teaching aides (videos, etc.)	Available
19.4	Laboratory	Not required
19.5	Equipment	Not required
19.6	Classroom infrastructure	LCD Projector and video playing facilities
19.7	Site visits	No

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	Nil
20.2	Open-ended problems	Nil
20.3	Project-type activity	Nil
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	20% for data collection and analysis

Date:

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT
3.	L-T-P structure	3 – 0 – 0
4.	Credits	3
5.	Course number	CVL773
6.	Status (<i>category for program</i>)	CORE

7.	Pre-requisites (course no./title)	NO
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	NO
8.2	Overlap with any UG/PG course of other Dept./Centre	NO
8.3	Supercedes any existing course	NO

9.	Not allowed for (indicate program names)	
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10.	Frequency of offering	☐ Every sem ☒ 1 st sem ☐ 2 nd sem ☐ Either sem
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11.	Faculty who will teach the course Prof K C Iyer, Dr. K N Jha, Dr. J Uma	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): This course aims to make the student well versed in: - theoretical aspects of of different quantitative methods in construction - practical applications of different quantitative methods in construction.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction and concepts of probability and statistics, Linear programming, Transportation and assignment problems. Dynamic programming, Queuing theory, Decision theory, Games theory. Simulations applied to construction, Modifications and improvement on CPM/PERT techniques.	
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction to Concepts of Probability and Statistics, Linear Programming, Dual Problem, Sensitivity Analysis	06
2	Transportation, Transshipment and Assignment Problems	04
3	Sequencing	03
4	Integer Programming, Goal Programming	04
5	Decision Theory- Under certainty, Under Uncertainty, Under Risk- Decision Tree, AHP	04
6	Game Theory and Markov Chain	04
7	Simulations applied to construction, Modifications and improvement on CPM/PERT techniques.	05
8	Dynamic Programming	03
9	Queuing Theory	03
10	Exposure to LP Software	02
11	Non-linear programming and optimisation	04
12		
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Not Applicable

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1		
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10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Text books:

1. Taha, A.H. Operations Research, Pearson Publishers, 2005.
2. Hillier, F.S. and Lieberman G.J., Introduction to Operations Research, 9th Ed., Tata McGraw Hill, 2010.
3. Jha, K.N. Construction Project Management: Theory and Practice (2015), Second Edition, Pearson Publishers, New Delhi, 2015.
4. Wagner, H.M. Principles of Operation Research, Prentice Hall, New Delhi, India, 2005.
5. Render, Stair, and Hanna, Quantitative Analysis for Management, Pearson Publishers, 2005.

Reference material

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19. Resources required for the course (*itemized & student access requirements, if any*)

19.1	Software	MATLAB,
19.2	Hardware	
19.3	Teaching aides (videos, etc.)	POWERPOINT
19.4	Laboratory	
19.5	Equipment	
19.6	Classroom infrastructure	LCD PROJECTOR
19.7	Site visits	NO

20. Design content of the course (*Percent of student time with examples, if possible*)

20.1	Design-type problems	up to 30%
20.2	Open-ended problems	up to 15%
20.3	Project-type activity	up to 30%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	Nil

Date: 10 Mar 2015

(Signature of the Head of the Department)

COURSE TEMPLATE

1.	Department /Centre proposing the course	CIVIL ENGINEERING
2.	Course Title (<i>< 45 characters</i>)	SUSTAINABLE MATERIALS AND GREEN BUILDINGS
3.	L-T-P structure	3 - 0 - 0
4.	Credits	3
5.	Course number	CVL875
6.	Status (<i>category for program</i>)	PE for CET & CEC; OE for others

7.	Pre-requisites (course no./title)	120 Credits for UG Students
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8.	Status vis-à-vis other courses (<i>give course number/title</i>)	
8.1	Overlap with any UG/PG course of the Dept./Centre	nil
8.2	Overlap with any UG/PG course of other Dept./Centre	Nil
8.3	Supercedes any existing course	No

9.	Not allowed for (indicate program names)	NONE
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10.	Frequency of offering	☐ Every sem ☐ 1 st sem ☐ 2 nd sem ☒ Either sem
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11.	Faculty who will teach the course 1. B. BHATTACHARJEE, 2.K.N.JHA, 3. S. BISHNOI	
12.	Will the course require any visiting faculty?	NO

13.	Course objective (<i>about 50 words</i>): To expose the students to • Concepts of sustainability in construction materials • Sustainable practices and green buildings. • Selecting materials and building elements • Construction on the basis of sustainability and greenness.	
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14.	Course contents (<i>about 100 words</i>) (<i>Include laboratory/design activities</i>): Introduction and definition of Sustainability. Carbon cycle and role of construction material such as concrete and steel, etc. CO ₂ contribution from cement and other construction materials. Construction materials and indoor air quality. No/Low cement concrete. Recycled and manufactured aggregate. Role of QC and durability. Life cycle and sustainability. Components of embodied energy, calculation of embodied energy for construction materials. Exergy concept and primary energy. Embodied energy via-a-vis operational	
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	energy in conditioned building. Life Cycle energy use. Control of energy use in building, ECBC code, codes in neighboring tropical countries, OTTV concepts and calculations, features of LEED and TERI Griha ratings. Role of insulation and thermal properties of construction materials, influence of moisture content and modeling. Performance ratings of green buildings. Zero energy building.
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15. Lecture Outline *(with topics and number of lectures)*

Module no.	Topic	No. of hours
1	Introduction, sustainability and goals, current situation, earth's natural system, carbon cycle, role of construction materials, CO ₂ from fossil fuel vis-à-vis cement and other construction materials. Construction material and indoor air quality.	3
2	Components of embodied energy: energy for production, transportation and erection, Estimation methodology, Computation of embodied energy for building. Primary energy and Exergy Concepts	4
3	High volume fly ash concrete, geo-polymer concrete and their embodied energy content against OPC concrete. Aggregate resource depletion, recycled aggregate from demolition etc. role of quality control and admixtures in sustainability. Durability of construction material and life cycle sustainability.	6
4	Operational energy, Frequency and time domain solutions of heat conduction in buildings for estimation of energy consumption,	4
5	Numerical simulation and Use of software	3
6	Relevant features of ECBC code with respect to building envelope,	4
7	Codes in tropical countries, OTTV Concepts, Estimation of OTTV coefficients. OTTV values for buildings.	3
8	Thermal properties of construction materials, effect of moisture, mineralogy and pores etc.	3
9	Role of insulation on operational energy, Envelop features, thermal mass and micro climatic change, modification of microclimate by trees.	3
10	Features of TERI GRIHA rating	3
11	LEED rating with respect to building envelope.	3
12	Economics of sustainability and benefits	3
COURSE TOTAL (14 times 'L')		42

16. Brief description of tutorial activities

Nil

17. Brief description of laboratory activities

Moduleno.	Experiment description	No. of hours
1	Nil	
2		
3		
4		
5		
6		
7		
8		
9		
10		
COURSE TOTAL (14 times 'P')		

18. Suggested texts and reference materials

STYLE: Author name and initials, Title, Edition, Publisher, Year.

Reference material:

1. Wu Chung, H. Advanced Civil Infrastructure Materials, First Edition, Woodhead Publishing Limited, 2006
2. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Processes, 1st Edition, Elsevier, 2003
3. Newman, J. and Choo, Ban Sang, Advanced Concrete Technology-Constituent Materials, 1st Edition, Elsevier, 2003
4. Kubba, S, LEED Practices, Certification, and Accreditation Hand book, 1st ed. Elsevier, 2010.
5. Ministry of Power, Energy Conservation Building Code 2007, Revised Version, Bureau of Energy Efficiency, 2008,
6. Architectural Energy Corporation, Building Envelope Stringency Analysis, International Institute for Energy Conservation, 2004
7. Indian Building Congress, Practical Handbook on Energy Conservation in Buildings, 1st ed. Nabhi Publication, 2008.
8. McQuiston, F.C., and Parker, J.D. Heating, Ventilating, and Air Conditioning, Analysis and Design, Fourth Ed. John Wiley & Sons, Inc, 1994.
9. Clarke, J.A., Energy Simulation in Building Design, Adam Hilger Ltd. 1985.
10. TERI-Griha's Green Design practices (www.teriin.org/bcsd/griha/griha.htm)
11. Leadership in Energy and Environmental Design (www.usgbc.org/LEED)
12. Article on Residential Green Choice (www.austinenergy.com)
13. Venkatarama Reddy, B. V., and Jagadish, K., S. "Embodied energy of common and alternative building materials and technologies". Energy and Buildings., 35, 129-137, 2003
14. Chani, P. S., Najamuddin., and Kaushik, S.K. "Comparative Analysis of Embodied Energy Rates for Walling Elements in India". Energy and Buildings., 84, 47-50. 2003
15. Andrew, H., Buchanan., and Brian, G. "Energy and carbon dioxide implications of building construction", Energy and Buildings., 20, 205-217. 1994
16. Sartori, I., and Hestnes, A. G. "Energy use in the life cycle of conventional and low-energy buildings: A review article", Energy and Buildings., 20, 249-257. 2007
17. Green Building Basics, California Integrated Waste Management Board (www.ciwmb.ca.gov/GREENBUILDING/Basics.htm#What)
18. Huberman, N., Pearlmuter, D. "A life-cycle energy analysis of building materials in the Negev desert". Energy and Buildings., 40, 837-848. 2007.
19. Catarina Thormark. "A low energy building in a life cycle—its embodied energy, energy need for operation and recycling potential", Building and Environment., 37, 429-435. 2001.

19. Resources required for the course *(itemized & student access requirements, if any)*

19.1	Software	Open source Building Energy Simulation softwares; e.g., Equest.
19.2	Hardware	Nil
19.3	Teaching aides (videos, etc.)	Nil
19.4	Laboratory	None
19.5	Equipment	None
19.6	Classroom infrastructure	LCD projection etc
19.7	Site visits	None

20. Design content of the course *(Percent of student time with examples, if possible)*

20.1	Design-type problems	20-30%, Design of materials for maximum sustainability, Design of envelope for least life cycle
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		energy consumption through computation of embodied and operational energy. Design for maximization of LEED or GRIHA rating in Office buildings Design for ECBC compliance and Design for OTTV.
20.2	Open-ended problems	Nil
20.3	Project-type activity	10%
20.4	Open-ended laboratory work	Nil
20.5	Others (please specify)	20% literature review

Date: 12/2/2015

(Signature of the Head of the Department)