

University of Mumbai



Syllabus

Honours/Minor Degree Program

In

Professional Practices in Structural Engineering

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2022-2023)

University of Mumbai Professional Practices in Structural Engineering (With effect from 2022-23)										
Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HPSC501: Concrete Consultant Practices	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										
TE Sem VI	HPSC601: Formwork Design Practices	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
BE Sem VII	HPSC701: Structural Consultant practices – I	04	--	--	20	80	--	--	100	04
	HPSSBL701: Structural Consultant Practices (SBL)			04	--		50	50	100	02
	Total	04		04	100		50	50	200	06
Total Credits = 04+02=06										
BE Sem VIII	HPSC801: Structural Consultant practices – II	04	-	--	20	80	--	--	100	04
		04	--		100		--	--	100	04
Total Credits = 04										
Total Credits for Semesters V,VI, VII & VIII = 04+04+06+04=18										

Professional Practices in Structural Engineering: Semester V		
Course Code	Course Name	Credits
HPSC501	Concrete Consultant Practices	04

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

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

Rationale

Basic concept of concrete technology is essential for civil engineering students to execute the civil engineering projects as per the standard laid down time to time. The concrete technology is the backbone of infrastructure of civil engineering field. The students must know various concreting operations and testing operations during and after construction. It is expected to know the properties of materials, especially concrete and to maintain quality in construction projects. The civil engineering students ought to know the selection of materials, its mix proportioning, mixing, placing, compacting, curing and finishing.

Objectives

- 1 To study the properties of fresh and hardened concrete.
- 2 To study the properties such as workability and durability.
- 3 To acquaint the practical knowledge by experimental processes of various materials required for concrete.
- 4 To understand the Mix design by different methods.
- 5 To understand ordering and handling of RMC.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Introduction to concrete making materials		09
	1.1	Cement Physical properties of cement as per IS Codes, types of cements and their uses.	
	1.2	Aggregates Properties of coarse and fine aggregates and their influence on properties of concrete, properties of crushed aggregates.	
2	Special cementitious materials		07

	2.1	GGBS: properties, advantages and disadvantages, uses	
	2.2	Silica fume: properties, advantages and disadvantages, uses	
	2.3	Admixture Plasticizers, Super-plasticizers, Retarders, Accelerators, Mineral admixtures and other admixtures, test on admixtures, chemistry and compatibility with concrete.	
3	Concrete and its properties		13
	3.1	Grades of concrete, Manufacturing of concrete, importance of w/c ratio.	
	3.2	Properties of fresh concrete - workability and factors affecting it, consistency, cohesiveness, bleeding, segregation.	
	3.3	Properties of hardened concrete - Compressive, Tensile and Flexural strength, Modulus of Elasticity, Shrinkage and Creep.	
	3.4	Durability - Factors affecting durability, Relation between durability and permeability	
4	Concrete Mix Design		10
	4.1	Design of concrete mixes by IS code method	
	4.2	Design of concrete mixes by ACI method	
	4.3	Design of concrete mixes by Road Note 4 method	
	4.4	Design of high strength concrete mixes, design of light weight aggregate concrete mixes, design of fly-ash cement concrete mixes, design of high-density concrete mixes.	
5	Testing of Concrete		07
	5.1	Non-Destructive testing of concrete Rebound Hammer test, ultrasonic pulse velocity test, load test, carbonation test, 1/2 cell potentiometer test, core test and relevant provisions of I.S. codes.	
	5.2	Durability Permeability test, Rapid chloride penetration test.	
6	Ready mix concrete		06
	6.1	Advantages of RMC, components of RMC plant, distribution and transport, handling and placing, mix design of RMC.	
	6.2	Distribution and transport, handling and placing, mix design of RMC.	
	6.3	Handling Quality Complaints	

Contribution to Outcome

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

- 1 Identify the properties of ingredients of concrete.
- 2 Know the properties of wet concrete, hardened concrete.
- 3 Understand the Mix design by different methods for different grades of concrete.
- 4 Perform various test on concrete.
- 5 Understand the concept of durability and cracking in concrete.

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 Concrete Technology: A. R. Shanthakumar, Oxford University Press.
- 2 Concrete mix proportioning-guidelines (IS 10262:2009).
- 3 Method making, curing and determining compressive strength of accelerated-cured concrete test specimens as per IS: 9013-2004.
- 4 Tentative Guidelines for cement concrete mix design for pavements (IRC: 44-1976): Indian Road Congress, New Delhi.
- 5 Properties of concrete: Neville, Isaac Pitman, London.

Reference Books:

- 1 Concrete Technology Theory and Practice: Shetty M.S., S. Chand.
- 2 Relevant I.S. codes: Bureau of Indian standard.
- 3 Concrete Technology: D.F. Orchard, Wiley, 1962.
- 4 Chemistry of Cement and Concrete: F.M. Lue, Edward Arnold, 3rd Edition, 1970.
- 5 Concrete Technology: Neville A.M. & Brooks. J. J., ELBS-Longman.
- 6 Concrete Technology: Gambhir M.L., Tata McGraw Hill, New Delhi.

Professional Practices in Structural Engineering: Semester VI		
Course Code	Course Name	Credits
HPSC601	Formwork Design Practices	04

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

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

Rationale

Course focuses on importance of Formwork design in RCC construction apart from concreting and bar bending work. It deals with the changing scenario towards formwork designing as a career option in Construction Industry. The course helps the students to know the market outlook as well as the requirements of formwork design by knowing all the technical as well as field considerations while designing formwork for various components of building. It gives the exposure to students regarding cost benefits and time saving along with advanced technologies and new formwork material in construction industry.

Objectives

- 1 To know the different types of formwork and importance of formwork in RCC Construction
- 2 To study the market outlook and requirements of system formwork in construction industry.
- 3 To design a formwork for walls, columns, beams and slabs considering all the live loads, concrete pressures, wind loads, concreting methods and do the necessary checks.
- 4 To understand the formwork selection criteria for various tunnel construction methods, bridge construction methods and high-rise construction.
- 5 To plan and estimate the material and man power required for Formwork.
- 6 To know the various advancements in formwork design in construction market.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Introduction to Formwork		08
	1.1	Various Activities and Equipment involved in concrete construction- Concrete, Reinforcement, Batching Plant, Boom Placer, Concrete Pumps, Buckets, Crane, Formwork (Shuttering/Centering), Scaffolding, etc.	

	1.2	Introduction of Formwork, Types of Formwork, Importance of Formwork in RCC Structure	
	1.3	Conventional Formwork and Scaffolding- Advantages and Disadvantages in view of ongoing approach and site requirements	
	1.4	System Formwork and Scaffolding, Time-Cost Distribution in RCC Construction with respect to Formwork, Reinforcement and Concreting.	
2	System Formwork		09
	2.1	Importance of System Formwork- Construction Market Outlook, Market Growth Drivers (Increasing Urbanization, Housing Shortage, Economic Development),	
	2.2	Factors driving demand for System Formwork and Scaffolding, Key Challenges at construction sites, Requirements and Solutions against Challenges- Design and Planning, Equipment usage time, etc.	
	2.3	Design and Planning- Project Planning Sequence- Current and Correct Practice, Any TWO Case Studies.	
	2.4	Equipment usage time- Crane Availability, Boom Placer, labour, etc.	
	2.5	Parameters considered in High Rise Buildings- Comparison between System Formwork and Conventional Formwork	
3	Formwork Design- Walls, Columns & Slabs		14
	3.1	Introduction to Formwork Design- Factors related to Concreting, Concrete Placing method influence pressure of Concrete - Crane Bucket Concreting, Boom Placer Concreting	
	3.2	Loads on formwork and lateral pressure of concrete, Calculation of design pressure based on type of concrete, method of concreting, grade of concrete, type of structure and rate of concreting	
	3.3	Concrete Pressure Calculation- Column and Wall Formwork	
	3.4	Design of formwork for slab (less than 4 m height)- Design Loads for slabs and beams formwork	
	3.5	Design of formwork Material for walls & Columns (Vertical application) - Sheathing Member (Plywood), Secondary Member, Primary Member, Tie System; Check against various forces and bending.	
	3.6	Design of Slab Formwork Material- Primary, Secondary and Prop Members; Checks against failures.	
	3.7	Planning & Estimation of Formwork for Residential & Commercial Buildings, Column Formwork Sets, Cycle time- Slabs and Beams	
4	Formwork for High Rise Constructions, Tunnels and Bridges		12
	4.1	Design Concept for Climbing system- Define, Types, CB 240 and SCS 250 system, Anchoring System	
	4.2	Study of IS: 875(Part3): Wind Loads on Buildings and Structures, Wind Force for Formwork design- High Rise Construction and Slab height more than 4 m	
	4.3	Design of Formwork system for any typical floor plan with self-climbing system for walls, columns, beams and slabs	
	4.4	Overview of Tunnel Construction Methods & Formwork selection	
	4.5	Overview Bridge Construction Methods & Formwork Selection	
	4.6	Overview of High-Rise Construction & Formwork Selection	

5	Economics and Maintenance of Formwork		05
	5.1	Factors affecting supply and demand of Formwork	
	5.2	Manpower Management required for formwork	
	5.3	Maintenance of Formwork & its Stacking.	
6	Advancement & Scope of Formwork Design		04
	6.1	Advance formwork technology Available in the market	
	6.2	Advanced Material used as a Formwork	
	6.3	Formwork field as career option	

Contribution to Outcome

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

- 1 Understand the different types of formwork and its importance in various RCC construction activities.
- 2 Understand various aspects of system formwork over conventional formwork. Also, understand the market outlook and various parameters need to be considered in design of formwork
- 3 Design a formwork for walls, columns, beams and slabs considering all the live loads, concrete pressures, wind loads in a view of different concreting methods and do the necessary checks
- 4 Understand the formwork selection criteria for various tunnel construction methods, bridge construction methods and high-rise construction.
- 5 Plan and estimate the material and man power required for Formwork.
- 6 Know the advance formwork technologies and advanced material available in the market.

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 Formwork for concrete structures: Robert L. Peurifoy and Garold D. Oberlender, The McGraw hill publishing company.
- 2 Concrete Formwork Systems: Awad S. Hanna, Marcel Dekker.

- 3 Design and Construction of Formwork for Concrete Structures: Albert Edward Wynn, Cement and Concrete Assn.
- 4 Concrete Formwork: Leonard Koel, Amer Technical Pub.

Reference Books:

- 1 IS: 875(Part3): Wind Loads on Buildings and Structures
- 2 Formwork for concrete structures: Dr. Kumar Neeraj Jha, The McGraw Hill Education India
- 3 Modern Practices in Formwork for Civil Engineering Construction Work: Dr. Janardan Jha, Prof. S. K. Sinha.

Professional Practices in Structural Engineering: Semester VII		
Course Code	Course Name	Credits
HPSC701	Structural Consultant Practice-1	04

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

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

Rationale

Course is equipped with the basic knowledge about structural designs and various other consultants and venders related with the structural consultant which combines together to carry out the design of any structural project. This will make students to understand the hierarchy of the work which has to carry out the structural consultant and structural engineer with other agencies and consultants and also it will highlight the brief information regarding structural quantity estimation and tenders.

Objectives

- 1 To understand types of various structures, importance of structural consultant and role of structural engineer
- 2 To understand the scope, responsibilities and activities of structural engineer
- 3 To study the schematic designs, documentation and certification in structural design.
- 4 To understand the roles of client, architect, another consultant with structural consultant.
- 5 To understand relation of structural consultant with different agencies and vendors.
- 6 To study structural quantity estimation and tender preparation and also documentation.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction	09
	1.1 Types of Structures, functionality, various forms of structures, usage driven requirements, notable structures in the world, country, state, city.	
	1.2 Information on team of consultants required for the comprehensive design of structures. Responsibilities of various consultants' team members – legal, professional, ethical and moral	

	1.3	Place of a structural engineer in the matrix of the overall project, Set up of a structural designer's office, Various personnel working in a structural designer's office	
2	Role of Structural Consultant		07
	2.1	Scope of a structural consultant, Tasks and deliverables for a structural consultant	
	2.2	Activities that a structural engineer has to carry out	
	2.3	Legal responsibilities of a structural engineer	
3			09
	3.1	Introduction to: Concept, Schematic, Tender, Design Development, Detail Design of various structural designs	
	3.2	Construction Stage Documentation, Construction Administration, Completion Stage Documentation, Certification	
	3.3	Bye laws pertaining to structural engineers in MCGM rule book, HRC, liaison, NBC, DCR etc.	
	3.4	Licensing requirements for a structural engineer	
4	Teaming up with other consultants, contractors and vendors – Nature of communication transactions – Part 1		11
	4.1	Client – Brief and scope defined by Client's representative Architects – Design and Liaison, Surveyor, Geotechnical Engineer, Wind Engineer	
	4.2	Façade Engineer, Interior Architect, Landscape architect, Steel Fabrication contractor's detailers	
	4.3	Water proofing Consultant/vendor, Fire proofing Consultant/Vendor, Concrete technologists, concrete manufacturers	
5	Teaming up with other consultants, contractors and vendors – Nature of communication transactions – Part 2		08
	5.1	Agencies: Material Testing Agency, Rebaring Agency, Anchoring Agency, Post Tensioning Agency, Ground Anchoring Agency, Piling Agency.	
	5.2	Vendors: Steel suppliers/manufacturers, Alternate material suppliers/ manufacturers/ vendors, Bearings/isolators suppliers/manufacturers / vendors, Electrical Engineers, Mechanical Engineers	
	5.3	Other vendor and agencies: Plumbing/Drainage Engineers, Traffic Consultants / Parking system vendor / parking requirements, Vertical Transportation Consultants, Pre-Engineered Building Agencies Contractors in general	
6	Structural Quantity Estimation and Tender		08
	6.1	Structural Quantity Estimation: Structural Specifications, Structural Bill of Quantities, General material consumption ratios, Actual sample workout problem.	
	6.2	Tender Stage: Preparation of Tender Drawings, Bill of Quantities, Specifications, Special Notes, Consultant's estimate, Disclaimers	
	6.3	Construction Documentation and Construction Administration Delivery of drawings and other documents to site for execution.	
Contribution to Outcome			

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

- 1 Understand types of various structures, importance of structural consultant and role of structural engineer.
- 2 Understand the various scope, responsibilities and activities of structural engineer has in structural consultant.
- 3 Study and understand the schematic designs, documentation and certification in structural design
- 4 Understand the roles and nature of client, architect, other consultant with structural consultant and also safety measures at site.
- 5 Understand the nature of communication transactions of structural consultant with different agencies and vendors.
- 6 Study the structural quantity estimation and tender preparation and also documentation works required to the structural consultant.

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. Fundamentals of Reinforced Concrete: Sinha& Roy, S. Chand and Co. Ltd.
2. Estimating, Costing, Specifications and Valuation: Chakraborty, M., Kolkata.
3. Relevant Indian Standard Specifications, BIS Publications
4. Professional Construction Management: Barrie D.S. & Paulson B C, McGraw Hill
5. The cost management toolbox; A Managers guide to controlling costs and boosting profits- Oliver, Lianabel (Tata McGraw Hill).

Professional Practices in Structural Engineering: Semester VII		
Course Code	Course Name	Credits
HPSSBL701	Structural Consultant Practice-Lab	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	04	-	--	02	--	02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
--	--	--	--	--	50	--	50	100

Course Objectives

- 1 To understand types of various structures, importance of structural consultant and role of structural engineer
- 2 To understand the scope, responsibilities and activities of structural engineer
- 3 To study the schematic designs, documentation and certification in structural design.
- 4 To understand the roles of client, architect, another consultant with structural consultant.
- 5 To understand relation of structural consultant with different agencies and vendors.
- 6 To study structural quantity estimation and tender preparation and also documentation.

Contribution to Outcome

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

1. Understand types of various structures, importance of structural consultant and role of structural engineer.
2. Understand the various scope, responsibilities and activities of structural engineer has in structural consultant.
3. Study and understand the schematic designs, documentation and certification in structural design
4. Understand the roles and nature of client, architect, and other consultant with structural consultant and also safety measures at site.
5. Understand the nature of communication transactions of structural consultant with different agencies and vendors.
6. Study the structural quantity estimation and tender preparation and also documentation works required to the structural consultant.

List of Tutorials and Assignments		
Week (Activity)	Detailed Content	Lab Session / Hr.
1	Study of different types of structures based on its utility, roles and responsibilities of various consultants.	02/04
2	Study of Legal responsibilities, scope and activities for structural consultant	02/04
3	Preparation of tender, documentations and detailed design of various structural components of any one structure	02/04
4	Design of single bay double storey building structure using softwares like ETAB/STAAD and SAFE	03/06
5	Application of different IS codes for the selection of parameters (like loading, design, materials, etc) for different types of structural systems	02/04
6	Structural quantity estimation which includes bill of quantities, general material consumption ratios, consultant's estimate	02/04

Assessment:

- **End Semester Oral Examination**

Oral examination will be based on entire syllabus

Reference Books:

1. Design of Reinforced Concrete Structures: Dayaratnam, P; Oxford and IBH.
2. Illustrated Reinforced Concrete Design: Dr. V. L. Shah and Dr. S. R. Karve, Structure Publications, Pune
3. Relevant IS codes, BIS Publication, New Delhi
4. Project Preparation, Appraisal, Budgeting, and Implementation: Prasanna Chandra (Tata McGraw Hill).
5. Construction Engineering and Management: S. Seetharaman, Umesh Publications, Delhi.

Professional Practices in Structural Engineering: Semester VIII		
Course Code	Course Name	Credits
HPSC801	Structural Consultant Practice-II	04

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

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

Rationale

This course is capable of different parameters with the designs and drawing of various structures and the roles of different structural consultant. The course will give ideas regarding the software applications in the structural engineering works which ease the design and drawing stage difficulties. It also provides students the brief knowledge about different tests required from various agencies, consultants and venders.

Objectives

- 1 To understand different structures, material required for construction and various interpretations
- 2 To study the various IS codes, loadings and framing structure systems.
- 3 To understand and prepare the cost comparison report and hand calculation techniques.
- 4 To study and run different software used in structural consultant.
- 5 To understand reinforcement details, drawings and various design audit
- 6 To conduct different tests and to form stagewise and final certifications for the designs.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction	09
	1.1 Concept and Schematic Stages Definition of a given structure – identifying the structural system	
	1.2 Material of construction – Appropriate selection based on functional requirement, space constraints, aesthetics, special demands from client/architect/function	
	1.3 Data and drawing reading and its interpretation as received from all collaborating agencies	
2	Introduction to IS codes	07

	2.1	Introduction to IS 456, IS 800, IS 1786, Loading parameters – as per architectural drawings and usage requirements	
	2.2	Introduction to IS 875, IS 875-Part 3, IS 1893	
	2.3	Various types of framing, structural systems – gravity and lateral, codal interpretations, parameter selection – comparative studies	
3	Cost Comparison and Report		12
	3.1	Comparative costing of components: Flooring, Column grids, Types of columns, Lateral Systems, Foundation systems and Soil retention structures – retaining walls, shoring systems etc	
	3.2	Formation of Design Basis Report, Preliminary Analysis Tools – Introduction	
	3.3	Preparation of Concept and Schematic Drawings. Contents of these drawings.	
	3.4	Hand Calculation techniques, Softwares available, tips for usage of software Introduction to Etabs/ Staad	
4	Softwares to carry out structural designs		10
	4.1	Hands on ETABS / STAAD / SAFE modelling for sample simple structures for understanding of the working of the software only, its various facilities, capacity and limitations. Meaning of various parameter definitions	
	4.2	Design Development / Working Stage, Incorporation of other consultants' requirements, Preparation of DD stage drawings	
	4.3	Running final ETABS model, Running final SAFE mode	
5	Reinforcement details		06
	5.1	Reinforcement calculations, Feeding data to structural draughtsman Preparation of GFC / working reinforcement drawings – contents	
	5.2	Notes on reinforcement drawings, Typical details, Standard formats of reinforcement drawings	
	5.3	Special requirements of detailing – Introduction to SP34 and IS 13920 Drawing and design audit	
6	Tests and Certifications		08
	6.1	List of submittals expected from contractors/vendors/agencies for structural engineer's approval	
	6.2	Site visit records / reports / approvals / comments / suggestions, Changes in design / drawings / details as per site situations, Monitoring safety / stability on the site during construction, Retrofitting / repairs / modifications etc. if necessary	
	6.3	Stage wise Certification, Monitoring quantities as construction progresses as in built drawings, Final certification	

Contribution to Outcome

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

- 1 Explain different concepts and schematic stages of structures, material required for construction and various interpretations.
- 2 Demonstrate use of the various IS codes, loadings parameters and different framing structure systems.

- 3 Prepare the cost comparison report and hand calculation techniques.
- 4 Prepare and run sample models in different software such as ETABS, STAAD, SAFE used in structural consultant.
- 5 Explain reinforcement details from samples, preparation of drawings and various design audit.
- 6 Conduct different tests according to list wise submittals and to form stage wise and final certifications for the designs.

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. Design of Reinforced Concrete Structures: *Dayaratnam, P*; Oxford and IBH.
2. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune
3. Relevant IS codes, BIS Publication, New Delhi
4. Project Preparation, Appraisal, Budgeting, and Implementation: *Prasanna Chandra* (Tata McGraw Hill).
5. Construction Engineering and Management: *S. Seetharaman*, Umesh Publications, Delhi.

University of Mumbai



Syllabus

Honours/Minor Degree Program

In

Green Technology and Sustainable Engineering

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2022-2023)

University of Mumbai Green Technology and Sustainable Engineering (With effect from 2022-23)										
Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/Tutorial	Pract	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HGSC501: Green Technologies and Practices	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										
TE Sem. VI	HGSC601: Green Building and Infrastructure Engineering	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
BE Sem. VII	HGSC701: Fundamentals of Sustainable Engineering	04	--	--	20	80	--	--	100	04
	HGSSBL701: Lab-1 Green Building and Infrastructure Engineering	--	--	04	--	--	50	50	100	02
	Total	04	-	04	100	-	50	50	200	06
Total Credits = 06										
BE Sem. VIII	HGSC801: Sustainable Built Environment Engineering	04	-	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
Total Credits for Semesters V,VI, VII &VIII = 04+04+06+04 = 18										

Green Technology and Sustainable Engineering: Semester V		
Course Code	Course Name	Credits
HGSC501	Green Technologies and Practices	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

Technology is application of knowledge to practical requirements. Green technologies encompass various aspects of technology which help us reduce the human impact on the environment and create ways of sustainable development. Social equitability, economic feasibility and sustainability are the key parameters for green technology. Today, the environment is racing towards the tipping point at which we would have done permanent irreversible damages to the planet earth. Our current actions are pulling the world towards an ecological landslide which if happens would make destruction simply inevitable. Green technologies are an approach towards saving earth and are necessary. Green technologies are our way out of destruction.

Objectives

1. To acquire knowledge on the concept of green technologies
2. To understand the principles of Green Chemistry in the Energy efficient technologies.
3. To analyze the methods of reducing CO₂ levels in atmosphere for Cleaner Production Project Development and Implementation
4. To evaluate the methods of Pollution Prevention and Cleaner Production Awareness Plan.
5. To analyze the application of Energy Efficacy.
6. To apply the knowledge of Green Fuels during implementation.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction to Green Technology	07
	1.1 Definition- Importance – Historical evolution – advantages and disadvantages of green technologies.	
	1.2 Factors affecting green technologies.	
	1.3 Role of Industry, Government and Institutions-Industrial Ecology.	
	1.4 Role of industrial ecology in green technology.	
2	Green Chemistry	08

	2.1	Principles of Green Chemistry, Green chemistry metrics-atom economy.	
	2.2	E factor, reaction mass efficiency.	
	2.3	Waste: Sources of waste, different types of waste.	
	2.4	Chemical, physical and biochemical methods of waste minimization.	
	2.5	Clean development mechanism: reuse, recovery & recycle.	
	2.6	Raw material substitution: Wealth from waste, case studies.	
3	Cleaner Production Project Development and Implementation		09
	3.1	Overview of CP Assessment Steps and Skills, Process Flow Diagram.	
	3.2	Material Balance, CP Option Generation: Technical and Environmental Feasibility analysis.	
	3.3	Economic valuation of alternatives: Total Cost Analysis – CP Financing.	
	3.4	Preparing a Program Plan: Measuring Progress-ISO 14000.	
4	Pollution Prevention and Cleaner Production Awareness Plan		10
	4.1	Waste audit: Environmental Statement.	
	4.2	Carbon credit, Carbon trading, Carbon footprint.	
	4.3	Carbon sequestration.	
	4.4	Life Cycle Assessment- Elements of LCA.	
	4.5	Life Cycle Costing.	
	4.6	Eco Labeling.	
5	Energy Efficacy		08
	5.1	Availability and need of conventional energy resources: major environmental problems related to the conventional energy resources.	
	5.2	Future possibilities of energy need and availability.	
	5.3	Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices.	
	5.4	Solar Energy: principles, working and application.	
6	Green Fuels		10
	6.1	Definition-benefits and challenges: comparison of green fuels with conventional fossil fuels with reference to environmental, economical and social impacts- public policies and market driven initiatives.	
	6.2	Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes.	
	6.3	Wind Energy, energy conversion technologies, their principles, equipment and suitability in Indian context.	
	6.4	Tidal and geothermal energy.	

Contribution to Outcome

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

-
1. Enlist different concepts of green technologies in a project.
 2. Describe the principles of Green Chemistry in the Energy efficient technologies.
 3. Select the best method for the carbon credits of various activities for Cleaner Production Project Development and Implementation.
 4. Evaluate the importance of life cycle assessment for Pollution Prevention and Cleaner Production Awareness Plan.
 5. To apply the problems related to Pollution Prevention and Cleaner Production Awareness Plan.
 6. To choose the green fuels based on their benefits for sustainable 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. 'Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International.
2. 'Pollution Prevention and Abatement Handbook –Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.
3. 'Cleaner Production Audit' by Prasad Modak, C. Visvanathan and Mandar Parasnis (1995), Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok
4. 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
5. 'Solar Energy' by Sukhatme S.P.

Reference Books:

1. 'Energy, The Solar Hydrogen Alternative' by Bokris J.O.
2. 'Non-conventional Energy Sources' by Rai G.D.
3. 'Waste Energy Utilization Technology' by Kiang Y. H.
4. Wind, Tidal, Geothermal, Biomass and Non-conventional energy Green fuel by G.D.Rai.

Green Technology and Sustainable Engineering : Semester VI		
Course Code	Course Name	Credits
HGSC601	Green Building and Infrastructure Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

This course incorporating sustainable design/thinking as a new civil engineering course and experiences from the pilot offering. Important areas are outlined to aid all engineers in understanding sustainability in context with traditional engineering principles. Green-building rating systems are used to introduce the concepts of sustainability in buildings and infrastructure, highlighted by presentations from green-building professionals. By providing a better understanding of sustainability through education, civil engineers can provide proactive solutions to a growing global infrastructure.

Objectives

1. To acquire knowledge on various aspects of green building concepts.
2. To acquire knowledge on Indian Green Building Council.
3. To understand to green building design.
4. To apply knowledge on material conservation handling of non-process waste.
5. To analyze green building assessment systems national as well international.
6. To evaluate various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Green Building Concepts		07
	1.1	What is Green Building, Why to go for Green Building, Benefits of Green Buildings-	
	1.2	Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building?	

	1.3	Principles of green building – Selection of site and Orientation of the building – usage of low energy materials – effective cooling and heating systems-	
	1.4	Effective electrical systems – effective water conservation systems-	
2	Green Building Practices in India		09
	2.1	Practices Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings-	
	2.2	Launch of Green Building Rating Systems, Residential Sector, Market Transformation-	
	2.3	Green Building Opportunities And Benefits: Opportunities of Green Building-	
	2.4	Green Building Features, Material and Resources, Water Efficiency	
	2.5	Optimum Energy Efficiency-	
	2.6	Typical Energy Saving Approach in Buildings-	
3	Introduction to Green Building Design		09
	3.1	Green Building Design Introduction, Reduction in Energy Demand-	
	3.2	Onsite Sources and Sinks, Maximize System Efficiency-	
	3.3	Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources.	
	3.4	Eco-friendly captive power generation for factory, Building requirement-	
4	Material Conservation and Occupational Health		09
	4.1	Material Conservation Handling of non -process waste, waste reduction during construction-	
	4.2	Materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture-	
	4.3	Indoor Environment Quality And Occupational Health: Air conditioning, Indoor air quality, Sick building syndrome, Tobacco smoke control-	
	4.4	Minimum fresh air requirements avoid use of asbestos in the building-	
	4.5	Improved fresh air ventilation, Measure of IAQ-	
	4.6	Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels-	
5	Green building Rating Systems		09
	5.1	Green building assessments system studying e.g. LEED US (Leadership in Energy and Environmental Design)-	
	5.2	Living Building Challenge, Green Globes (Green Building Initiative) (US), Green Globes (ECD-Canada; LEED-Canada, Built Green CANADA	
	5.3	BREEAM (Building Research Establishment Environmental Assessment Method) (UK)-	
	5.4	LEED India (Indian GBC); IGBC Green modules; TERI-GRIHA (Green Rating for Integrated Habitat Assessment) (India) Rating modules-	
6	Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management		09
	6.1	Introduction to the Concept: “Life Cycle assessment of materials”-	

	6.2	EIA: Introduction to EIA. Process of EIA and its application through a case study, EIA as a strategic tool for sustainable development-Social Impact Assessment of Infrastructure projects-	
	6.3	Embodied energy of various construction materials-Energy Management with respect to buildings-	
	6.4	Clean Development Mechanism, Kyoto Protocol, Energy Conservation Building Code-	

Contribution to Outcome

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

1. Explain the concepts of green building.
2. Learn practices Indian Green Building Council and GRIHA.
3. Use the green building design in the projects.
4. Learn material conservation handling of non -process waste.
5. Learn green building assessment systems national as well international.
6. Study various terminologies Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

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 of Tropical housing and climate by Koenisberger
2. Climate responsive architecture by Arvind Krishnan
3. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
4. Energy Efficient Buildings in India by Milli Mujumdar
5. Solar Energy in Architecture and Urban Planning by Herzog Thomas
6. Sustainable Building Design Manual-Volume I and II –TERI Publication
7. Green building codes and standards
8. International Green Construction Code
9. Complete Guide to Green Buildings by Trish riley
10. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009

Reference Books:

1. Green Building Hand Book by Tom woolley and Sam kimings, 2009.
2. Green Building Materials by Ross Spiegel and Dru Meadows
3. Publications from - CBRI, SERC, BMTPC
4. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
5. Michael Bauer, Peter Möhle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
6. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison "Green Building Handbook" Volume I, Spon Press, 2001.

Green Technology and Sustainable Engineering : Semester VII		
Course Code	Course Name	Credits
HGSC701	Fundamentals of Sustainable Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

This course contains content that address sustainability issues and innovations of relevance to the discipline area. Sustainability content (principles and theory) is well integrated into the course. The course outline specifically addresses the sustainability content.

Objectives

1. To acquire knowledge and awareness among students on issues in areas of sustainability.
2. To understand the role of engineering Environmental Pollution and Environmental legislations in India.
3. To understand the International Environmental Management Standards.
4. To apply a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.
5. To analyze the Sustainable Engineering.
6. To evaluate the Sustainable Assessment Systems.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction to Sustainability	08
	1.1 Sustainability-Introduction, Historical Evolution-Goals of Sustainable Development-Principles of Sustainability-Sustainability-need and concept, challenges.	
	1.2 Social, Environmental and Economic sustainability concepts	
	1.3 Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development.	
	1.4 Multilateral environmental agreements and Protocols-Clean Development Mechanism (CDM)	
2	Environmental Pollution and Environmental legislations in India	09

	2.1	Regional and Local Environmental Issues-Air Pollution, Sources- Effects-Preventative Measures of Air Pollution; Water pollution- Land Pollution	
	2.2	Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concepts, 3 R concept-	
	2.3	Environmental legislations in India-Water Act, Air (Pollution & Prevention) Act	
	2.4	Environmental Protection Act and Climate Change Act	
	2.5	Forest Act, Animal Protection Act, Factory Act, Labour Act	
	2.6	SEZ Notifications, CRZ Notifications etc	
3	International Environmental Management Standards		09
	3.1	International Environment Acts and Protocols, Global, Regional and Local environmental issues, Natural resources and their pollution, Carbon credits, Carbon Trading, Carbon Foot Print	
	3.2	ISO 14000, ISO 14001, Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat	
	3.3	Global environmental issues-Resource degradation, Climate change, Global warming, Ozone layer depletion	
	3.4	Sustainable materials-Conventional and renewable material sources, sustainable development, Sustainable urbanization, Industrial Ecology	
4	Basic concepts of sustainable habitat and Energy sources		09
	4.1	Basic concepts of sustainable habitat, Sustainable materials for building construction	
	4.2	Material selection for sustainable design	
	4.3	Conventional and non-conventional energy sources-Solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy-Methods for increasing energy efficiency of buildings	
	4.4	Embodied energy of various construction materials-Energy Management with respect to buildings	
	4.5	Clean Development Mechanism	
	4.6	Kyoto Protocol, and Energy Conservation Building Code	
5	Sustainable Engineering-		08
	5.1	Sustainable Urbanization- Sustainable cities-	
	5.2	Sustainable transport-Industrialization and poverty reduction-Social and technological change-	
	5.3	Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis	
	5.4	Bio-mimicking	
6	Sustainable Assessment Systems		09
	6.1	Studying few Green/Sustainable building assessments systems e.g. Living Building Challenge, Green Globes (Green Building Initiative) (US)	
	6.2	LEED India and GRIHA Sustainability Assessment Techniques-	
	6.3	Green Globes (ECD–Canada, International Initiative for a Sustainable Built Environment: iiSBTool	

	6.4	SBModel 15	
Contribution to Outcome			

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

1. To explain issues in areas of sustainability.
2. To summarize the role of engineering Environmental Pollution and Environmental legislations in India.
3. To interpret the International Environmental Management Standards.
4. To relate a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.
5. To connect the Sustainable Engineering
6. To develop the Sustainable Assessment Systems.

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. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley, A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Lang.
5. Prohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication uage Book Society (ELBS).

Reference Books:

1. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
2. ECBC Code 2016, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

Green Technology and Sustainable Engineering : Semester-VII

Course Code	Course Name	Credits
Lab 1: HGSSBL601	Green Building and Infrastructure Engineering	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04 Per Week	-	-	02		02

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
-	-	-	-	-	50	-	50	100

Course Objective:

1. To acquire knowledge on various aspects of green building concepts.
2. To acquire knowledge on Indian Green Building Council.
3. To understand green building design.
4. To analyze green building assessment systems national as well international.
5. To apply knowledge on material conservation handling of non-process waste.
6. To evaluate various terminologies of Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management

List of Experiments (Conduct six practicals out of nine mentioned below)

Module	Detailed Content	Lab Session / Hr.
1	To study sustainable planning aspects for urban housing (Literature based).	04
2	To study the benefits given by Municipal Corporations to Green Buildings (Literature based).	04
3	To prepare detailed plan for a hypothetical site indicating utility of solar path, wind direction, rainfall intensity etc., to make it sustainable (Literature based)	04
4	To prepare a report on energy efficient buildings in India (Case Study based).	04
5	To compare the benefits under different green building rating systems (Literature based)	04
6	To study: Innovative Materials Developed by CBRI, SERC (Literature based).	04
7	To study, analyze present scenario of organic waste collection and management of any of the premise; preferably hotels (Case Study based)	04
8	To prepare a report on carbon credit, carbon Trading and Carbon footprint (Literature based).	04
9	To study: Environmental Audit of any existing building and prepare a report (Case Study based).	04

Course Outcomes

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

1. Understand the concepts of green building.
2. Learn practices of Indian Green Building Council and GRIHA
3. Design a sustainable green building
4. Assessed green building systems nationally as well internationally.
5. Learn material conservation handling of non-process waste.
6. Study various terminologies of Embodied Energy, Life Cycle Assessment, Environmental Impact Assessment, Energy Audit and Energy Management.

Assessment:

Term work:

Shall consist of Assignment, design report, case study and Site visit report related to this course. Distribution of marks for Term Work shall be as follows:

Assignment: 15 marks

Case study/Literature report: 15 marks

Site visit: 15 marks

Attendance: 05 marks

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

End Semester Oral Examination:

Oral examination shall be based upon the entire theory, site visit and laboratory syllabus.

Recommended Books:

1. 'Handbook of Organic Waste Conversion' by Bewik M.W.M.
2. Green Building Hand Book by Tom woolley and Sam kimings, 2009.
3. Energy Efficient Buildings in India by Milli Mujumdar
4. Allen, D. T. and Shonnard, D. R., 'Sustainability Engineering: Concepts, Design and Case Studies', Prentice Hall.
5. 'Solar Energy' by Sukhatme S.P.
6. 'Waste Energy Utilization Technology' by Kiang Y. H.

Reference Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air-conditioning Engineers, 2009.
2. Manual of Tropical housing and climate by Koenisberger
3. Climate responsive architecture by Arvind Krishnan
4. Manual of solar passive architecture - by Nayak J.K. R. Hazra J. Prajapati.
5. Green Building Materials by Ross Spiegel and Dru Meadows Publications from - CBRI, SERC, BMTPC
6. Solar Energy in Architecture and Urban Planning by Herzog Thomas
7. Sustainable Building Design Manual-Volume I and II –TERI Publication
8. Green building codes and standards
9. International Green Construction Code
10. Complete Guide to Green Buildings by Trish riley
11. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009
12. Shahane, V. S, "Planning and Designing Building", Poona, Allies Book Stall, 2004.
13. Michael Bauer, Peter Möslle and Michael Schwarz "Green Building – Guidebook for Sustainable Architecture" Springer, 2010.
14. Tom Woolley, Sam Kimmins, P. Harrison and R. Harrison "Green Building Handbook" Volume-I, Spon Press, 2001.

Green Technology and Sustainable Engineering : Semester VIII

Course Code	Course Name	Credits
HGSC801	Sustainable Built Environment Engineering	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

Education for sustainability is an important part of the journey to live and work in a sustainable manner. Curricula changes to incorporate sustainability education in the built environment disciplines is not a new phenomenon. Often, curricula changes are made from the perspective of the discipline and the individual learning the course.

Objectives

1. To Understand Sustainable Development
2. To apply knowledge for Understanding Ecosystems
3. To evaluate Environmental Sustainability.
4. To create Socio-economic Sustainability.
5. To create Urban Planning and Environment.
6. To analyze the Built in Environment.

Detailed Syllabus

Module	Course Module / Contents		Hours
1	Sustainable Development		08
	1.1	Definitions and principles of Sustainable Development - History and emergence of the concept of Sustainable Development.	
	1.2	Environment and Development linkages- Globalization and environment.	
	1.3	Millennium Development Goals- Status (global and Indian)-	
	1.4	Impacts on approach to development policy and practice in India, future directions.	
2	Understanding Ecosystems		09
	2.1	Understanding Ecosystems-biodiversity hotspots, Understanding Critical Perspectives on Environment and Development-Environmental Policy and Law, Landscape Ecology and human development.	
	2.2	Introduction to Policy, Institutions and Governance-Urbanization-Conservation of natural resources and livelihood security.	

	2.3	Environment- Evaluation and Impact Assessment Frameworks-Knowledge of ecosystem dynamics, ecosystem-livelihood linkages, Environmental vulnerabilities and adaptations.	
	2.4	Resilience towards climate change and disasters-Environment-development-poverty linkages, issues of access and justice.	
	2.5	Understanding of field techniques and skills to assess ecological processes-Skills to engage with local communities, undertake impact assessments.	
	2.6	Experiential learning of conservation and development issues.	
3	Environmental Sustainability		09
	3.1	Land, Water and Food production	
	3.2	Moving towards sustainability: Energy powering	
	3.3	Sustainable Development - Financing the environment	
	3.4	Sustainable Development- Development of Environmental Protection Mechanism	
4	Socio-economic Sustainability		09
	4.1	Empowerment of Women, Children, Youth, Indigenous People	
	4.2	Non-Governmental Organizations, Local Authorities, Business and Industry	
	4.3	Sustainability Performance indicators and Assessment mechanism	
	4.4	Hurdles to sustainability- Constraints and barriers for sustainable development	
	4.5	Operational guidelines-Interconnected prerequisites for sustainable development	
	4.6	Science and Technology for sustainable development	
5	Urban Planning and Environment		08
	5.1	Environment and Resources	
	5.2	Sustainability Assessment- Future Scenarios	
	5.3	Form of Urban Region- Managing the change	
	5.4	Integrated Planning-Sustainable Development	
6	The Built in Environment		09
	6.1	Urban Form	
	6.2	Land Use-Compact Development	
	6.3	Principles of street design-complete streets	
	6.4	Transport Integrated Urban land use Planning- Guidelines for Environmentally sound Transportation	

Contribution to Outcome

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

1. Describe the concept and socio-economic policies of Sustainable Development.
2. Identify the strategies for implementing eco development programs.
3. Identify different approaches for resource conservation and management.

4. Suggest action plans for implementation of sustainable development.
5. Explain Urban Planning and Environment.
6. Explain the built in environment.

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. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
3. ECBC Code 2016, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
4. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
5. Prohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication uage Book Society (ELBS).
6. Ganesha Somayaji and Sakarama Somayaji, "Environmental Concerns and Sustainable development: Some perspectives from India", Editors:, publisher TERI Press, ISBN 8179932249.
7. Kirkby, J, O'Keefe P. and Timberlake, "Sustainable development" Earth Scan Publication, London, 1996.

Reference Books:

1. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
2. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
3. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Lang
4. Gilg A W and Yarwood R, "Rural Change and Sustainability - Agriculture, the Environment and Communities", CABI Edited by S J Essex, September2005.
5. James H. Weaver, Michael T. Rock, Kenneth Kustere, "Achieving Broad-Based Sustainable Development: Governance, Environment, and Growth with Equity", Kumarian Press, West Hartford, CT. Publication Year, 1997.
6. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press, ISBN: 1852930039.
7. Munier N, "Introduction to Sustainability", Springer2005.

University of Mumbai



Syllabus

Honours/Minor Degree Program

In

Infrastructure Policies & Regulations

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2022-2023)

University of Mumbai Infrastructure Policies & Regulations (With effect from 2022-23)										
Year & Sem	Course Code and Course Title	Teaching Scheme Hours / Week			Examination Scheme and Marks					Credit Scheme
		Theory	Seminar/ Tutorial	Pract.	Internal Assessment	End Sem Exam	Term Work	Oral	Total	Credits
TE Sem V	HIPC501: Environmental Policies & Regulations	04	--	--	20	80	-	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										
TE Sem. VI	HIPC601: Land Policies & Regulations	04	--	--	20	80	-	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
BE Sem. VII	HIPC701: Infrastructure Finance & Business Policies	04	--	--	20	80	--	--	100	04
	HIPSBL 701: Lab-1 Infrastructure Finance & Business Policies	--	--	04	--	--	50	50	100	02
	Total	04	-	04	100	50	50	50	200	06
Total Credits = 06										
BE Sem. VIII	HIPC801: Arbitration & Conciliation	04	-	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
Total Credits for Semesters V, VI, VII & VIII = 04+04+06+04 = 18										

Infrastructure Policies & Regulations : Semester-V		
Course Code	Course Name	Credits
HIPC 501	Environmental Policies & Regulations	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

Environmental law describes a network of regulations and customary laws that address the effects of human activity on the natural environment. These laws are also referred to as environmental and natural resource laws and centre on the idea of environmental pollution. Environmental law is necessary to combat issues related to the environment and conservation of natural resources. Environmental law addresses a wide variety of different areas like reducing air pollution and maintaining air quality, Water Quality, Waste management, Sustainability of resources. This course covers the laws related to sustainable development and protections of environment under general laws. It also emphasizes the laws regarding hazardous and solid waste management, water, air and noise pollution and its prevention. It explores the compliance and enforcement of international environmental law.

Objectives

1. To understand and explain the significance of sustainable development and laws regarding protection of environment.
2. To study the laws related to environment (protection) act, 1986.
3. To emphasize the salient features of water act and describe the laws related to water pollution.
4. To study the salient features of air pollution act and understand the laws related to air and noise pollution.
5. To study the laws regarding hazardous and solid waste management.
6. To understand the International Environment Laws and policies.

Detailed Syllabus

Module	Course Modules / Contents	Hours
1	Sustainable Development and Protection of environment under General Laws	10
	Introduction, Sustainable development, Precautionary principle, the polluter pays principle, the public trust doctrine, eco-development, sustainable development and the Indian judiciary, Environment protection under the law of Torts, Environment protection under the Indian Penal Code:1860, Environment protection under the criminal procedure code:1973, Constitutional provisions and environment protection in India.	
2	The Environment (Protection) Act, 1986	8

	Introduction, Aims and objectives, Scope and commencement of the act, Salient features of the act, definitions, general powers of the central government, prevention, control and abatement of environmental pollution, offences and penalties, miscellaneous provisions.	
3	Water Pollution Introduction, aims and objectives, Salient features of the water pollution act, constitution of central and state boards and their powers and functions, appeals and revisions, offences and penalties, prevention and control of water pollution, miscellaneous provisions.	9
4	Air pollution and Noise Pollution Introduction, Aims and objectives, Salient features of the air pollution act, constitution of central and state boards and their powers and functions, appeals and revisions, offences and penalties, miscellaneous provisions, Noise Pollution regulation and control rule 2000, legislative and non-legislative measures, control of noise pollution.	10
5	Hazardous and Solid Waste Management Introduction, ozone depleting substances (Regulation and control rule 2000), Hazardous and other waste (Management and transboundary movement) Rules 2016, Construction and demolition waste management Rule 2016, Solid waste management Rule 2016, Wetland (Conservation and management) Rule 2017.	8
6	International Environment Law An introduction to international law, Sources and basic principles of international law, development of international laws, nature and scope, establishment of environment institutions like UNEP, World charter for nature 1982, Relationship between international laws and domestic laws: Compliance and enforcement.	7
	Total	52

Contribution to Outcome

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

1. Illustrate the significance of sustainable development and protection of environment under general laws.
2. Explain and implement the laws related to environment (protection) act, 1986.
3. Summarize the salient features of water act and identify the laws related to water pollution.
4. Understand the salient features of air pollution act and classify the laws related to air and noise pollution.
5. Analyze and appraise the laws regarding hazardous and solid waste management.
6. Explore and justify the importance of International Environment Laws and policies.

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 lectures 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. Divan S. and Rosencranz A. (2005) Environmental Law and Policy, 2nd ed., New Delhi.
2. Leelakrishnan P. (2008) Environmental Law in India, 3rd ed., Lexis Nexis, India.
3. Shastri S. C. (2012) Environmental Law, Eastern Book Company, 4th ed., Lucknow.
4. Gurdip Singh (2016) Environmental Law in India, 2nd ed.
5. Dr. Paramjit Jaswal, Dr. Nishtha Jaswal and Vibhuti Jaswal (2021) Environmental Law, Allahabad Law Agency, 5th ed., Allahabad.

Reference Books:

1. Alaxander kiss and Diana Shelton (2007) Guide to International Environmental Laws, Martinus Nijhoff Publisher, USA.
2. Philippe Sands and Jacqueline Peel, Principles of International Environmental Law (4th ed., 2018).
3. Shibani Ghosh ed., Indian Environmental Law: Key Concepts and Principles (2019).
4. Geetanjoy Sahu, Environmental Jurisprudence and the Supreme Court: Litigation, Interpretation, Implementation (2014).
5. Stuart Bell & Donald Mc Gillivray, Environmental Law (7th ed., 2008).

Infrastructure Policies & Regulations : Semester-VI		
Course Code	Course Name	Credits
HIPC 601	Land Policies & Regulations	04

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	-	-	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						
20	20	20	80	3 hrs.	--	-	-	100

Rationale

Land law is important in relation with the Infrastructure Engineering students. This will familiarize the students with the acts and codes that are applicable as per actual conditions in the field. The course deals with the overall knowledge of the central and state acts and rules. Land law is the form of law that deals with the rights to use, alienate, or exclude others from land. In many jurisdictions, these kinds of property are referred to as real estate or real property, as distinct from personal property. Land use agreements, including renting, are an important intersection of property and contract law. Civil and Infrastructural Engineers need to have a working knowledge of the land laws that affect their work and that will enable them to comply with local, state & national regulations; understand the boundaries of their personal and professional liability; negotiate contracts; protect their intellectual property; develop a relationship with a law firm that understands the engineering business.

Objectives

1. To understand and explain the registration act and coastal regulations zones.
2. To provide knowledge of the urban land act & the land acquisition act.
3. To understand Maharashtra stamp act & the development control regulations.
4. To understand the MHADA and MahaRERA act.
5. To study Maharashtra Regional Town Planning Act.
6. To study the Maharashtra Land Revenue Code.

Detailed Syllabus

Module	Course Module / Contents		Periods
A	CENTRAL LEGISLATION		
1	The Registration Act, 1908 & The Environment (Protection) Act, 1986 – Coastal Regulation Zones (CRZ)		08
	1.1	The Registration Act, 1908: Introduction, definitions, documents, time limit for registration and effects of non-registrations of documents.	
	1.2	The Environment (Protection) Act, 1986 – Coastal Regulation Zones (CRZ): Areas covered, prohibited and regulated activities and classification of CRZ.	
2	The Urban Land (Ceiling and Regulation) Act, 1976 & The Land Acquisition Act, 1894		09
	2.1	The Urban Land (Ceiling and Regulation) Act, 1976: Introduction and repeal, definitions, ceiling limits on vacant lands and power to exempt and retention of excess vacant land	

	2.2	The Land Acquisition Act, 1894: General, introduction and definitions, acquisition of land, reference to the court, miscellaneous provisions and case law. Land Records documents i.e. 7x12 abstract, 8A, Ferfar, property card, Gut book. CTS Plan	
B	STATE LEGISLATION		
3	Maharashtra Stamp Act, 1958 & The Development Control Regulations (DCR), 1991		07
	3.1	Maharashtra Stamp Act, 1958: Constitutional provisions, objects & summary of the act, payment of stamp duty, adjudication of stamp duty, impounding of instruments, admissibility of instrument and prosecution for stamp law offences.	
	3.2	The Development Control Regulations (DCR), 1991: Floor Space Index (FSI), transfer of development rights (TDR), heritage buildings and precincts.	
4	The Maharashtra Housing & Area Development Act (MHADA), 1976 & Maharashtra's Real Estate (Regulation and Development) Act, 2016 (MahaRERA)		14
	4.1	The Maharashtra Housing & Area Development Act (MHADA), 1976: Definitions, powers & duties of the Mumbai repairs and reconstruction board, levy and collection of cess, structural repairs, acquisition of cessed properties for cooperative societies.	
	4.2	Maharashtra's Real Estate (Regulation and Development) Act, 2016 (MahaRERA): Introduction, regulatory framework, registration of real estate project and registration of real estate agents, functions and duties of promoter, rights and duties of allottees, the real estate regulatory authority, central advisory council, offences, penalties and adjudication, FAQ's.	
5	Maharashtra Regional Town Planning (MRTP) Act, 1966		04
	5.1	Introductory & definitions, control of development, unauthorized development and acquisition of land.	
6	Maharashtra Land Revenue Code, 1966		10
	6.1	Introduction, use of land, removal & regularisation of encroachments, grant of sanad, record of rights, rights in unoccupied land, appeals, revision and review	
	6.2	Special provisions for land revenue in Bombay city: general, assessment and collection of land revenue, Bombay city survey & boundary marks, government lands and foreshore, transfer of lands.	
Total			52

Contribution to Outcome

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

1. Understand the functionality of the registration act and coastal regulations zones as per central regulations of India.
2. Analyse and integrate functionality of the urban land act & the land acquisition act in India.
3. Explain Maharashtra Stamp Act & the development control regulations.
4. Understand the MHADA and MahaRERA act.
5. Understand Maharashtra Regional Town Planning Act.
6. Familiarise with the Maharashtra Land Revenue 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 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 & Reference Books:

1. MahaRERA Act, The Real Estate (Regulation and Development) Act, 2016 and Rule 2017 - Y. M. Agarwala, Adv. A. B. Shah; Aarti & Company's Publications
2. Land Law – Prof. H.D. Pithawalla; C. Jamndas & Co.
3. Maharashtra Land Laws by D N Mathur, Central Law Publications
4. Land Laws in Maharashtra by Sunil Dighe, Snow White Pub. P Ltd
5. Land Laws by Abhay Shah; Aarti & Company's Publications
6. Land Law (Law and Real Estate Laws) by Krishan Keshav; Singhal's Publications
7. Land Laws (Including Land Acquisition and Rent Laws) by Kanwal D.P. Singh; Satyam Law International

Infrastructure Policies & Regulations : Semester-VII		
Course Code	Course Name	Credits
HIPC 701	Infrastructure Finance & Business Policies	04

Contact Hours			Credits Assigned					
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total		
04	-	-	04	-	-	04		
Theory				Term Work/Practical/Oral			Total	
Internal Assessment			Duration of End Sem Exam	TW	PR	OR		
Test-I	Test-II	Average						
20	20	20	80	3 hrs.	--	-	-	100

Rationale

Looking at India's exponential growth with the infrastructure space teeming with activity and the government as well as the private sector heavily investing in the creation of better infrastructure both in terms of its business and with an eye on its longevity, this course will prove to be a holy grail for students considering the aspects of business law. The course will provide an overview of the underlying legal framework for doing business in India including Constitutional Acts, Companies Act and other relevant statutes. The course will familiarize students with the sector specific legislation, the constitutional, general legal context, regulatory law, where it exists. The course intends to enable each student to have knowledge of fundamental tools of legal research and application of the same in development of the infrastructure sector.

Objectives

1. To highlight the business environment, forms of business, scale of business and emerging trends in business.
2. To describe about the general legal environment and framework in India.
3. To provide an overview of Indian Constitutional Acts, Companies Act and other relevant statutes.
4. To define & interpret the financing of infrastructure and growth of PPP (Public Private Partnership) in various sectors of Infrastructural development.
5. To understand preconstruction and post construction processes involved in infrastructural projects/contracts.
6. To examine the details of Project Financing in Infrastructure Contracts.

Detailed Syllabus		
Module	Course Modules / Contents	Hours
1	Business Environment	8
	Types of Business Environment, Forms of Business Organization, Concept and Features in relation to following business models- Sole Proprietorship; Partnership, Company; Statutory Bodies and Corporations; HUF and Family Business. Scales of Business, Micro, Small and Medium Enterprises; Large Scale Enterprises and Public Enterprises; MNC's Emerging Trends in Business, Concepts, Advantages and Limitations-Franchising, Aggregators, Business Process Outsourcing (BPO)& Knowledge Process Outsourcing (KPO); E-Commerce, Digital Economy.	
2	Legal Environment of Business in India	10
	Introduction to Bills, Laws/Acts, Rules, Regulations, and associated legal reasoning and procedures, Introduction to Constitution and Constitutional Law. Stakeholders including legal	

	system covering judicial, quasi-judicial authorities & Constitutional Authorities etc. and other Advisory Boards/entities. Outline the intent of Business Allocation of Rules of Government (e.g. Departments in States and Ministries at the Centre)	
3	Acts, Statutes and Regulation Introduction to various Acts and their key provisions, such as Indian Companies Act- 2013, Negotiable Instruments Act, Industrial Dispute Act, Minimum Wages Act, Special Relief Act, Transfer of property act, Right to fair compensation & transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, Income Tax Act.	10
4	Infrastructure Contracts Introduction and Features of Infrastructure contracts, Introduction to PPP in India, PPP Models in India, Contracts in PPP model Principles of contract-essential conditions, Void & voidable contract, capacity & consideration, types & terms of contracts (in accordance with Indian Contract Act 1872); Performance and discharge of contract; breaches of contracts and remedies; introduction to special contracts such as contract of indemnity, guarantee, leasing agreement.	8
5	Infrastructure Project Contracts Parties in Infrastructure Contracts, Bidding Process, Negotiation of Infrastructure Project Management Contracts, Allotment of Contracts, Drafting EPC & Concession Agreements, Project Appraisal, Compliances and Due Diligence.	8
6	Project Financing in Infrastructure Contracts Introduction to project financing, Equity and corporate debt financing, Stages in Project Financing, Regulatory Framework and Authorities, Borrowing from International financial institutions, FDI in Infrastructure developments, Documentation in Project Financing, Restructuring in project finance transactions, Case Studies on Infrastructure Project Management	8
Total		52
Contribution to Outcome		

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

1. Explain the concepts related to Business environment
2. Elaborate the general legal environment and framework in India
3. Understand the acts, statutes and their regulation involved in infrastructure projects
4. Apply models of infrastructure development on respective projects in PPP
5. Understand preconstruction and post construction processes involved in infrastructural projects/contracts.
6. Define and interpret the financing of Infrastructure Contracts.

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 lectures 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. Satyanarayana, G. (2017). Infrastructure Development & the Role of Public-PrivatePartnership. 1st ed. New Delhi, India: New Century Publications.
2. Piyush Joshi(2003), Law Relating to Infrastructure Projects, New Delhi: Butterworths.
3. N.D. Kapoor &DinkarPagare Business Laws and Management; Sultan Chand & Sons.
4. P. P. S. Gogna A Textbook of Business Law; Sultan Chand & Company, New Delhi.
5. Poonam Gandhi Business Studies; Dhanpat Rai & Company Private Limited, Delhi.
6. Willie Tan, (2007). Principles of Project and Infrastructure Finance, 1 edition. Routledge;
7. Hoffman, Scott L., (2007). The Law and Business of International Project Finance, 3rd Edition, London: Cambridge University Press.
8. Vinter, Graham (2013) Project Finance, 4th Edition, London: Sweet and Maxwell.
9. Gajendra Haldea, (2011). Infrastructure at Crossroads: The Challenges of Governance, Oxford University Press; 1st ed edition
10. Dewar, John (2015) International Project Finance: Law and Practice, 2nd Edition, Oxford University Press
11. Mulla, D.F., The Indian Contract Act, 13th Ed., LexisNexis/Butterworths
12. Tripathi, S.C., Modern Company Law, 5th Ed., Central Law Publications
13. I.P Massey (2008), Administrative Law, Lucknow: Eastern Book Company.
14. D D Basu (2009), The Constitutional Law of India, New Delhi: Lexis Nexis Butterworths.

Reference Books:

1. Sen & Mitra Commercial Law; The World Press Pvt. Ltd., Calcutta.
2. Ian Wirthington & Chris Britton The Business Environment; Pearson Education Ltd., England.
3. Raymond W.Y. Kao Entrepreneurship and Enterprises Development

Infrastructure Policies & Regulations : Semester-VII		
Course Code	Course Name	Credits
HIPSBL 701	Infrastructure Finance & Business Policies (Lab)	02

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	04	-	-	02	-	02

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

Objectives

1. To study the business environment and emerging trends in business.
2. To learn the general legal environment followed for infrastructure projects in India.
3. To provide detail overview of land acquisition, rehabilitation and redevelopment of infrastructure.
4. To explain emerging sectoral growth of PPP (Public Private Partnership) in various sectors of infrastructural development.
5. To develop contracts and agreements with various stakeholders related to infrastructure projects.
6. Examine the intricacies of Project Financing in Infrastructure Contracts.

Module	Detailed Contents (Any Six)	Lab Sessions/Hr
1	To prepare a case study report of Knowledge Process Outsourcing (KPO) related to infrastructure-based company.	4
2	To prepare a case study report of Business Process Outsourcing (BPO) related to infrastructure-based company.	4
3	To prepare a case study report based on legal environment of business in India.	4
4	To prepare a case study report based on land acquisition and rehabilitation (eg. Sardar Sarovar).	4
5	To prepare a case study report of PPP in one of the sectors of Infrastructural development.	4
6	Prepare a sample draft of EPC contracts enlisting all the necessary elements for infrastructure project.	4
7	To prepare a case study report of business model applying key parameters in project financing.	4
8	To prepare a case study report highlighting the important features of slum rehabilitation (eg. SRA project).	4
9	To prepare a case study report based on mega redevelopment projects in India (eg. BDD chawl).	4

Lab Outcomes

Learner will be able to...

1. Explain the business environment and emerging trends in business.
2. Elaborate the general legal environment followed for infrastructure projects in India.
3. Apply intricacies of land acquisition, rehabilitation and redevelopment of infrastructure.
4. Apply emerging techniques related to PPP (Public Private Partnership) in various sectors of infrastructural development.
5. Build contracts and agreements with various stakeholders related to Infrastructure projects.
6. Define the intricacies of project financing in infrastructure contracts.

End Semester Oral Examinations:

Oral exam will be based on laboratory work performed (case study report).

Recommended Books:

1. Satyanarayana, G. (2017). Infrastructure Development & the Role of Public-Private Partnership. 1st ed. New Delhi, India: New Century Publications.
2. Piyush Joshi(2003), Law Relating to Infrastructure Projects, New Delhi: Butterworths.
3. N. D. Kapoor & Dinkar Pagare Business Laws and Management; Sultan Chand & Sons.
4. P. P. S. Gogna A Textbook of Business Law; Sultan Chand & Company, New Delhi.
5. Poonam Gandhi Business Studies; Dhanpat Rai & Company Private Limited, Delhi.
6. Willie Tan, (2007). Principles of Project and Infrastructure Finance, 1 edition. Routledge;
7. Hoffman, Scott L., (2007). The Law and Business of International Project Finance, 3rd Edition, London: Cambridge University Press.
8. Vinter, Graham (2013) Project Finance, 4th Edition, London: Sweet and Maxwell.
9. Gajendra Haldea, (2011). Infrastructure at Crossroads: The Challenges of Governance, Oxford University Press; 1st ed edition
10. Dewar, John (2015) International Project Finance: Law and Practice, 2nd Edition, Oxford University Press
11. Mulla, D. F., The Indian Contract Act, 13th Ed., LexisNexis/Butterworths
12. Tripathi, S.C., Modern Company Law, 5th Ed., Central Law Publications
13. I. P. Massey (2008), Administrative Law, Lucknow: Eastern Book Company.
14. D. D. Basu (2009), The Constitutional Law of India, New Delhi: Lexis Nexis Butterworths

Infrastructure Policies & Regulations : Semester-VIII		
Course Code	Course Name	Credits
HIPC801	Arbitration & Conciliation	

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
4	-	-	4	-	-	4

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

Rationale

The Arbitration and Conciliation concept has been modelled on lines of the UNCITRAL (United Nations Commission on International Trade Law) framework of laws with the idea to modernize Indian arbitration law and bring it in line with the best global practices and also make India a global hub for arbitration. Arbitration and conciliation play significant role in construction industry due to disputes arising on large scale construction projects. Alternative Dispute Resolution (ADR) mechanism provides scientifically developed techniques to Indian judiciary. ADR provides various modes of settlement including arbitration, conciliation, mediation, negotiation, etc. This course deals with introduction to arbitration and conciliation, their requisites, rules, proceedings, roles of individuals, etc.

Objectives

1. To understand the importance of arbitration in resolving disputes in construction infrastructure industry.
2. To study the constitution of arbitral tribunal in the process of arbitration.
3. To study the procedures and conduct of arbitral proceedings.
4. To understand the making of arbitral award & termination of proceedings.
5. To study the significance and concepts of conciliation.
6. To study of the alternative means of settlement of disputes with negotiations.

Detailed Syllabus		
Module	Course Modules / Contents	Hours
1	Arbitration	09
	Arbitration and its significance in construction industry, Role of arbitrator, The Construction Industry Arbitration Commission (CIAC), Arbitration agreement- Form, constitution, Guarantor to agreement, Interim measures by court, Arbitral award, Arbitral tribunal, International commercial arbitration, legal representative, Scope of arbitration, Arbitral disputes, the arbitration & conciliation act 1996- Consolidating & amendment act, provisions, preamble & its purpose.	
2	Composition of Arbitral Tribunal	09

	Arbitrator, No. of arbitrator, Agreement providing two arbitrators, Appointment of arbitrator, Appointment of international commercial arbitrator, appointment of sole arbitrator, objection to nationality of arbitrator, Selection of arbitrator, appointment of arbitrator by court, Removal of arbitrator, Grounds for challenge, challenge procedure, Termination and substitution of mandate of arbitrator, insolvency notice.	
3	Conduct of Arbitral Proceedings	06
	Equal treatment of parties, Determination of rules of procedure- English law, Indian law, Place of arbitration, Commencement of arbitral proceedings, Statement of claim and defense, Expert appointment by arbitral tribunal,	
4	Making of Arbitral Award & Termination of Proceedings	06
	Rules applicable to substance of disputes, decision making by panel of arbitrators, Settlement, Form and contents of arbitral award, Termination of proceedings, Correction and interpretation of award, Additional award	
5	Conciliation	13
	Application and scope, commencement of proceedings, Appointment of conciliation, Role of conciliator, sole conciliator, Communication between conciliator and parties, Settlement agreement- Concept, status and effect, Confidentiality, Termination of proceedings, costs, Deposits, Role of conciliator in other proceedings, Difference between conciliation and mediation. ICC Rules of Conciliation and arbitration, Rules of arbitration of the Indian council of arbitration.	
6	Alternative Means of Settlement of Disputes (ADR)	09
	Introduction, Methods, merits, demerits, Indian statutes, Difference between mediation and arbitration, Mediator and its necessity, Rules and Limitation of mediation, mediator's settlement. Negotiation- Necessity, state of negotiation, power sources, , styles, kinds of approaches, qualities of negotiation power, Obstructions to negotiation, Trade unions and negotiation.	
	Total	52

Contribution to Outcome

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

1. Appraise the significance and concepts of arbitration in resolving disputes in construction infrastructure industry.
2. Explain the intricacies of constitution of arbitral tribunal in the process of arbitration.
3. Value the importance of the procedures and conduct of arbitral proceedings.
4. Comply the making of arbitral award & termination of proceedings.
5. Compare and study the significance and concepts of conciliation and mediation.
6. Apply the process of alternative means of settlement of disputes with negotiations.

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. Dr. S C Tripathi (2012), The Arbitration and Conciliation Act, 1996, 6th Edn. Central Law Publication.
2. Dr. Rega Surya Rao. (2021), Lextures on Arbitration, Conciliation and ADR Systems, Andhra Law House.
3. Dr. Harman Shergil Sullar (2021), Alternative Dispute Resolution - Including Arbitration Conciliation Act, 1996 Amended Amendment Act, 4th Edn., Shreeram Law House Publication.
4. H C Johari Edition, A Guide to Arbitration and Conciliation Act, 1996 (2022), Kamal Law House.
5. Rahul Ranjan (2020), Alternative Dispute Resolution Arbitration, Conciliation, Negotiation and Mediation, 2022 Edn., Proflic Publication.
6. Madhusudan Saharay, Textbook on Arbitration & Conciliation with Alternative Dispute Resolution, 4th Edn., Universal Law Publishing.
7. Dr. Anupam Kurlwal (2017), An Introduction to Alternative Dispute Resolution, 3rd Edn., Central Law Publications.

Reference Books:

1. P. C. Markanda, Naresh Markanda & Rajesh Markanda (2020), Law Relating to Arbitration and Conciliation, 10th Edn., LexisNexis.
2. Abraham P. Ordoover & Andrea Doneff (2002), Alternatives to Litigation: Mediation, Arbitration, and the Art of Dispute Resolution, 2nd Edn., LexisNexis / National Institute for Trial Advocacy Publication.
3. Elkouri & Elkouri (2003), How Arbitration Works, Bna Books Publications, Edison, New Jersey, USA.