

UNIVERSITY OF MUMBAI



Bachelor of Engineering in **Civil & Infrastructure Engineering**

Second Year with Effect from AY: 2021-22

Third Year with Effect from AY: 2022-23

Final Year with Effect from AY: 2023-24

Under

**FACULTY OF SCIENCE &
TECHNOLOGY**

(As per AICTE guidelines with effect from the academic year 2019–
2020)

UNIVERSITY OF MUMBAI



Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Second Year B.E. Civil and Infrastructure Engineering
2	Eligibility for Admission	After Passing Second Year Engineering as per the Ordinance 0.6242
3	Passing Marks	40%
4	Ordinances /Regulations(if any)	Ordinance 0.6242
5	No. of Years/Semesters	8 semesters
6	Level	U.G.
7	Pattern	Semester
8	Status	New
9	To be implemented from Academic Year	With effect from Academic Year: 2021-2022

Date:

Dr. S. K. Ukarande

Associate Dean

Faculty of Science and Technology

University of Mumbai

Dr. Anuradha Muzumdar

Dean

Faculty of Science and Technology

University of Mumbai

Preamble

In the last decade there has been rapid urbanization all over the country. It is due to constant human endeavor to strive for a more comfortable living. This is making existing infrastructure fall short to fulfil the demands of society. Accomplished infrastructure is required for the society in all its domains. Civil infrastructure consists of roads, bridges, buildings, dams, levees, water & wastewater treatment facilities, solid waste management, power generation-transmission and communications facilities.

There is a need to train engineers who have a holistic view of infrastructure and multidisciplinary knowledge background. A sound understanding of emerging and transformative technologies and functioning of the infrastructure systems is essential. Existing civil engineering program is not fully addressing this increasingly recognized need. This educational gap prompted new engineering program with more emphasis on planning, design and execution of infrastructure along with knowledge of civil engineering at undergraduate level. Accordingly AICTE proposed 'Civil and Infrastructure Engineering - a new programme at undergraduate level. Mumbai University intends to be on the forefront with a program in 'Civil and infrastructure Engineering which involves the design, construction and management of infrastructure.

The Faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the entire program will be of 171, wherein focus is not only on providing knowledge but also on building skills, attitude and self-learning. Therefore, in the present curriculum, skill-based laboratories and mini projects are made mandatory across all disciplines of engineering in the second and third year of programs, which will definitely facilitate self-learning of students. The overall credits and approach of curriculum proposed, is in line with AICTE model curriculum.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for Internal assessment, revision, guest lectures, coverage of content beyond syllabus etc.

The curriculum will be implemented for Second Year of Civil and Infrastructure Engineering from the academic year 2021-22. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2022-23, 2023-24, respectively.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum design is mainly focused on knowledge component, skill based activities and project based activities. Self-learning opportunities are provided to learners. In the design process of syllabus of 'C' scheme wherever possible, additional resource links of platforms such as NPTEL/Swayam are appropriately provided. In an earlier design of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current design based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self-learning to learner. Learners are now getting sufficient time for self-learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ Heads/ Faculty members of all the institutes are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

Dr. S. K. Ukarande

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Preface

The engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality of education and employability of students. To meet this challenge, the issue of quality needs to be addressed and taken forward in a systematic manner. **Accreditation** is the principal means of quality assurance in higher education. It reflects that, in achieving recognition, the institution or program of study is committed and open to external review to meet specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program Outcomes (POs) are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this, Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education (OBE) in the process of curriculum development from Rev-2012 onwards and continued to enhance the curriculum further based on OBE in Rev-2016 and Rev-2019 -CII scheme.

As Chairman and Members of Board of Studies in Civil Engineering, University of Mumbai, we are happy to state here that, the Program Educational Objectives (PEOs) for Undergraduate Program were finalized by faculty members from different affiliated Institutes of the University, who are either Heads of Departments or their senior representatives from the Department of Civil Engineering. The PEOs finalized for the undergraduate program in **Civil and Infrastructure Engineering** are listed below;

1. To prepare the Learner with a sound foundation in mathematical, scientific and engineering fundamentals.
2. To motivate the Learner in the art of self-learning and to use modern tools for solving real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organizations and for excelling in Post-graduate studies.
4. To motivate learners for life-long learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above listed PEOs, every institute is encouraged to add a few (2-3) more PEOs suiting their institute vision and mission

Apart from the PEOs, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to support the philosophy of OBE. We strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

Board of Studies in Civil Engineering, University of Mumbai

Dr. S. K. Ukarande	: Chairman	Dr. V. Jothi prakash	: Member
Dr. D.D. Sarode	: Member	Dr. K. K. Sangle	: Member
Dr. S. B. Charhate	: Member	Dr. D. G. Regulawar	: Member
Dr. Milind Waikar	: Member	Dr. A. R. Kambekar	: Member
Dr. R.B. Magar	: Member	Dr. Seema Jagtap	: Member

Semester-VI

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CIC601	Water Management Infrastructure	3	-		3	-	-	3
CIC602	Transport Infrastructure – II	3	-	-	3	-	-	3
CIC603	Design of RCC Structures	3	-	-	3	-	-	3
CIDO601X	Department Optional Course – III	3	-	-	3	-	-	3
CIDO602X	Department Optional Course – IV	3	-	-	3	-	-	3
CIL601	Water Management Infrastructure (Lab)	-	2	-	-	1	-	1
CIL602	Transport Infrastructure – II (Lab)	-	2	-	-	1	-	1
CIL603	Design of RCC Structures (Lab)	-	2	-	-	1	-	1
CIL604	Professional Communication and Ethics (Lab)			2			1	1
CIL605	Skill based lab Course-IV	-	3	-	-	1.5	-	1.5
CIM601	Mini Project–2B	-	3	-	-	1.5	-	1.5
Total		15	12	02	15	6	01	22

Examination Scheme

Course Code	Course Name	Theory					Term Work	Pract /oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (Hrs.)			
		Test I	Test II	Avg.					
CIC601	Water Management Infrastructure	20	20	20	80	3	-	-	100
CIC602	Transport Infrastructure – II	20	20	20	80	3	-	-	100
CIC603	Design of RCC Structures	20	20	20	80	3	-	-	100
CIDO601X	Department Optional Course – III	20	20	20	80	3	-	-	100
CIDO602X	Department Optional Course – IV	20	20	20	80	3	-	-	100
CIL601	Water Management Infrastructure (Lab)	--	--	-	-	-	25	25	50
CIL602	Transport Infrastructure – II (Lab)						25	25	50
CIL603	Design of RCC Structures (Lab)	-	-	-	-	-	25	25	50
CIL604	Professional Communication and Ethics (Lab)	-	-	-	-	-	25	25	50
CIL605	Skill based lab Course – IV	-	-	-	-	-	50	-	50
CIM601	Mini Project–2B	-	-	-	-	-	25	25	50
Total				100	400	-	175	125	800

Department Level Optional Course – III

Sr. No.	Course Code CEDO 601X	Department Level Optional Course – III
1	CIDO 6011	Environmental Engineering
2	CIDO 6012	Ground Improvements Techniques
3	CIDO 6013	Water Resource Engineering
4	CIDO 6014	Advanced Structural Mechanics
5	CIDO 6015	Entrepreneurship Development and Management

Department Level Optional Course – IV

Sr. No.	Course Code CEDO 602X	Department Level Optional Course – IV
1	CIDO 6021	Urban Infrastructure Planning
2	CIDO 6022	Material Procurement and Management
3	CIDO 6023	Traffic Engineering and Management
4	CIDO 6024	Coastal Engineering
5	CIDO 6025	Sustainable Infrastructure Material

Semester-VI

Course Code	Course Name	Credits
CIC 601	Water Management Infrastructure	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	--	--	-	100

Rationale

India is an agricultural country where the majority of the population lives in villages so the agricultural industry is the backbone of the Indian economy. Being a tropical country with large temporal and spatial variation of rainfall and availability of rainfall only for three to four months, planning of existing water resources is strongly needed in India. To satisfy this need, this course provides necessary knowledge and information about planning water resources efficiently, control level fixation of dams and reservoirs and hydraulics of wells. In addition to this, it provides necessary knowledge about analysis and design of gravity dams and earthen dams, detailed classification of canal head-works and its distribution system and discusses different canal structures and cross drainage works. Water conservation and harvesting techniques are also discussed in this course. At the end how the potential of water can be used in generating electricity is discussed.

Objectives

1. To study the water resources development projects in India
2. To study control level fixation for reservoir, dams i.e., gravity dam, its various components and analysis and suitable conditions of earthen dam and its seepage analysis.
3. To study and calculate discharge from aquifers.
4. To study canal headwork, its distribution system and design of canal structures
5. To study water harvesting techniques and its conservation
6. To study hydropower plant development in India and the world.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Water Resources Planning		06
	1.1	India's water resources, scenario of water use, purposes of water resources development, classification of water resources development projects, functional requirements in multipurpose projects	
	1.2	Process of project formulation, project evaluation, strategies for the future: planning strategies and management strategies	
2	Dams and Spillways		11
	2.1	Reservoir, various zones of storage reservoir, control level fixation for a reservoir. Introduction to reservoir sedimentation and control measures.	
	2.2	Gravity Dams: Definition, typical cross section and components of gravity dam, forces acting on gravity dam, modes of failure of gravity dam, structural stability analysis of gravity dam, elementary and practical profile of gravity dam, low and high gravity dam, galleries in gravity dam – Function of gallery and different cross-sections of gallery adopted in practice, joints in gravity dam.	
	2.3	Earthen Dam: Types of earthen dams and methods of construction of earthen dam, causes and failures of earthen dams, seepage line/phreatic line for different conditions and its location using graphical method, seepage control through embankment and through foundations.	
	2.4	Spillways: Introduction, types of spillways – its working and functionality, spillway gates	
3	Ground Water and Well Hydraulics		05
	3.1	Ground water resources and occurrence of ground water, Well hydraulics: steady state flow conditions in wells.	
	3.2	Equilibrium equations for confined and unconfined aquifer, aquifer tests, difference between open well and tube well, well Losses	
4	Canal Headwork-Distribution System and Canal Structures		06
	4.1	Canal Headwork and Distribution System: Classification of canals, canal alignment, canal losses, canal lining, water logging and remedial measures for water logging.	
	4.2	Canal Structures, canal falls and types of canal falls, canal escapes and types of canal escapes, canal regulators and types of canal regulators, canal outlets and types of canal outlets, cross drainage works and types of cross drainage work.	

5	Water Harvesting and Conservation		05
	5.1	Water Harvesting Techniques – Micro catchments, design of small water harvesting structures	
	5.2	Farm Ponds – Percolation tanks, yield from a catchment, conservation of rainwater, roof water harvesting, recharging of groundwater.	
6	Hydropower Plant Development		06
	6.1	Sources and forms of energy, types of power plants, elements of hydropower scheme, hydropower development in India and World – Hydropower plants classification, layout and components- development of hydropower	
	6.2	Schemes – Comparison of hydro, thermal and nuclear power , survey and investigation, concept of feasibility and detailed project reports, review of IS codes.	
TOTAL			39

Contribution to Outcome

On completion of this course, the students will be able to:

1. Formulate planning and management strategies in different water resources development projects
2. Analyze and design gravity dams and earthen dams with spillways for sustainable development
3. Apply knowledge on ground water, well hydraulics to estimate the safe yield and ground water potential
4. Classify and explain various canal structures and suggest remedial measures for water logging to save fertile irrigation
5. Design a small water harvesting structure
6. Analyze different sources and forms of energy and its power generation

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Water Power Engineering, Barrows, H.K, Tata McGraw Hill Publishing Company Ltd., New Delhi
2. Hydro Power Structure, Varshney, R.S, Nem Chand Brothers, Roorkee, 2001
3. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
4. Design of Small Dams: USBR.
5. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
6. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.A
7. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.
8. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, New York.
9. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.

Reference Books:

1. Irrigation water power and Water Resources Engineering, Arora, K. R, Standard Publishers Distributors, Delhi
2. Irrigation and Water Power Engineering: B.C. Punmia, Pande B.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi.
3. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-9789383656899.
4. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
5. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.
6. Vir Singh, Raj, Watershed Planning and Management, Yash Publishing House, Bikaner, 2000.
7. Dhruva Narayana, G. Sastry, V. S. Patnaik, "Watershed Management", CSWCTRI, Dehradun, ICAR Publications, 1997.

Semester-VI

Course Code	Course Name	Credits
CIC 602	Transport Infrastructure-II	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	–	–	03	–	–	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	–	–	–	100

Rationale

Transportation contributes to the economical, industrial, social and cultural development of any country. The adequacy of the transportation system of a country indicates its economic social development. Three basic modes of transportation include land, water and air. The land mode further includes highways and railways. This course is developed so as to impart the basic principles behind railway engineering, airport engineering, water transportation engineering in respect of their various types of materials used, function of component parts, methods of construction, planning principles, aspects of supervision maintenance.

Objectives

1. To study the various elements and materials pertaining to railway transportation
2. To study the suburban and mass rapid transit system in metro cities
3. To study and design the various elements pertaining to air transportation
4. To study and differentiate the various modes of water transportation
5. To study the fundamental concepts of bridge engineering
6. To familiarize the students with latest techniques of transportation systems

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Rail Infrastructure		08
	1.1	Rail alignment surveys; Permanent way- rails, sleepers, ballast; Curvature of track, types of curves, degree of curvature, super - elevation, transition curves; railway points, crossings and junctions; station yards	
	1.2	Terminals- size, parking, circulation, platforms, passenger service and amenities area; Modernization of track and railway station for high speed trains, Monorail and Metro rails	
2	Suburban railways in Metro cities		05
	2.1	Urban transport: about the suburban rail service of India's major cities.	
	2.2	MRTS in metro cities: Requirement, suitability and characteristics	
3	Airport Infrastructure, Planning and Design		10
	3.1	Airport location planning; Components of airport design; Air side development – runways, taxiways, aprons, air and ground navigation and traffic control aids	
	3.2	Land side development – passenger building, cargo facilities, internal airport circulation and parking	
	3.3	Design of ground access facilities and airport support facilities; landside airport connectivity planning.	
4	Ports, Docks and Harbor		06
	4.1	Ports- Port Infrastructure for cargo handling and storage, marine access infrastructure, cargo specific berths and port facilities	
	4.2	Harbors - Types, layout, components of harbor- entrance, approach channel, turning basin, sheltered basin, breakwaters, wharves and quays, dry docks, Jetties and piers; Appurtenances to harbor- aprons, transit sheds, warehouses, scouring.	
5	Bridge Engineering		05
	5.1	General Bridge systems: Considerations in alignment, planning, economic, aesthetics and selection of type of bridge	
	5.2	Bridge hydrology, scour depth, depth of foundation, estimation of design discharge	

	Intelligent Transport System		
6	6.1	Definition, concepts, types of Intelligent Transport System (ITS); ITS technology, software, equipment, traffic management, public transport system, terminal and depot management system, parking infrastructure management, commercial vehicle management, highway surveillance.	05
		TOTAL	39

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand the various aspects of Rail Infrastructure
2. Explain the suburban and MRTS transport in metropolitan cities
3. Plan and design the different elements of airport infrastructure
4. Recognize the different modes of water transportation
5. Explain the basic concepts of Bridge Engineering
6. Recognize the techniques of smart transportation system.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Kadiyali L. R (2016), Transportation Engineering, Khanna Publishers, New Delhi.
2. Blow, C. J. (2005), Transport terminals and modal interchanges: planning and design, Elsevier, United Kingdom.
3. Horonjeff, R. Mickelvey, F.X, Planning & design of airports, Mc Graw Hill, New York, 5th edition. 2016
4. Khanna, S.K., Arora, M.G., and S.S. Jain; Airport Planning and Design, Nem Chand & Brothers, 2012
5. Sussman, J. M., Perspectives on Intelligent Transportation Systems (ITS),

Springer 2005

6. Turban, E., and Aronson, J. E., Decision Support Systems and Intelligent Systems, 5th Edition, Prentice Hall
7. Sarkar, P., Jain, A.K. (2017), Intelligent Transport Systems, PHI Learning Private Limited, New Delhi.

Reference Books:

1. Blonk, W.A.G. (1979), Transport and Regional Development. Saxon House, Farnborough.
2. O'Flaherty, C.A. (2000), Transport Planning and Traffic Engineering, Dept. of Transport, USA.
3. Ortúzar, J. De and Willumsen, L. G. (2011), Modelling Transport, John Wiley and Sons, United

Semester-VI

Course Code	Course Name	Credits
CIC 603	Design of Reinforced Concrete Structures	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR		OR
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	-	-	-	100

Rationale

The Limit State Method (LSM) is based on the statistical probability which provides the rational solution to the design problems. The philosophy which lies behind, LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states. The subject involves the application of working stress method and limit state method in the analysis and design of various elements of the civil engineering structures.

Objectives

1. To develop clear understanding of design philosophy amongst the students for the design of reinforced concrete structure using limit state method (LSM).
2. To apply various concepts of LSM in the analysis and design of beams for flexure and shear as per IS 456:2000.
3. To apply various concepts of LSM in the analysis and design of beams for bond and torsion as per IS 456:2000
4. To apply various concepts of LSM in the analysis and design of slabs per IS 456:2000

5. To develop the concept of design using design charts and curves for columns subjected to axial load and moment.
6. To study the concept of reinforced concrete footing design subjected to axial load and moment

Detailed syllabus

Module	Course Modules / Contents		Periods
1	Limit State Method:		06
	1.1	Introduction to limit state method of design as per IS:456-2000.	
	1.2	Concepts of probability and reliability, characteristic load, characteristic strength, partial safety factors for loads and materials, introduction to various limit states of collapse and serviceability.	
2	Limit State of Collapse: Flexure, Shear		08
	2.1	Design of singly and doubly reinforced rectangular and flanged sections for flexure, shear.	
3	Limit State of Collapse: Bond and Torsion		04
	3.1	Design of singly rectangular section for bond.	
	3.2	Design of singly rectangular section for torsion.	
4	Design of Slabs using Limit state method:		07
	4.1	Design of simply supported one-way slabs as per IS:456-2000.	
	4.2	Design of simply supported two-way slabs as per IS:456-2000.	
	4.3	Design of continuous slabs as per IS:456-2000.	
5	Limit State of Collapse – Compression:		08
	5.1	Limit state of collapse: compression for short and slender column.	
	5.2	Introduction to members subjected to combined axial and uniaxial as well as biaxial bending.	
	5.3	Development of interactive curves and their use in column design	
6	Design of Foundations:		06
	6.1	Design of Isolated square and rectangular footings subjected to axial load and moment.	
	6.2	Introduction to basic concepts of combined rectangular pad footing, slab beam type footing and Raft foundation.	
TOTAL			39

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand the fundamentals of LSM.

2. Apply various concepts of LSM in the analysis and design of beams for flexure and shear as per IS 456:2000.
3. Apply various concepts of LSM in the analysis and design of beams for bond and torsion as per IS 456:2000
4. Apply various concepts of LSM in the analysis and design of slabs per IS 456:2000
5. Understand the use of readymade design charts and curves from Special Publications of Bureau of Indian Standards.
6. Apply the concept of reinforced concrete footing design subjected to axial load and moment.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Use of IS:456-2000 shall be allowed in the examination
2. Question paper will comprise of total six questions, each carrying 20 marks.
3. Question 1 will be compulsory and should cover maximum contents of the curriculum
4. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
5. Only Four questions need to be solved.

Recommended Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Limit State Design of Reinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Ultimate Strength Design for Structural Concrete: Arthur, P. D. and Ramakrishnan, V., Wheeler and Co. Pvt. Ltd.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.
7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune.
8. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A, John Wiley (2007), 7th Edition.
9. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

Reference Books:

1. Design of RCC structural Elements (RCC Vol-I): Bhavikatti, S. S., New Age International Publications.
2. Reinforced Concrete: Syal and Goel; Wheeler Publishers.

3. Reinforced Concrete Design: Pillai, S.U. and Menon, Devdas, Tata Mc-Graw Hill PublishingHouse, New Delhi.
4. Reinforced Concrete Design by S.N. Sinha, Tata Mc-Graw Hill Publishing House, New Delhi.
5. Theory of Reinforced concrete structures by N. Subramanian, Oxford University Press.
6. RCC Design (WSM and LSM): Punmia, B. C., Jain, A. K., and Jain, Arun, K., Laxmi Publications.
7. Limit State Design of Reinforced Concrete (as per IS: 456-2000): Punmia, B. C., Jain, A. K., andJain, Arun, K., Laxmi Publications.
8. Relevant IS Codes: BIS Publications, New Delhi.

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Semester-VI

Course Code	Course Name	Credits
CIDO 6011	Department Level Optional Course – III Environmental Engineering	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	-	-	-	100

Rationale

Every civil engineer must be acquainted with the principles of public health engineering, purification of water, estimation of water and design of water treatment and develop rational approaches towards sustainability via appropriate treatment and reuse of water. The course deals with the overall features and study of treatment of water, building drainage, and water treatment processes.

Objectives

- To demonstrate the necessary knowledge and concepts in the fields of water supply.
- To demonstrate the necessary knowledge and concepts in the fields of quality of water.
- To impart necessary skill for the estimation of water demand.
- To recognize the necessary knowledge of good plumbing system and building drainage.
- To impart necessary skill for the design and operation of various units of water treatment facilities.
- To impart necessary skill for the design and operation of disinfection & advanced treatment of water.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	Water Supply System		
	1.1	General requirements, System of distribution – Gravity system, combined system, direct pumping. Methods of supply – Intermittent and continuous. Maintenance of required pressure in distribution system.	

	1.2	Storage – Underground, ground level and overhead service reservoirs –Sketch, necessity and accessories. Types of layout – dead end, grid iron, radial and ring system, their merits and demerits and their suitability.	05
	1.3	Appurtenances in distribution system: use of sluice valves, check valves, air valve, scour valve, zero velocity valves, fire hydrants.	
2	Quality of Water		
	2.1	Quality of water: Introduction to pure water: potable, wholesome, palatable, distilled, polluted and contaminated water, drinking water standards and characteristics of water, water borne diseases.	06
3	Estimation of Water		
	3.1	Estimation surface water resources, ground water velocity, springs, galleries, wells, tube well, quality of water from different sources, demand & quantity of water, fire demand, water requirement for various uses, fluctuations in demand, and forecast of population.	06
	3.2	Hardy-cross method, leak detection, maintenance of distribution systems, service reservoir capacity and height of reservoir.	
4	Building Water Supply and Drainage		
	4.1	Building water supply: Water demands, per capita supply, service connection from main, water meter.	04
	4.2	Building drainage: basic principles, traps-types, location and function, systems of plumbing, anti-siphon and vent pipes.	
5	Water Treatment – Preliminary & Primary Treatment		
	5.1	WTP: Typical layout of WTP, aeration, types of aeration systems, design of aeration tank, sedimentation, types of settling, tube settlers, design of sedimentation tank.	12
	5.2	Coagulation and flocculation: Principle & design of coagulation, flocculation, clariflocculator, coagulants aids.	
	5.3	Filtration: slow & rapid sand filters, operation, cleaning and back-washing, entire design of slow & rapid gravity filter with under drainage system. Pressure filter: Construction and operation	
6	Water Treatment – Secondary Treatment		
	6.1	Disinfection: Different methods of disinfection, chlorination and chemistry of chlorination, chlorine demand, free and combined chlorine, various forms of chlorine, types of chlorination. Numerical to calculate quantity of required chlorine doses.	06
	6.2	Advanced and Miscellaneous Treatments: Water softening by lime soda process and by base exchange method, reverse osmosis, activated carbon, membrane filtration, removal of iron and manganese.	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand the water supply system.
2. Identify the quality of water.
3. Analyze and plan water supply system.
4. Build service connection of water supply from main and building drainage system at construction site
5. Design and operation of various units of water treatment facilities.
6. Understand the operation of disinfection & advanced treatment of water.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

- 1 Water Supply Engineering: S. K. Garg, Khanna Publication.
- 2 Water Supply Engineering: P.N. Modi, Rajsons Publication.
- 3 Water Supply and Sanitary Engineering: S.K. Hussain, Oxford & IBH Publication, New Delhi
- 4 Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.

Reference Books:

- 1 Water Supply and Sewerage: E.W. Steel.
- 2 Manual on Water Supply and Treatment, (latest Ed.): Ministry of Urban Development, New Delhi.
- 3 Water supply and pollution control: J.W. Clark, W. Veisman, M.J. Hammer, International textbook company.
- 4 CPHEEO Manual on Water Supply and Treatment.
- 5 Environmental Engineering: Peavy, H.S., Rowe D.R., Tchobanoglous G.; 1991, Tata-Mcgraw Hill.

Semester-VI

Subject Code	Subject Name	Credits
CIDO 6012	Department Level Optional Course – III Ground Improvement Techniques	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	--	-	03	--	-	03

Theory					Term Work/ Practical/Oral			Total
Internal Assessment			End Sem	Duration of	TW	PR	OR	
Test-I	Test-II	Average	Exam	End Sem Exam				
20	20	20	80	3 Hrs.	-	-	-	100

Rationale

A geotechnical engineer often needs to design new structures or repair the structures on or in problematic soils in engineering practices. The types of soil at construction sites are not always totally favorable for supporting civil engineering structure such as buildings, bridges, highways, tunnels, retaining walls, dams, offshore structures and many more. Soil needs to be treated using ground improvement techniques to enhance the soil strength. Similarly, specific types of soil improvement techniques are required in the case of expansive soils and collapsible soil and in the case of earthquake prone areas. For both cases, the knowledge of ground Improvement is required as ground improvement is an important to for a geotechnical engineer. This course will deal with different ground improvement techniques along with principles, design issues and construction procedures.

Objectives

1. To identify the problematic soils and their associated issues.
2. To make the student understand for different ground improvement methods adopted for improving the properties of in-situ and remolded soils.
3. To understand the concepts of the reinforced earth and soil nailing to the students in conventional retaining walls.
4. To make the student remember the concepts, purpose and effects of grouting.
5. To explain the application, installation and design of stone column.
6. To understand the concept of ground anchors that can be used to improve the engineering performance of soils both in static and seismic condition.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	Introduction Need for Ground Improvement, different types of problematic soils, classification of ground improvement techniques, emerging trends in ground improvement techniques, economic considerations and suitability.	04
2.	Compaction and Consolidation Methods of compaction, shallow compaction, deep compaction techniques: vibro-floatation, blasting, dynamic consolidation, pre-compression; accelerated consolidation by sand drains, free strain and equal strain cases, design of sand drain layout.	07
3.	Stabilization of Soil Methods of stabilization, mechanical stabilization: lime, cement, lime, fly-ash, bitumen, chemicals and polymer stabilization, stabilization by electro-osmosis.	05
4.	Grouting Grouting technology, grout materials, physical and chemical properties, strength, rheological aspects of coarse and fine grouts, penetrability and performance aspect of coarse and fine grouts, various application of grouting.	06
5	Stone Columns Application, layout feature, procedures of installation, vibrofloat and rammed stone column, unit cell concept, load transfer mechanism, settlement in stone column, methods of improving the effectiveness of stone column, design for stone column layout.	08
6.	Reinforced Earth and Anchors Necessity of reinforced earth, theory of reinforced earth, materials and method, application, design of reinforced earth, characteristics of reinforced earth masses; introduction to soil nailing and ground anchors; Capacity of shallow horizontal and vertical strip anchors by using Mononobe-Okabe method.	09
TOTAL		39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Identify problematic soils and their associated issues.
2. Study the various ground improvement techniques and propose suitable remedial techniques and design.
3. Develop the understanding for selection of appropriate soilimprovement technique based on the soil type and application.
4. Cover details related to necessary knowledge for grouting design for various

engineering applications in the field.

5. Highlight on topics to know the application, installation and design of stone column
6. Acquaint with the pseudo-static method mostly used in designing the geotechnical structures under seismic condition

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Ground Improvement Techniques: P.P. Raj, Prentice Hall of India, (2005).
2. Engineering Principles of Ground Modification: M.R. Housmann, McGraw Hill, (1990).
3. Foundation Engineering Manual: N. V. Nayak, (2015).
4. IS15284 (Part 1): Design and Construction for Ground Improvement–Guidelines: (Stone Column), Bureau of Indian Standards, New Delhi, (2003).
5. Ground Improvement Techniques: Nihar Ranjan Patro, Vikas Publishing House (P) Limited, (2012).
6. Geotechnical Earthquake Engineering: S. L. Kramer, Pearson, (2013).
7. Earth Anchors: B. M. Das, Elsevier, (2012).

Reference books:

1. Constructional and Geotechnical Methods in Foundation Engineering: R.M. Koerner, McGraw Hill, (1985).
2. Design and Construction of Stone Column: FHWA Report No. Rd 83/026, (1983)
3. Principles of Foundation Engineering: B. M. Das, 7th edition, Cengage Learning, (2013).
4. Designing with Geosynthetics: R.M. Koerner, 4th Edition, Prentice Hall, Jersey, (1999)

Semester-VI

Course Code	Course Name	Credits
CIDO 6013	Department Level Optional Course – III Water Resources Engineering	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	-	-	03	-	-	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	3 Hrs.	-	-	-	100

Rationale

India is an agricultural country where majority of population lives in villages so agricultural industry is the backbone of Indian economy. Being a tropical country with large temporal and spatial variation of rainfall and availability of rainfall only for three to four months, irrigation is strongly needed in India. To satisfy this need, enhancing the irrigation facilities in the country is required. This course provides necessary knowledge and information about various irrigation methods as well as water requirements of crops and hydrologic processes. In addition to this, it provides necessary knowledge about different silt theories related to irrigation channels, estimation and forecasting of floods and critical review of the various flood management works in India and finally discusses about different lessons learnt from various case studies.

Objectives

1. To study smart irrigation engineering methods.
2. To study soil water relationship and water requirement of crops.
3. To study hydrological cycle, its elements and plotting of hydrographs.
4. To study importance of silt theories and its design considerations.
5. To study estimation and forecasting of floods.
6. To study review of flood management work in India and some solutions.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	Smart Irrigation Methods		07
	1.1	Introduction to irrigation and need of irrigation, benefits of irrigation and ill effects of irrigation, types of Irrigation Projects: minor, medium and major irrigation projects	
	1.2	Methods of Irrigation Systems: Surface irrigation and different techniques of water distribution for surface irrigation, subsurface irrigation, sprinkler irrigation and drip irrigation.	
2	Water Requirement of Crops		07
	2.1	Water Requirement of Crops: Crops and crop seasons in India, delta and duty of crops, relationship between delta and duty of crops.	
	2.2	Soil water relationship and its significance from irrigation considerations, root zone soil water, infiltration, consumptive use, frequency of irrigation.	
3	Hydrology		05
	3.1	Hydrologic cycle, Precipitation: Forms and types of precipitations.	
	3.2	Measurement of rainfall by rain gauges and stream flow measurement. calculation of missing rainfall data and adequacy of rain gauge stations.	
	3.3	Runoff: Runoff- factors affecting runoff, computation of runoff, yield of the catchment runoff hydrograph, flood discharge and its calculations.	
	3.4	Hydrograph: Flood hydrograph- Its components and base-flow separation, unit hydrograph, application of unit hydrograph, methods of deriving unit hydrograph, S-hydrograph and its application.	
4	Design of Channel (Silt Theories)		09
	4.1	Kennedy's theory and method of channel designs silt supporting capacity according to Kennedy's theory. Lacey's regime theory and application of Lacey's theory for designing channel cross-section.	
	4.2	Comparison between Kennedy's theory and Lacey's theory, drawbacks of Kennedy's theory and Lacey's theory, Introduction to sediment transport in channels.	

5	Flood Estimation and Forecasting		06
	5.1	Estimation of peak flood, flood frequency studies, methods of flood control	
	5.2	Flood routing through a reservoir, channel flow routing, muskingam method flood forecasting and warning.	
6	Review of flood management work in India and some solutions		05
	6.1	Flood Prone Areas in India, Approach to Flood Management in The Country: Structural and Non-structural measures, Urban floods, Important Government Initiatives	
	6.2	Critical Review of the various flood management works in India, Solutions: International case studies for better flood management, Major flood events of the country: Case studies and lessons learnt	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Classify various types and methods of smart irrigation.
2. Calculate Crop water requirement
3. Estimate flood discharge and Runoff by traditional and modern usage tools for planning and management of water resources projects.
4. Compare different silt theories related to irrigation channel and design the same.
5. Estimate and forecast flood
6. Review various flood management works in India

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum

3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended books

1. Irrigation and Water Power Engineering: B.C. Punmia, Pande B.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-9789383656899.
3. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0
4. Irrigation Engineering and Hydraulics Structures: S. K. Garg, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: S. K. Sharma, S. Chand and Co.

Reference books

1. Theory and Design of Irrigation Structures: R. S. Varshney and R, C. Gupta, Nem Chand
2. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
3. Design of Small Dams: USBR.
4. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
5. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.

Semester-VI

CIDO 6014	Department Level Optional Course – III Advanced Structural Mechanics	03
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Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	--	-	03	--	-	03

Theory				Term Work/ Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR		OR
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

The structures are subjected to various types of loading/ forces. These are axial force, shear force, bending moment, etc. This course enables the students with the knowledge in conformity with analysis of behavior of structural members under different types of loading. The course facilitates in imparting theoretical concepts and physical understanding, which in turn will help in solving structural mechanics problems, mostly involving beams & thin-walled structures under different loading conditions.

Objectives

1. To understand the concept of shear center & evaluate the shear center for symmetrical & unsymmetrical thin-walled sections.
2. To understand the concept of bending of beams with large initial curvature loaded in plan
3. To understand the concept & behavior of beams resting on elastic foundation.
4. To study the behavior of beams curved in plan.
5. To understand the concept of different theories of failure in regards of materials.
6. To study the behavior of deep beams using different theories available for the analysis of different sections.

Detailed Syllabus

Module	Sub-Modules/Contents	Periods
1	Shear center:	05
	Shear centre for symmetrical & unsymmetrical (about both axes) thin walled Open sections.	
2	Bending of beams with large initial curvature:	08

	2.1	Bending of beams with large initial curvature, loaded in their plane of curvature.	
	2.2	Application to analysis of hooks, circular closed rings, chain links with Straight length & semi-circular ends.	
3	Beams on elastic foundation:		08
	3.1	Analysis of beams of infinite length subjected to concentrated force/moment & semi-infinite length subjected to concentrated load/moment at one end.	
	3.2	Semi-infinite beam hinged at one end (origin) & subjected to UDL throughout.	
4	Beams curved in plan:		05
	4.1	Analysis of beams loaded perpendicular to their own plane.	
	4.2	Simply supported, fixed & continuous beams.	
5	Theories of Failure:		07
	5.1	Maximum principal stress theory, maximum principal strain theory, maximum shear stress theory.	
	5.2	Maximum total strain energy theory.	
6	Analysis of deep beams:		06
	6.1	Determination of deflection	
	6.2	Determination of shear correction factor for various sections: rectangular solid & hollow section, circular solid & hollow section & I-section	
	6.3	Stress concentration, stress concentration factor.	
TOTAL			39

Note: Minimum one industrial visit based on above module may be

Contribution to Outcome

On successful completion of the course, the students shall be able to:

1. Understand the concept of shear center for thin-walled open sections.
2. Calculate bending responses of beams with large initial curvature
3. Study the behavior of beam resting on elastic foundation with various loading conditions.
4. Analyze the beam curved in plan for different support conditions.
5. Understand the concept of different theories of failure in different sections.
6. Determine deflection, shear correction factor for different sections like solid & hollow sections.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Mechanics of Materials: Popov, E.P. Prentice Hall of India Pvt. Ltd.
2. Mechanics of Materials: James Gere, M., Thomson Brooks.
3. Mechanics of Materials: Beer, F.P., E. Russell Johnston and John T. DeWolf, TMH, New Delhi.
4. Advanced Mechanics of Materials: Arthur P. Boresi and Omar M. Sidebottom, Wiley and Sons.
5. Advanced Mechanics of Materials: Arthur P. Boresi and Richard Schmidt, John Wiley and sons.

Reference Books:

1. Strength of Material Part I and Part II: Timoshenko, McGraw Hill, New York.
2. Mechanics of Solids: Shames, I and Pitarresi, J. M., Prentice Hall, New Delhi.
3. Beams on Elastic Foundation: Herten M.
4. Strength of Materials: Subramanian, Oxford University Press.

Semester-VI

Course Code	Course Name	Credits
CIDO 6015	Department Level Optional Course – III Entrepreneurship Development and Management	3

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of EndSem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

Entrepreneurship is the ability and readiness to develop, organize and run a business enterprise, along with any of its uncertainties in order to make a profit. The most prominent example of entrepreneurship is the starting of new businesses. Economies are powered by innovation. Much of that innovation derives from forward-thinking individuals who possess the drive, skills, and background to turn a business vision into reality. The entrepreneur is defined as someone who has the ability and desire to establish, administer and succeed in a startup venture along with risk entitled to it, to make profits. The best example of entrepreneurship is the starting of a new business venture. The entrepreneurs are often known as a source of new ideas or innovators, and bring new ideas in the market by replacing old with a new invention. The importance of entrepreneurs extends beyond the effect those individuals have on their own companies, however. They impact their broader communities, and, in some cases, even the world.

Objectives

1. To explain fundamental management functions of a manager. Also explain planning and decision-making processes.
2. To explain the organizational structure, staffing and leadership process.
3. To describe the understanding of motivation and different control systems in management.
4. To explain understanding of Entrepreneurships and Entrepreneurship development process.
5. To illustrate small scale industries, various types of supporting agencies and financing available for an entrepreneur.
6. To summarize the preparation of project report and to explain about industrial ownership.

Detailed Syllabus

Module	Course Modules / Contents	Periods	
1	Entrepreneurship	09	
	1.1		Entrepreneur: Meaning of entrepreneur; evolution of the concept; functions of an entrepreneur, types of entrepreneur, entrepreneur – an emerging class
	1.2		Concept of Entrepreneurship - Evolution of entrepreneurship, development of entrepreneurship; stages in entrepreneurial process; role of entrepreneurs in economic development; entrepreneurship in India; entrepreneurship - its barriers.
2	Entrepreneurship management	08	
	2.1		Management: Introduction, meaning, nature and characteristics of management, scope and functional areas of management, management as art or science, art or profession, management & administration, roles of management, levels of management, development of management thought, early management approaches, modern management approaches.
	2.2		Planning: Nature, importance and purpose of planning process objectives - types of plans (meaning only), decision making, Importance of planning, steps in planning & planning premises, hierarchy of plans.
3	Organizing and staffing:	08	
	3.1		Nature and purpose of organization, principles of organization, types of organization, departmentation committees, centralization Vs decentralization of authority and responsibility, span of control. MBO and MBE (meaning only), Nature and importance of staffing, process of selection & recruitment (in brief).
	3.2		Directing: Meaning and nature of directing leadership styles, motivation, theories, communication, meaning and importance, coordination, meaning and importance and techniques of coordination.
	3.3		Controlling: Meaning and steps in controlling, essentials of a sound control system, methods of establishing control (in brief).
4	Preparation of project:	05	
	4.1		Meaning of a Project; project identification; project selection; project report; need and significance of report; contents; formulation guidelines by planning commission for project report.
	4.2		Network analysis; errors of project report; project appraisal. identification of business opportunities: market feasibility study; technical feasibility study; financial feasibility study & social feasibility study.

5	Industrial ownership		04
	5.1	Definition and meaning of partnership, characteristics of partnership, kinds of partners, partnership agreement or partnership deed, registration of partnership firm, rights, duties and liabilities of partners	
	5.2	Advantages and disadvantages of partnership, sole proprietorship, features, scope, advantages and disadvantages of sole proprietorship.	
6	Small scale industries (SSI):		05
	6.1	Definition; characteristics; need and rationale; objectives; scope; role of SSI in economic development. Advantages of SSI, steps to start SSI - Government policy towards SSI; different policies of SSI; government support for SSI during 5 year plans. Impact of liberalization, privatization, globalization on SSI	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain management functions of a manager. Also explain planning and decision-making process
2. Explain the organizational structure, staffing and leadership processes.
3. Describe the understanding of motivation and different control systems in management.
4. Understand entrepreneurships and entrepreneurship development process.
5. Illustrate small scale industries, various types of supporting agencies and financing available for an entrepreneur.
6. Summarize the preparation of project report and to explain about industrial ownership.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3

- then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill.
2. Dynamics of Entrepreneurial Development & Management-Vasant Desai, Himalaya Publishing House.
3. Entrepreneurship Development – Purnima. M. Charantimath, Small Business Enterprises – Pearson Education - 2006 (2 & 4).

Reference Books:

1. Management Fundamentals - Concepts, Application, Skill Development – Robers Lusier, Thomson.
2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi.
3. Management - Stephen Robbins, Pearson Education/PHI - 17th Edition, 2003.

Semester-VI

Course Code	Course Name	Credits
CIDO 6021	Department Level Optional Course – IV Urban Infrastructure Planning	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

Indian cities are currently expanding at a rapid rate, and are therefore facing immense pressure for the improvement of their services and infrastructure. Without coordination and planning for the anticipated spatial growth and densification, the infrastructure services are neglected. Such growth areas can become under-serviced places of the cities, one from which many problems of the city stem: water, sanitation and waste problems, uncontrolled pests, and crime due to poor access to water and sanitation services. To address the emerging issues of urban center, there is a pressing need to train urban infrastructure specialists who can comprehensively plan for city's growing infrastructure needs and formulate projects for efficient infrastructure service delivery for existing areas. There are ample urban infrastructure challenges and opportunities in terms of planning; effective policy, program and project formulation for well-trained young urban infrastructure professionals with specific domain knowledge

Objectives

1. To describe an infrastructure system using accurate terminology.
2. To understand the main concepts and principles of infrastructure planning.
3. To identify the key features of a sustainable infrastructure system and explain how

- they promote sustainable development.
4. To apply analytical tools for infrastructure planning.
 5. To analyze infrastructure cases/projects/proposals through the lens of sustainability.
 6. To identify the gaps between theoretical principles of sustainable infrastructure and their application in practices.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Introduction to Planning		04
	1.1	Origins and growth of cities, effects of cultural influence on physical form; Human settlements as an expression of civilizations; Basic elements of the city; Concepts of space, time, scale of cities.	
	1.2	Contribution of housing to micro and macro economy, contribution to national wealth and GDP, housing taxation, national budgets, fiscal concessions; need of affordable housing for urban poor, concept of RERA	
2	Urban Economics		06
	2.1	General introduction to principles of economics and public finance. Importance of economics in urban development and planning.	
	2.2	Industrial location policies, any other economic activity base policies and their impact on urban development, role of land economics in preparation of urban development plans. relevant case studies of urban land economics.	
	2.3	Economic growth and development, quality of life; Human development index, poverty and income distribution, employment and livelihood; Economic principles in land use planning; Policies and strategies in economic planning, balanced versus unbalanced growth, public sector dominance; changing economic policies, implications on land.	
3	Infrastructure Planning		12
	3.1	Role of infrastructure in development, Elements of Infrastructure (physical, social, utilities and services); Basic definitions, concepts, significance and importance; Data required for provision and planning of urban networks and services; Resource analysis, provision of infrastructure, and land requirements; Principles of resource distribution in space; Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc.	

	3.2	Zoning, Various growth patterns of town, Housing layouts and road networks in town, Urban aesthetics and landscaping, MRTP and Land Acquisition Acts	
	3.3	Planning and Management of Water, sanitation and storm water; water – sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions and management issues; Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, institutional arrangements, planning provisions and management issues. Storm water – rainfall data interpretation, points of water stagnation, system of natural drains, surface topography and soil characteristics, ground water replenishment, storm water collection and disposal, norms and standards, institutional arrangements, planning provisions and management issues	
	3.4	Solid waste disposal and management basic principles, generation, characteristics, collection, disposal, management	
	3.5	Fire and Electrification and social infrastructure planning for fire protection, services and space standards, location criteria; Planning for education, health, civic, cultural infrastructure and facilities for transport and other miscellaneous infrastructure services	
	3.6	Planning for education, health, civic, cultural infrastructure and facilities for transport and other miscellaneous infrastructure services	
	Traffic and Transportation Planning		
4	4.1	Evaluation of urban structure: Transport system, infrastructure and management, transport systems and their types, design and operating characteristics, urban road hierarchy, planning, and management criteria for road and junction improvements, arterial improvement techniques.	07
	4.2	Traffic management, mass transit system: Problems and prospects. Review of existing traffic management schemes in Indian cities. Case study of various metro rail project envisaged for Mumbai, Navi Mumbai & Pune	
	4.3	Economic evaluation: pricing and funding of transport services and systems, economic appraisal of highway and transport projects. Techniques for estimating direct and indirect road user costs and benefit value of time	
	4.4	Intelligent transport system (ITS) its types and application	
5	Urban Management and Governance		06
	5.1	Introduction to development management and urban	

		governance- concept, approaches, components, interface with national goals and political economic system. Urban development management strategies, tools and techniques; organizations involved land and real estate development economic concepts of land, land pricing / valuation; urban reforms and acts and policies. Overview of Urban Governance Definition, concepts, components, government and governance, hierarchy and structure, forms of governance, process of inclusion and exclusion.	
	5.2	Information system and urban reforms spatial and non - spatial information systems; Use of GIS in overlaying infrastructure facilities, use of remote sensing in identifying and mapping urban structures.	
	5.3	Present organizations and involved in urban governance with focus on MCGM, TMC and CIDCO. Urban Local Governance and participatory processes system, structure, functions, powers, process and resource, performance, interface with NGO's, other agencies.	
	Environmentally Safe and Disaster Resilient Infrastructure		
6	6.1	Frame work, statement prediction and assessment of impacts of air, water, noise, cultural and socio-economic environment. Methods of impact analysis, public participation. Environmental protection international and national agencies and legislation, Environment Impact Assessment. Urban Heat Island Effect, Effect of uncontrolled growth of town	04
	6.2	Disaster response planning, roles and responsibilities of various agencies emergency operation support and management planning for disaster prone areas, planning requisites for disaster prone areas and preventive measures, vulnerability analysis	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain the concepts related to planning of modern cities, GDP contribution, RERA, affordable housing.
2. Elaborate the economics involved in urban infrastructure planning.
3. Interpret the various elements required for infrastructure development of a city and describe the concepts, significance and importance of each.
4. Integrate the technical, social and economic feasibility of transportation projects within the cities.

5. Understand the modern tool usage for urban management and governance.
6. Analyze environmentally safe and disaster resilient infrastructure.

Internal Assessment (20 Marks):

Consisting Two Compulsory Class Tests. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. The Urban and Regional Planning Reader, edited by Eugenie L. Birch, Published by Routledge, 2008; ISBN 978-0-415-319
2. Housing: The Essential Foundations, edited by Dr. Paul Balchin, Paul Balchin, Maureen Rhoden, Edition Routledge, DOI, eBook ISBN 9780203010426
3. New Urban Housing by Hilary French, Publisher: Yale University Press, ISBN0300115784 (ISBN13: 9780300115789)
4. Sociology: A Brief Introduction, by Richard T. Schaefer, Publisher: McGraw-Hill Education, ISBN 10:1259425584, ISBN 13: 9781259425585
5. Sociology: Principles of Sociology with an Introduction to Social Thoughts, by Rao C.N. Shankar, S. Chand Publication
6. Projects: Preparation, Appraisal, Budgeting and Implementation by Prasanna Chandra, Tata McGraw-Hill; ISBN0074516280 (ISBN13: 9780074516287)
7. Introduction to Transportation Planning, by B. Bruton, Michael J. Bruton; Published by Hutchinson Radius; ISBN0091580412 (ISBN13: 9780091580414)

Reference Books/Codes:

1. Modern Economics by H.L. Ahuja, 19th Revised Edition, Published by S.Chand (G/L) & Company Ltd
2. Economics, An Introductory Analysis by Paul A. Samuelson, William D. Nordhaus, Published July 27th 2004 by Irwin/McGraw-Hill (first published 1948), ISBN0072872055 (ISBN13: 9780072872057)
3. Modelling Transport, by de Dios Ortuzar and Luis G. Willumsen, 4th Edition, Wiley Publication
4. Principles of Urban Transport Systems Planning, by B.G. Hutchinson, Publisher: Scripta Book Co.; ISBN0070315396 (ISBN13: 9780070315396)

5. Traffic Engineering and Transport Planning, L. R. Kadiyali, Khanna Publishers, 1983
6. Remote Sensing and GIS, by Basudeb Bhatta, second Edition, Oxford University press
7. NEPA and Environmental Planning: Tools, Techniques, and Approaches for Practitioners; Charles H. Eccleston; CRC Press
8. Planning for Disaster: How Natural and Manmade Disasters Shape the Built Environment, by William Ramroth; Publisher: Kaplan Business; Original edition; ISBN-13: 978-1419593734.

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Semester-VI

Course Code	Course Name	Credits
CIDO 6022	Department Level Optional Course – IV Material Procurement and Management	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

This subject imparts knowledge and skills of complete procurement procedure, shop floor inventories, material handling and optimal utilization of materials as well as resources provided with in the shop floor. The subject also imparts skill in analyzing the material requirement well before, and buffer (re order) stock quantity.

Objectives

1. To understand and explain various types of material procurement.
2. To study the methods of procurement and purchasing materials of desired quality and quantity.
3. To understand materials management to reduce investment tied in inventories for use in other productive purposes and develop high inventory turnover ratios.
4. To study the concept of purchase, receive, transport and store materials efficiently to reduce the storage and warehouse related costs.
5. To study quality control methods.
6. To apply knowledge of MMS in planning, procurement & management.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Introduction		05
	1.1	Scope and Importance of material management and its role in construction industry, objectives and function of material management.	
	1.2	Integrated approach to materials management, Role of materials manager, forecasting of material- types, methods.	
2	Material Requisition Procedure		05
	2.1	Steps involved in material procurement, purchase requisition, selection of suppliers, vendor development & rating, make or buy decision, floating of enquiry.	
	2.2	Preparation of tender notices, comparative statement, placing of purchase order, follow up, inspection of incoming material, verification of bills, value analysis, pricing theory.	
3	Classification and Codification of Materials of Construction		05
	3.1	ABC, FSN, VED, SOS analysis-Procedure and its use, standardization in materials and their management, procurement, identification of sources of procurement, vendor analysis.	
	3.2	Vendor analysis concept of (MRKP) material requirement planning, planning, purchase procedure, legal aspects.	
4	Inventory Management		10
	4.1	Store purchase manual, contractors obligation. Inventory control techniques. EOQ, advantages and limitation of use of EOQ, periodic ordering and order point control, safety stock, stock outs.	
	4.2	Application of ABC analysis in inventory control, concept of (JIT) - Just in time management, indices used for assessment of effectiveness of inventory management	
5	Stores Management		05
	5.1	Material planning and factors affecting the planning, store location and layout, storing methods and equipment's, bulk purchasing	
	5.2	Procedure for issue of material and receipt of materials, store record keeping, bin card system, protection and physical verification of stores.	
6	Quality Control		09
	6.1	Quality control methods-conventional; statistical, sampling techniques. Quality management and its economics	
	6.2	Application of Materials Management Systems (MMS). Project evaluation: discounted cash flow, real options theory. Project delivery methods, competitive bidding. Risk allocation	

		and management. Integrated project delivery. Contract negotiation.	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Identify and understand the need and role of material management.
2. Understand the procedure of material requisition and to prepare tender notices.
3. Classify materials, identify sources of procurement and conduct vendor analysis.
4. Exercise control for effective management of inventory.
5. Manage stores and exercise quality control on materials.
6. Apply MMS in planning, procurement, inventory and cost control, evaluate projects and manage risks.

Internal Assessment (20 Marks):

Consisting Two Compulsory Class Tests. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Chitale A.K. and R.C. Gupta, "Material Management – Text and Cases", Prentice Hall of India Pvt. Ltd., 2007
2. P. Gopalkrishnan, "Purchasing and materials Management"
3. K. K. Chitkara, "Construction Project Management"
4. Dr. K. C. Jain, Er. Jeet Patidar, "Purchasing and materials Management"
5. M. M. Verma, "Materials Management"

Reference Books/Codes:

1. A Guide to the Project Management Body of Knowledge (PMBOK Guide) - Fourth Edition, An American National Standard, ANSI/PMI 990001-2008"
2. Chitale A.K. and R.C. Gupta, "Material Management – Text and Cases", Prentice Hall of India Pvt. Ltd., 2007

3. Denise Bower, "Management of Procurement", Construction Management Series, Thomas Telford Publishing, 2003
4. Joseph Philips, PMP, Project Management and Professional (Certification Study Guides), McGraw Hill Publication, 2013
5. Jhamb L.C., "Inventory Management", Everest Publishing house, 2005
6. Menon K.S., "Purchasing and Inventory Control", Wheeler Publication, 1993
7. Ministry of Rural Development, GOI, "Procurement Manual", National Rural Livelihoods Project, 2010
8. Peter Holm Andreasen, "Dynamics of Procurement Management – A Complexity Approach", Copenhagen Business School, 2012
9. Peter Baily, David Farmer, Barry Crocker, David Jessop & David Jones, "Procurement Principles and Management", FT Prentice Hall, 2010
10. Manual for Ministry of Roads, Transport and Highways (MoRTH), GOI, 2007, 4th Revision

Semester-VI

Course Code	Course Name	Credits
CIDO 6023	Department Level Optional Course – IV Traffic Engineering and Management	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

Traffic Engineering Management follows the transportation planning and is the specialized branch of the highway engineering, which introduces the concepts of characterizing traffic, various modeling approaches, and design of facilities to control and manage traffic. A key feature of the course is that it is well connected with the current design and analysis practice stipulated in national standards, and manuals. Therefore, it deals with the application of scientific principles, tools, techniques and findings for safe, rapid, economical and efficient movement of people and vehicles.

Objectives

1. To understand the concepts of traffic characteristics, traffic surveys to be conducted for planning any transportation network or judging the adequacy of the existing one
2. To analyze the application of various statistical tools of the large data base, emerging out of extensive traffic surveys, transportation and traffic planning.
3. To understand the concept of various features of the intersection infrastructures, their necessity, pros and cons, design or planning principles and subsequently, to design / plan the features such as channelization, island, speed change lanes and parking facility.
4. To understand the concept of highway capacity and such other components such as

- Passenger car unit and level of service affecting the capacity; and speed- flow-density relationship and various theories describing these relationships.
5. To understand the importance of highway safety and implementation of traffic system management (TSM) measures and subsequent to study the various traffic control devices and aspects of highway lighting.
 6. To explore the future of traffic engineering in the form of intelligent transportation System.

Detailed Syllabus

Module	Course Modules / Contents	Periods
1	Traffic Characteristics and Surveys	
	1.1	Scope, Traffic Elements - Characteristics-vehicle, road user and road - Traffic studies-speed & delay, traffic volume, O & D, parking and accidents - Sample size, study methodology - Data analysis & inferences.
2	Application of Statistics in Traffic Engineering	
	2.1	Various probability distributions & their applications - Parameter estimation - Hypothesis testing - Random variables
	2.4	Estimation and analysis of simple regression models - Correlation coefficients - Analysis of correlation coefficients
	2.3	Application of queuing theory as applied to traffic flow problems for study state conditions
3	Intersection Design	
	3.1	Types of intersections - Conflict diagrams –Control hierarchy- Design of rotaries (Indo-HCM 2017) & at-grade intersections – Signal design as per IRC:93- Grade separated intersections & their warrants, coordination of signals, types of area traffic control
4	Traffic Flow Theory	
	4.1	Measurement, microscopic and macroscopic study of traffic stream characteristic-flow, speed and density; pace – time diagram, headways, speeds, gaps and lags; gap acceptance. fundamental equation of traffic flow, speed-flow-density relationships, shock wave theory passenger’s car units, factors affecting PCU and methods to determine PCU, level of service, factor affecting capacity and level of service. Capacity and level of service suggested for different road facilities as discussed in Indo-HCM 2017, review of flow density speed studies, light hill and whitham’s theory, fundamentals of traffic stimulation modeling.
5	Traffic Management and Road safety Audit	07

	5.1	Various measures for traffic systems management and travel demand management - congestion management -cost effective management, their scope, relative merits and demerits. (Pedestrians and Cyclist Management) (IRC SP:55-2014)	
	5.2	Highway Lighting: Important definitions, law of illumination, discernment by artificial lighting, mounting height, spacing, lantern arrangements, types of lamps, lighting of some important highway structures.	
	5.3	Accidents: Accident cause, recording system, analysis and preventive measures, accident cost, alternative methodologies for calculation	
	5.4	Road Safety Audit: Global & local perspective – road safety issues – road safety programmers – types of RSA, planning, design, construction & operation stage audits – methodology – road safety audit measures, road safety audit process as per IRC: SP-88-2010	
	Intelligent Transportation System		
6	6.1	Overview of ITS implementations in developed countries, ITS in developing countries. Study of IRC: SP-110-2017	04
	6.2	Historical Background, Benefits of ITS – Introduction to Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), Traffic control and monitoring aspects.	
	6.3	Application of ITS: Advanced Traffic Management Systems (ATMS) Advanced Vehicle Control Systems (AVCS), Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS), Automated Highway Systems	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand different characteristics of the road users and vehicles from their consideration and view point in the traffic engineering and transportation planning.
2. Conduct different traffic surveys, analyzing the data collected as a part of such studies and interpreting it with the help of the different statistical models.
3. Explain the concepts of PCU and LOS, their implication in determination of the capacity using Speed-Flow-Density relationships.
4. Discuss the aspects associated with road safety, its audit and different TSM measures.
5. Discuss transportation planning and ascertain the financial viability of any transportation network in the inception stage itself.

6. Improve the effectiveness and efficiency of transportation systems through advanced technologies in Information systems and communication.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Kadiyali, L.R., Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, 2002.
2. Srinivasa Kumar.R , Introduction to Traffic Engineering, The Orient Blackswan; south Asian Edition,2018.
3. Chakroborty P., Das N., Principles of Transportation Engineering, PHI,New Delhi,2003
4. Khanna S.K., Justo C.E.G., Highway Engineering, Nem Chand & Bros., Roorkee, 2001
5. Khisty C J, LallB. Kent; Transportation Engineering-An Introduction, Prentice- Hall, NJ, 2005
6. May, A.D., Traffic Flow Fundamentals, Prentice – Hall, Inc., New Jersey,1990.
7. O’Flaherty C A, Highways- Traffic Planning & Engineering, Edward Arnold, UK
8. Drew, D.R., Traffic Flow Theory and Control, McGraw-Hill, New York.
9. Benjamin J. R., Cornell C. A., Probability Statistics and Decision for Civil Engineers, McGraw-Hill, 1970.
10. Asad J. Khattak, Intelligent Transportation Systems: Planning, Operations, and Evaluation, CRC Press

Reference Books/Codes:

1. Transportation Engineering and Planning Papacostas, C. S., Prevedouros, P. D., PHIL earning Pvt. Ltd.
2. Transportation Engineering: Khisty, C.J. and Lall, K.B.; PHI Learning Pvt.Ltd.
3. Introduction to Urban Transport Systems, Planning: Hutchinson, B.G.;McGraw-Hill.

4. Economics of Transportation: Fair and Williams, Harper and Brothers, Publishers, New York.
5. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington D.C.
6. Relevant IRC Codes amended time to time.

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Semester-VI

Course Code	Course Name	Credits
CIDO 6024	Department Level Optional Course – IV Costal Engineering	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test- II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

Coastal engineering is defined here as the application of skills, knowledge, expertise, and theory associated with purposeful engineering intervention in the coastal system. This definition includes the application of scientific principles underlying a broad range of traditional engineering disciplines to a zone in which there are significant interactions between water and land, including shorelines, bays, river mouths, and harbors, and the structures within these environments. Coastal engineering involves the practice of civil engineering, as well as the sciences of oceanography and coastal geology, to control erosion; place, construct, and monitor coastal structures; nourish beaches; and develop and maintain ports, harbors, and related navigation facilities. More and more, the role of the coastal engineer is also expanding to encompass environmental and ecological issues, as the role of wetlands and water quality becomes more important. Coastal sciences, are the scientific knowledge base for coastal engineering. A number of coastal engineers are involved in research in many aspects of coastal sciences, such as sediment transport in the surf zone and the mechanics of breaking waves.

Objectives

1. To understand the fundamentals of wave mechanics.
2. To study the effects and causes of tides and their effects on coastal structures.
3. To understand the types and design criteria for coastal /offshore structures.
4. To describe the process of dredging in coastal zones.

5. To illustrate planning and management aspects of ports and harbors.
6. To understand regulations and activities related to coastal zones and its pollution.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Basics of Wave Mechanics		05
	1.1	Basic understanding of wave mechanics including wave generation, propagation, form and assessment in the surf zone.	
	1.2	Statistical and spectral analysis of recorded wave data and prediction in coastal zone.	
2	Coastal Tides and its Significance		07
	2.1	Global tidal cycle, tidal analysis, types of tides, effect of tides, significance in coastal engineering	
	2.2	Coastal process-erosion/accretion due to waves, estimation of littoral drift, effect of construction of coastal structures on stability of shoreline / beaches, shoreline configuration.	
3	Coastal Structures		08
	3.1	Introduction to coastal structures: Design criteria and functional aspects of coastal structures including sea wall, revetment, bulk-head, quay- wall, jetties, breakwater types: rubble-mound, composite, floating and pneumatic types, design of RBW.	
	3.2	Offshore structures: oil platform, design criteria for sub marine pipelines, cables, response of oil platform members, floating structure to wave load -vibration and spacing of piles, forces on piles.	
4	Dredging		05
	4.1	Dredging technology: types of dredgers, radioactive tracers studies for feasibility of dumping ground for dredged materials- environmental aspects of dredging etc.	
5	Port and Harbors		06
	5.1	Planning and management of port and Harbors, Modern trends and techniques in port engineering-roll on-roll off/ lift on-lift off etc.	
	5.2	Special purpose ports: Concepts of twin /mother port, SBM, outer to outer port etc. Significance of port cost analysis economics.	
6	Coastal Zones and Regulations		08
	6.1	Pollution in coastal zone, disposal of waste/dredged spoils, design criteria of coastal outfall inlets and system. Oil spills and contaminants	

	6.2	Coastal zone management: Activities in coastal zone, CRZ, Issues related to Integrated coastal zone management, Coastal regulation zone.	
TOTAL			39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand the fundamentals of wave mechanics.
2. Analyse the effects and causes of tides and their effects on coastal structures.
3. Describe the types and design criteria for coastal /offshore structures.
4. Explain the process of dredging in coastal zones.
5. Illustrate planning and management aspects of ports and harbors.
6. Understand activities, regulations and activities related to coastal zones.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Basic Coastal Engineering-R.M. Sorensen,2006,
2. Coastal Hydrodynamics-J.S.Mani ,PHI pvt.Ltd,NewDelhi-2012
3. Shore Protection Manual-U.S. Waterways Experiment Station Corps of Engineer,
4. Coastal Protection Manual 2002.
5. Narasimhan and S. Kathirolu, Harbor and Coastal Engineering", Vol 1&II,
6. Ocean and Coastal Engineering Publication, NIOT, Chennai

Reference Books/Codes:

1. Srinivasan D, (1989), Indigenous Instruments for Oceanographic measurements published by NIOT

2. William J. Emery and Richard E. Thomson (2014) "Data Analysis methods in Physical Oceanography" Third ed.,
3. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill Book Company, inc., New York, 1978
4. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc. Englewood Cliffs, New Jersey, 1994
5. Sarpkaya, T. and Isaacson, M., Mechanics of Wave Forces on Offshore Structures, Van Nostrand Reinhold Co. New York, 1981
6. Weigel, R.L, Oceanographical Engineering, Prentice Hall Inc., 1982.
7. Cormick, Vol. I & II, Dock and Harbor Engineering.

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Semester-VI

Course Code	Course Name	Credits
CIDO 6025	Department Level Optional Course – IV Sustainable Infrastructure Materials	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
03	--	--	03	--	--	03

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	-	-	-	100

Rationale

Meeting the needs of the present without compromising the ability of future generations to meet their needs is considered to be the simplest and effective sustainable development. The greatest threats to the sustainable development on earth are: population growth and urbanization, energy use and global warming, excessive waste generation and the subsequent pollution and limited supply of resources. Concrete is the primary construction material in the world. Construction industry consumes 40 percent of the total energy and about one half of world's major resources. Hence, it is imperative to regulate the use of materials and energy in this industry. The largest environmental impact of the concrete industry comes from the cement manufacturing process that leads to relatively high greenhouse gas emissions. Minimizing the quantity of cement in a concrete mix has many potential benefits. Thus, the use of industrial byproducts such as fly ash, silica fume as cementitious materials in concrete structures can lead to significant reduction CO₂ emissions and consumption of energy and raw materials. Green and intelligent buildings also have been evolved for sustainability of the construction industry. This course provides knowledge of different sustainable building materials and technologies in construction industry.

Objectives

1. To study about the need and concept about sustainability.
2. To understand environmental issues due to building materials and the energy

- consumption in manufacturing building materials.
3. To study the alternative masonry unit and mortar for sustainable practices.
 4. To know the importance of cement reduction and replacements for a sustainable development.
 5. To understand the alternative building technologies which are followed in construction.
 6. To understand about the building materials and roofing systems in practice.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Sustainability		07
	1.1	Introduction: Need and concept of sustainability, social environmental and economic sustainability concepts.	
	1.2	Sustainable development, nexus between technology and development, challenges for sustainable development fundamentals of sustainability.	
	1.3	Global Environmental issue: Resource degradation, ozone layer depletion climate change, carbon cycle, factors affecting carbon credits and carbon trading, carbon foot print, carbon sequestration-carbon capture and storage (CCS).	
	1.4	Environment legislation in India-water act and air act	
2	Energy in Building Materials		06
	2.1	Embodied energy and life cycle energy, calculation of embodied energy in wall, environmental issues concerned to building materials, global warming and construction industry.	
	2.2	Environment friendly and cost-effective building technologies. Requirements for building of different climatic regions.	
	2.3	Traditional building methods and vernacular architecture Green buildings, Intelligent buildings, green materials, green building ratings-IGBC & LEED	
	2.1	Renewable and nonrenewable energy sources.	
3	Elements of Structural Masonry		06
	3.1	Characteristics of building blocks for walls, stones and laterite blocks, bricks, fly ash bricks and hollow clay blocks, concrete blocks, stabilized blocks: mud blocks, steam cured blocks, Fal-G blocks stone masonry block	
	3.2	Masonry Mortars: Mortars, CEMENTITIOUS materials: Lime, OPC, PPC, masonry cement, lime pozzolana (LP) cement. Sand: natural and manufactured, classification of mortar as per bis, types of mortar, properties and requirements of mortar, selection of mortar.	

	Cementitious and Supplementary Cementitious Materials and their Characterization		
4	4.1	Lime, Lime pozzolana cements, Pozzolana: Surkhi, Fly ash, IS (3812) (Type C and F), GGBFS, Silica Fumes, Metakaolin, RHA, Composite cements and its types, IS (16415:2015), Magnesia based cements, Calcium sulfo-cement, Alkali activated, cement (Type 1 and Type II), Geopolymers, Composition, Properties and uses.	06
	4.2	Membrane curing: wax and resin based, self-curing compound: Polymer and polyethylene glycol, Water reducing admixtures, use of treated domestic effluent (TDE) for mixing and curing	
	Alternate Building Technologies		
5	5.1	Fiber reinforced cement composites: Matrix materials, reinforcing materials, applications	07
	5.2	Fiber reinforced polymer composites: Matrix materials, types of polymers used and applications	
	5.3	Ferrocement and ferroconcrete building components: materials, construction methods, mechanical properties, applications	
	5.4	Nanotechnology for sustainable construction	
	Alternate Building Materials and Roofing Systems		
6	6.1	Building materials from agro and industrial waste: Typical agro-waste and biomass resources, use of industrial waste: Fly ash, blast furnace slag, iron ore tailings, gold mine tailings, granite and marble polishing fines, demolished building waste	07
	6.2	Concepts in roofing alternatives, types of roof, roof as a structural system, cost reduction through construction process efficiency	
	6.3	Filler slab roofs, composite beam and panel roofs, construction details and roof assembly	
	6.4	Masonry domes and vaults: Relevance, analysis and design, barrel vault	
		TOTAL	39

Note: Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Explain sustainable practices by utilizing engineering practices.
2. Understand different types of environmental problems and their sustainable solution.
3. Suggest appropriate type of masonry unit and mortar for civil engineering constructions.

4. Analyze different alternative building materials for construction.
5. Suggest suitable alternative building technologies for sustainable development.
6. Propose different roofing systems and use of waste materials in construction industry.

Internal Assessment (20 Marks):

Consisting **Two Compulsory Class Tests**. First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I). Duration of each test shall be one hour. Average of marks will be considered for IAE.

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total six questions, each carrying 20 marks.
2. Question 1 will be compulsory and should cover maximum contents of the curriculum
3. Remaining questions will be mixed in nature (for example if Q.2 has part (a) from module 3 then part (b) will be from any module other than module 3)
4. Only Four questions need to be solved.

Recommended Books:

1. Alternative Building Materials and Technologies by KS Jagadish, BV Venkatraman Reddy and KS Nanjunda Rao, New Age International publications.
2. Sustainability Engineering: Concepts, Design and Case studies by Allen D.T, and Shonnard D.R , Prentice Hall.
3. Sustainability Engineering: Concepts, Design and Case studies by Bradley A.S; Adebayo A.O, and Mario P., Cengage learning
4. Sustainability of construction materials by Jamal M Khatib, Woodhead publishing limited.
5. Renewable energy sources by Twidell J.W and Weir A.D, English Language Book Society (ELBS) Geotechnical Earthquake Engineering: S. L. Kramer, Pearson, (2013).

Reference Books/Codes:

1. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications—Rating system, TERI Publications – GRIHA Rating system.
2. Structural Masonry by Arnold W Hendry, Macmillan Publishers
3. Systems Analysis for Sustainable Engineering: Theory and Application by Ni bin Chang, Mc Graw Hill Professional
4. NPTEL course on sustainable materials and green building <https://nptel.ac.in/courses/105/102/105102195>
5. Relevant codes

Semester-VI

Course Code	Course Name	Credits
CIL 601	Water Management Infrastructure (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	01

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	25	-	25	50

Objectives

1. To understand India's current water resources potential
2. To study analysis and design of gravity dam.
3. To study and calculate discharge from aquifers.
4. To study canal headwork, its distribution system and design of canal structures.
5. To study the design of rainwater harvesting structure.
6. To study hydropower plants classification, layout and components and development of hydropower

Contribution to Outcome

On completion of this course, the students will be able to:

1. Understand India's current water resources potential
2. Study analysis and design of gravity dam.
3. Study and calculate discharge from aquifers.
4. Study canal headwork, its distribution system and design of canal structures.
5. Study the design of rainwater harvesting structure.
6. Study hydropower plants classification, layout and components and development of hydropower

List of Experiments (Minimum six)

Module	Detailed Contents	Lab Sessions/Hr
11.	A study report on India's current water resources potential, demand, future challenges and management strategies to overcome it	02
12.	Analysis and design of gravity dam	02
13.	Numerical based on yield of aquifer	02
14.	Case study on different canals in India and Abroad	02
15.	Design of rain water harvesting structure	02
16.	Visit and detailed report on hydroelectric power plant	02
17.	Case study on successful implementation of ground water recharge projects/methods	02
18.	Case study on major dam failures in India and Abroad	02

Assessment:

- **Term Work:** Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory Work	:	10 Marks
Site Visit	:	05 Marks
Assignments	:	05 Marks
Attendance	:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75% - 80%: 03 Marks; 81% - 90%: 04 Marks; 91% onwards: 05 Marks.

- **End Semester Practical/Oral Examination:** Oral examination will be conducted on the basis of term work, site visit and laboratory work.

Recommended Books:

1. Water Power Engineering, Barrows, H.K, Tata McGraw Hill Publishing Company Ltd., New Delhi
2. Hydro Power Structure, Varshney, R.S, Nem Chand Brothers, Roorkee, 2001
3. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
4. Design of Small Dams: USBR.
5. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
6. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.A
7. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.
8. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, New York.
9. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988.

John Wiley and Sons, Inc., New York.

Reference Books/Codes:

1. Water Power Engineering, Barrows, H.K, Tata McGraw Hill Publishing Company Ltd., New Delhi
2. Hydro Power Structure, Varshney, R.S, Nem Chand Brothers, Roorkee, 2001
3. Engineering for Dams, Vol. I to III: Crager, Justin and Hinds, John Wiley
4. Design of Small Dams: USBR.
5. Hydro Power Structures: R. S. Varshney, Nem Chand and Bross.
6. Concrete Dams: R. S. Varshney, Oxford and IBH Publishing Co.A
7. Brooks, K. N., P. F. Ffolliott, H. M. Gregersen and L. F. DeBano. 1997. Hydrology and the Management of Watersheds. Second Edition. Iowa State University Press. Ames, Iowa. 502 pp. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.
8. Lal, Ruttan. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, New York.
9. Heathcote, I. W. Integrated Watershed Management: Principles and Practice. 1988. John Wiley and Sons, Inc., New York.

Semester-VI

Course Code	Course Name	Credits
CIL 602	Transport Infrastructure-II (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	01

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	25	-	25	50

Objectives

1. To understand various components of a railway station
2. To study various components of metro station
3. To design an airport runway
4. To study the various structures, its construction and operations of port or harbour
5. To study the design of a bridge
6. To familiarize the students with latest techniques of transportation systems

Contribution to Outcome

On completion of this course, the students will be able to:

1. Identify the various components of a railway station
2. Describe the various components of metro station
3. Analyze and design the different elements of airport runway
4. Distinguish between ports and harbour
5. Illustrate the various components of bridge
6. Annotate the latest techniques of transportation system

List of Experiments (Minimum six)

Module	Detailed Contents	Lab Sessions/Hr
1.	Visit to a major railway station and to study its various components	02

2.	Visit to a major metro station and study its various components	02
3.	Design of a runway	02
4.	Visit to any harbour or port structure to understand the various structures, its construction and operations	02
5.	Design of a bridge	02
6.	Case study on intelligent transport system	02
7.	Case study on international airport	02
8.	Case study on mono rail project	02

Assessment:

- **Term Work:** Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory Work	:	10 Marks
Site Visit	:	05 Marks
Assignments	:	05 Marks
Attendance	:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

- **End Semester Practical/Oral Examination:** Oral examination will be conducted on the basis of term work, site visit and laboratory work.

Recommended Books:

1. Kadiyali L. R (2016), Transportation Engineering, Khanna Publishers, New Delhi.
2. Blow, C. J. (2005), Transport terminals and modal interchanges: planning and design, Elsevier, United Kingdom.
3. Horonjeff , R. Mickelvey, F.X, Planning & design of airports, Mc Graw Hill, New York, 5th edition. 2016
4. Khanna, S.K., Arora, M.G., and S.S. Jain; Airport Planning and Design, Nem Chand & Brothers ,2012
5. Sussman, J. M., Perspectives on Intelligent Transportation Systems (ITS), Springer 2005
6. Turban, E., and Aronson, J. E., Decision Support Systems and Intelligent Systems, 5th Edition, Prentice Hall
7. Sarkar, P., Jain, A.K. (2017), Intelligent Transport Systems, PHI Learning Private Limited, New Delhi.

Reference Books/Codes:

1. Blonk, W.A.G. (1979), Transport and Regional Development. Saxon House, Farnborough.
2. O'Flaherty, C.A. (2000), Transport Planning and Traffic Engineering, Dept. of Transport, USA.
3. Ortúzar, J. De and Willumsen, L. G. (2011), Modelling Transport, John Wiley and Sons, United

Semester-VI

Course Code	Course Name	Credits
CIL 603	Design of Reinforced Concrete Structures (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	01

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	25	-	25	50

Objectives

1. To develop a clear understanding of design philosophy amongst the students for the Design of reinforced concrete structures using working stress method (WSM) and limit state method (LSM).
2. To study various clauses of IS: 456-2000 and their significance in the RCC design.
3. To apply various concepts of LSM in the analysis and design of beams, slabs and columns.
4. To study the concept of serviceability and durability for deflection and crack width calculation in RCC structures.
5. To develop the concept of design using design charts and curves for columns subjected to axial load and moment.
6. To study the concept of reinforced concrete footing design subjected to axial load and moment.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Develop a clear understanding of design philosophy amongst the students for the design of reinforced concrete structures using working stress method (WSM) and limit state method (LSM).
2. Study various clauses of IS: 456-2000 and their significance in the RCC design.
3. Apply various concepts of LSM in the analysis and design of beams, slabs and columns.
4. Study the concept of serviceability and durability for deflection and crack width

- calculation in RCC structures.
- Develop the concept of design using design charts and curves for columns subjected to axial load and moment.
 - Study the concept of reinforced concrete footing design subjected to axial load and moment.

Note: The project shall be given to a group of students consisting of **not more than 10** students.

List of Experiments (Minimum nine)

Schedule/ Week	Detailed Contents	Lab Sessions/Hr
1.	Analysis and Design of Singly and Doubly Reinforced RCC beam using WSM (Numericals Based on this module will be solved in tutorial class)	02
2.	Analysis and Design of Singly and Doubly reinforced RCC beam using WSM or any one activity from below: Solve set of Questions given by the course instructor. Write a report on provisions in IS 456 2000 related to the design of beams A comparative study consisting of advantages and disadvantages of WSM and LSM	02
3.	Analysis and Design of Singly and Doubly Reinforced RCC beam using LSM. (Numericals Based on this module will be solved in tutorial class)	02
4.	Analysis and Design of Singly and Doubly Reinforced RCC beam using LSM. Or any one activity from below: Solve set of Questions given by the course instructor. Study of IS 456 2000 provisions on Limit state of collapse: Flexure.	02
5.	Analysis and Design of Flanged beams for Flexure using LSM. Design of RCC beams in shear, bond, and torsion. (Numericals Based on this module will be solved in tutorial class)	02
6.	Analysis and Design of Flanged beams for Flexure using LSM. Or any one activity from below: Design of RCC beams in shear, bond, and torsion. Solve set of Questions given by the course instructor. Study of IS 456 2000 provisions on Limit state of collapse- Shear, Bond and Torsion.	02
7.	Design of Simply supported One-way and Two-way slabs as per IS: 456-2000 (Numericals Based on this module will be solved in tutorial class)	02
8.	Design of Simply supported One-way and Two-way slabs as per IS: 456-2000. Or any one activity from	02

	below: Solve set of Questions given by the course instructor. Study of IS: 456-2000 provisions on Design of RCC slabs	
9.	Analysis and Design of Columns loaded Axially, Uni-axially, and Bi-axially, using LSM. (Numericals Based on this module will be solved in tutorial class)	02
10.	Analysis and Design of Columns loaded Axially, Uni-axially, and Bi-axially, using LSM. or any one activity from below: Solve set of Questions given by the course instructor. Studying the development of interactive curves and their use in Column design. Study of IS: 456-2000 Provisions for Limit State of Collapse – Compression	02
11.	Design of Isolated square and rectangular footings subjected to axial load and moment. (Numericals Based on this module will be solved in tutorial class)	02
12.	Design of Isolated Square and rectangular footings subjected to axial load and moment. or any one activity from below: Solve set of Questions given by the course instructor. Study of IS: 456-2000 provisions related to design of RCC foundations.	02
13.	Report or presentation on Significance and Design of different types of RCC Foundations by various groups of students.	02

Assessment:

- **Term Work:** Shall consist of design report and fabrication drawings for the above projects and Site visit report related to this course, distribution of marks for Term Work shall be as follows:

Project Work : 15 Marks

Site Visit : 05 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

- **End Semester Practical/Oral Examination:** Oral examination will be conducted on the basis of sketching examination, site visit, project work and entire syllabus.

Recommended Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Limit State Design of Reinforced Concrete: Jain A. K, Nemchand and Bros., Roorkee
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.

4. Ultimate Strength Design for Structural Concrete: Arthur, P. D. and Ramakrishnan, V., Wheelerand Co. Pvt. Ltd.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Fundamentals of Reinforced Concrete: Sinha & Roy, S. Chand and Co. Ltd.

Reference Books/Codes:

1. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, StructurePublications, Pune.
2. Reinforced Concrete Design: Wang, C. K., Salmon, C. G., and Pincheira, J. A., John Wiley (2007), 7th Edition.
3. Reinforced Concrete Fundamentals: Ferguson, P. M., Breen, J. E., and Jirsa, J. O., John Wiley & Sons (1988) 5th Edition.

Semester-VI

Course Code	Course Name	Credits
CIL 604	Professional Communication and Ethics (Lab)	01

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	01

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	25	25	--	50

Objectives

1. To discern and develop an effective style of writing important technical/business documents.
2. To investigate possible resources and plan a successful job campaign.
3. To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. To develop creative and impactful presentation skills.
5. To analyze personal traits, interests, values, aptitudes and skills.
6. To understand the importance of integrity and develop a personal code of ethics.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4. Deliver persuasive and professional presentations.
5. Develop creative thinking and interpersonal skills required for effective professional communication.
6. Apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

Detailed Syllabus

Module	Course Modules / Contents	Periods
1	Advanced Technical Writing: Project/ Problem Based Learning (PBL)	06
	1.1 Purpose and classification of reports, classification on the basis of: subject matter (technology, accounting, finance, marketing, etc.); time interval (periodic, one-time, special); function (informational, analytical, etc.); physical factors (memorandum, letter, short & long)	
	1.2 Parts of a long formal report: prefatory parts (front matter), report proper (main body), appended parts (back matter)	
	1.3 Language and style of reports: tense, person & voice of reports, numbering style of chapters, sections, figures, tables and equations, referencing styles in APA & MLA format, proofreading through plagiarism checkers	
	1.4 Definition, purpose & types of proposals: solicited (in conformance with RFP) & unsolicited proposals, types (short and long proposals)	
	1.5 Parts of a proposal elements: scope and limitations, conclusion	
	1.6 Technical paper writing: parts of a technical paper (abstract, introduction, research methods, findings and analysis, discussion, limitations, future scope and references), language and formatting, referencing in IEEE format	
2	Employment Skills	06
	2.1 Cover letter & resume: parts and content of a cover letter, difference between bio-data, resume & CV, essential parts of a resume, types of resume (chronological, functional & combination)	
	2. Statement of Purpose: Importance of SOP, tips for writing an effective SOP	
	2.3 Verbal Aptitude Test: Modelled on CAT, GRE, GMAT exams	
	2.4 Group Discussions: Purpose of a GD, parameters of evaluating a GD, Types of GDs (normal, case-based & role plays), GD Etiquettes	
	2.5 Personal Interviews: Planning and preparation, types of questions, types of interviews (structured, stress, behavioral, problem solving & case-based), modes of interviews: face-to-face (one-to one and panel) telephonic, virtual	
3	Business Meetings	02
	3.1 Conducting Business Meetings: Types of meetings, roles and responsibilities of chairperson, secretary and members,	

		meeting etiquette	
	3.2	Documentation: Notice, agenda, minutes	
	Technical/ Business Presentations		
4	4.1	Effective Presentation Strategies: Defining purpose, analysing audience, location and event, gathering, selecting & arranging material, structuring a presentation, making effective slides, types of presentations aids, closing a presentation, platform skills	02
	4.2	Group Presentations: Sharing responsibility in a team, building the contents and visuals together, transition phases	
	Interpersonal Skills		
5	5.1	Interpersonal Skills: Emotional intelligence, leadership & motivation, conflict management & negotiation, time management, assertiveness, decision making	08
	5.2	Start-up Skills: Financial literacy, risk assessment, data analysis (e.g., consumer behaviour, market trends, etc.)	
	Corporate Ethics		
6	6.1	Intellectual Property Rights: Copyrights, trademarks, patents, industrial designs, geographical indications, integrated circuits, trade secrets (undisclosed information)	02
	6.2	Case Studies: Cases related to business/ corporate ethics	
TOTAL			26

List of Assignments for Term Work

In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analysing a Published Technical Paper
5. Writing a SOP
6. IPR
7. Interpersonal Skills
8. Aptitude test (Verbal Ability)

Note:

- The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
- The group size for the final report presentation should not be less than 5 students and not to exceed more than 7 students.
- There will be an end–semester presentation based on the book report.

Assessment:

- **Term Work:** Term work shall consist of minimum 8 experiments, distribution of marks for Term Work shall be as follows:

Assignments	:	10 Marks
Presentation Slides	:	05 Marks
Book Report (Hard Copy)	:	05 Marks
Attendance	:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

- **Internal Oral:** Oral Examination will be based on a GD & the Project/Book Report presentation

Group Discussion	:	10 Marks
Individual Presentation	:	10 Marks
Group Dynamics	:	05 Marks

Recommended Books:

1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected
2. chapters from Olsen/ Huckin: Technical writing and professional communication, second edition. Boston, MA: McGraw-Hill.
3. Bovée, C. L., & Thill, J. V. (2021). Business communication today. Upper Saddle
4. River, NJ: Pearson.
5. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
6. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). Personal development for life and work. Mason: South-Western Cengage Learning.
7. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour.
8. Harlow, England: Pearson.
9. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and
10. Practice. Oxford University Press
11. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness.
12. Oxford University Press
13. Sanjay Kumar & Pushp Lata (2018). Communication Skills a workbook, New Delhi:
14. Oxford University Press.

Semester-VI

Course Code	Course Name	Credits
CIL 605	Skill based lab course-IV Project Management Software <u>OR</u> Structural Design software	1.5

Project Management Software

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	03	--	--	1.5	--	1.5

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	50	--	--	50

Objectives

1. To provide hands on training of management software used in infrastructure engineering projects.
2. To prepare work breakdown structure and develop a project plan, including scoping, sequencing tasks, and determining a critical path.
3. To perform resource allocation management in a scheduled project.
4. To perform project updating and earned value analysis in project management software.
5. To update multiple projects in project management software.
6. To create a final report of project data in graphical formats.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Demonstrate the basic features and components of the management software environment.
2. Establish relationships, constraints and create project plan, including scoping, sequencing tasks, and determining the critical path on project management software.

3. Analyze and manage resource allocation in a scheduled project.
4. Perform project updating and evaluate risk involved in the schedule and budget of an infrastructure project.
5. Analyze and work with multiple projects in project management software.
6. Generate the graphical representation of the project data on the project management software.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	Introduction to Project Management Software		03
	1.1	Introduction and importance of project management software in civil and infrastructure engineering. Hands on training on utilization of basic features and components used in construction management applications.	
	Exp. 1	Basic features, tools and techniques, calendar allocation and work breakdown structures	
2	Relationship, Constraints and Creating a Project Plan		03
	2.1	Prepare work breakdown structure, link the dependent tasks.	
	Exp. 2	Create a work breakdown structure in the project plan and link the tasks	
	2.2	Basic functions required for creating an infrastructure project plan, setting-up project calendar, adding project tasks, its estimated duration and number of estimated resources required. Create a critical path for the project plan.	06
	Exp. 3	Create a project plan for any infrastructure project for its construction activities (tasks), allocate estimated duration, estimated resources, estimated cost to the activities, mark milestones and recurring event. (eg. High rise tower, bridge, etc.)	
3	Resource Analysis and Resource Levelling		06
	3.1	Identify how much time each resource will require to perform a task. To manage resources, perform resource analysis and resource levelling with different available methods	
	Exp. 4	Perform resource analysis and resource levelling to manage resources allocated to the project.	
4	Project Updating and Earned Value Analysis		06
	4.1	Setting baseline project for project updating and calculating lead/lag.	

	Exp. 5	Set baseline, update project plan and compare with baseline plan to evaluate the lead/lag	
	4.2	To track the time and budget of the project, earned value analysis is important feature.	03
	Exp. 6	Perform earned value analysis for the project and generate S- curve for the project.	
5	Inculcate Multiple Projects		06
	5.1	Working with multiple projects on project management software.	
	Exp. 7	Working with multiple projects, linking them and explain how to consolidate projects.	
6	Generation of Visual Report		06
	6.1	Project management software highlights on graphical reporting which quickly generate reports on the project schedule data and road map.	
	Exp. 8	Summarize and prepare visual report using different graphical reporting techniques.	
TOTAL			39

Assessment:

- **Term Work:** Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory Work : 30 Marks (Comprising of min 4 software generated sheets and 4 written/printed practicals)

Presentation : 15 Marks

Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

Reference Books/Codes:

1. Software manuals
2. Refereed Journal papers on software applications

Semester-VI

Course Code	Course Name	Credits
CIL 605	Skill based lab course-IV Project Management Software <u>OR</u> Structural Design software	1.5

Structural Design Software

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	03	--	--	1.5	--	1.5

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	50	--	--	50

Objectives

1. To determine shear force and bending moments of flexural members using structural software.
2. To carry out analysis of plane frames of one bay one storey.
3. To determine responses of determinate trusses.
4. To find the responses of two bay and two storied framed structures.
5. To carry out analysis of space frames and space trusses.
6. To determine responses of G+3 R.C.C framed structures.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Determine shear force and bending moments of flexural members using structural software
2. Differentiate out analysis of plane frames and space frames of one bay one storey.
3. Classify responses of determinate trusses and indeterminate trusses.

4. Validate responses of two bay and two storied framed structures using software and manual calculations.
5. Measure responses of indeterminate space trusses
6. Determine responses of G+3 R.C.C framed structures.

List of Experiments (Minimum nine)

Module	Detailed Contents	Lab Sessions/Hr
12.	Analyze the beam by using structural software and plot SFD, BMD and elastic curve (any one of continuous or fixed beam) also cross check by manual calculations.	02
13.	Analyze the plane frame (1 bay and 1 storey with horizontal loads at joint and vertical load on all members) by using structural software and plot AFD, SFD, BMD and elastic curve	02
14.	Analyze the determinate truss with external loads applied at joints	02
15.	(type of truss: Any one of Howe /Pratt/Compound fink) by using structural software	02
16.	Analyze the plane frame (2 bay and 2 storey with horizontal loads at joint and vertical load on all members) by using structural software	02
17.	and plot AFD, SFD, BMD and elastic curve.	02
18.	Analyze the indeterminate truss with external loads applied at joints	02
19.	(type of truss: Any one of Howe /Pratt/Compound fink) by using structural software	02
20.	Analyze the simple space truss with horizontal loads applied at joints in both directions by using structural software. (type of truss: Any one of Howe /Pratt/Compound fink or similar)	02
21.	Analyze the simple space frame (2 bay and 2 storey with horizontal loads at joint and vertical load on all members) by using structural software and plot AFD, SFD, BMD and elastic curve.	02

Assessment:

- **Term Work:** Including Laboratory Work and Assignments both, Distribution of marks for Term Work shall be as follows:

Laboratory Work	:	30 Marks
Presentation	:	15 Marks
Attendance	:	05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to: 75%- 80%: 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks.

Recommended Books:

1. N. Vazirani & M. M. Ratwani, Analysis of Structures, Khanna Publishers

Reference Books/Codes:

1. R. L. Jindal, Indeterminate Structures, Tata McGraw Hill Publishing House.
2. G. S. Pandit & Gupta S. P., Structural Analysis (A matrix approach), Tata McGraw

Hill Publishing Ltd.

3. Wang C. K., Matrix Method of Structural Analysis, Jon Wiley publications.
4. IS:456 -2000, IS:800-2007.

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Semester-VI

Course Code	Course Name	Credits
CIM 601	Mini Project – 2B	1.5

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	03	--	--	1.5	--	1.5

Theory					Term Work / Practical / Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test-I	Test-II	Average						
--	--	--	--	--	25	--	25	50

Rationale

Civil engineers deal with many challenges on daily basis. The civil engineering industry's growth has been need based and society centric. Computers and IT systems have touched almost every part of our lives and inter-disciplinary approach is way of life ahead. Mumbai University proposed Mini projects in the syllabus so that the budding civil engineers can connect with the world outside their textbooks and have the idea of future course. The Mini project should actually provide solution to a typical problem after a brainstorming and in a stipulated period. The solutions based on software, development of computer application, or IT systems based on artificial intelligence or IOT are expected from civil engineering students. The competitions ahead will give students the experience of the civil engineering industry's real-world problems and make students brainstorm ideas, learn, and explore the civil engineering industry.

Objectives

1. To recognize societal problems and convert them into a problem statement by understanding of facts and ideas in a group activity.
2. To deal with new problems and situations by applying acquired knowledge, facts, techniques and rules in a different way.
3. To examine and break information into parts, by analyzing motives or causes.
4. To learn evaluating information, validity of ideas and work based on a set of criteria.
5. To create solutions by compiling information together in a different way.

6. To design model by combining elements in a new pattern or proposing new solutions.

Contribution to Outcome

On completion of this course, the students will be able to:

1. Identify problems based on societal /research needs and formulate a solution strategy.
2. Apply fundamentals to develop solutions to solve societal problems in a group
3. Analyze the specific need, formulate the problem and deduce the interdisciplinary approaches, software-based solutions and computer applications.
4. Develop systematic flow chart, evaluate inter disciplinary practices, devices, available software, estimate and recommend possible solutions.
5. Draw the proper inferences from available results through theoretical/ experimental/ simulations and assemble physical systems.
6. Design a software/hardware based model.

Guidelines for Mini Project – 2A

- Expected outcome is software/hardware based, "Model and demonstration"
- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students in consultation with faculty supervisor/ head of department/ internal committee of faculties select the title of the mini project based on operational infrastructure projects in India.
- Mini project topic can also be based on the internship completed by the students after semester 4 related to infrastructure projects or in consideration with the allotted guide.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor, with the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that Students come out with original solution.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-by-case basis.

Assessment:

- **Term Work:** The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on

continuous basis, minimum two reviews in each semester.

In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions, distribution of term work marks for both semesters shall be as below:

Marks awarded by guide/supervisor based on log book	:	15 Marks
Marks awarded by review committee	:	05 Marks
Quality of Project report	:	05 Marks

- **One-year project:**

Only if a project is very demanding it will be considered for 'One Year Project'. Subject to approval by the Head of the department.

Outcome shall be a 'Hardware or software based' solution

There shall also a 'technical paper' to be presented in conference/published in journal (UGC approved) or student's competition.

In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.

In second semester expected work shall be finalization of problem and proposed solution to the problem.

- **Half-year project:**

In this case in one semester students group shall complete project in all aspects including Identification of need/problem Proposed final solution Procurement of components/systems

- **Guidelines for Assessment of Mini Project Practical/Oral Examination**

Report should be prepared as per the guidelines issued by the University of Mumbai.

Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years and approved by head of Institution.

Students shall be motivated to publish a paper based on the work in conferences/students competitions.

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

- **Assessment criteria of Mini Project:**

- Mini Project shall be assessed based on following criteria:
- Quality of survey/ need identification
- Clarity of Problem definition based on need.
- Innovativeness in solutions
- Feasibility of proposed problem solutions and selection of best solution
- Cost effectiveness and Societal impact
- Contribution of an individual as member or leader