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 2020–2021)

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Final Year B.E. Civil and InfrastructureEngineering**
2	Eligibility for Admission	**After Passing First 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: 2023-2024**

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 ofinfrastructure.

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 presentcurriculum, 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 andencourage 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.

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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 haveat 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 BE in Rev-2016 and Rev-2019 ―C 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-longing 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. Jothiprakash	: 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-VII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./ Tut.	Theory	Pract./ Tut.	Total
CIC701	Waste Management Infrastructure	3	-	3	-	3
CIC702	Power & Info-Com technologies Infrastructure	3	-	3	-	3
CIDO701X	Department Optional Course – V	3	-	3	-	3
ILO701X	Institute Optional course – I	3	-	3	-	3
CIL701	Waste Management Infrastructure	-	2	-	1	1
CIP701	Onsite Training for Infrastructure Project Practices (Operations and Management)	-	8	-	4	4
CIP702	Major Project-I	-	6	-	3	3
	Total	**12**	**16**	**12**	**8**	**20**

Examination Scheme									
Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC701	Waste Management Infrastructure	20	20	20	80	3	-	-	100
CIC702	Power & Info-Com technologiesInfrastructure	20	20	20	80	3	-	-	100
CIDO701X	Department Optional Course - V	20	20	20	80	3	-	-	100
ILO701X	Institute Optional Course - I	20	20	20	80	3	-	-	100
CIL701	Waste Management Infrastructure	-	-	-	-	-	25	25	50
CIP701	Onsite Training for Infrastructure Project Practices (Operations and Management)	-	-	-	-	-	50	50	100
CIP702	Major Project-I	-	-	-	-	-	50	50	100
	Total	**-**	**-**	**80**	**320**	**-**	**125**	**125**	**650**

Department Optional Course – V

Sr. No.	Course Code CIDO701X	Department Optional Course – V
1	CIDO7011	Repairs, Rehabilitation and Retrofitting of Structures
2	CIDO7012	Appraisal & Implementation of Infrastructure Projects
3	CIDO7013	Applied Hydrology & Flood Control
4	CIDO7014	Legal Aspects in Construction
5	CIDO7015	Design and Drawing of Reinforced Concrete Structures

Institute Optional course – I

Sr. No.	Course Code ILO701X	Institute Optional course – I
1	ILO7011	Product Life-cycle Management
2	ILO7012	Reliability Engineering
3	ILO7013	Management Information System
4	ILO7014	Design of Experiments
5	ILO7015	Operations Research
6	ILO7016	Cyber Security and Laws
7	ILO7017	Disaster Management and Mitigation Measures
8	ILO7018	Energy Audit and Management
9	ILO7019	Development Engineering

Semester-VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./ Tut.	Theory	Pract./ Tut.	Total
CIC801	Quantity Survey, Estimation and Valuation	3	-	3	-	3
CIC 802	Infrastructure Management & Economics	3	-	3	-	3
CIDO801X	Department Optional Course - VI	3	-	3	-	3
ILO801X	Institute Optional Course - II	3	-	3	-	3
CIL 801	Quantity Survey, Estimation and Valuation	-	2	-	1	1
CIP801	Onsite Training for Infrastructure Project Practices (Finance and Business Communication)	-	8	-	4	4
CIP802	Major Project-II	-	10		5	5
Total		**12**	**20**	**12**	**10**	**22**

Examination Scheme									
Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC801	Quantity Survey, Estimation and Valuation	20	20	20	80	3			100
CIC 802	Infrastructure Management & Economics	20	20	20	80	3			100
CIDO801X	Department Optional Course - VI	20	20	20	80	3			100
ILO801X	Institute Optional Course - II	20	20	20	80	3			100
CIL 801	Quantity Survey, Estimation and Valuation	-	-	-	-	-	25	25	50
CIP801	Onsite Training for InfrastructureProject Practices (Finance and Business Communication)	-	-	-	-	-	50	50	100
CIP802	Major Project-II	-	-	-	-	-	50	100	150
Total		**-**	**-**	**80**	**320**		**125**	**175**	**700**

Department Optional Course – VI

Sr. No.	Course Code CIDO801X	Department Optional Course – VI
1	CIDO8011	Environmental Impact Assessment
2	CIDO8012	Advanced Design of Steel Structures
3	CIDO8013	Design of Hydraulic Structures
4	CIDO8014	Bridge Engineering
5	CIDO8015	Advance Construction Equipments & Techniques

Institute Optional Course - II

Sr. No.	Course Code ILO801X	Institute Optional Course - II
1	ILO8011	Project Management
2	ILO8012	Finance Management
3	ILO8013	Entrepreneurship Development and Management
4	ILO8014	Human Resource Management
5	ILO8015	Professional Ethics and CSR
6	ILO8016	Research Methodology
7	ILO8017	IPR & Patenting
8	ILO8018	Digital Business Management
9	ILO8019	Environmental Management

Cumulative Credits

Semester	Credits and Marks	
	Credits	**Marks**
Sem I	18	675
Sem II	20	725
Sem III	23	800
Sem IV	24	825
Sem V	22	750
Sem VI	22	800
Sem VII	20	650
Sem VIII	22	700
Total	**171**	**5925**

Semester- VII

Course Code	Course Name	Credits
CIC701	Waste 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 Hours	-	-	-	100

Rationale

Environment has gained increasing importance in the relation with the principles of public health engineering, design of waste water collection and treatment systems; and develops rational approaches towards sustainable waste management via appropriate treatment. The course deals with the overall features and study of treatment of sewage processes, solid waste and waste management. The course lays emphasis on complete update of the knowledge of these processes related to design of treatment plant.

Objectives

1. To understand and explain the role of sanitation and its relation to public health and environment.
2. To provide knowledge of wastewater collection system, characteristics of wastewater.
3. To provide students the necessary knowledge and concepts of advancements/emerging techniques of treatment processes.
4. To study the appropriate treatment, reclamation and resource recovery and re-use at both centralized and decentralized levels. Also, to study self-purification in nature.
5. To develop rational approaches towards sustainable wastewater management via sludge recovery and treatments.
6. To provide necessary skill for understanding and operation of solid waste management & fly ash waste management facilities.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Sewage Generation, Collection and Conveyance**		07
	1.1	Introduction: Need for sewerage system, Domestic sewage, Industrial waste and Storm water, Conservancy and water carriage system, Systems of sewerage and their layouts: Separate, Combined and partially combined system, Merits and demerits, Patterns of sewerage layout, Quantity of sewage.	

	1.2	Conveyance of sewage sewer: Shapes and materials of sewers, open drains, Design of sewers: sewer size, Determination of velocity of flow using empirical formulae, limiting velocities. Laying and testing of sewers, Sewer joints, Sewer appurtenances, Ventilation of sewers. Construction and Maintenance of sewers. Pumping of sewage: Pumping station components.	
2	**Characterization and Primary Treatment of sewage**		**07**
	2.1	Need for Analysis, Characteristics of sewage: Composition, Biochemical characteristics, aerobic decomposition, anaerobic decomposition, Sampling of sewage, Analysis of sewage.	
	2.2	Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment. Primary treatment: Screening, Grit removal, Oil and Grease removal, settling tank.	
3	**Conventional Biological treatments**		**11**
	3.1	Secondary Treatment Methods: Trickling filter- Principle, Process description and Operational problems and Design. Activated sludge process (ASP) - Principle, Process description, Recirculation of sludge, Operational problems, Sludge volume index and Design of ASP. Aerated lagoons- Process description and Design, Rotating Biological contractors, Stabilization Ponds, UASB.	
	3.2	Septic Tank and Soak Pit –Operation, suitability and Design. Concepts of advances in wastewater treatment. Imhoff Tank On-site treatment: Meaning of decentralized treatment.	
4	**Reclamation and Reuse of Waste water**		**06**
	4.1	Tertiary and Grey water treatment, recycling and reuse of wastewater.	
	4.2	Self-Purification of Natural Water Bodies: Oxygen economy, Sewage farming. Disposal of treated effluent. Disposal of Raw and treated sewage on land and water, standards for disposal. Stream pollution: Self-purification, DO sag curve and numerical based on this. Effects of wastes on self-purification of streams and fish life, Statement and significance of the parameters of Streeter and Phelp's equation and BOD equations (excluding derivation), Deoxygenating and reaeration.	
5	**Sludge Treatment and Disposal**		**02**
	5.1	Thickening, Dewatering, Sludge Digestion: Principles of anaerobic digestion, quantity and characterization of sludge, design of sludge digestion tanks. Disposal- disposal of digested sludge, drying beds.	
6	**Municipal Solid Waste & Waste Management**		**06**
	6.1	Solid waste: Sources, Types, generation and collection, storage, handling, transportation, processing, treatment and disposal methods, 5R Principles. Introduction to Hazardous wastes, E-wastes and Plastic wastes.	
	6.2	Waste management & fly ash: Power plant waste – fly ash; chemical composition & classification; disposal and reuse;	

		applications in cement, soil stabilization, pavement construction, geo-polymers, bricks, etc., environmental issues and exposure concerns; flue gas desulfurization.	
		Total	**39**

Note: The students will visit to wastewater treatment plant in the nearby vicinity or in the city and prepare detailed report thereof. This report will form a part of the term work.

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain wastewater collection systems in buildings and municipal areas and to determine the quantity of wastewater and storm water production. Also, gain the knowledge of the construction of new sewer line and importance of sewer appurtenances.
2. Explain and analyze the characteristics of wastewater and design the primary treatment for wastewater
3. Explain on-site treatment methods and solve Analyze and design wastewater treatment systems (ASP, Aerated lagoon and Oxidation ponds).
4. Identify and apply proper treatment for reclamation and reuse of wastewater and disposal.
5. Explain sludge characteristics and processing methods.
6. To provide knowledge of solid waste collection system, characteristics of solid waste and to identify hazardous waste. Study related to plastic waste management & fly ash waste management will be studied.

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)

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. Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, T.M.H. Edition, New Delhi, 1995.
2. Environmental Engineering: Peavy, H.S., RoweD.R., Tchobanoglous G.; 1991, Tata-Mcgraw Hill.
3. Environmental Engineering Vol II- Sewage Disposal and Air Pollution Engineering: S. K. Garg, Khanna Publishers New Delhi.
4. Water supply and sanitary Engineering: Hussain S. K., Oxford and IBH Publication, New Delhi.
5. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
6. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan.

7. Integrated solid waste management, Tchobanoglous, Theissen and Vigil, McGraw Hill Publication.

Reference Books:

1. Manual on Wastewater Treatment 3rd Ed. Pub: CPH and Env. Engg. Organization, Ministry of Urban Development, Govt. of India, New Delhi, 1991.
2. Plumbing Engineering, Theory and Practice: Patil S. M., Seema Publication, Mumbai.
3. CPHEEO Manual on Sewage and Treatment.
4. Relevant Indian standard specifications and BIS publications.
5. Water Supply and Sewerage: E.W. Steel.
6. Introduction to Environmental Engineering, Vesilind, PWS Publishing Company 2000.
7. Introduction to Environmental Engineering: P. Aarne Vesilind, Susan M. Morgan, Thompson.
8. Wastewater Treatment- Concepts and Design Approach: G. L. Karia and R. A. Christian.
9. Manual on Municipal Solid Waste Management: Ministry of urban development, New Delhi.

Semester- VII

Course Code	Course Name	Credits
CIC702	Power and Info-com Technologies 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 Hours	-	-	-	100

Rationale

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the ever-increasing energy needs requiring huge investments to meet them. Today the Power Engineer are concerned with three "E"s" namely Energy, Economics and Ecology (Environment). Thus, the power engineer must try to develop systems that produce large quantities of energy with minimal cost and with low impact on environment. The proper balance of these 3 "E"s" is a major technological challenge. The course deals with fundamentals of different types of energies that can be used in major infrastructure projects. In addition to this, course provides the knowledge about telecommunication and IT infrastructure. The course lays emphasis on implementing the energy power in major infrastructure with the help of IT and telecommunication.

Objectives

1. To understand the fundamentals of tidal energy infrastructure and wind energy infrastructure.
2. To study the basics of solar energy infrastructure.
3. To understand the overview and fundamentals of thermal energy infrastructure.
4. To understand the basics of nuclear energy infrastructure.
5. To acquire the knowledge of telecommunication and apply the same in infrastructure industries.
6. To learn and apply the concepts of information technology to infrastructure industries.

Detailed Syllabus

Module	Course Modules / Contents		Periods
1	**Module Name-Tidal and Wind Energy Infrastructure**		7
	1.1	Tidal energy infrastructure: Fundamentals of tide; wave theory; operating principle - oscillating device; turbine characteristics; devices; moorings and anchors.	
	1.2	Wind energy infrastructure: Offshore and onshore wind; properties of wind; wind resource assessment; wind turbine blades; wind turbines in	

		grid; wind projects.	
2	**Module Name-Solar Energy Infrastructure**		**4**
	2.1	Solar energy infrastructure: Basics of solar PV, fundamentals of the design of solar energy fields; concentrated solar power plant; solar water heating systems.	
3	**Module Name-Thermal Energy Infrastructure**		**4**
	3.1	Thermal energy infrastructure: Plant configuration; emission reduction; repair; maintenance; cooling; reliability and risk assessment.	
4	**Module Name-Nuclear Energy Infrastructure**		**6**
	4.1	Nuclear energy infrastructure: Policy and regulations; economics and financing of nuclear power plants; fuel supply, radioactive waste and management; issues; facilities and basic infrastructure.	
5	**Module Name- Telecommunication**		**7**
	5.1	Telecommunication – definition, use, functions, and components, modulation and its types (analog and digital). Telecommunication signals (frequency spectrum). Modes of telecommunication, telecommunication network.	
	5.2	Role of telecommunication in Infrastructure industries. Wireless communication, Introduction to mobile and satellite communication.	
6	**Module Name- IT infrastructure**		**11**
	6.1	Computer Networking- Introduction to computer communication, TCP/IP protocol, Client-Server architecture of computing, Internet Infrastructure Architecture, Introduction to WWW.	
	6.2	Internet of Everything- Architecture and its components, communication protocols, Edge computing and data analytics	
	6.3	Cloud computing- Technology, Data center architecture, its components and design considerations.	
	6.4	Augmented reality – 3D Modeling and simulation of civil structures Computing Infrastructure.	
		Total	**39**

Contribution to Outcome

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

1. Apply the knowledge of tidal and wind energies for the benefits of major infrastructure projects.
2. Use the concept of solar energy for optimizing the use of electricity in major infrastructure projects.
3. Use the knowledge of thermal energy in major infrastructure projects.
4. Describe the knowledge about the economics and financing of nuclear power plants.
5. Illustrate the role of telecommunication in infrastructure industries.
6. Comprehend the necessary knowledge and concepts of IT 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)

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. Renewable energy technologies - R. Ramesh, Narosa Publication
2. Energy Technology – S. Rao, Parulkar
3. Non-conventional Energy Systems – Mittal, Wheelers Publication.
4. Non-Conventional Sources of Energy- B. H. Khan, TMH Publication
5. Electronics Communication by Author, Louis E. Frenzel (Jr.); Edition, 5; Publisher, McGraw-Hill Education
6. Modern Digital and Analog Communication Systems. Oxford University Press, third edition. B. P. Lathi. T. Srinivasa Rao
7. Chetankumar G Shetty, "Augmented Reality- Theory, Design and Development", Mc Graw Hill, 2020 Edition.
8. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals Networking Technologies, Protocols, and Use Cases for the Internet of Things CISCO".

Reference Books:

1. Non-Conventional Sources of Energy- G.D.Rai, Khanna Publishers
2. Renewable Energy sources And Emerging Technologies, DP. Kothari, PHI.
3. Hand Book of Renewable Energy Technology, Ahmed F Zooba, R C Bansal World scientific.
4. Electronic Communication system Author, George Kennedy, Bernard Davis, 4th ed, Tata McGraw-Hill Education
5. Wireless Communications: Principles and Practice, Pearson Education India, Theodore S. Rappaport.
6. Tanenbaum, Andrew S. Computer networks. Pearson Education India, 2003.
7. D. Schmalsteig and Tobias Hollerer, "Augmented Reality- Principles and Practice", Pearson Education, Inc.2016 Edition.
8. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, "Internet of Things", Wiley Publication, 2019 Edition.
9. Cloud computing Bible, Barrie Sosinsky, Wiley publication.

Semester- VII

Course Code	Course Name	Credits
CIDO7011	Department Level Optional Course – V Repairs, Rehabilitation and Retrofitting of 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 Hours	-	-	-	100

Rationale

Structures need strengthening and repairs due to variety of reasons. Now-a-days different materials, techniques and machineries are used to improve the structures and prolong their serviceable life. A structure needs regular maintenance to perform satisfactorily during its lifetime. This subject deals with damage assessment, preparing a strengthening strategy of RCC, steel structures, Seismic Retrofitting and maintenance of heritage structures.

Objectives

1. To understand the concept of Repair of repair and its need.
2. To understand various causes of deterioration of concrete structure and Distresses monitoring techniques.
3. To understand various materials of repairs and their properties.
4. To understand various methods of repairs of concrete structure.
5. To understand various methods of repairs of steel structure.
6. To understand seismic retrofitting and maintenance of heritage structures.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		03
	1.1	Need for repair, rehabilitation and maintenance of structure. Repair Management. Sustainable development.	
	1.2	Maintenance and its importance, life cycle cost of structure.	
	1.3	Heritage structure and need for their Rehabilitation.	
2	**Damage Assessment**		08
	2.1	Causes of deterioration of concrete: Physical, Chemical and Mechanical causes.	
	2.2	Distresses monitoring, Visual inspection, Non-Destructive Testing using Rebound hammer, Ultra sonic pulse velocity, Semi destructive testing, Probe test, Pull out test, Chloride penetration	

		test, Carbonation, Carbonation depth testing, Corrosion activity measurement.	
	2.3	Types of cracks: Diagonal Cracks, Horizontal Cracks, Splitting Cracks, Corrosion Cracks, Plastic shrinkage cracks, thermal cracks.	
	2.4	Crack Measurement techniques: Steel Ruler, Magnified Graticule, Plastic Tell Tale Glass Tell Tale Brass Screws and Caliper Displacement Transducer.	
3	**Repair of Concrete Structures**		**06**
	3.1	Methods of crack repairs: Epoxy injection, Routing and Sealing of Cracks, Stitching Prestressing steel Drilling and Plugging Method Gravity Filling Method.	
	3.2	Repair Materials: Essential parameters for repair materials. Materials for repair: Materials for Surface Preparation, Chemical Rust removers for corroded reinforcement, Passivators for reinforcement protection, Bonding Agents, Structural Repair Materials, Non-structural Repair Materials, Injection grouts, Joint sealants, Surface coatings for protection of RCC. Premixed Cement concrete/mortars, Polymers/latex modified cement mortars, Epoxy resins.	
	3.3	Corrosion repair methods: Cathodic Protection, Chloride Removal.	
4	**Rehabilitation and Retrofitting Methods**		**10**
	4.1	Repair Stages: Concrete Removal and Surface Preparation, Fixing formwork, Bonding / passivating coat and repair application.	
	4.2	Repair Methods: Repairs using mortars/modified mortars, Epoxy based material repairs, Shotcrete, Ferro-cement, Plate bonding, RCC Jacketing Propping and Supporting, Fibre Wrap Technique.	
	4.3	Foundation Rehabilitation Methods: Shoring, raking shores, Flying shores, Dead shores. Underpinning. Slab jacking.	
5	**Repair of Steel Structures**		**06**
	5.1	Types and causes for deterioration - Preventive measures - Repair procedure - Brittle fracture - Lamellar tearing - Defects in welded joints	
	5.2	Design and fabrication errors - Distress during erection - Causes and remedies	
	5.3	Repair methods for structures	
6	**Seismic Retrofitting and Maintenance of Heritage Structures**		**06**
	6.1	Earthquake damages of buildings, their retrofitting and restoration. Effects of earthquakes.	
	6.2	Methods of seismic retrofitting, restoration of buildings Special care in repair and rehabilitation of heritage structures.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Describe the concept of repair and its need.
2. Classify various causes of deterioration of concrete structure and Distresses monitoring techniques.
3. Classify various materials of repairs and their properties.
4. Explain various methods of repairs of concrete structure.
5. Describe various methods of repairs of steel structure.
6. Explain seismic retrofitting and maintenance of heritage structures.

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)

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. CPWD Handbook on Repair and Rehabilitation of RCC buildings, Govt of India Press, New Delhi
2. Santhakumar A.R., "Concrete Technology" Oxford University Press, 2007, New Delhi
3. Bhattacharjee J, Concrete Structures Repair Rehabilitation and Retrofitting- 2019, CBS Publishers & Distributors Pvt. Ltd.

Reference Books:

1. Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" R and D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
2. Maintenance, Repair & Rehabilitation and Minor Works of Buildings P.C.Varghese, PHI Publications
3. P.K.Guha , Maintenance & Repairs of Buildings, New Central Book Agency (P) Limited,
4. R.Dodge , Concrete structures Concrete Structures Protection Repair and Rehabilitation, woodson

Semester- VII

Course Code	Course Name	Credits
CIDO7012	Department Level Optional Course – V Appraisal & Implementation of Infrastructure Projects	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 Hours	-	-	-	100

Rationale

For any Civil & Infrastructure Engineering project, a range of alternative schemes meeting project goals are feasible. Thus, to identify the most suitable out of it, project evaluation has to be carried out in terms of financial viability, environmental impact, utility to the society, engineering feasibility, profitability, etc. This course is intended to make students aware of this evaluation (appraisal) criterion for any Civil engineering project. Students will understand the importance of feasibility studies and get acquainted to the process of preparing a project report, both being crucial role players while deciding the viability of a project. The professional construction engineering practice will be rendered meaningful if students learn about ways to raise project funds, their effective planning and optimum utilisation. This course is devised to help students in understanding financial and economic aspects of a project.

Objectives

1. To know the procedure of feasibility studies for any infrastructure project.
2. To learn the procedure of appraisals required for deciding the worthiness of any project.
3. To learn the procedure of forecasting demand and know the uncertainties involved.
4. To know the components and importance of technical & managerial appraisal.
5. To get acquainted with decision making tools like Break even analysis, SWOT analysis etc.
6. To get acquainted with different methods of project finance and implementation.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Construction Projects and Report Preparation**		03
	1.1	Classification of construction projects. Project Formulation and phases involved in it.	
	1.2	Feasibility studies, SWOT analysis. Preparation of Project report.	
2	**Project Appraisal**		06
	2.1	Importance and phases in a project development cycle for major infrastructure projects.	

	2.2	Importance of Appraisal, its need and steps involved in it.	
3	**Market Appraisal**		**09**
	3.1	Importance and methods of carrying out demand analysis. Sources to gather project related information and ways to carry out market survey.	
	3.2	Methods to forecast demands. Uncertainties involved in demand forecasting.	
4	**Technical and Managerial Appraisal**		**06**
	4.1	Method to study the technical appraisal/viability of a project in terms of its location, type of land and intended use of building, technology requirements of the project, Size and complexity of tools and plants, raw materials to be used and their impact on the vicinity, energy requirements, water supply and disposal of effluents if any.	
	4.2	Study of managerial requirements of a project, Desirable organisational structure and hierarchy to manage as well as implement the project, Method of assessment of entrepreneurs.	
5	**Financial Analysis and Economic Appraisal**		**09**
	5.1	Various costs related to a project, Methods to determine the profitability of a project, Break even analysis.	
	5.2	Economic appraisal: Urgency, Payback period, Avg. Rate of return, Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.	
6	**Project Financing and Implementation**		**06**
	6.1	Types and Sources of finance in local, National and International context. Issues related to project financing.	
	6.2	Agencies involved in the implementation of a project. Methods of implementation like Built, operate and Transfer and its other variants like B.O.O, B.O.O.T, B.L.T, EPC, etc.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Classify the projects and describe the phases involved in project formulation.
2. Prepare a detailed project report on the basis of various feasibility studies and swot analysis.
3. Devise a project's development cycle and get acquainted with the different appraisals in the process of deciding the worthiness of a project.
4. Exhibit and apply the managerial skills and knowledge of financial aspects required during the implementation of projects.
5. Identify various sources for project finance.
6. Know the various agencies involved in project implementation as well as select the method of project implementation which is best suited for a particular project.

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)

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. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
2. Infrastructure Development & Financing in India - N. Mani (New Century Publications).
3. Infrastructure & economic development - Anu Kapil (Deep &Deep Publications).
4. Construction Management: Planning and finance - Cormican D. (Construction press, London).

Reference Books:

1. The cost management toolbox; A Managers guide to controlling costs and boosting profits. - Oliver, Lianabel (Tata McGraw Hill).
2. Engineering Economics – Kumar (Wiley, India).
3. Real Estate, Finance and investment - Bruggeman.Fishr (McGraw Hill).

Course Code	Course Name	Credits
CIDO7013	Department Level Optional Course – V Applied Hydrology & Flood Control	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 Hours	-	-	-	100

Rationale

This subject deals with the various processes involved in hydrological cycle and provides in depth understanding of the theories and concepts of surface, subsurface and ground water hydrology. It focuses on types and forms of precipitations. It also explains the application of hydrographs, unit hydrographs and further describes various techniques of estimating stream flows. It further describes the various techniques of estimating streamline flows. It also describes the importance of floods, flood routing and ground water hydrology.

Objectives

1. To explain the various processes involved in the hydrological cycle.
2. To measure rainfall, computation of average rainfall, various water losses etc.
3. To differentiate the various stream flow measurement and its importance.
4. To interpret the hydrograph and unit hydrographs, applications of unit hydrograph concept.
5. To evaluate various flood control methods, estimate design flood, and flood routing
6. To describe the concepts of ground water movement, steady and unsteady flow towards fully penetrating wells and well yields.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		08
	1.1	Hydrological cycle, scope of hydrology, water budget equation, data sources.	
	1.2	Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area - Duration relationship, Intensity-Duration –Frequency relationship, Probable Maximum Precipitation.	

2	**Abstractions from Precipitation & Stream Flow Measurement**		**06**
	2.1	Evaporation and transpiration, evapo-transpiration, interception, depression storage, infiltration and infiltration indices, determination of water losses.	
	2.2	Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.	
3	**Runoff**		**06**
	3.1	Catchment, watershed and drainage basins, Factors affecting runoff, rainfall- runoff relationship, runoff estimation, droughts	
4	**Hydrograph Analysis**		**07**
	4.1	Characteristics, base flow separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.	
5	**Floods**		**06**
	5.1	Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk- reliability and safety factor. Flood routing: Hydrologic and hydraulic routings.	
6	**Ground Water Hydrology**		**06**
	6.1	Yield, transmissibility, Darcy's law, Dupuit's theory of unconfined flow, steady flow towards fully penetrating wells (confined and unconfined). Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain hydrologic cycle and various methods of Measurement of rainfall.
2. Calculate optimum number of rain gauge stations for average rainfall and missing rainfall over catchment
3. Describe various methods of measurement of stream flow and to calculate abstraction losses over the catchment
4. Develop rainfall runoff relationship and calculating runoff over catchment
5. Perform hydrologic and hydraulic routing
6. Calculate the discharge of well for confined and unconfined aquifer

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)

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 Engineering and Hydraulic Structures: S.K. Ukarande, Ane Books Pvt. Ltd. ISBN-978-93-83656-89-9
2. Irrigation and Water Power Engineering: B.C. Punmia, Pande B.B.Lal, A.K Jain. Laxmi Publications Pvt, Ltd. New Delhi
3. Contribution to Outcomes
4. Irrigation Water Resources and Water Power Engineering: P.N. Modi, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
5. Hydrology: H. M. Raghunath, New Age International Publishers, New Delhi

Reference Books:

1. Engineering Hydrology: Principles and practice: V. M. Ponce, Prentice Hall
2. Elementary Hydrology: V. P. Singh, Prentice Hall
3. Engineering Hydrology: K. Subramanya, Tata McGraw Hill Publishing Co. Ltd. New Delhi.

Course Code	Course Name	Credits
CIDO7014	Department Level Optional Course – V Legal Aspects in Construction	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 Hours	-	-	-	100

Rationale

Construction industry is one of the most regulated industries in the World and subjected to various laws, rules, and regulation and ethical standards. A civil Engineering graduate must be able to understand and interpret these laws and navigate through these environments with utmost certainty and responsibilities. The syllabus of this course has been designed to give preliminary introduction to Civil Engineering about legal aspects in construction industry. Along with this, the course intends to help students understand various aspects of contracts, tenders and roles & responsibilities of various involved individual and parties.

Objectives

1. To explain needs of various laws and legislation related to Construction Industry.
2. To summarize application of various Contracts and their forms (Documents)
3. To describe application of various Tenders and their forms (Documents)
4. To understand needs & Methods of arbitration and dispute resolution mechanism
5. To explain needs health, safety and labour laws associated with Construction Industry
6. To describe needs of Environmental protection and ethics in Construction Industry

Detailed Syllabus

Module		Course Module / Contents	Periods
1	**Introduction to Legal Aspects in Construction Industry**		06
	1.1	Need of laws in the construction industry. Role of Builders, Engineers, Architects and Contractors.	
	1.2	Need for legislation. Important Laws related to construction industry: Indian Contract Act 1872, Labour laws, The Building and Other Construction Workers Act, 1996, The Environment (Protection) Act, 1986.	
2	**Contracting in Construction**		08
	2.1	Contract: Definition, Purpose and Sanctity of Contract, Classification of Construction Contracts and their advantages and disadvantages: Lump-Sum Contract, Unit Price Contract, Cost-Plus Contract and Target Contract. Types of Documents (Forms) in a Construction Contract.	

	2.2	Contract Management: Indian Contract Act- 1872, Breach of Contract and Professional ethics to be followed by Contracting Parties.	
3	**Tendering in Construction**		**06**
	3.1	Tender: Definitions. Requisites of a Valid Tender Types of Tendering: Open Tendering, Selective Tendering and Negotiated Tendering.	
	3.2	Tender Documents, Scrutinization process, Award, acceptance, Bidding models & bidding strategies. E-Tendering process of PWD.	
4	**Arbitration and Dispute Resolution**		**06**
	4.1	Claims & disputes, Standard methods of resolving disputes.	
	4.2	Dispute Resolution Board (DRB) – Necessity, formation, Functioning, Advantages etc	
	4.3	Arbitration & conciliation Act -1996 – Arbitration agreement, Arbitration process, duties & powers of an arbitrator, rules of preparing evidence, Publication of an award.	
5	**Health, Safety and Labour Laws**		**06**
	5.1	Safety rules on construction sites. Roles and responsibilities of owner, contractor and engineers on site.	
	5.2	Important laws: BOWC Act 1996	
	5.3	Minimum Wage Act, 1948	
	5.4	GST Tax Act 2017	
6	**Environmental Protection and Ethics**		**07**
	6.1	Impact of construction industry in global warning and climate change. Environmental impact assessment report and case study of any recent infrastructure project.	
	6.2	Paris agreement 2020 and Indian's Climate target as per Paris agreement.	
	6.3	Ethical responsibilities of Civil Engineers, contractors and other parties in construction.	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain needs of various laws and legislation related to Construction Industry.
2. Describe application of various Contracts and their forms (Documents)
3. Describe application of various Tenders and their forms (Documents)
4. Evaluate needs & Methods of arbitration and dispute resolution mechanism
5. Explain health, safety and labour laws associated with Construction Industry
6. Apply needs of Environmental protection and ethics 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)

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. Manual for Procurement of Works 2019 GoI, Ministry of Finance
2. PWD manual for E-tendering 2018 PWD, India
3. Construction contracts and claims - Simon M.S., McGraw Hill, New York
4. Construction contracts Management- NICMAR Publication India
5. Estimation and contracts B.S. Patil

Reference Books:

1. Construction contracts and claims - Simon M.S., McGraw Hill, New York
2. Construction contracts Management- NICMAR Publication India

Course Code	Course Name	Credits
CIDO7015	Department Level Optional Course – V Design & Drawing 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	04 Hours	-	-	-	100

Rationale

Reinforced concrete construction is widely used for residential, commercial and industrial structures. IS code has specified the use of Limit State Method (LSM) design philosophy for design of structures. During previous semester students have studied design of basic elements by LSM. This course covers complete design of G+3 RCC framed building in addition to other structures like water tank and retaining wall. Prestressed Concrete structures are another class of structures used for bridge girders, long span slabs etc. Civil Engineers must have knowledge of designing and detailing of RCC and PSC structures to make structures safe and serviceable during its life span. The knowledge about response of structures during an earthquake is prerequisite for Civil Engineers. The course introduces Prestressed concrete and Earthquake Resistant Design of structures with drawing and detailing as per IS Code specifications.

Objectives

1. To explain the LSM design procedure of G+3 RCC framed building by application of IS code clauses including loading calculations, analysis and design of individual elements with detailing of reinforcements.
2. To explain the concepts in the design of water tanks.
3. To explain the concepts in the design of retaining walls.
4. To introduce the basics of structural dynamics, structural behaviour under the dynamic load and the effect of damping.
5. To introduce earthquake resistant design approach.
6. To develop the practice of design using charts and tables from SP:16 published by BIS.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Comprehensive Design of Building**		12
	1.1	Analysis and design of residential/commercial/industrial (G+ 3) RCC framed building.	
	1.2	Load transfer mechanism, arrangement of beams, slabs and columns.	

	1.3	Design of Staircase (Dog legged and Open well type), Slabs (One way and Two way with continuity), Beams (Simply supported, Cantilever, Continuous), Columns (Axially loaded and eccentrically loaded), Footings (Isolated and Combined)	
2	**Design of Retaining Wall**		**06**
	2.1	Design of Cantilever retaining wall	
	2.2	Design of Counterfort retaining wall	
3	**Design of Water Tank**		**06**
	3.1	Classification of Water Tank, Permissible Stresses, and Design of circular and rectangular water tanks resting on ground and underground. Codal provisions as per IS 3370:2020. Use of IS coefficient method and approximate method.	
4	**Introduction to Structural Dynamics**		**06**
	4.1	Definition of basic terms used in structural dynamics. Static and dynamic loads, types of dynamic load.	
	4.2	Introduction to single degree of freedom system (SDOF), evaluation of dynamics response of SDOF system. Approximate method for determination of time period of vibration.	
5	**Earthquake Resistant Design of Structures**		**06**
	5.1	Earthquake motion and response of structure.	
	5.2	Design load calculation by seismic coefficient method	
	5.3	Ductile design and detailing as per IS: 13920.	
6	**Introduction to Pre-stressed Concrete**		**03**
	6.1	Prestressed Concrete: basic principles of prestressed concrete, materials used, systems of prestressing.	
	6.2	Losses in prestress.	
		Total	**39**

Contribution to Outcome

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

1. Design G+3 RCC framed building using IS code recommendations.
2. Design different types of retaining walls with detailing of reinforcement
3. Design different types of water tanks with detailing of reinforcement.
4. Apply the basic concepts of structural dynamics
5. Evaluate the response of structure during an earthquake and calculate design forces.
6. Explain principles of Pre-stressed Concrete and its losses.

Internal Assessment (20 Marks):

Consisting of two class tests - first test based on approximately 40% of content and second test based on remaining content (approximately 40% but excluding content covered in first test). Average of marks will be considered for IA.

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 relevant IS codes 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 based on entire syllabus.
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. Four questions need to be solved in total

Recommended Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Reinforced Concrete - Limit State Design: Ashok K. Jain, Nemchand & bro.
3. Limit State Design of Reinforced Concrete: Shah and Karve, Structure Publications, Pune.
4. Design of Prestressed Concrete Structures: Lin T.Y. and Ned Burns; John Wiley.
5. Reinforced Concrete: H.J. Shah, Charotar Publishers, Anand.
6. Prestressed concrete: Krishna Raju, Tata Mc-Graw Hill Publishing House, New Delhi
7. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structures 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.
10. Earthquake resistant design of structures: Pankaj Agarwal, Manish Shrikhande, PHI, New Delhi.

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 Publishing House, 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. Pre-stressed concrete: N. Rajgopalan, Narosa Publishers.
7. Relevant IS Codes: BIS Publications, New Delhi.

Course Code	Course Name	Credits
ILO7011	Institute Level Optional Course – I Product Life-cycle 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	3 Hours	-	-	-	100

Objectives

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Product Life-cycle Management (PLM) & PLM Strategies**		10
	1.1	Product Life-cycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications	
	1.2	Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy, Change management for PLM	
2	**Product Design**		09
	2.1	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	

3	**Product Data Management (PDM)**		**05**
	3.1	Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	
4	**Virtual Product Development Tools**		**05**
	4.1	For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	
5	**Integration of Environmental Aspects in Product Design**		**05**
	5.1	Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	
6	**Life Cycle Assessment and Life Cycle Cost Analysis**		**05**
	6.1	Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

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)

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**.

Reference Books:

1. John Stark, “Product Lifecycle Management: Paradigm for 21st Century Product Realisation”, Springer-Verlag, 2004. ISBN: 1852338105
2. Fabio Giudice, Guido La Rosa, AntoninoRisitano, “Product Design for the environment-A life cycle approach”, Taylor & Francis 2006, ISBN: 0849327229
3. Saaksvuori Antti, Immonen Anselmie, “Product Life Cycle Management”, Springer, Dreamtech, ISBN: 3540257314
4. Michael Grieve, “Product Life-cycle Management: Driving the next generation of lean thinking”, Tata McGraw Hill, 2006, ISBN: 0070636265

Course Code	Course Name	Credits
ILO7012	Institute Level Optional Course – I Reliability 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 Hours	-	-	-	100

Objectives

1. To familiarize the students with various aspects of probability theory.
2. To acquaint the students with reliability and its concepts.
3. To introduce the students to methods of estimating the system reliability of simple and complex systems.
4. To understand the various aspects of Maintainability, Availability and FMEA procedure.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Probability Theory, Distributions & Measures of Dispersion**		08
	1.1	Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem	
	1.2	Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance	
	1.3	Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis	
2	**Reliability Concepts, Failure Data Analysis & Reliability Hazard Models**		08
	2.1	Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve.	
	2.2	Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions	
	2.3	Constant Failure Rate, linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis	
3	**System Reliability**		05
	3.1	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems	
4	**Reliability Improvement**		08

	4.1	Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis	
	4.2	System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	
5	**Maintainability and Availability**		**05**
	5.1	System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	
6	**Failure Mode, Effects and Criticality Analysis**		**05**
	6.1	Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fau1t tree analysis and Event tree Analysis	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out failure mode effect and criticality analysis

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)

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**.

Reference Books:

1. L.S. Srinath, “Reliability Engineering”, Affiliated East-Wast Press (P) Ltd., 1985.
2. Charles E. Ebeling, “Reliability and Maintainability Engineering”, Tata McGraw Hill.
3. B.S. Dhillion, C. Singh, “Engineering Reliability”, John Wiley & Sons, 1980.
4. P.D.T. Conor, “Practical Reliability Engg.”, John Wiley & Sons, 1985.
5. K.C. Kapur, L.R. Lamberson, “Reliability in Engineering Design”, John Wiley & Sons.
6. Murray R. Spiegel, “Probability and Statistics”, Tata McGraw-Hill Publishing Co. Ltd.

Course Code	Course Name	Credits
ILO7013	Institute Level Optional Course – I Management Information System	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 Hours	-	-	-	100

Objectives

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Information Systems (IS)**		04
	1.1	Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	
2	**Data and Knowledge Management**		07
	2.1	Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management	
	2.2	Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	
3	**Ethical Issues and Privacy**		07
	3.1	Information Security. Threat to IS, and Security Controls	
4	**Social Computing (SC)**		07
	4.1	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce	
5	**Computer Networks Wired and Wireless Technology**		06
	5.1	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model	

6	**Information System within Organization & Acquiring Information Systems and Applications**		**08**
	6.1	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process.	
	6.2	Acquiring Information Systems and Applications: Various System development life cycle models.	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Evaluate the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

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)

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**.

Reference Books:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008

Course Code	Course Name	Credits
ILO7014	Institute Level Optional Course – I Design of Experiments	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 Hours	-	-	-	100

Objectives

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		06
	1.1	Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments, Response Surface Methodology	
2	**Fitting Regression Models**		08
	2.1	Linear Regression Models, Estimation of the Parameters in Linear Regression Models, Hypothesis Testing in Multiple Regression, Confidence Intervals in Multiple Regression, Prediction of new response observation, Regression model diagnostics, Testing for lack of fit	
3	**Two-Level Factorial Designs**		07
	3.1	The 2^2 Design, The 2^3 Design, The General 2^k Design, A Single Replicate of the 2^k Design, The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design, Split-Plot Designs	
4	**Two-Level Fractional Factorial Designs**		07
	4.1	The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design, The General 2^{k-p} Fractional Factorial Design, Resolution III Designs, Resolution IV and V Designs, Fractional Factorial Split-Plot Designs	

5	**Response Surface Methods and Designs**		**07**
	5.1	Introduction to Response Surface Methodology, The Method of Steepest Ascent, Analysis of a Second-Order Response Surface, Experimental Designs for Fitting Response Surfaces	
6	**Taguchi Approach**		**04**
	6.1	Crossed Array Designs and Signal-to-Noise Ratios, Analysis Methods, Robust design examples	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

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)

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**.

Reference Books:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean

Course Code	Course Name	Credits
ILO7015	Institute Level Optional Course – I Operations Research	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 Hours	-	-	-	100

Objectives

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems
3. Use mathematical software to solve the proposed models

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Operations Research, Linear Programming, Transportation Problem, Assignment Problem & Integer Programming Problem**		14
	1.1	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research	
	1.2	Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis	
	1.3	Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	
	1.4	Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem.	
	1.5	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm,	

		Branch and Bound Technique. Introduction to Decomposition algorithms.	
2	**Queuing Models**		**05**
	2.1	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	
3	**Simulation**		**05**
	3.1	Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	
4	**Dynamic programming**		**05**
	4.1	Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	
5	**Game Theory**		**05**
	5.1	Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	
6	**Inventory Models**		**05**
	6.1	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Describe the applications of integer programming and a queuing model and compute important performance measures

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)

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**.

Reference Books:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
3. Hiller, F. S. and Liebermann, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
5. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.

Course Code	Course Name	Credits
ILO7016	Institute Level Optional Course – I Cyber Security and Laws	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 Hours	-	-	-	100

Objectives

1. To understand and identify different types cyber-crime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Cyber Crime**		04
	1.1	Cyber-crime definition and origins of the world, Cyber-crime and information security, Classifications of cyber-crime, Cyber-crime and the Indian ITA 2000, A global Perspective on cyber crimes	
2	**Cyber offenses & Cyber crime**		09
	2.1	How criminal plan the attacks, Social Engg, Cyber stalking, Cybercafé and Cyber-crimes, Botnets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	
3	**Tools and Methods Used in Cyber line**		06
	3.1	Phishing, Password Cracking, Key loggers and Spy-wares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
4		**The Concept of Cyberspace**	08
	4.1	E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law, The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	

5	**Indian IT Act**		**06**
	5.1	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	
6	**Information Security Standard compliances**		**06**
	6.1	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

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)

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. Manual for Procurement of Works 2019 GoI, Ministry of Finance
2. PWD manual for E-tendering 2018 PWD, India
3. Construction contracts and claims - Simon M.S., McGraw Hill, New York
4. Construction contracts Management- NICMAR Publication India
5. Estimation and contracts B.S. Patil

Reference Books:

1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley India, New Delhi
2. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
3. The Information Technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
4. Cyber Law & Cyber Crimes by Advocate Prashant Mali; Snow White Publications, Mumbai
5. Nina Godbole, Information Systems Security, Wiley India, New Delhi
6. Kennetch J. Knapp, Cyber Security &Global Information Assurance Information Science Publishing.
7. William Stallings, Cryptography and Network Security, Pearson Publication
8. Websites for more information is available on: The Information Technology ACT, 2008- TIFR: https://www.tifrh.res.in
9. Website for more information , A Compliance Primer for IT professional : https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538

Course Code	Course Name	Credits
ILO7017	Institute Level Optional Course – I Disaster Management and Mitigation Measures	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 Hours	-	-	-	100

Objectives

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To describe role of individual and various organization during and after disaster
5. To explain application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		03
	1.1	Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	
2	**Natural Disaster and Manmade disasters**		09
	2.1	Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion.	
	2.2	Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	
3	**Disaster Management, Policy and Administration**		06
	3.1	Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management.	
	3.2	Policy and administration: Importance and principles of disaster management policies, command and coordination of in disaster management, rescue operations-how to start with and how to	

		proceed in due course of time, study of flowchart showing the entire process.	
4	**Institutional Framework for Disaster Management in India**		**06**
	4.1	Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations.	
	4.2	Use of Internet and software for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	
5	**Financing Relief Measures**		**09**
	5.1	Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams.	
	5.2	International relief aid agencies and their role in extreme events.	
6	**Preventive and Mitigation Measures**		**06**
	6.1	Pre-disaster, during disaster and post-disaster measures in some events in general.	
	6.2	Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication.	
	6.3	Non-Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans.	
	6.4	Do's and Don'ts in case of disasters and effective implementation of relief aids	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

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)

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**.

Reference Books:

1. 'Disaster Management' by Harsh K.Gupta, Universities Press Publications.
2. 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S.Dagur, published by Centre for land warfare studies, New Delhi, 2011.
3. 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elseveir Publications.
4. 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.
5. 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
6. 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
7. Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)

Course Code	Course Name	Credits
ILO7018	Institute Level Optional Course – I Energy Audit 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	3 Hours	-	-	-	100

Objectives

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Energy Scenario**		04
	1.1	Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	
2	**Energy Audit Principles**		08
	2.1	Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring& targeting; Energy audit Instruments; Data and information-analysis.	
	2.2	Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	
3	**Energy Management and Energy Conservation in Electrical System**		10
	3.1	Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings.	

	3.2	Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers.	
	3.3	Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers.	
4	**Energy Management and Energy Conservation in Thermal Systems**		**10**
	4.1	Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system.	
	4.2	General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities	
5	**Energy Performance Assessment**		**04**
	5.1	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis	
6	**Energy conservation in Buildings**		**03**
	6.1	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of a utility.
3. To describe the energy performance evaluation of some common electrical installations and identify
4. the energy saving opportunities.
5. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
6. To analyze the data collected during performance evaluation and recommend energy saving measures

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)

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**.

Reference Books:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in

Course Code	Course Name	Credits
ILO7019	Institute Level Optional Course – I Development 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 Hours	25	-	25	100

Objectives

1. To understand the characteristics of rural Society and the Scope, Nature and Constraints of rural Development.
2. To study Implications of 73rd CAA on Planning, Development and Governance of Rural Areas.
3. An exploration of human values, which go into making a ‘good’ human being, a ‘good’ professional, a ‘good’ society and a ‘good life’ in the context of work life and the personal life of modern Indian professionals.
4. To understand the Nature and Type of Human Values relevant to Planning Institutions.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		08
	1.1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	
2	**Post-Independence Rural Development Balwant Rai Mehta Committee**		04
	2.1	Post-Independence Rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people’s participation and Panchayati Raj; Ashok Mehta Committee- linkage between Panchayati Raj, participation and rural development.	
3	**Rural Development Initiatives**		06
	3.1	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing	

		and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.	
4	**Post 73rd Amendment Scenario**		**04**
	4.1	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	
5	**Values and Science and Technology**		**10**
	5.1	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education. Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	
6	**Ethics**		**04**
	6.1	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Apply knowledge for Rural Development.
2. Apply knowledge for Management Issues.
3. Apply knowledge for Initiatives and Strategies
4. Develop acumen for higher education and research.
5. Master the art of working in group of different nature.
6. Develop confidence to take up rural project activities independently

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)

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**.

Reference Books:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District
6. Planning, 2006, PlanningCommission New Delhi
7. Planning Guide to Beginners
8. Weaver, R.C., The Urban Complex, Doubleday.
9. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
10. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
11. Watson, V., Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 40

Semester- VII

Course Code	Course Name	Credits
CIL701	Waste 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 analyse engineering skill related to wastewater sample.
2. To apply decision related to treatment of wastewater based on standards.
3. To understand the fundamental characteristics of municipal solid waste.
4. To acquire knowledge for removal of oil & grease from sewage sample.
5. To understand the classification of fly ash.

Outcome

At the end of the course, learner will be able to:

1. Impart the knowledge on quality or characteristic of wastewater sample.
2. Interpret the required treatment for wastewater based on standards and norms.
3. Impart the knowledge on quality of solid waste.
4. Understanding the need for the removal of oil & grease from sewage sample.
5. Inspect the class of fly ash.

List of Experiments (Any eight to be performed)		
Module	**Detailed Content**	**Lab Session / Hr.**
1.	Determination of pH of sewage sample /solid waste.	02
2.	Determination of Total Solids, suspended solids, dissolved solids, volatile solids.	02
3.	Determination of Dissolved Oxygen.	02
4.	Determination of Bio Chemical Oxygen Demand of sewage sample	02
5.	Determination of Chemical Oxygen Demand of sewage sample.	02
6.	Determination of Total Organic Carbon of sewage sample.	02
7.	Determination of Sludge Volume Index of sewage sample.	02
8.	Determination of Most Probable Number of sewage sample.	02
9.	Determination of moisture content of solid waste.	02
10.	To study oil & grease removal from the sewage sample.	02
11.	Determination of fly ash class.	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 Oral Examination

Oral exam will be based on experiments performed, site visit and theory syllabus.

Reference

1. Sewage Supply & Air Pollution Engineering: S. K. Garg, Khanna Publication.
2. Environmental Engineering Vol II: Garg, S. K., Khanna Publishers New Delhi.
3. Water Supply Engineering: P.N. Modi, Rajsons Publication.
4. Environmental Engineering: B. C. Punmia, Laxmi Publications, New Delhi.
5. Solid waste management in developing countries: A.D. Bhide and B.B. Sundaresan.
6. CPHEEO Manual on Sewage and Treatment.
7. IS 1727:1967, "Methods of Test for Pozzolanic Materials", New Delhi, India.
8. IS 3812 (Part 1):2013, "Pulverized Fly Ash - Specification", Bureau of Indian Standard", New Delhi, India.

Semester- VII

Course Code	Course Name	Credits
CIP701	Onsite training for Infrastructure Project Practices (Operations and Management)	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	08	-	-	04	-	04

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	100

Rationale

Construction industry is one of the most regulated industries in the world and subjected to various operations, techniques, laws, rules, and regulations handled by project management. Infrastructure project works on four M's of Managements i.e. Men, Material, Money and Machinery. There are certain ethical standards involved in it. A Civil & Infrastructural Engineering graduate must be able to understand to implement all these four M's in industry project and their management while working on site with utmost certainty and responsibilities. Also, an infrastructure engineer needs perfect understanding of operation and techniques. As an entrepreneur or as a manager of an industry, he/she must be able to effectively manage the site as per professional standards. The syllabus of this course has been designed to give ONSITE training in a reputed professional infrastructure industry under industry professionals to learn different ongoing operations on the sites and apply skilful management policies and techniques during entire semester.

Objectives

1. To prepare students to meet the varying and challenging needs of the industry.
2. To provide knowledge and skills to the students and help them to perform their role and job responsibilities.
3. To coach students for complex and higher-level jobs.
4. To educate students for new and innovative ways and techniques of performing job.
5. To prepare students to establish professionalism in the workplace by identifying and combating different behaviors among employees.
6. To teach students how to handle real-life situations from an ethical standpoint.

Contribution to Outcome

After the completion of the course the student should be able to:

1. Meet the expectations and challenging needs of the industry.
2. Perform their role and job responsibilities well as per the industry norms.
3. Qualify for complex and higher-level jobs.
4. Apply new and innovative ways and techniques for solving the problems in the industry.
5. Establish good relations with their subordinates while working in the industry.
6. Handle real life situations from an ethical standpoint.

Guidelines for onsite training – (Operations and Management)

The duration of training will be four weeks. It will be after completion of VI Semester or during ongoing VII semester.
One of the following two options can be preferred by the students but not limited to:

1. **Onsite training in industry** – Onsite Training in industry will be entirely **offline** for the entire semester. The aim of this training is to provide real life professional environment to the students for making them aware of professional challenges in the industry. Attendance of every student is mandatory for the successful completion of the course. The training may be subjected to MOU issued between institute and the company, with written consent of the student and parents. Students can work individually or in a group of not more than four students. The assessment of report of on-site training will be on individual basis.

- All students should follow guidelines for safety and security as provided by the industry.
- Preparation of consolidated report of on-site training (operations & management) per group is mandatory. The work should include the study of technical details and documents related to on-site training (operations & management). The name of guide and trainer should be mentioned along with respective signatures. All onsite attendance records, letters of permissions and onsite work proofs should be submitted along with the report. Work shall be carried out under the guidance of faculty and industry expert. A detailed report shall be submitted.

2. **Software based hands on training** - Software based hands on training by the industry experts or academia. Assignments and test must be completed by each student based on the training.

Other Guidelines:

- Group has to prepare detailed report and submit to their authorized faculty. A copy of report must be submitted in the departments for record.
- The evaluation of the work done by students will be carried out by the internal and external examiner.
- Term work will be of 50 marks based on the overall performance and onsite report submitted by the student.
- For Viva voce examination, the average of internal and external examiner evaluation of 50 marks will be considered.

Responsibilities of Students On-Site

- Student must focus on learning the on-site operations techniques, learning soft skills required on-site, interpreting site drawings, finding out quantity and estimate, studying tender documents, preparing bills & work orders, preparing daily work progress report, prepare minutes of meeting, etc.
- Student must try to find out the on-site challenges.
- Student must try to acquire knowledge and skills from site and perform their role/job as per the given responsibilities.
- Student must learn the skills to manage the on-site operations effectively.
- Student must be able to explain the new and innovative techniques which are implemented on-site.
- Student should learn and follow professionalism in the workplace and adopt coordination with the team.
- Student must be able to handle real life situations from an ethical and technical standpoint.

Assessment:

Two progressive seminars (presentation) evaluation should be conducted per group during the semester in department.

Term Work

The review/ progress monitoring committee shall be constituted by head of department. The progress of training to be evaluated on continuous basis, log book has to be submitted by each student. In continuous assessment, focus shall be on individual student. Assessment will be based on individual performance during training, their understanding and response to questions. distribution of term work marks is as below:

Marks awarded based on the performance in consultation with the industry: 10 Marks

Progress seminar evaluation: 10 Marks

Log book consistency: 10 Marks

On-site training project report: 10 Marks

On-site training Attendance: 10 Marks

Oral Examination

Viva voce examination of 50 marks will be conducted in the presence of an industrial expert and internal supervisor/guide at the end of the semester. Viva voce examination shall be based on knowledge of individual student about onsite training (via seminar) and their overall performance reflected during the oral examination. Students must carry all documents related to their onsite training session along with duly signed authenticated onsite training report during the viva voce examination.

Semester- VII

Course Code	Course Name	Credits
CIP702	Major Project-I	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	06	-	-	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						
-	-	-	-	-	50	-	50	100

Rationale

In the field of Civil & Infrastructure Engineering, new problems arise every now and then; but a professional infrastructure engineer must know how to precisely identify & state those problems, define the scope & objectives of the probable solution(s), carry out effective review of available literature in the domain of the problem and formulate a systematic methodology to solve the problem. Modern tools and multidisciplinary knowledge are vastly used nowadays for the effective solution of Infrastructure Engineering problem. It is also important to work effectively & ethically as a team and communicate the work done in the form of written reports. The aim of this course is to acquaint the learners with all of the above-mentioned aspects of the Civil infrastructure Engineering field by inculcating the process of research.

Objectives

1. To acquaint the learners to identify problems
2. To accustom the learners to formulate the scope and objectives
3. To familiarize the learners with the process of review of literature
4. To advice the learners to formulate a methodology
5. To accustom the learners to work as a team
6. To appraise the learners on proper documentation of work

Outcome

At the end of the course, learner will be able to:

1. Review & comprehend literature in the selected domain
2. Articulate problem statement & identify the objectives
3. Identify existing methods or solutions to solve identified problem
4. Identify modern engineering tools & other resources to solve the problem
5. Formulate methodology to solve the identified problem
6. Effectively communicate their project work by writing reports & presentations

Guidelines for Major Project – 1

- A project group should consist of minimum 3 and maximum of 4 students.
- The problem statement of the project should preferably be (but not limited to) from the domains of Civil & infrastructure Engineering.
- The solutions to the problem may be multidisciplinary i.e., incorporating concepts, tools, techniques etc. of disciplines apart from Civil & infrastructure Engineering.
- The project work may include but not limited to:
    - Experimental Analysis
    - Design of Structures
    - Preparation of Working Drawing
    - Research on Novel Materials
    - Development of Working Models
    - Studies on Technical and Economic Feasibility
    - Application of Internet of things (IOT) and Software in field of Civil & infrastructure Engineering.
    - Application of any other innovative tools and techniques.
- Students should do literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor
- Students should use multiple literatures and understand the problem.
- Students should attempt solution to the problem by experimental/simulation methods.
- The solution to be validated with proper justification and report to be compiled in standard format.

Assessment of Major Project-I:

Project I should be assessed based on following points:

1. Quality of problem selected
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization
4. Clarity of objective and scope
5. Breadth and depth of literature survey

Project I should be assessed through a presentation by the student project group to a panel of internal and external examiners appointed by the Head of the Department/Institute of respective Programme.

End Semester Oral Examination

Oral exam will be based on experiments performed, site visit and theory syllabus.

Semester-VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract./ Tut.	Theory	Pract./ Tut.	Total
CIC801	Quantity Survey, Estimation and Valuation	3	-	3	-	3
CIC 802	Infrastructure Management & Economics	3	-	3	-	3
CIDO801X	Department Optional Course - VI	3	-	3	-	3
ILO801X	Institute Optional Course - II	3	-	3	-	3
CIL 801	Quantity Survey, Estimation and Valuation	-	2	-	1	1
CIP801	Onsite Training for Infrastructure Project Practices (Finance and Business Communication)	-	8	-	4	4
CIP802	Major Project-II	-	10		5	5
Total		**12**	**20**	**12**	**10**	**22**

Examination Scheme									
Course Code	Course Name	Theory					Term Work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Dura-tion (Hrs.)			
		Test I	Test II	Avg.					
CIC801	Quantity Survey, Estimation and Valuation	20	20	20	80	3			100
CIC 802	Infrastructure Management & Economics	20	20	20	80	3			100
CIDO801X	Department Optional Course - VI	20	20	20	80	3			100
ILO801X	Institute Optional Course - II	20	20	20	80	3			100
CIL 801	Quantity Survey, Estimation and Valuation	-	-	-	-	-	25	25	50
CIP801	Onsite Training for InfrastructureProject Practices (Finance and Business Communication)	-	-	-	-	-	50	50	100
CIP802	Major Project-II	-	-	-	-	-	50	100	150
Total		**-**	**-**	**80**	**320**		**125**	**175**	**700**

Department Optional Course – VI

Sr. No.	Course Code CIDO801X	Department Optional Course – VI
1	CIDO8011	Environmental Impact Assessment
2	CIDO8012	Advanced Design of Steel Structures
3	CIDO8013	Design of Hydraulic Structures
4	CIDO8014	Bridge Engineering
5	CIDO8015	Advance Construction Equipments & Techniques

Institute Optional Course - II

Sr. No.	Course Code ILO801X	Institute Optional Course - II
1	ILO8011	Project Management
2	ILO8012	Finance Management
3	ILO8013	Entrepreneurship Development and Management
4	ILO8014	Human Resource Management
5	ILO8015	Professional Ethics and CSR
6	ILO8016	Research Methodology
7	ILO8017	IPR & Patenting
8	ILO8018	Digital Business Management
9	ILO8019	Environmental Management

Semester- VIII

Course Code	Course Name	Credits
CIC801	Quantity Survey, Estimation & Valuation	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 Hours	25	-	25	150

Rationale

Any structure, i.e., building, bridge, dam etc. consists of various building materials. Due to rise in the cost of materials, the structure has to be designed so that it is safe, serviceable and economical. Without proper design and estimation, it may lead to the increase in cost of construction and it further affects the economical aspect of the structure. A prior knowledge of various building materials is required for the construction and it controls the cost of the structure, save wastage of labour-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in estimating resources like labour, materials and machinery to be used during the different stages of the project. The scope of the subject includes estimating, costing, analysis of rates, specification, valuation, tender and contracts etc.

Objectives

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand measurement systems for various items of civil engineering structures.
2. To draft the specifications for various items of work & determine unit rates of items of works & to prepare the rate analysis for various items of work using DSR for reference.
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork using various methods.
5. To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.
6. To explain the concept of valuation & to determine the present fair value of any constructed building at stated time.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction**		03
	1.1	Importance of Course	
	1.2	Measurement systems for specific items of civil engineering structures	

	1.3	Units of measurement of various items of works	
	1.4	IS1200: - Introduction, deduction rules for Masonry & Plastering work	
2	**Specifications & Rate Analysis**		**06**
	2.1	Types & importance of specifications, rules to be followed for drafting the specifications of important items of work etc.	
	2.2	Rate analysis, its importance & necessity, Factors affecting rate analysis, Task work, sources of materials, Study of IS 7272 regarding labour output, District Schedule of Rates (DSR) Rate analysis of important items of construction works.	
3	**Estimates**		**12**
	3.1	Approximate Estimate: Definition & Purposes of approximate estimates, Methods for preparing approximate estimates & numerical based on methods, Various terms such as administrative approval, technical sanction, Contingencies, Work charged establishments etc.	
	3.2	Detailed Estimate: Definition & purposes of detailed estimate, Data required for preparation of detailed estimate. Introduction of detailed estimate of load bearing structure. Methods of taking out quantities such as long wall & short wall method, Centre line method for R.C.C. framed structure, Bar Bending Schedule & its necessity, preparation of bar bending schedule of various structural elements as per code IS2502.	
4	**Estimation of Earthwork for Roads & Canals**		**04**
	4.1	Methods of computation of volume of earthwork such as mean area method, mid-sectional area method, Prismoidal formula, Trapezoidal formula etc. & numerical based on methods. Introduction of Mass Haul diagram, Terms like lead & lift etc.	
5	**Tenders & Contracts**		**06**
	5.1	Tenders: Definition & types of tenders, Tender notice & its inclusions, Pre-qualification of contractors, Pre-bid meeting, Procedure for submission & opening of tender, acceptance & rejection of tender, Tender validity period, E-Tendering	
	5.2	Contracts: Definition, basic forms such as Valid, void & voidable contract. General types of contracts with their suitability, conditions of contract	
6	**Valuation**		**08**
	6.1	Difference between cost, price & value. Types of value, Valuation & its purposes. Various terms such as depreciation, sinking fund, capitalized value, years purchase etc. Methods for calculating depreciation of building such as Straight-line method, Sinking fund method Freehold Properties, Leasehold Properties, Easement rights	
	6.2	Methods of valuation such as Rental method, land & building method, Belting method etc. Numerical based on valuation	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Apply the measurement systems to various civil engineering items of work.
2. Draft the specifications for various items of work & determine unit rates of items of works
3. Estimate approximate cost of the structures by using various methods & prepare detailed estimates of various civil engineering structures, including bar bending schedule, by referring drawings.
4. Assess the quantities of earthwork & construct mass haul diagrams.
5. Draft tender notice & demonstrate the significance of the tender as well as contract process.
6. Determine the present fair value of any constructed building at stated time.

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)

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. Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
2. Building and Engineering Contracts: Patil, B. S., University Press, Hyderabad.
3. Estimating and costing: Datta, B. N., UBS Publications.
4. Estimating, Costing and Valuation, Rangwala, Charotar Publication
5. Construction Cost Estimating: Process and Practices, Holm Leonard, E. Schaufelberger John, Griffin Dennis, Cole Thomas, Pearson Publications.

Reference Books:

1. Relevant Indian Standard Specifications, BIS Publications.
2. Professional Practice: Dr. Roshan H. Namavati.
3. World Bank approved contract document.

Semester- VIII

Course Code	Course Name	Credits
CIC802	Infrastructure Management and Economics	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 Hours	-	-	-	100

Rationale

The construction industry is recognised as one of the key enablers for delivering transformational change and here management plays a vital role for a timely, efficient and economical construction. Economics is a key factor which impacts cost of the mega infrastructure projects. This course is intended to teach students the management skills to be applied during all the stages of major infrastructural projects. This course deals with the techniques to be applied for planning and scheduling projects, optimizing time-cost and other resources in construction, monitoring and ensuring quality and safety aspects in the projects. Moreover, it deals with the basic concepts of economics and covers the importance of financial and marketing management required in managing an infrastructure project.

Objectives

1. To remember the fundamentals of infrastructure management.
2. To analyse the scheduling of construction projects using techniques like CPM & PERT.
3. To understand the management of resources required for a construction project.
4. To acquire the knowledge of the control, monitoring and safety of construction projects.
5. To understand the different economic concepts in industry.
6. To illustrate the concepts of financing & marketing of infrastructure projects.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Management & Infrastructure projects**		06
	1.1	Introduction to Management, Management Principles: Scientific principles by Henry Fayol, F. W. Taylor, Elton Mayo, Maslow's Hierarchy of needs theory. Objectives & functions of construction management.	

	1.2	Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization.	
	1.3	Infrastructure Projects: Classification, Characteristics, Project life cycle. Roles & responsibilities of various agencies associated with a construction project.	
2	**Infrastructure Project Planning & Scheduling**		**08**
	2.1	W.B.S, Bar chart- uses & limitations, Milestone charts.	
	2.2	Network- Terminology, Fulkerson's network rules, precedence network.	
	2.3	C.P.M- Activity & event with their types, activity times, event times, critical path, forward pass, backward pass, float & its types.	
	2.4	P.E.R.T- Assumptions underlying time estimates, Slack & its types, Probability of completing the project.	
3	**Resource Management & Allocation**		**08**
	3.1	Material Management- Objectives, functions, Inventory control, A-B-C analysis & EOQ.	
	3.2	Human Resource Management: Objectives of manpower planning, process, sources of recruitment, process of selection.	
	3.3	Resource Allocation Methods- Resource levelling & Smoothening	
4	**Project Monitoring and Cost-Quality Control**		**05**
	4.1	Network Updating, Time & cost optimization in construction-Compression & Decompression of network, Concept of Quality & Quality Control, causes of Time & Cost overrun, its corrective measures.	
	4.2	Common causes of accidents on construction site, its cost & preventive measures, O.S.H.A, Importance of labour acts, Introduction to Payment of wages act, Minimum wages act, Workmen's compensation act.	
5	**Introduction to Economics**		**07**
	5.1	Economics: Introduction & Scope, Difference between Microeconomics & Macroeconomics. Theory of Demand & Supply, equilibrium between demand & supply.	
	5.2	Cost: Short run & long run cost, fixed & variable cost, total, average & marginal cost, opportunity cost. Break even analysis.	
	5.3	National Income, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP, NDP, Personal income, disposal income	
6	**Economic Issues, Finance and Marketing Management**		**05**
	6.1	Basic economic problems; Unemployment: meaning, types, causes, remedies Inflation; meaning, types, causes, measures to control; Introduction to Finance Management; meaning, scope, sources, functions.	

	6.2	Markets: Types of markets & their characteristics, Introduction to Marketing management: Marketing Mix, concepts of marketing, demand forecasting and methods, market segmentation; Corporate Social Responsibility.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Understand the fundamental principles and basic management structure involved in management of any construction project.
2. Apply the knowledge of scheduling techniques like CPM & PERT in scheduling construction projects.
3. Illustrate the allocation & effective utilization of resources on site.
4. Acquire the knowledge of the project monitoring, cost-quality control and safety aspects of construction works.
5. Understand various economic concepts in the industry.
6. Utilize the concepts of financing & marketing in infrastructure projects.

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)

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. Construction Engineering and Management: S.Seetharaman.
2. Construction Planning & Management – Dr.U.K.Shrivastava.
3. Handbook of Construction Management: P K Joy, Macmillan, India
4. Prasanna Chandra, “Projects Planning, Analysis Selection, Implementation and Review”, Tata McGraw Hill, New Delhi.
5. Singh H., “Construction Management and Accounts”, Tata McGraw Hill, New Delhi.
6. Engineering Economics, R.Paneerselvam, PHI publication
7. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
8. Principles and Practices of Management by L.M.Prasad
9. Principles of Management by Tripathy and Reddy

Reference Books:

1. Construction Project Management: Chitkara K K Tata McGraw Hill
2. Critical Path Methods in Construction Practice: Antill J M &Woodhead R W, Wiley
3. Construction Hazard and Safety Handbook: King &Hudson, Butterworths
4. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
5. Cormican D., "Construction Management: "Planning and Finance", Construction Press, London.
6. Modern Economic Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publications
7. Block Hirt, "Foundations of Financial Management" McGraw Hill.
8. Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill

Semester- VIII

Course Code	Course Name	Credits
CIDO8011	Department Level Optional Course – VI Environmental Impact Assessment	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 Hours	-	-	-	100

Rationale

In order to overcome the problems of environmental degradation, it is very necessary to plan the development process in a sustainable manner so that control and mitigation measures can be undertaken prior to occurrence of degradation. One important tool to do this is carrying out Environmental Impact Assessment. This course provides the necessary knowledge of the process, methods along with the need of public participation in decision making in EIA. Additionally, this course provides knowledge of preparation of written documentation along with EIA regulations & case studies.

Objectives

1. To understand and explain concept of EIA.
2. To define the process of EIA.
3. To integrate the impact identification with the analysis.
4. To prepare the document of EIA.
5. To encourage public participation in decision making.
6. To analyse the EIA of infrastructure projects.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Concept of EIA**		10
	1.1	Introduction to EIA; definitions and concepts; utility and scope of EIA; evolution of EIA; historical development of EIA; significance of EI forecasting environmental changes; strategic environmental assessment; ISO provisions, environmental clearance procedure; Environmental Impact Statement (EIS)	
	1.2	Environment attributes: air; water; noise; land and soil; socioeconomic; cultural & biological	

2	**EIA Processes**		**07**
	2.1	EIA processes; preliminary stages of EIA; project types and screening; impact prediction; evaluation and mitigation; EIA monitoring and auditing.	
3	**Methods of Impact Identification & Analysis:**		**06**
	3.1	Environmental Indices and indicators for describing the affected environment, matrix methodologies, network, checklist, and other method.	
	3.2	Framework, statement predication and assessment of impact of air, water, noise and socio-economic environment.	
4	**Preparation of written documentation**		**04**
	4.1	Initial planning phase, detailed planning phase, writing phase, organizing relevant information, co-ordination of team writing effort.	
5	**Public Participation in Environmental Decision making**		**05**
	5.1	Basic definitions, Regulatory requirements, Advantages & disadvantages of Public Participation, Selection of Public participation techniques, Practical considerations for implementation	
6	**EIA Regulations & Case studies**		**07**
	6.1	EIA regulations; TOR for EIAs; environmental indices, EIA at regional level, sectoral level, and policy level; sustainable development; Environmental Management Plan (EMP)	
	6.2	Case studies on mega infrastructure projects.	
	Total		**39**

Note: The students will prepare a report of case study on mega infrastructure projects in a group of 4 students. This report will form a part of the term work. Minimum one industrial visit based on above module may be conducted.

Contribution to Outcome

After the completion of the course the student should be able to:

1. Apply the concepts on EIA in the various projects.
2. Identify the correct process of EIA.
3. Identify the impacts that can prevent the degradation of environment.
4. Monitor and audit the projects & then prepare a report.
5. Convince the public for the active participation in decision making process.
6. Review a comprehensive report of infrastructure projects with the help of the EIA regulation.

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)

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. Canter, L., Environmental Impact Assessment, McGraw Hill, NewYork, 1996
2. Environmental Impact Analysis Handbook – by Rau Whooten; McGraw Hill publications
3. Environmental Impact Assessment – by Larry Canter; McGraw Hill publications
4. Environmental Impact Analysis – A Decision Making Tool by R K Jain

Reference Books:

1. Handbook of Environment Impact Assessment by Judith Petts; McGraw Hill publications
2. World Bank, 'Environmental Assessment Source Book', Environment Dept., Washington D.C., 1991. 2.
3. Environmental Impact Analysis Handbook, Rau, G.J. and Wooten, C.D., Mc Graw Hill, New York, 1980. Preventive environmental management.

Semester- VIII

Course Code	Course Name	Credits
CIDO8012	Department Level Optional Course – VI Advanced Design of Steel 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 Hours	-	-	-	100

Rationale

The civil engineering structures are subjected to different types of loading and their combination. Many of the structure are made of steel, these structures are design by working stress method and limit state method. The design method of different component is given in the syllabus are based on limit state method and working state method.

Objectives

1. To understand the design philosophies of Working stress and Limit state methods and design of moment resistant connections.
2. To explain the design concept of gantry girder
3. To understand the analysis and design concept of round tubular structures
4. To describe the design concept of different type of steel water tank
5. To explain the design concept of lattice tower
6. To describe the design concept of steel chimney.

Detailed Syllabus

Module		Course Module / Contents	Periods
1	**Introduction to Steel Structure and Moment Resistant Beam End Connections**		07
	1.1	Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM), Limit state method and design of simple riveted connection.	
	1.2	Design of moment resistant bolted and welded beam end connections by limit state method	

2	**Gantry Girder**		**06**
	2.1	Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.	
3	**Round Tubular Structural Members**		**06**
	3.1	Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports	
4	**Elevated Steel Tanks and Stacks**		**08**
	4.1	Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation	
5	**Lattice Tower**		**06**
	5.1	Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower	
6	**Steel Chimney**		**06**
	6.1	Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Analyze and design Moment Connection.
2. Analyze and design gantry girder by limit state method.
3. Analysis and design of tubular truss using IS code.
4. Analysis and design of Elevated water tank using IS code.
5. Analyze and design Lattice Tower using IS code.
6. Analyze and design Steel Chimney using IS code.

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)

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 six question; each carrying 20 marks.
2. The first question will be compulsory.

3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt any three questions out of remaining five questions.
5. Total four questions need to be attempted.

Recommended Books:

1. Design of Steel Structures: N Subramanian, Oxford- University Press
2. Design of Steel Structures: Punamia, A. K. Jain & Arun Kumar Jain. Laxmi Publication
3. Design of Steel Structures: Dayaratnam, Wheeler Publication, New Delhi.
4. Design of steel structures: Krishnamachar B.S, & Ajitha Sinha D.

Reference Books:

1. Design of Steel Structures: Mac. Ginely T.
2. Design of Steel Structures: Kazimi S. M. & Jindal R. S., Prentice Hall of India.
3. Design of Steel Structures: Breslar, Lin and Scalzi, John Willey, New York.
4. Design of Steel Structures: Arya and Ajmani, New chand & Bros.
5. Relevant IS codes, BIS Publication, New Delhi
6. Steel structures, Controlling behavior through design: R. Englekirk, Wiley
7. LRFD Steel Design: William T. Segui, PWS Publishing
8. Design of Steel Structures: Edwin H. Gaylord, Charles N. Gaylord and James. Stallmeyer, McGraw-Hil

Semester- VIII

Course Code	Course Name	Credits
CIDO8013	Department Level Optional Course – VI Design of Hydraulic 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 Hours	-	-	-	100

Rationale

Hydraulic structures are the structures designed to retain, convey, control, regulate, mix and dissipate the energy of water. Such structures are constructed in all domains of water engineering; primary domains being water quantity management (water supply, irrigation, hydro power, flood control, drainage, navigation, socio-economic and recreational use), water quality management and various transportation aspects. While the course emphasizes the "WHY" aspect; e.g., design of multi-purpose reservoirs and canal works, it also examines the "HOW" aspect of hydraulic structures. It is only through this mindful approach that the engineer can determine the advantages of a proposed design for a specific application.

Objectives

1. To understand the reservoir and planning of reservoir, different zones, capacity and sedimentation control.
2. To develop understanding of the various causes of failure, design criteria and stability analysis of Gravity & Embankment dam.
3. To convey the knowledge of Arch and Buttress Dams, design criteria of Arch dams
4. To develop understanding of the various causes of failure, design criteria and stability analysis of Earth and Rock Fill Dams.
5. To understand Spillways and Energy dissipators, their applicability.
6. To impart knowledge of canal headwork, canal regulation works and cross drainage works

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Reservoir Planning and Management**		05
	1.1	Purpose of reservoir, classification of Reservoir, site selection, Investigation works for reservoir, storage zones storage	

		capacity of reservoir, Yield and capacity of reservoir, mass inflow curve and demand curve, Determination of reservoir capacity, determination of safe yield, reservoir losses, reservoir sedimentation, sediment control, Multipurpose reservoirs, Flood Routing and its methods.	
2	**Gravity Dams**		**10**
	2.1	Various forces acting on gravity dam, Load combinations for design, Stability requirements& modes of failure, principal and shear stress, Profile of dam- elementary and practical profile, low and high gravity dam, Limiting height of gravity dam, High and Low gravity dam, Design of gravity dams, Galleries, Joints, Keys, Water seals, crack control in concrete dams.	
3	**Arch and Buttress Dams**		**04**
	3.1	Types of arch dams, forces acting on arch darn, design of arch dams, types of buttress dams.	
4	**Earth and Rock Fill Dams**		**09**
	4.1	Types of earth dams, causes of failures of earth dams, design criteria, section of earth dam, downstream drainage system, seepage analysis, phreatic line, Stability analysis, stability of d/s slope during steady seepage, stability of u/s slope during sudden drawdown, stability of u/s and d/s slopes during construction, slope protection, seepage control measures, design considerations in earthquake regions, types of rock fill dams.	
5	**Spillways and Flood Control Works**		**06**
	5.1	Introduction, Necessity of spillways, location of spillway, design consideration of main spillway, Classification of spillways, straight drop spillway, design principles of ogee spillway, Chute spillway, Side channel spillway, conduit spillway, Siphon spillway and shaft spillway, energy dissipation below spillways, location of hydraulic jump and its characteristics, design of bucket type energy dissipater and stilling basin. Crest gates, types, advantages, design of radial gate, outlet works.	
6	**Miscellaneous Topics**		**05**
	6.1	Diversion head Works-Component parts, functions, weirs and barrages, Bligh's Creep theory, Lane's weighed theory, Khosla's Theory. Canal regulation works - classification, Sarda type fall, Head regulators and Cross regulators, Canal escape. Cross Drainage Works-Types, classification of aqueducts and syphon aqueducts.	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain the Reservoir planning, storage capacity, Sedimentation & Reservoir losses.
2. Carry out the stability analysis of Gravity & Earth Dam.
3. Explain the types of Arch and Buttress dams & their design criteria.

4. Carry out the stability analysis of Earth and Rock Fill Dams.
5. Design an ogee spillway and suggest suitable energy dissipation measures.
6. Describe the various minor irrigation structures such as Weirs & barrages, Canal Regulators and Cross-drainage works.

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)

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, PandeB.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- VIII

Course Code	Course Name	Credits
CIDO8014	Department Level Optional Course-VI Bridge 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 Hours	-	-	-	100

Rationale

In the age of increase in traffic load and rapid transportation, bridges are very important part of nation's transportation infrastructure associated with the economic growth. Bridges allow for roads and railways to cross over obstacles such as rivers, valleys or other roads etc. Bridges are being built mainly with reinforced concrete, pre-stressed concrete or structural steel depending on various factors such as environment, site conditions, nature of loads and spans etc. The civil engineering profession is much concerned with proper planning, design, construction, maintenance, repairs and rehabilitation of bridges which are of utmost importance.

Objectives

1. To take the appropriate decision in respect of selection of site, type of bridge, etc.
2. To analyze and design reinforced concrete culverts and pre-stressed concrete bridges using relevant IRCs.
3. To analyze and design lattice girder steel bridge for railway loading using relevant bridge rules and IRS code.
4. To illustrate the types of foundations and their selection criteria along with pier, abutments and bearing in substructure.
5. To understand the launching method of girder and construction methods as per conditions.
6. To inspect the bridge and understand general aspects of repairs and rehabilitation.

Detailed Syllabus

Module		Course Module / Contents	Periods
1	**Introduction of Bridge Engineering**		02
	1.1	Types of bridges and their classification, components of a bridge	
	1.2	Selection of suitable site (data required and investigations)	

	1.3	Economic span	
2	**IRC Loads, their Distribution and Design of Superstructure for Roadway Bridges Using Limit State Method**		**20**
	2.1	IRC loads: IRC-Class AA and 70R tracked vehicle, Class-A and Class-B train of vehicles	
	2.2	Design of RC culvert	
	2.3	Preliminary design of balanced cantilever bridge	
	2.4	Design of PSC deck slab bridge	
	2.5	Design of PSC I- girder bridge	
3	**IRS Loads, Analysis and Design of Steel Lattice Girder Bridge for Broad Gauge Railway**		**08**
	3.1	Various IRS loadings, analysis of steel lattice girder bridge for broad gauge loading	
	3.2	Design guidelines for main components (top chord, bottom chord, diagonal member, end post) of steel lattice girder bridge [Numerical not expected]	
4	**Substructure**		**04**
	4.1	Types of foundations and their choices, well foundation, pile foundation	
	4.2	Types of piers & abutments and their shapes, wing walls	
	4.3	Need of bearing, types and suitability	
5	**Erection of Girder and Construction Method**		**02**
	5.1	Various methods of erection of bridge girders	
	5.2	Cantilever method of construction of bridge	
6	**Inspection and Repairs of Bridges**		**03**
	6.1	Categories of bridge inspection and instruments	
	6.2	General aspects of repairs, retrofitting and rehabilitation	
		Total	**39**

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

Contribution to Outcome

After the completion of the course the student should be able to:

1. Identify the suitable type of bridge according to site condition.
2. Design RC Culvert and RC balanced cantilever bridge using relevant IRCs.
3. Design prestressed concrete deck slab bridge, lattice girder and I-girder bridge using relevant IRCs.
4. Illustrate different bearings, foundations, piers and abutments based on their suitability.
5. Apply the knowledge of launching method of girder and construction methods as per conditions.
6. Select appropriate method of erection for bridge superstructure and repair techniques of existing bridges.

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)

End Semester Examination (80 Marks):

Weightage of each module in end semester examination will be proportional to the 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.
5. IRC: 6, IRC: 112 and IS: 1343 are allowed in the examination.

Recommended Books:

1. Design of Bridges: Raju N. K., Oxford and IBH
2. Bridge Engineering: Ponnuswamy S., Tata Mc Graw Hill
3. Design of Bridge Superstructures: T.R. Jagdeesh andM.A. Jayaram, Prentice Hall India Private Ltd., New Delhi
4. Comprehensive Design of Steel Structures: Dr. B C Punmia, Ashok Kumar Jain and Arun Kumar Jain; Laxmi Publications (P) Limited

IRC Codes:

IRC: 5- 2015, IRC: 6- 2017, IRC: 78-2014, IRC: 83-(Part-I)-2015, IRC: 83-(Part-II)-2018, IRC: 83-(Part – III)-2018, IRC: 112-2020, IRC:123-2017, IRC SOR17-1996, IRC SOR18-1996, IRC SP13-2004, IRC SP37-2010, IRC SP40-1993, IRC SP54-2000, IRC: SP105-2015

IRS Codes:

Bridge Rules: Rules specifying the loads for design of super-structure and sub-structure of bridges and for assessment of the strength of existing bridges -2014 Indian railway standard code of practice for the design of steel or wrought iron bridges carrying rail, road or pedestrian traffic (steel bridge code) -2017

Reference Books:

1. Concrete Bridge Practice: Raina V. K., Tata Mc Graw Hill
2. Essentials of Bridge Engineering: Victor D.J, Oxford and IBH
3. Bridge Engineering Handbook: Chen W. F. and Duan L., CRC Press, 2000
4. Bridge Bearings and Expansion Joints: David Lee, E & FN Spon

Semester- VIII

Course Code	Course Name	Credits
CIDO8015	Department Level Optional Course-VI Advanced Construction Equipments and Techniques	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 Hours	-	-	-	100

Rationale

Machines have revolutionized every sphere of human being's life. Engineering constructions have seen a drastic reformation due to introduction of various construction equipments and techniques. This course provides an extensive overview of advanced equipments used in construction industry and also discusses certain methods used to construct facilities using these equipments. It makes the student aware of the equipment/techniques required while constructing different kinds of civil engineering structures. Student will be introduced to some emerging technologies in the field of civil engineering which will make them more industry ready.

Objectives

1. To understand the various kinds of conventional equipments used in construction industry and their usage.
2. To study the various modern equipments used on, below or above ground/water.
3. To study modern formwork systems and methods that increase productivity and efficiency in construction.
4. To learn the equipments required for the construction of utility structures.
5. To study the equipments required for construction of power generation structures.
6. To understand the various equipments and techniques used for the construction of railway lines, metros, airports and sea ports

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
1	**Introduction**		06
	1.1	Equipment v/s Labour, Standard and Special equipments, Types of costs related to equipments including related numerical, Equipment life and Replacement decisions including related numerical, Cycle time, Balancing of equipments and related numerical.	

	1.2	Different categories of construction equipments used conventionally with reference to available types and their output, working mechanism, factors affecting their performance and criteria for selecting a particular equipment: Earthmoving and other hauling equipment, Drilling and blasting equipment. Pile driving equipment. Pumping equipment (for water as well as concrete), Applications of Air compressor. Dewatering techniques for trenches, tunnels. Stone crushing equipment	
2	**Equipments for Underground and Underwater tunneling.**		**09**
	2.1	Various purposes for which tunneling may be carried out, Basic terms related to tunneling, Conventional methods of carrying out tunneling in different types of soils/rocks.	
	2.2	Modern methods of tunneling and detailed study of following equipments/techniques in this regard:	
	2.3	Use of drones, construction robots for aerial surveys. Use of GPS and remote sensing for setting out tunnel alignment	
	2.4	Jumbo used for drilling and blasting, Vertical shaft sinking machine (VSM).	
	2.5	Tunnel Boring machine (TBM), Micro tunneling, New Austrian tunneling method (NATM).	
	2.6	Cut & cover method, Top to bottom construction. Diaphragm wall construction, Tunnel lining trolley.	
3	**Modern formwork systems and working techniques in limited space**		**06**
	3.1	Difference in conventional and modern systems of formwork Mivan, Doka shuttering along with their advantages and disadvantages. Modular shuttering, Slip and jump form.	
	3.2	High rise construction: Concrete making on mass scale, pumping and placing booms. Tower cranes and the benefits they offer for high rise construction. Range diagram.	
	3.3	Prefabricated housing systems, Difficulties faced in the installation and operation of all these systems. Emergency housing for disaster management.	
	3.4	Working skills/tricks required for managing a site in urban/restricted space environment. Techniques for controlled demolition of buildings.	
4	**Equipments for construction of underground utilities, road construction and bridges/flyovers**		**06**
	4.1	Use of ground penetrating radar (GPR) for locating underground utilities. Laying of pipes using pipeline insertion system, Installation and operation of underground power transmission lines as well as overhead transmission towers.	
	4.2	Incremental launching method and balanced cantilever method of bridge/flyover construction with reference to the recent infrastructure developed in the local and global context, Construction of roads using paver machines	

5	**Equipments/Techniques for Setting Up of Power Generation/Supply Structures**		**06**
	5.1	Hydropower station, Thermal power station, Solar power station, atomic power generation, Installation and operation of wind mills.	
6	**Equipments/ Techniques for Construction of Transporting Facilities**		**06**
	6.1	Construction of railway lines using track laying machine. Methods, techniques and equipments involved in the construction of Metro, mono and maglev trains. Connecting link between underground and overhead metro systems. 5D BIM integration in Metro projects.	
	6.2	Equipments required for construction and operation of an airport and sea port. Application of Drones, GIS, GPS and BIM for monitoring project progress/working of Airports and Seaports.	
	6.3	Light Detection and Ranging (Lidar) Technique for Railways/ Highways/ Bullet train alignments.	
		Total	**39**

Contribution to Outcome

1. Understand the use/applications of various conventional construction equipments and select the best out of them for a particular site requirement.
2. Know modern methods/equipments used for underground as well as underwater tunnelling.
3. Compare conventional and modern methods of formwork and get acquainted with techniques used on sites with restricted space.
4. Understand the techniques involved and the equipments required thereof for laying of utility lines, bridge construction.
5. Gain knowledge about the setting up of different kinds of the power generating structures.
6. Get acquainted with the equipments/ techniques for construction of transporting facilities.

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). 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 the 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. Construction Equipment & Planning, Purifoy, R.L & Ledbetter McGraw Hill
2. Construction Equipment & its Management. Sharma, S. C. Khanna Publishers
3. Tunnel Engineering HandbookThomas R. Kuesel, Elwyn H. King, John O. Bickel Springer

4. Practical tunnel construction Gary B. Hemphill Wiley Publishers
5. Success with drones in Civil Engineering Brett Hoffstadt Kindle
6. Construction Technology for Tall BuildingsMichael Yit Lin Chew World Scientific
7. The prefabricated home Colin DaviesReaktion Books
8. Literature/specifications/downloadable videos available on Doka and Mivaan shuttering websites.
9. Accelerated Bridge Construction: Best Practices and Techniques Mohiuddin Ali Khan BH Elsevier

Reference Books:

1. Design and Construction of Nuclear Power Plants Rüdiger Meiswinkel, Julian Meyer, Jürgen Schnell Wiley Publishers
2. Energy and Power generation handbook K.R Rao ASME Press
3. Magnetic Levitation Hyung-Suk Han Dong-Sung Kim Springer
4. Metro Rail Projects in India M Ramachandran Oxford
5. BIM Handbook Eastman, Teicholz, Sacks, Liston John Wiley and Sons
6. IRC:43-2015 Recommended Practice for Plants, Tools and Equipment Required for Construction and Maintenance of Concrete Roads (First Revision).
7. IRC-2018 Pocket book for Road Construction Equipment.
8. IRC: SP-97- 2013 Guidelines on Compaction Equipment for Roads Work

Semester- VIII

Course Code	Course Name	Credits
ILO8011	Institute Level Optional Course – II Project 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	3 Hours	-	-	-	100

Objectives

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Project Management Foundation**		05
	1.1	Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical), Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	
2	**Initiating Projects**		06
	2.1	How to get a project started, selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	
3	**Project Planning and Scheduling**		08
	3.1	Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT	

		chart. Introduction to Project Management Information System (PMIS).	
4	**Planning Projects**		**06**
	4.1	Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	
5	**Executing, Monitoring, Controlling and Contracting Projects**		**08**
	5.1	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings.	
	5.2	Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit.	
	5.3	Project Contracting: Project procurement management, contracting and outsourcing	
6	**Project Leadership and Ethics and Closing the Project**		**06**
	6.1	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects.	
	6.2	Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lesson learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference.

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)

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**.

Reference Books:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7th Ed.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.

Semester- VIII

Course Code	Course Name	Credits
ILO8012	Institute Level Optional Course – II Finance 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	3 Hours	-	-	-	100

Objectives

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Financial System, Instruments, Markets and Institutions**		06
	1.1	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System.	
	1.2	Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills	
	1.3	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market	
	1.4	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	
2	**Concepts of Returns and Risks and Time Value of Money**		06
	2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio	
	2.2	Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary	

		Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	
3	**Corporate Finance and Financial Ratio Analysis**		**09**
	3.1	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision.	
	3.2	Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis	
4	**Capital Budgeting and Management**		**10**
	4.1	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)	
	4.2	Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.	
5	**Sources of Finance and Capital Structure**		**05**
	5.1	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.	
	5.2	Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	
6	**Dividend Policy**		**03**
	6.1	Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches—Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Describe Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

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)

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**.

Reference Books:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.

Semester- VIII

Course Code	Course Name	Credits
ILO8013	Institute Level Optional Course – II Entrepreneurship Development 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	3 Hours	-	-	-	100

Objectives

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Overview of Entrepreneurship**		04
	1.1	Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	
2	**Business Plans and Development**		09
	2.1	Business Plans and Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur	
	2.2	Entrepreneurship and Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	

3	**Entrepreneurship Development**		**05**
	3.1	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises.	
4	**Indian Environment for Entrepreneurship**		**08**
	4.1	key regulations and legal aspects, MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc.	
5	**Effective Management of Business**		**08**
	5.1	Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	
6	**Achieving Success in The Small Business**		**05**
	6.1	Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Describe government policies for entrepreneurs

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)

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**.

Reference Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. MaddhurimaLall, ShikahSahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in

Semester- VIII

Course Code	Course Name	Credits
ILO8014	Institute Level Optional Course – II Human Resource 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	3 Hours	-	-	-	100

Objectives

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers.

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to HR**		05
	1.1	Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions.	
	1.2	Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	
2	**Organizational Behaviour (OB)**		07
	2.1	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness	

	2.2	Perception: Attitude and Value, Effect of perception on Individual Decision making, Attitude and Behaviour	
	2.3	Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor)	
	2.4	Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	
3	**Organizational Structure &Design**		**06**
	3.1	Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress.	
	3.2	Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.	
	3.3	Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	
4	**Human Resource Planning**		**05**
	4.1	Recruitment and Selection process, Job-enrichment, Empowerment – Job Satisfaction, employee morale.	
	4.2	Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning.	
	4.3	Training & Development: Identification of Training Needs, Training Methods	
5	**Emerging Trends in HR**		**06**
	5.1	Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development, managing processes & transformation in HR. Organizational Change, Culture, Environment	
	5.2	Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation	
6	**HR & MIS, Strategic HRM and Labour Laws & Industrial Relations**		**10**
	6.1	HR & MIS: Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g., manufacturing R&D, Public Transport, Hospitals, Hotels and service industries	
	6.2	Strategic HRM: Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals	
	6.3	Labour Laws & Industrial Relations: Evolution of IR, IR issues in organizations, Overview of Labour Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	
		Total	**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain the concepts, aspects, techniques and practices of the human resource management.
2. Describe the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

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)

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**.

Reference Books:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15thedition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Semester- VIII

Course Code	Course Name	Credits
ILO8015	Institute Level Optional Course – II Professional Ethics and CSR	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 Hours	-	-	-	100

Objectives

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Professional Ethics and Business**		04
	1.1	The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	
2	**Professional Ethics in the Marketplace and the Environment**		08
	2.1	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy	
	2.2	Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	
3	**Professional Ethics of Consumer Protection and Job Discrimination**		06
	3.1	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy	
	3.2	Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs	

4	**Introduction to Corporate Social Responsibility**		
	4.1	Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	**05**
5	**Corporate Social Responsibility**		
	5.1	Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP)	**08**
6	**Corporate Social Responsibility in Globalizing India**		
	6.1	Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	**08**
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Summarize rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Explain legal aspects of corporate social responsibility

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)

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**.

Reference Books:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi

Semester- VIII

Course Code	Course Name	Credits
ILO8016	Institute Level Optional Course – II Research Methodology	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 Hours	-	-	-	100

Objectives

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction and Basic Research Concepts**		09
	1.1	Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology	
	1.2	Need of Research in Business and Social Sciences	
	1.3	Objectives of Research	
	1.4	Issues and Problems in Research	
	1.5	Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	
2	**Types of Research**		07
	2.1	Types of Research: Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches	
3	**Research Design and Sample Design**		07
	3.1	Research Design: Meaning, Types and Significance	
	3.2	Sample Design: Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	
4	**Research Methodology**		08
	4.1	Meaning of Research Methodology, Stages in Scientific Research Process: Identification and Selection of Research Problem,	

		Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design, Data Collection, Data Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report	
5	**Formulating Research Problem**		**04**
	5.1	Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	
6	**Outcome of Research**		**04**
	6.1	Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

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)

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**.

Reference Books:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R.,1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2^{nd}), Singapore, Pearson Education

Semester- VIII

Course Code	Course Name	Credits
ILO8017	Institute Level Optional Course – II IPR & Patenting	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 Hours	-	-	-	100

Objectives

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as international treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction and Importance to Intellectual Property Rights (IPR)**		05
	1.1	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc.	
	1.2	Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	
2	**Enforcement and Indian Scenario of Intellectual Property Rights**		07
	2.1	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement	
	2.2	Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	
3	**Emerging Issues in IPR**		05

	3.1	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	
4	**Basics of Patents**		**07**
	4.1	Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	
5	**Patent Rules**		**08**
	5.1	Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	
6	**Procedure for Filing a Patent and Patent Databases**		**07**
	6.1	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement	
	6.2	Patent databases: Important websites, Searching international databases	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain Intellectual Property assets
2. Assist individuals and organizations in capacity building
3. Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

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)

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**.

Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian,2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

Semester- VIII

Course Code	Course Name	Credits
ILO8018	Institute Level Optional Course – II Digital Business 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	3 Hours	-	-	-	100

Objectives

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction to Digital Business**		09
	1.1	Introduction to Digital Business: Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts. Difference between physical economy and digital economy	
	1.2	Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services) Opportunities and Challenges in Digital Business	
2	**Overview of E-Commerce**		06
	2.1	E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals	
	2.2	Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing, EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	

3	**Digital Business Support Services and Application Development**		**06**
	3.1	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system	
	3.2	Application Development: Building Digital business Applications and Infrastructure	
4	**Managing E-Business**		**06**
	4.1	Managing Knowledge, Management skills for e-business, Managing Risks in e –business, Security Threats to e-business - Security Overview, Electronic Commerce, Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	
5	**E-Business Strategy**		**04**
	5.1	E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	
6	**Caterializing e-business**		**08**
	6.1	From Idea to Realization-Business plan preparation, Case Studies and presentations	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

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)

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**.

Reference Books:

1. A textbook on E-commerce, Er. Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011 2.
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-Business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in: Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:10.1787/9789264221796-enOECD Publishing

Semester- VIII

Course Code	Course Name	Credits
ILO8019	Institute Level Optional Course – II Environmental 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	3 Hours	-	-	-	100

Objectives

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Detailed Syllabus

Module	Course Module / Contents		Periods
1	**Introduction and Definition of Environment**		10
	1.1	Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario	
2	**Global Environmental Concerns**		06
	2.1	Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	
3	**Concepts of Ecology**		05
	3.1	Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	
4	**Environment Management**		05
	4.1	Scope of Environment Management, Role & functions of Government as a planning and regulating agency.	
5	**Environment Quality**		10
	5.1	Environment Quality Management, Total Quality Environmental Management.	
	5.2	ISO-14000, EMS certification and Corporate Environmental Responsibility.	

6	**Environmental Management Legislation**		**03**
	6.1	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	
	Total		**39**

Contribution to Outcome

After the completion of the course the student should be able to:

1. Describe the concept of environmental management.
2. Evaluate ecosystem and interdependence, food chain etc.
3. Compare and interpret environment related legislations

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)

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**.

Reference Books:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999 2.
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management,T V Ramachandra and Vijay Kulkarni, TERI Press
4. Indian Standard Environmental Management Systems — Requirements with Guidance for Use, Bureau of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Maclillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing 2015

Semester- VII

Course Code	Course Name	Credits
CIL801	Quantity Survey, Estimation & Valuation	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	100

Objectives

1. To emphasize the importance of relevant IS: 1200 - 1964 codes and understand measurement systems for various items of civil engineering structures
2. To draft the specifications for various items of work & determine unit rates of items of works by preparing rate analysis
3. To study the various methods of detailed and approximate estimates.
4. To calculate the quantity of earthwork by using various methods.
5. To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.
6. To understand the concept of valuation & to determine the present fair value of any constructed building at stated time.

List of Tutorials		
Module	Detailed Content	Lab Session / Hr.
1.	Market Survey for rates of materials & items	02
2.	Study of District Schedule of Rates & Prepare rate analysis of few important Items of work	02
3.	Prepare approximate estimate of residential building	02
4.	Prepare detailed estimate (Measurement sheet & Abstract Sheet) of any two of the following: RCC structure, Road work and Cross drainage work	02
5.	Work out Steel quantity by using BBS	02
6.	Work out earthwork volume in banking & cutting for a Road section	02
7.	Draft Tender Notice for proposed construction Project & study tender documents & Conditions of contract	02
8.	Prepare Valuation Report of any Civil Engineering Structure	02

Course Outcome

At the end of the course, learner will be able to:

1. Identify current unit rates of various construction materials through market survey & also study District Schedule of Rates (DSR)
2. Prepare rate analysis of few important Items of work
3. Estimate approximate cost of the structures by using various methods & prepare detailed estimates of various civil engineering structures, including bar bending schedule, by referring drawings.
4. Assess the quantities of earthwork & construct mass haul diagrams.
5. Draft tender notice & demonstrate the significance of the tender as well as contract process.
6. Evaluate present fair value of any constructed building at stated time.

Assessment:

Term Work

The term work shall consist of all tutorials enlisted in the syllabus. The use of quantity survey software and the use of worksheets/databases while solving some of the afore-mentioned tutorial is desirable. Distribution of marks for Term Work shall be as follows:

Tutorials: 20 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 Oral Examination

Oral exam will be based on tutorials and theory syllabus.

Recommended Books:

1. Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
2. Building and Engineering Contracts: Patil, B. S., University Press, Hyderabad.
3. Estimating and costing: Datta, B. N., UBS Publications.
4. Estimating, Costing and Valuation, Rangwala, Charotar Publication
5. Construction Cost Estimating: Process and Practices, Holm Leonard, E. Schaufelberger John, Griffin Dennis, Cole Thomas, Pearson Publications.

Reference Books:

1. Relevant Indian Standard Specifications, BIS Publications.
2. Professional Practice: Dr. Roshan H. Namavati.
3. World Bank approved contract document.

Semester- VIII

Course Code	Course Name	Credits
CIP801	Onsite training for Infrastructure Project Practices (Finance and Business Communication)	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	08	-	-	04	-	04

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	100

Rationale

Construction industry is one of the most regulated industries in the World and subjected to various laws, rules, and regulations and methods related for handling and managing finances and business communications. Infrastructure industry works on two pillars of business finance and business communications. There are certain ethical standards involved in it. A civil and infrastructure Engineering graduate must be able to understand financial transactions and their managements while working on site with utmost certainty and responsibilities. Also, an infrastructure engineer needs perfect understanding of methods and types of business communications. As an entrepreneur or as a service engineer in any industry the graduate must be able to carry out all financial transactions or business communications effectively as per professional standards. The syllabus of this course has been designed to give ONSITE training in a reputed professional infrastructure industry under professionals of the industry to learn financial matters and business communication techniques during entire semester. Along with this, the course intends to help students understand various aspects of live infrastructure projects along with various involved individual and parties in the industry.

Objectives

1. To make students well acquainted with onsite infrastructural financial activities.
2. To understand various types of financial sources and their professional implementations.
3. To learn financial roles and responsibilities of different parties involved in construction and infrastructure industry by experts in the industry.
4. To understand needs & Methods of business communications and actual executions in the industry according to the hierarchy of the managing authority.
5. To learn and work on different types of communications methods under guidance of trained professionals on site.
6. To implement the onsite training of finance and business communications to become entrepreneur or a skilled industry oriented professional infrastructure engineer.

Contribution to Outcome

After the completion of the course the student should be able to:

1. Explain needs of various types of financial terms used in infrastructure Industry.
2. Describe on site requirements/applications of various financial documents
3. To recognize good and bad financial practices during execution of the infrastructure works.
4. Evaluate needs & methods different types of business communication means required in a professional infrastructure industry.
5. Draft effective professional business documentations involving major aspects of infrastructure project.
6. Apply communication techniques effectively in entrepreneurship or in service within the infrastructure Industry

Guidelines for onsite training – (Finance and Business Communication)

The duration of training will be four weeks. It will be after the completion of VII Semester or during the ongoing VIII semester.

One of the following two options can be preferred by the students but not limited to:

1. **Onsite training in industry** – Onsite Training in industry will be entirely **offline** for the entire semester. The aim of this training is to provide real life professional environment to the students for making them aware of professional challenges in the industry. Attendance of every student is mandatory for the successful completion of the course. The training is subjected to MOU issued between the institute and the company, with written consent of the student and parents. Students can work individually or in a group of not more than four students. The assessment of report of on-site training will be on individual basis.

- All students should follow guidelines for safety and security as provided by the industry.
- Preparation of consolidated report of on-site training (finance and business communications) per group is mandatory. The work should include the study of technical details and documents related to on-site training (Finance and Business communication). The name of guide and trainer should be mentioned along with respective signatures. All onsite attendance records, letters of permissions and onsite work proofs should be submitted along with the report. Work shall be carried out under the guidance of faculty. A detailed report shall be submitted.

2. **Software based hands on training** - Software based hands on training by the industry experts or academia. Assignments and test must be completed by each student based on the training.

Other Guidelines:

- Group has to prepare detailed report and submit to their authorized faculty. A copy of report must be submitted in the departments for record.
- The evaluation of the work done by students will be carried out by the internal and external examiner.
- Term work will be of 50 marks based on the overall performance and onsite report submitted by the student.

- For Viva voce examination, the average of internal and external examiner evaluation of 50 marks will be considered.

Responsibilities of Students On-Site

- Student must focus on learning the on-site financial operations, learning soft skills required on-site for finance managements, finding out all types of estimates, studying tender documents, preparing bills & work orders, preparing daily work progress report, prepare minutes of meeting, etc.
- Student must try to find out the on-site challenges involved in sourcing the finance and financial operations or risks in execution and marketing of the project.
- Student must learn legal and professional documents related to finance in infrastructure industry and practical execution of the financial works in the industry.
- Student should learn and follow professionalism in the workplace and adopt coordination with the team.
- Student must be able to handle real life situations from an ethical and technical standpoint.
- Student should be able to apply entrepreneurship skills in the infrastructure Industry

Assessment:

Two progressive seminars (presentation) evaluation should be conducted per group during the semester in department.

Term Work

The review/ progress monitoring committee shall be constituted by head of department. The progress of training to be evaluated on continuous basis, log book has to be submitted by each student. In continuous assessment, focus shall be on individual student. Assessment will be based on individual performance during training, their understanding and response to questions. Distribution of term work marks is as below:

Marks awarded based on the performance in consultation with the industry: 10 Marks

Progress seminar evaluation: 10 Marks

Log book consistency: 10 Marks

On-site training project report: 10 Marks

On-site training Attendance: 10 Marks

Oral Examination

Viva voce examination of 50 marks will be conducted in the presence of an industrial expert and internal supervisor/guide at the end of the semester. Viva voce examination shall be based on knowledge of individual student about onsite training report and their overall performance reflected during oral examination. Students must carry all documents related to their onsite training session along with duly signed authenticated onsite training report during the viva voce examination.

Semester- VII

Course Code	Course Name	Credits
CIP802	Major Project-II	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	06	-	-	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						
-	-	-	-	-	50	-	50	100

Rationale

In the field of Civil & Infrastructure Engineering, new problems arise every now and then; but a professional Civil & Infrastructure Engineer must know how to precisely identify & state those problems, define the scope & objectives of the probable solution(s), carry out effective review of available literature in the domain of the problem and formulate a systematic methodology to solve the problem. Modern tools and multidisciplinary knowledge are vastly used nowadays for the effective solution of Civil & Infrastructure Engineering problem. It is also important to work effectively & ethically as a team and communicate the work done in the form of written reports. The aim of this course is to acquaint the learners with all of the above-mentioned aspects of the Civil & Infrastructure Engineering field by inculcating the process of research.

Objectives

1. To acquaint the learners to identify problems
2. To accustom the learners to formulate the scope and objectives
3. To familiarize the learners with the process of review of literature
4. To advice the learners to formulate a methodology
5. To accustom the learners to work as a team
6. To appraise the learners on proper documentation of work

Outcome

At the end of the course, learner will be able to:

1. Perform on analytical, experimental or numerical method to solve identified problem
2. Produce alternative design solution to meet the functional requirements of the defined problem.
3. Represent the data in Tabular or graphical forms so as to facilitate, analysis & explain of the data.
4. Express Engineering principles & manage the finance required for the execution of the Project.
5. Infer at results, conclusion with its validation, also propose the future scope of work on the identified problem.
6. Communicate effectively their project work by writing reports and publishing technical papers based on entire project work.

Guidelines for Major Project – II

- A project group should consist of minimum 3 and maximum of 4 students.
- The problem statement of the project should preferably be (but not limited to) from the domains of Civil & Infrastructure engineering.
- The solutions to the problem may be multidisciplinary i.e., incorporating concepts, tools, techniques etc. of disciplines apart from Civil & Infrastructure Engineering.
- The project work may include:
    - Experimental Analysis
    - Design of Structures
    - Preparation of Working Drawing
    - Research on Novel Materials
    - Development of Working Models
    - Studies on Technical and Economic Feasibility
    - Application of Internet of things (IOT) and Software in field of Civil & Infrastructure Engineering.
    - Application of any other innovative tools and techniques.
- Students should do literature survey/visit industry/analyse current trends and identify the problem for Project and finalize in consultation with Guide/Supervisor
- Students should use multiple literatures and understand the problem.
- Students should attempt solution to the problem by experimental/simulation methods.
- The solution to be validated with proper justification and report to be compiled in standard format.

Assessment of Major Project-II:

Project II should be assessed based on following points:

1. Quality of problem selected
2. Clarity of Problem definition and Feasibility of problem solution
3. Relevance to the specialization / Industrial trends
4. Clarity of objective and scope
5. Quality of work attempted
6. Validation of results
7. Quality of Written and Oral Presentation

Project Report has to be prepared strictly as per University of Mumbai report writing guidelines. Project II should be assessed through a presentation by the student project group to a panel of Internal and External Examiner approved by the University of Mumbai

Students should be motivated to publish a paper in Conferences/students competitions based on the work

End Semester Oral Examination

Oral exam will be based on experiments performed, site visit and theory syllabus.