

University of Mumbai



Syllabus

Honours/Minor Degree Program

in

Infrastructure Engineering

FACULTY OF SCIENCE & TECHNOLOGY

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

University of Mumbai Infrastructure 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	HIEC501: Transportation Infrastructure	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										
TE Sem. VI	HIEC601: Energy and IT Infrastructure	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
BE Sem. VII	HIEC701: Geographic Information System	04	--	--	20	80	--	--	100	04
	HIESBL701:Lab1 Geographic Information System	--	--	04	--	--	50	50	100	02
	Total	04	-	04	100	--	50	50	200	06
Total Credits = 06										
BE Sem. VIII	HIEC801: Infrastructural Planning and Management	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 Engineering: Semester-V		
Subject Code	Subject Name	Credits
HIEC501	Transport Infrastructure	4

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

Urban sprawl worldwide is causing tremendous pressure on transport infrastructure. Transportation infrastructure is one of the most important factors for a country's progress. The complex network of connections between coastal ports, inland ports, rails and air routes is the 'lifeline' of a nation and it forms a foundation of economic development. Transportation is an important sector of the economy in its own right and that has been proven by so many instances how transport infrastructure has added speed and efficiency to a country's progress. India has a large and diverse transport sector with its own share of challenges and students will be conversant with transport infrastructure, diverse Transportation needs and equipments after completion of this course.

Objectives

1. To understand the fundamentals of infrastructure and different modes of transportation globally and current state of affairs in India
2. To illustrate the types of modern highways, bridges and tunnels required for the transport infrastructure.
3. To identify the Mass Transit systems, for end to end transport and the structural systems required for the same.
4. To design airport infrastructure mechanism
5. To classify water way infrastructure
6. To study all the important tools and equipments required for the efficient functioning of Transportation infrastructure.

Module	Contents	Hours
1	Introduction to Infrastructure: Definition of infrastructure, Need of infrastructure, different forms of infrastructure, physical and social infrastructure, role of infrastructure in the development of a nation, Transportation scenario globally and in India; Overview of various transport systems in India-rail, road, air, waterways. Major organizations and players in the field of transport infrastructure	07
2	Modern Highways: Roads, Planning concepts, Uninterrupted traffic systems, Signal free intersections, Freeway, Expressway, Service roads, bye pass, Turnpike.	10

	Bridges and Tunnels: Classification based on Structural Materials like Steel, RCC, Pre-stressed concrete or Composite. Bridge types based on structural behaviour such as Beam bridge, Truss Bridge, Arch Bridge, Suspension & Cable stayed cantilever and special purpose bridges. Tunneling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods – soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Supports in Tunnels: Different types of supports in tunneling and their applicability.	
3	Mass Transit system: trains, ferries, buses, trams, Rapid mass transit systems such as subways and surface light rail systems, Cable cars, Various types of guided transport, tube, U-Bahn, metropolitan or underground, Metro rails, Structural components and their selection criteria.	07
4	Airport Planning: Airport Master Plan, Airport Site Feature, Economic and Financial feasibility, Zoning around airports, design considerations for Apron, Runway, Taxiway, Hangar. Air traffic control: radar, satellite navigation, One way, Two-way radio communication. ATC assistance during Departure, En-Route, Descent, Approach and Landing.	08
5	Waterways transportation: History of water transportation, policies related to water transportation in India. Status of river, canals and ocean transportation in India. Modes of water transport - pontoons, amphibians, hovercrafts, boats, ships, water taxi. Advantages and disadvantages of water transportation. Ports harbours and docks: Historical development of Port, Docks and Harbour. Port building facilities, Classification of harbours, Requirement of Harbour, Jetty, Harbour components, characteristics of good harbour and principles of harbour planning	09
6	Modern surveying tools - Drones, satellite survey, GIS software, GPS system, Total station, Electronic Distance Measurement (EDM) Instruments Modern Equipment- Dumper trucks, dozers, vibratory rollers, graders, tunneling equipments, lifting equipments (Cranes), sand washing equipments, earth movers, different excavators, wheel tractor scraper, trenchers, loaders, pile boring and pile driving machine, concrete mixers. concrete batching/mixing plant, concrete pumps, slip forms, concrete vibrator, hot mix plant	11

Contribution to Outcomes

After completion of the course work, students will be able to,

1. Understand the fundamentals of infrastructure and different modes of transportation
2. Illustrate the types of modern highways, bridges and tunnels along with tunnelling methods required for the transport infrastructure.
3. Identify the mass transit system in transport infrastructure
4. Design different components of airport infrastructure along with its economical and financial feasibility
5. Classify different modes of water transportation and evaluate the principles of harbour planning
6. Study different modern surveying tools and modern equipment required for transport infrastructure

Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

Text Books:-

1. A Sustainable Vision for Urban India, Jain A K, Publisher: Kalpaz Publications
2. Highway Engineering, C. E. G. Justo and S. K. Khanna, Nem Chand & Bros; 10th Edition 2015 (1 January 2001)
3. Railway Engineering, M. M. Agarwal and Satish Chandra, Oxford University Press.
4. Design of Bridges, N. Krishna raju, Oxford and IBH Publishing
5. Airport Engineering: Planning And Design by Saxena S C , CBS Publication
6. Airport planning and design, S.K. Khanna, S. S Jain, M.G Arora , Nem Chand Brothers; 6th edition (January 1, 1999)
7. Inland Water Transport in India by R.P. Misra published by Prasaranga, University of Mysore in 1972.
8. Docks and Harbour Engineering: Dr. S.P Bindra, Dhanpatrai Publications, India
9. Harbour, Dock and Tunnel Engineering: R. Srinivasan, Charotar Publication, India
10. Remote sensing and Geographical Information System, By A. M. Chandra and S. K. Ghosh, Narosa Publishing House.
11. Advanced Surveying -Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathikumar and N. Madhu, Pearson publication
12. Surveying Vol. 2 by S. K. Duggal, McGraw Hill Publication

Recommended Books:-

1. Introduction to Infrastructure: An Introduction to Civil and Environmental Engineering, Michael R Penn
2. Remote Sensing & GIS,2/E—Bhatta— Oxford University Press
3. Modern Construction Equipment and Methods by Frank Harris
4. Construction Planning, Equipment, and Methods (McGraw-Hill Series In Civil Engineering) by Robert L Peurifoy), Clifford J. Schexnayder, AviadShapira
5. Driving Horizontal Workings and Tunnel, by Pokorovski, Mir Publishers, 1980.
6. Harbour, Dock and Tunneling Engineering by R. Srinivasan Published by Charotar Publication

Infrastructure Engineering: Semester-VI		
Subject Code	Subject Name	Credits
HIEC601	Energy and IT Infrastructure	4

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

The power infrastructure consists of generation, transmission, and distribution systems that are essential to all other infrastructures and every aspect of the economy. In India, various sources of energy are used to generate power. These include coal, natural gas, hydro, nuclear, and renewable (includes solar, wind, small hydro and biomass). Telecommunications infrastructure is a physical medium through which all Internet traffic flows. This includes telephone wires, cables and mobile technology such as fifth-generation (5G) mobile networks. The IT infrastructure consists of all elements that support the management and usability of data and information. These include the physical hardware and facilities (including data centers), data storage and retrieval, network systems, legacy interfaces, and software to support the business goals of an enterprise.

Objectives

1. Evaluate energy infrastructure and hydroelectric power plant.
2. Classify the tidal, wind and solar energy and its operation
3. Explain nuclear energy infrastructure, policies and regulations for establishing nuclear power plant and issues related to radioactive waste
4. Design criteria for telecommunication tower
5. Describe the fundamental elements of IT infrastructure
6. Design criteria for development of smart grid networks

Module	Contents	Hours
1	Introduction to energy infrastructure: Types of electrical generation; generation system architecture; power plant planning and design. Hydroelectric infrastructure: Site selection; classification; hydrographs; storage and pondage; essential elements; selection of turbines, environmental impact assessment.	04
2	Tidal energy infrastructure: Fundamentals of tide; wave theory, loading and energy; operating principle - oscillating device; turbine characteristics; devices; moorings and anchors; foundations. Wind energy infrastructure: Offshore and onshore wind; properties of wind; wind resource assessment; wind turbine blades; wind turbines in grid; wind projects.	06

	Solar energy infrastructure: Basics of solar PV, fundamentals of the design of solar energy fields; concentrated solar power plant; solar water heating systems	
3	Nuclear energy infrastructure: Policy and regulations; economics and financing of nuclear power plants; nuclear technology selection and project implementation; fuel supply, radioactive waste and management; issues; environmental impact	10
4	Telecommunication – Definition, use, functions, and components, site surveys- raw land tower site survey and boundary survey, classification of telecommunication towers, Telecommunication signals, Design of towers – configuration, tower erection, transmission lines construction, operation and maintenance of distribution systems.	13
5	IT infrastructure – components of IT infrastructure, Internet and world wide web, design, planning, and implementation of networks and servers, storage management , Backup / Restore Methodology, Remote Access, Control, Administration.	12
6	Smart grid, transmission and distribution: Grid resilience; environmental performance; operational efficiencies; network architecture; transmission systems; wide area monitoring, protection and control, transmission and distribution architecture; micro grids; vulnerability; peak load shifting and grid storage.	07

Contribution to Outcomes

After completion of the course work, students will have ability to

1. Explain generation of hydroelectric power and its impact on environment
2. Classify and design infrastructure for non conventional energy sources
3. Describe the policies and regulations for nuclear power plant, infrastructural requirement and its environmental impact assessment
4. Evaluate the components and functions of telecommunication
5. Summarize the fundamental elements of IT infrastructure such as networks and servers, storage and remote access
6. Design and develop smart grid networks for transmission and distribution of the energy

Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

Text Books:-

1. Textbook of Renewable Energy (Wood head Publishing India in Energy) ,by S.C. Bhatia , R.K. Gupta
2. P. Jain, Wind Energy Engineering, McGraw-Hill.
3. Nuclear Power in India by N. Sharma, B. Banerjee, Rupa Publication 2008
4. Environmental Issues for 21st Century by S. P. Dasgupta, Mittal Publication.
5. Steve Morris, Up the Tower: The complete Guide to Tower Construction, Champion Radio Products Brian W. Smith, Communication Structures, Thomas Telford publications
6. ICT in Urban services, Compendium of global good practices, National Institute of Urban affairs, http://pearl.niua.org/sites/default/files/books/GPGL1_ICT.pdf
7. Fundamentals of telecommunication- https://www.net.t-labs.tuberlin.de/teaching/computer_networking/documents/telecomm_fundamentals.pdf

Recommended Books:-

1. Hydroelectric Energy, Renewable Energy and the Environment By Bikash Pandey, Ajoy Karki, ISBN 9781439811672 CRC Press
2. Tidal Energy Systems, 1st Edition, Design, Optimization and Control, Vikas Khare Cheshta Khare Savita Nema Prashant Bareda, Elsevier
3. E book on Energy Law in India by Mohammad Naseem, Saman Naseem, 2017, publisher Wolters Kluwer
4. Graham, S. and Marvin, S. Planning Cybercities Integrating Telecommunications into Urban Planning, The town planning review, 70(1), Liverpool University Press
5. S. Borlase (2013) Smart Grid Infrastructure, Technology, and Solutions, CRC Press. ISBN 9781439829103.
6. L.F. Drbal, P.G. Boston, K.L. Westra, R.B. Erickson (1996) Power Plant Engineering, Kluwer Academic Publishers. ISBN 9781461380474.
7. D. Greaves, G. Iglesias (2018) Wave and Tidal Energy, John Wiley & Sons Ltd. ISBN 9781119014454.
8. S. A. Kalogirou (2009) Solar Energy Engineering Processes and Systems, Elsevier. ISBN 9780123745019.
9. Basic Infrastructure for a Nuclear Power Project (2006) Technical Report, CI#128 IAEA. ISBN 9201085060.
10. Kiessling, F., Nefzger,P., Nolasco,J.F., Kaintzyk,U., (2003), Overhead Power Lines Planning Design Construction, 4th Edition, Springer
11. Ganguli, S.K., Kohli,V., (2016), Power Cable Technology, CRC Press

Infrastructure Engineering: Semester-VII		
Subject Code	Subject Name	Credits
HIEC701	Geographic Information Systems	4

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

Geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships. IS technology is a crucial part of spatial data infra-structure. Many different types of information can be compared and contrasted using GIS. The system can include data about people, such as population, income, or education level. It can include information about the landscape, such as the location of streams, different kinds of vegetation, and different kinds of soil. It can include information about the sites of factories, farms, and schools, or storm drains, roads, and electric power lines. Use of Geographic's Information system in all infrastructures will enhance the social, economic, development of India in all aspects.

Objectives

1. To understand the fundamentals of GIS, basics tools, and its applications in all branches of Civil and infrastructure Engineering.
2. To Illustrate the various Component of GIS, co-ordinate systems for creations of vector data and raster dataset by using various GIS tools.
3. To understand Basic geodata base system for Creation of various types of maps.
4. To create various thematic maps by using the vector Data set as well as raster data set.
5. To analyze spatial Data for solving real word problems.
6. To apply GIS output data for solving real life problems.

Module	Contents	Hours
1	Introduction to Geographic Information System GIS: History, Development of GIS, Objective of GIS, Advantages of GIS.	03
2	Introduction to Maps: Definition, Scale, Types of Maps, elements of Map, Projection Coordinate Systems: Geographic, rectangular and Polar – Transformation, types and application. GIS: What is GIS, components of GIS, its applications, open source softwares.	09

3	DBMS: -Database Management system – function – types – advantages, Introduction to Toposheet. Various open data sources. GIS Data Model: Spatial Data Types- , Vector data, Raster data, TIN (Triangulated reregulated network) data model, comparison of Vector & raster data, Non spatial data (attributes) & its types. Preprocessing of spatial data set.	10
4	GIS input data: Vector Data: -Sources for GIS Data Shape files, Vector Data Input – Georeferencing, Map digitization and editing, and Topology – Topological Relationship. Raster Data Input – Digital Elevation Mode (DEM)- Introduction to DEM, types of Dem, Uses of Dem & different types of resolution, Introduction to satellite images, image classification, Quality assessment of freely available Digital Elevation Model, Raster File Formats, Vector File Formats – Raster to Vector and Vector to Raster Conversion.	12
5	GIS Data Analysis: Introduction to GIS data Analysis – Data selection, reclassification, overlaying analysis, Buffer Analysis, Spatial Analysis (Dem Analysis,) Surface Analysis, Network Analysis, proximity Analysis, Vector & Raster Analysis Methods. Error in GIS and key elements of maps.	12
6	GIS Output Design and Presentation Introduction - Spatial and non-spatial data presentation - Map layout – Charts, graphs and multimedia output, elements of spatial data quality, Meta data and introduction to web GIS.	06

Contribution to Outcomes

After completion of the course work, students will be able to,

1. Explain GIS applications in various fields
2. Illustrate the types of maps, their characteristics and different co-ordinate system, Components of GIS& Familiar with new GIS software.
3. Compare the basics of Data Base Management system for GIS - vector data set, raster data set & Produce an error free GIS database for civil engineering applications.
4. Create & design basic database like creation of shape files, vector data set, raster data set & Produce an error free GIS database for civil engineering applications
5. Analyze GIS Data which includes creating buffers, Clipping Features, raster data analysis, vector Data Analysis and Dissolve Features.
6. Application of spatial data output along with quality assessment for applications in Civil & Infrastructure Engg.

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):

Weight age 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) The students will have to attempt any **three** questions out of remaining five questions
- 5) Total Four questions need to be attempted.

Text Books:-

1. Remote Sensing and Geographic Information System, By A.M. Chandra and S.K. Ghosh, Narosa Publication House.
2. Remote Sensing: Principles and Applications by B C Panda.
3. Geographic Information System by Jatin Pandey .
4. Remote Sensing and GIS by Basudeb Bhatta, Oxford University.

Recommended Books:-

1. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, 2011, Saylor Foundation, ISBN: 9781453321966.
2. Michael N. DeMeres, Fundamentals of Geographic Information Systems, 4th Edition, 2009, Wiley, ISBN: 9780470129067
3. NPTEL GIS web course.

Infrastructure Engineering: Semester-VII		
Subject Code	Subject Name	Credits
HIESBL701	Geographic Information System – Lab	2

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
-	4	-	-	2	-	2

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 acquire basic knowledge of Geographic Information System Lab practices and applying it for solving real life problem in Civil & Infrastructure Engineering.
2. To illustrate basic GIS-terms which are connected to data processing by means of exercises
3. To prepare basic geo data for Spatial and non spatial Analysis.
4. To apply Google earth in Geographic information system for preparation of various shapes files, preparation of vector data set.
5. To analyze basic geodata base by using various tools.
6. To convert GIS output into various thematic maps for solving various real life problems in Civil – infrastructure Engineering.

List of Experiments

Module	Contents	Hours
1	Getting started with GIS software (QGIS, ArcGIS) & data collection from various free available sources.	4
2	Georeferencing and projection of toposheet, Digitization of map/ Toposheet.	4
3	Creation of thematic maps, Base Map preparation, Data Conversion – Vector to Raster, Raster to Vector.	4
4	Google earth integrations in GIS.	4
5	Vector analysis and Raster analysis, adding attribute data – quarries on attribute data, Map composition.	4
6	Developing Digital Elevation Model, its application & analysis.	4
7	A case study of GIS applications.	4

Contribution to Outcomes

Learner will be able to...

1. Apply the installation of GIS software's and various tools.
2. Explain various Database structure like vector data, raster data set.
3. Prepare and convert vector data set into raster data set.

4. Interpret Google earth with GIS.
5. Perform various types of Analysis on raster data, vector data.
6. Transform GIS output by preparation of various thematic maps.

GIS Software's: Arc GIS 10.3, QGIS.

Assessment

Term Work Including

Laboratory work :	25 Marks
Case Study/Report/Tutorial:	20 Marks
Attendance:	05 Marks

End Semester Oral Examination

Oral examination will be based on the entire syllabus.

Text Books:-

1. Remote Sensing and Geographic Information System, By A.M. Chandra and S.K. Ghosh, Narosa Publication House.
2. Remote Sensing: Principles and Applications by B C Panda.
3. Geographic Information System, by Jatin Pandey .
4. Remote Sensing and GIS by Basudeb Bhatta, Oxford University.

Recommended Books:-

1. Jonathan Campbell and Michael Shin, Essentials of Geographic Information Systems, 2011, Saylor Foundation, ISBN: 9781453321966.
2. Michael N. DeMeres, Fundamentals of Geographic Information Systems, 4th Edition, 2009, Wiley, ISBN: 9780470129067
3. NPTEL GIS web course.

Infrastructure Engineering: Semester-VIII		
Subject Code	Subject Name	Credits
HIEC801	Infrastructural planning and management	4

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

Infrastructure is the resources required for a society and its economy to function. Infrastructure Planning primarily relates to new infrastructure creation but also phasing out of deficient and outdated infrastructure when it is cost-effective.

Economic infrastructure is an internal facility of a country that make business activity possible, Such as communication, transportation and distribution networks, financial institutions and markets, and energy supply systems. Economic infrastructure definitely ensures the mobility of labour and capital within/from the economy. It results in the overall growth of towns and cities. Infrastructures provide for a lot of employment generation and employment opportunities. They also play a crucial role in national defense activities.

Objectives

1. To understand the infrastructural scenario in India and opportunities and challenges to be faced in road development.
2. To understand the Infrastructure economics, finance and social environmental risk in infrastructure
3. To Realizing the real-world risks and challenges in managing infrastructure.
4. To identify the needs in urban infrastructure development and recycling technologies
5. To Understand the impact of infrastructural projects on environment
6. To analyse success and failure of measure infrastructural projects in India

Module	Contents	Hours
1	Introduction- Infrastructure scenario in India, transportation, power and telecom sectors, urban and rural infrastructure in India, road infrastructure development in India, rural roads development in India-opportunities and challenges	06
2	Infrastructure economics and finance, project structuring and risk allocation in project finance, Public-Private Partnership (PPP) for infrastructure- case studies, risk management in infrastructure projects, term sheet development economic and social e4nvironmental risk in infrastructure,	08
3	Project Governance, public sector governance, strategies for governing against infr6astructure project turbulence, the governance model, data-base management,	10

	actor mapping and social network analysis, fair process and negotiations, design thinking, life cycle and benefit cost analysis	
4	Innovative infrastructure financing, urban infrastructure needs in India and funding options, new and innovative materials for long lasting road infrastructure, green highways –recycling technology, durable road infrastructure –options and recent developments, polycentric governance and incomplete design, successful project delivery strategies.	10
5	Environmental impact assessment: Tools, impact on air ,water, soil & Noise, Role of Biodiversity impact Assessment, Identification ,Prediction &Evaluation of Impacts on Biodiversity, Techniques of Biodiversity impact assessment, E I A Report Preparation	10
6	Case Studies: Case studies for 1)BOT 2)Dams 3)Mass Transit System 4)Government Funded Projects	08

Contribution to Outcomes

Students will have the ability to

1. Explain Indian Infrastructural framework and future challenges.
2. Analyze the infrastructure projects based on various risks.
3. Develop critical thinking on a variety of novel solutions or fixes which aids in execution infrastructure projects better.
4. Design innovative methods for long lasting infrastructure and understand the successful project delivery strategies.
5. Analyze the effect of infrastructural projects on environment.
6. Apply the design methodologies to the real world case studies

Theory Examination:-

1. The question paper will comprise **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** that will have short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules. For this, the module shall be divided proportionately further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. A total of **four** questions need to be attempted.

Text Books:-

1. Infrastructure Planning and Management (2018) by Prof. Ashwin Mahalingam NPTEL. <https://nptel.ac.in/courses/105/106/105106188/>
2. Projects planning, Analysis Selection, Implementation and Review, Prasanna Chandra Tata McGraw Hill, New Delhi, 2005
3. Vasant Desai, "Project Management", Himalaya Publishing, 1st Edition, 2010
4. Arbitration", Jubilee Publications, 2nd Edition., 1996 Engineering Contracts and B. J. Vasavada, "

5. Construction Management & PWD Accounts --- D Lal, S. K. Kataria & Sons, 2012
6. Fundamentals of Engineering Economics—Pravin Kumar, Wiley, India

Recommended Books:-

1. Goodman AS, Hastak M (2006). Infrastructure planning handbook: planning, engineering, and economics. New York: ASCE Press.
2. Miller R, Lessard DR (2001). The strategic management of large engineering projects: Shaping institutions, risks, and governance. MIT press.
3. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford, London, 1999.
4. Construction project scheduling and control ----Mubarak, Wiley India
5. Construction Management: Planning and finance-- Cormican D. Construction press, London, Feb 2002.

University of Mumbai



Syllabus

Honours/Minor Degree Program

in

Smart Cities

FACULTY OF SCIENCE & TECHNOLOGY

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

University of Mumbai Smart Cities (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	HSCC501: Smart City Planning and Development	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										
TE Sem VI	HSCC601: Smart City-Project Management	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										
BE Sem VII	HSCC701: Smart Urban Infrastructures	04	--	--	20	80	--	--	100	04
	HSCSBL701: Lab-1: Smart City-Project Management	--	--	02	--	--	50	50	100	02
	Total	04	-	04	100	50	50	200	06	
Total Credits = 06										
BE Sem VIII	HSCC801: Smart Management of Smart Urban Infrastructures	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										

Smart Cities: Semester V		
Course Code	Course Name	Credits
HSCC501	Smart City Planning and Development	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 Hrs.	-	-	-	100

Rationale

Today, more than 54% of the world's total population lives in urban areas. It is projected that urbanization will continue in the coming years, raising the urban population to 6.0 billion people by 2045. The significant increase in urban population will put awesome load on urban infrastructure which results in increasing the demand for energy, mobility, water, and other urban services in cities. So, cities have to become smarter in provision of urban services. Also due to the global awareness about negative environmental impacts of pollution, cities are feeling more pressure to improve their environmental performance, while improving their level of services. Increasing demand for sustainable, inclusive, reliable and efficient urban service puts our urban infrastructures under a huge pressure. But digitalization provides a powerful tool to address these issues and create a paradigm shift in our concept of cities. Due to this novel nature of smart cities, it is important that policymakers, urban managers and other relevant actors be prepared to understand and address the challenges that the transition will bring about. This course will provide the basic principles that to consider for a successful transition into a smart city.

Objectives

1. Enable students in understanding the concepts, discourses and practices of "Smart Cities" across the Globe.
2. To develop competence in planning projects at the city level to ensure sustainability of environment and human beings.
3. Apply smart technologies across the spectrum of infrastructure and governance.
4. Develop overall city strategy to become contemporary and competitive.
5. Enable students to understand city centric capital formation and finance, risk and feasibility to ensure the economic health of the city.
6. Develop overall smart cities and villages.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction to Smart Cities-	09

	1.1	Definition and concept of smart city, Introduction to City planning, Introduction to Development Control Rules, Building Bye Laws	
	1.2	Conventional Vs. Smart city, Understanding Smart City	
	1.3	Various approaches to smart city, Pan city concept	
	1.4	Challenges of Urbanization, Smart City Characteristics	
2	Smart City Standards-		09
	2.1	Smart City Planning and Development, Dimensions of Smart Cities	
	2.2	Government of India initiatives “100 Smart Cities” Policy and Mission	
	2.3	Global experience of smart cities	
	2.4	Smart cities –Global standards	
	2.5	Smart cities-Performance benchmarks	
	2.6	Smart cities-Practice codes	
3	Important sectors of smart city		09
	3.1	Various sectors in smart city, Smart building and home device	
	3.2	Smart water, Smart Transportation, Smart Health, Smart Energy, smart public service	
	3.3	Cyber security, Safety and privacy, Concept of smart community	
	3.4	Concept of Digitalization, brief information about the various tools used for digitalization such as- ICT, IoT, Sensors, Artificial Intelligence	
4	Governance of Smart Cities-E-Governance		09
	4.1	Introduction to smart E-Governance, Smart E-Governance for Citizen services	
	4.2	Smart E-Governance for Industries and Commerce	
	4.3	Smart E-Governance within Government	
	4.4	Envisaging Future Smart E-Governance	
	4.5	Models for smart Governance	
	4.6	Regulatory Guidelines and Standards for E-Governance	
5	Smart Citizen Services		08
	5.1	Smart leadership and strategy; Stakeholder’s engagement	
	5.2	Smart healthcare	
	5.3	Smart education, skill development centers, incubation/ Trade facilitation centers	
	5.4	Safety and security of citizens particularly women, children and the elderly people	
6	Green Building in Smart Cities and Smart Villages-		08
	6.1	Sustainability, smart housing, Green buildings, Rating system of Green Building	
	6.2	Energy efficient buildings, Energy Saving System in buildings	
	6.3	Introduction to Rural Planning and Development, Understanding Concept of Smart Village, Issues of Smart Village	
	6.4	Smart Village Performance Benchmark, Smart Village Policy and Mission, Planning and Management of Smart Village, Financing Smart Village	

Contribution to Outcome

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

1. Conceptualize cities as socio-technical systems
2. Evaluate the main impacts of information and communication technologies on urban infrastructures and services.
3. Describe the main steps and considerations of the smart city transition.
4. Compare the main managerial and governance challenges of developing and managing a smart city.
5. Apply such concepts and tools in the case of smart water and smart housing 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.

Reference Books:

1. "Smart Cities Unbundled" by, Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
2. "Introduction to Smart Cities" by P.P. Anil Kumar, Pearson Publications
3. "Smart Cities & Urban Development in India "by N. Mani, New Century Publications
4. "Smart City" by Arun Firodia, Vishwakarma Publications.
5. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
6. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
7. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
8. "Urban Systems Design Creating Sustainable Smart Cities in the Internet of Things Era", by Yoshiki Yamagata, Perry P. J. Yang, Elsevier publications
9. "Internet of Things in Smart Technologies for Sustainable Urban Development" by G. R. Kanagachidambaresan, R. Maheswar V. Manikandan, K. Ramakrishnan by Springer Publications
10. "Smart Cities: Introducing Digital Innovation to Cities" by Oliver Gassmann, Jonas Böhm, Maximilian Palmié, Emerald Publications.

Honours in Smart Cities: Semester VI		
Course Code	Course Name	Credits
HSCC601	Smart City-Project Management	4

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 Hrs.	-	-	-	100

Rationale

Smart City projects involve great technical complexity, and require a wide diversity of skills to control and monitor them. Project Management would be an integral part for smart infrastructure and cities. Like other complex infrastructure projects; smart city projects are subjected to risk and uncertainties leading to huge time and cost overrun. Managers are faced with the problem of putting together and directing large temporary organizations subjected to constrained resources, limited time, and environmental uncertainty. Project management plays an important role in developing the Smart Cities. It has grown in response to the need for a managerial approach that deals with the problems and opportunities of modern society. It provides the technical and managerial competency, communication and decision making necessary to meet the challenges of complex activities. Application of modern project management tools would ensure more collaboration, communication flow and much flawless implementation of Smart City projects. Modern project management concepts of application of Integrated Project Delivery (IPD) and Building Information Modeling (BIM) would reduce the co-ordination problems and ensure much higher probability of successful completion of the projects within stipulated time and cost frame

Objectives

1. This course is designed to give exposure to project management tools and techniques applicable for planning, controlling and monitoring of Smart Infrastructure and Cities.
2. This course would also enable to develop insight for managing project risks, uncertainties and complexities of smart city projects.
3. To provide overview on sound disaster risk management practices for preparing towards "Safe Cities". To educate and sensitize students, government officers, planners, policy makers, academicians, researchers and others on process of disaster management in smart cities.
4. To educate participants on various tools and methods that can be adopted for hazard identification, vulnerability analysis and disaster risk reduction measures.
5. To stimulate thought process to address hazard risks and vulnerabilities of distinct groups within the city to make more resilient communities.
6. To stimulate process of critically analyzing risks to various urban sectors like Health, Transport, Communication, Housing, Services, Infrastructure etc to come up with strategy to reduce risks Researchers and Academicians.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Name of Module 1: Philosophy and Concepts of Project Management in smart cities-	08
	1.1 Philosophy and Concepts of Project Management-Phases	
	1.2 Philosophy and Concepts of Project Management- Stages of Project-	
	1.3 Philosophy and Concepts of Project Management-Approval Status	
	1.4 Philosophy and Concepts of Project Management-Work Break down Structure	
2	Name of Module 2: Project Organization Structure-	08
	2.1 Project Organization Structure- Planning	
	2.2 Project Organization Structure- Scheduling	
	2.3 Project Organization Structure-Controlling	
	2.4 Project Organization Structure-CPM	
	2.5 Project Organization Structure-The PERT Model	
	2.6 Project Management using BIM	
3	Name of Module 3: Project Cost Analysis	09
	3.1 Project Cost Analysis	
	3.2 Updating a Project	
	3.3 Resource Allocation and Leveling	
	3.4 Line of Balance Technique	
4	Name of Module 4: Smart City Project Management with Case Studies -	09
	4.1 Smart Project Planning	
	4.2 Smart Project Scheduling	
	4.3 Smart Project Monitoring	
	4.4 Smart Project Controlling	
	4.5 Project Risk Management	
	4.6 Case Studies on Smart Cities	
5	Name of Module 5: Safety, Security and Disaster Management for Smart Citizen-	09
	5.1 Safety, Security and Disaster Management for Smart Citizen	
	5.2 Disaster Risk Reduction (DRR) Overview	
	5.3 Smart Cities and Disaster Management	
	5.4 DRR Framework for Smart Cities	
6	Name of Module 6: Thematic Analysis and Resilience Strategy for Smart Cities-	09
	6.1 Thematic Analysis, Infrastructure Data/Digital Services	

	6.2	Data Management and Analytics	
	6.3	Resilience Strategy for Smart Cities	
	6.4	Stakeholder Capacity Building, Self-Assessment at project and city level	

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

1. Explain role of project management in developing the Smart Cities.
2. Evaluate the risk and uncertainties throughout all the phases of Smart City projects.
3. Compare application of modern project management tools for flawless implementation of smart city projects.
4. Evaluate the managerial approach that deals with the problems and opportunities challenges of modern society of developing and managing a smart city.
5. Apply such concepts and tools for smart infrastructure and cities.

Internal Assessment

20 Marks

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

End Semester Examination

80 Marks

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

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

Reference Books:

1. "Principles of Sustainable Project Management" by Mohamed Salama, Goodfellow Publishers
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
7. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
8. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
9. Smart City Tech Planning Handbook by Wade Sarver
10. <https://www.projectsmart.co.uk/project-management-ebooks.php>

Smart Cities: Semester VII		
Course Code	Course Name	Credits
HSCC701	Smart Urban Infrastructures	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 Hrs.		-		100

Rationale

The smart city infrastructure is the introductory step for establishing the overall smart city framework and architecture. The scope of these cities is mainly limited to construct a technology park converting the industrial real estate to state-of-the-art information technology using the evolution in the telecom and IP networks including insignificant asset management automation system. Urbanization is not only associated with economic development but over the time it started aspiring people to better quality of life. Cities are seen as solutions for boosting economy, generating employment, creating skills, providing better health services and many more things. However, the state of urban service delivery in India's cities and towns is far poorer than is desirable for India's current income levels. Considering that the Indian economy has been one of the fastest growing economies in the world for some time, and aspirations and standards are raising, the current state of service delivery is simply unacceptable. Moreover, a successful city cannot operate efficiently in isolation from its environment. It must balance social, economic and environmental needs. Smart Cities focus on their most pressing needs and on the greatest opportunities to improve lives. They tap a range of approaches – digital and information technologies, urban planning best practices, public private partnerships, and policy change to make a difference.

Objectives

1. To study application of Solar Energy for Smart Cities-Conventional vs. Smart City
2. To prepare the qualified resource persons for the upcoming specialization in solid waste management practices after the mission period of SBM i.e., after 2020.
3. To learn from the challenges and limitations faced in e-governance projects in Citizen Services delivery, industries and commerce and intra-government systems for efficiency and transparency.
4. To develop ability to conceptualize, design, implement and manage the new era smart e-governance projects.
5. An understanding of the urban water supply and sanitation systems and linkages with urban forms.
6. Understanding the fundamentals of large project financing-Financial markets for smart city project finance such as syndicated bank loans, capital markets, private equity fund, multilateral institutions, joint ventures, public-private-partnership (PPP)
7. Understanding the projects and their business risks.
8. Understanding the documentation used to structure individual large project financings.

Detailed Syllabus

Module	Course Module / Contents		Hours
1	Conceptualization of Smart Energy System for Smart city:		08
	1.1	Application of Solar Energy for Smart Cities, Conventional vs. Smart City, Green approach to meet Energy demand, Energy scenarios of conventional cities, Energy Efficient Building	
	1.2	Meeting energy demand through direct and indirect solar resources, Efficiency of indirect solar resources and its utility, Structure of Smart Grid, Indian Perspective, Advantage and limitation	
	1.3	Renewable in Smart grid Structural concept, Specific applications, Perspective in Smart Cities	
	1.4	Application of Solar in mobility, Matching demand and supply of energy in typical Smart city through Green mobility	
2	Smart Water Management in Smart Cities-		10
	2.1	Introduction to water Bye-Laws	
	2.2	Details of Water Supply system, various stages in implementing the system	
	2.3	Planning Stage: Conversion of existing maps to GIS	
	2.4	Assessing earlier population forecast, Demand estimation	
	2.5	Validation of ground elevations	
	2.6	Design Stage: Hydraulic model of distribution system	
3	Solid Waste Management in Smart Cities		09
	3.1	Introduction to an effective urban Solid Waste Management (SWM) with 5Rs, MSW Characteristics and Quantities, MSW Rules 2016, Swachh Bharat Mission and Smart Cities Program	
	3.2	Disposal of Municipal Solid Waste: Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, case study of any Smart Cities in the Country	
	3.3	Construction and Demolition (C&D) Waste Management - Overview, Regulation, Beneficial Reuse of C&D Waste Materials, E-Waste Management Issues & Challenges and Status in India, E-Waste Management Rules 2016 and Management	
	3.4	Critical examinations of SBM endeavor with special emphasis on clean city rankings along with case study on solid waste management	
4	Smart Transportation in Smart Cities-		08
	4.1	Introduction of "Smart Transport"	
	4.2	Application of traffic engineering to smart cities: Level of service, Traffic system management, reduction of conflicts, signal design	
	4.3	Smart pavement materials: plastic pavement, porous pavement, electric generating roads (Piezo electric roads) etc.	
	4.4	Introduction to Urban Transportation system planning: Trip Generation, distribution	
	4.5	Modal split and traffic assignment	

	4.6	Highway economics	
5	Smart sanitation and storm water drainage system for Smart city-		09
	5.1	Crisis of Sanitation- India, Key Sanitation policy issues and goals, Benchmarks for Smart Sewerage and Sanitation, steps required to achieve these benchmarks	
	5.2	Need of sewer model, Assessment of sewerage system at Planning and Design stage for transforming into smart sanitation	
	5.3	Sludge Management, Wastewater Reuse and Recycling. Need of Storm water drainage system, Storm water Planning, Challenges in Sustainable Storm water Planning	
	5.4	Trends and issues in storm water system Storm water management to for sustainable water management in Indian smart cities	
6	Smart Funding for Smart Cities-		08
	6.1	Financing Smart Cities Development-Types of sources for sustainable smart city funding: GOI seed capital grant of Rs 500 crore to each smart city, Leveraging this grant for funding from open sources, Business Risk Assessment, Public Private Partnership PPP concept and Modes of Smart City funding-BOOT, BOT, BOO, DBFOT etc.	
	6.2	PPP Request for Qualification (RFQ) and Criteria as per Planning Commission guidelines (Case Study), PPP request for Proposal (RFP) along with Concession agreement terms and conditions as per Planning Commission Guidelines	
	6.3	Debt funding, Consortium of financiers, Guarantees and mortgage, Joint venture, Municipal Bonds, Documentation of debt funding, Equity Funding through Initial Public Offer	
	6.4	Private equity funding and risk factors in IPO, Procedure of IPO funding, Other funding sources like Viability gap funding, Special subsidy for the project, Merger and Acquisition, Long term Lease, Financing etc.	

Contribution to Outcome

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

1. Smart Energy System required for Smart city.
2. Explain the effective urban Solid Waste Management practices, MSW rules.
3. Evaluate the importance of best sanitation practices, storm water management and its linkage for the smart city transition.
4. Describe the evolution of e-governance and smart public services to be provided for developing and managing a smart city.
5. Evaluate application of traffic engineering to smart cities

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. "Water, Wastewater, and Stormwater Infrastructure Management", by Neil S. Grigg, CRC Press Taylor and Francis Group
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "Municipal Stormwater Management" by Debo, Thomas, Reese, Andrew, Lewis Publishers
7. "State of the Capital: Creating a Truly Smart City", by K.S. Mehra, Rupa Publications India
8. Security in Smart Cities: Models, Applications, and Challenges", by Aboul Ella Hassanien Mohamed Elhoseny, Syed Hassan Ahmed, Amit Kumar Singh Published by Springer
9. "Transportation and Power Grid in Smart Cities: Communication Networks and Services" by Melike Erol-Kantarci, Hussein T. Mouftah, Mubashir Husain Rehmani, Wiley Publications
10. Cities and Mobility & Transportation: Towards the next generation of Urban Mobility by Pascual Berrone, Joan Enric Ricart Costa, Ana Duch T-Figueras, IESE CITIES IN MOTION: International.

Smart Cities: Semester VII						
Course Code		Course Name				Credits
Lab 1: HSCSBL701		Smart City-Project Management				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

Rationale

Smart City projects involve great technical complexity. It requires a widespread diversity of skills to control and monitor them. For any smart infrastructure project management would be an integral part. Like other complex infrastructure projects; smart city projects are subjected to risk and uncertainties leading to huge time and cost overrun. Project managers are faced with many problems that are putting together subjected to constrained resources, finance, time, and environmental uncertainty. Therefore, project management plays an important role in the development of the Smart Cities. It provides the technical and managerial competency, communication and decision making necessary to meet the challenges of complex activities. It has grown in response to the need for a managerial approach that deals with the problems and opportunities of modern society. A successful city operates efficiently only when it balances social, economic and environmental needs. Smart Cities focus on their most demanding needs to improve lives. They tap various approaches like digital and information technologies, urban planning best practices, public private partnerships, capacity building, policy change to achieve the success.

Course Objective:

1. To acquire knowledge on various components of Smart Cities.
2. To study ongoing projects and their business risks
3. To understand documentation, financings, capacity building used to structure individual large project
4. To study urban water supply, sanitation, solid waste management, transportation & application of Solar Energy for Smart Cities

List of Experiments (Conduct three practical out of six practical's mentioned below)		
Module	Detailed Content	Lab Session / Hours.

1	Preparing a report on Project Management- Phases-Stages of project -Work Break down Structure of Smart city in India (Ongoing Smart City Project-Case study).	08
2	Preparing a report of Project Cost Analysis-Resource Allocation and Leveling, Line of Balance Technique (Ongoing Smart City Case Study).	08
3	Preparing a report on Smart Energy System for Smart city (Ongoing Smart City-Case Study).	08
4	Preparing a report on Smart Water Management in Smart Cities (Ongoing Smart City-Case Study).	08
5	Preparing a report on Solid Waste Management in Smart Cities (Ongoing Smart City-Case Study).	08
6	Preparing a report on Smart Transportation in Smart Cities (Ongoing Smart City-Case Study).	08

Course Outcomes:

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

1. Compare various stages of project of smart city.
2. Evaluate the effective urban Solid Waste Management practices, MSW rules.
3. Compare the importance smart water management, best sanitation practices, storm water management and its linkage for the smart city transition.
4. Prepare application of traffic engineering to smart cities

Assessment:

- Term Work Including Laboratory Work and neatly written project report of the work done.
Laboratory Work: 50 Marks
- End Semester Oral Examination: 50 Marks

Recommended Books:

1. Manual on Water Supply and Treatment, (latest Ed.): Ministry of Urban Development, New Delhi
2. Manual on Wastewater Treatment 3rd Ed. Pub: CPHEEO, Ministry of Urban Development, Govt. of India, New Delhi,
3. Municipal Solid Waste Management Manual, (Part1,2,3) Ministry of Urban Development, CPHEEO, 2016
4. Refer various websites of municipal corporations of the cities selected under the smart city mission to study success story,
5. Refer following official government websites
 - <http://cpheeo.gov.in>
 - <https://moef.gov.in/en/>

Smart Cities: Semester VIII		
Course Code	Course Name	Credits
HSCC801	Smart Management of Smart Urban Infrastructures	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

The introduction of Smart urban technologies into legacy infrastructures has resulted in numerous challenges and opportunities for contemporary cities and will continue to do so. Over the past few years, advances in the Information and Communication Technologies (ICTs) have significantly challenged the traditionally stable landscape of urban infrastructure service provision. This has resulted in increasing interest from both technology vendors and public authorities in the transition of cities towards so-called “Smart Cities”. Although such “Smart technologies” can provide immense opportunities for citizens and service providers alike, the ICTs often act as disruptive innovators of urban infrastructure service provision.

Objectives

1. Enable students to develop competence in planning of projects at the city level to ensure sustainability of environment and humans
2. Enable students to apply smart technologies across the spectrum of infrastructure and governance
3. Enable students to develop overall city strategy to become contemporary and competitive
4. Enable students to understand city centric capital formation and finance, risk and feasibility to ensure the economic health of the city

Detailed Syllabus			
Module	Course Module / Contents		Hours
1	Management of Smart Urban Infrastructures		08
	1.1	Issues and Challenges in Construction and Maintenance of Infrastructure, Information Technology and Systems for Successful Infrastructure Management	

	1.2	Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques	
	1.3	Capacity Building and Improving the Governments Role in Infrastructure Implementation	
	1.4	An Integrated Framework for Successful Infrastructure Planning and Management, Infrastructure Management Systems and Future Directions	
2	Management of Smart water, Wastewater System-		10
	2.1	Overview of Urban Water Supply, Rainwater Harvesting, Dual water supply system, water recycling	
	2.2	Building blocks of 24x7 water supply system,	
	2.3	Performance indicator and Benchmark for water supply services	
	2.4	Smart metering, Leakage management & NRW reduction for achieving 24x7 water supply	
	2.5	Smart monitoring through SCADA system for various components of water and sewerage system	
	2.6	Redressal of complaints on real time basis, Current Practices in Wastewater Recycling	
3	Management of Smart Urban Energy Systems		08
	3.1	Meaning of 'Smart Energy Management	
	3.2	Smart Energy Management – Water, Transport	
	3.3	Smart Energy Management-Waste Management and Public Services etc	
	3.4	Challenges and Implementation Barriers for Smart Energy Management, Way forward for achieving integrated Smart Energy Management	
4	Management of Smart Solid Waste System-		10
	4.1	The environmental impact of waste management and its relationship on the sustainable development and smart city development	
	4.2	Management of Solid Waste using IoT	
	4.3	management issues in source reduction, recycling, material recovery and transformation of waste through composting	
	4.4	Implementation of solid waste management options -collection system, energy recovery and landfill disposal.	
	4.5	Biomedical waste management, Economy and financial aspects of solid waste management.	
	4.6	Case Studies of Smart cities having successful solid waste Management program	
5	Name of Module 5: Management of Smart Urban Transportation Systems		08
	5.1	Introduction of "Smart Transport", Smart Automobile and Sustainable fuels	
	5.2	Smart infrastructure-Intelligent Transport systems (ITS), GIS, RS, GPS, Navigation and Identification Systems	
	5.3	Electronic fee payment technology (E-ticketing), Traffic Safety Management	

	5.4	Human and Environmental Impacts, Safety and Sustainability, Case Study: BRTS or Smart Parking with economics and costing, Mobility Services, Smart Mobility	
6	Case Study Towards Smart Cities: Part I & II		08
	6.1	Towards Smart Cities: Part I: (04 hours) The transition of legacy cities to Smart Cities is not a spontaneous process. To get the transition process right, and to the benefit of citizens, cities have to adopt effective management and governance approaches to successfully deal with numerous complexities of this process. This Module will help to understand the most important factors in the transition phase of legacy cities to smart cities and their managerial implications	
	6.2	Towards Smart Cities: Part II: (04 hours) Management of Smart Cities calls for different approaches from conventional urban management approaches, Role of city government in the network of actors who play an important role in management of clean, safe, healthy living conditions. Modern, efficient infrastructure that enables and promotes high-quality work opportunities and high-quality living, Efficient and sustainable use of resources, The city challenges such as city master plans, long term urban plans, city mobility plans, city strategic plans for renewable energy, water sources, waste management, pricing on water, power, tax assessment and frequent revisions, appropriation of resources, water harvesting and recycling, public participatory approach, citizen participation, citizen audit, capacity building in key disciplines, effective urban governance, adoption of ICT facilities, in due respect to local and regional culture, social aspects, safety and security based on economical vibrancy-Smart Cities-Internet of Things (IoT) and Artificial Intelligence (AI).	

Contribution to Outcome

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

1. Explain how to make the best of these smart technologies in your cities' legacy infrastructures.
2. Learn about state-of-the-art strategies for effectively managing the transition from legacy infrastructures to smart urban systems.
3. Evaluate Life Cycle Analysis Techniques and sustainable development of Infrastructure.
4. Describe principles for the management of Smart urban infrastructures as well as the applications of these principles in the various sectors.

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. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil Tata McGraw Hill
2. "Smart Cities Unbundled" by Sameer Sharma, Bloomsbury Publishing India Pvt. Ltd.
3. "Introduction to Smart Cities" by P.P. Anilkumar, Pearson Publications
4. "Smart Cities & Urban Development in India" by N. Mani, New Century Publications
5. "Smart City" by Arun Firodia, Vishwakarma Publications
6. "The Smart City Transformations: The Revolution of the 21st Century" by Amitabh Satyam & Igor Calzada, Bloomsbury Publishing India Pvt. Ltd.
7. "Financing Cities in India: Municipal Reforms, Fiscal Accountability and Urban Infrastructure" by, Prasanna K. Mohanty, SAGE publications India pvt. Ltd.
8. "Transforming Our Cities: Facing Up To India's Growing Challenge: Postcards of Change", by Isher Judge Ahluwalia, Harper Collins publications
9. "Urban Systems Design Creating Sustainable Smart Cities in the Internet of Things Era", by Yoshiki Yamagata, Perry P. J. Yang, Elsevier publications
10. "Internet of Things in Smart Technologies for Sustainable Urban Development" by G. R. Kanaga chidambaresan, R. Maheswar V. Manikandan, K. Ramakrishnan by Springer Publications
11. "Smart Cities: Introducing Digital Innovation to Cities" by Oliver Gassmann, Jonas Bohm, Maximilian Palmie, emerald Publications

University of Mumbai



Syllabus

Honours/Minor Degree Program

In

Waterways Transportation Engineering

FACULTY OF SCIENCE & TECHNOLOGY

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

University of Mumbai
Waterways Transportation 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	HWTC501: Waterways and Ports	04	--	--	20	80	--	--	100	04
	Total	04	-	--	100	-	-	-	100	04
Total Credits = 04										

TE Sem. VI	HWTC601: Design of Ports and Harbour structures	04	--	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										

BE Sem. VII	HWTC701: Port and Harbour Operations and Services	04	--	--	20	80	--	--	100	04
	HWTSBL701: Lab-1	--	--	04	--	--	50	50	100	02
	Total	04	-	04	100	-	50	50	200	06
Total Credits = 06										

BE Sem. VIII	HWTC801: Construction and Management of Port and Harbour	04	-	--	20	80	--	--	100	04
	Total	04	-	-	100	-	-	-	100	04
Total Credits = 04										

Waterways Transportation Engineering : Semester V		
Course Code	Course Name	Credits
HWTC501	Waterways and Ports	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 Hrs.	-	-	-	100

Rationale

Waterways are critically important to the transportation of people and goods throughout the world. The complex network of connections between coastal ports, inland ports, rail, air, and truck routes forms a foundation of material economic wealth worldwide. This subject introduces the basic elements related to waterway engineering.

Objectives

- To understand the historical development of waterways at a national and global level and also the significance of ports and harbours as a mode of transport.
- To understand the present status and different surveys required for the planning of Ports and Harbours.
- To understand the policies related to water transportation in India.
- To understand the natural phenomenon affecting waterways and its elements.
- To understand the coastal protection works and coastal Regulations to be adopted
- To study and understand all the important facilities required at the port for the efficient planning of port.

Detailed Syllabus		
Module	Contents	Hours
1	General: Comparison of different modes of transportation. Types, Characteristics, advantages and disadvantages of water transportation. History of water transportation at world level and at national level. Case studies of countries with excellent water transportation facilities.	04
2	Historical development and Harbour planning: Development and policies related to water transportation in India. Status of river, canal and ocean transportation in India. Classification of harbours, Requirement of Harbour. Harbour components, ship characteristics,	12

	characteristics of good harbour and principles of harbour planning, size of harbour, site selection criteria and layout of harbours. Surveys to be carried out for harbour planning Marine surveys, Topographic survey of marine area. Hydro graphic surveys, Tide Surveys.	
3	Port development and planning: Port building facilities. Differences between Port, Docks and Harbour. Requirement of a good port, Port development in India, Major ports in India. Maritime policies, Port authorities, bodies and associations. Port modernization and new port development (Sagarmala project). Connectivity enhancement Port-linked industrialization and Coastal community development and development of river information services. Environment Impact Statement (EIS). Approvals and mitigation .Case studies of various available Ports in India and abroad.	10
4	Natural Phenomena: Wind, waves, tide formation and currents phenomena, their generation characteristics and effects on marine structures. Wind strength, water waves, origin of water waves, effect of wind duration, and bottom friction and water depth on water waves. Wave form and generation. Velocity, height and length of waves. Diffraction, breaking and reflection of waves, wave action on vertical walls, piles. Beach protection, littoral drift, silting, erosion and littoral drift.	12
5	Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage Types, Objective, principal function and suitability.	06
6	Harbour Terminal facilities and Navigational Aids: Port building facilities, Transit sheds, Warehouses, Cargo handling facility, Services for shipping terminals, Inland port facilities planning, purpose and general description. Necessity of navigation aids and their types, Requirement of signals, Fixed and floating navigation aid.	08

Contribution to Outcomes

After completion of the course work, the students are expected to

1. Develop a strong fundamentals related to waterways transportation Engineering.
2. Understand the present status and different surveys required for the planning of Ports and Harbours.
3. The students shall be in a commanding position to plan and execute hydrographic surveys required at various stages of planning, construction and execution of Port and harbours. Also understand the policies related to water transportation in India.
4. The student will also be able to understand the role and effect of natural phenomenon such as wind and waves on the waterways.
5. Understand the coastal protection works and coastal Regulations to be adopted.
6. The student is expected to get full knowledge related to all the modern techniques and various important methods for effective management of port facilities.

Internal Assessment (20 Marks)

Consisting Two Compulsory Class Tests - First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

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. Docks and Harbour Engineering: *Dr. S.P Bindra*, Dhanpatrai Publications, India
2. Docks and Harbour Engineering: *Hasmukh P. Oza, Gautam H. Oza*, Charotar Publication, India
3. Harbour, Dock and Tunnel Engineering: *R. Srinivasan*, Charotar Publication, India
4. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw – Hill Book Company, New York.
5. PeraBrunn, “Port Engineering”, 1 st Edition, Gulf Publishing Company, 2000.
6. Leslie A.Bryan, “Principles of Water Transportation”, University of Chicago Press

Waterways Transportation Engineering : Semester VI		
Course Code	Course Name	Credits
HWTC601	Design of Ports and Harbour structures	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 Hrs.	-	-	-	100

Rationale

In the subject of Transportation Engineering, study of Harbour, Dock and Port Engineering is essential. This course is designed to give the basic understanding of ports and harbour structures. The course will also cover wide areas such as vessel types, types of harbours, design of entrance channel, turning circle, breakwaters, berthing structures etc. A key feature of this course is to introduce the international practice and technologies in fields of coastal, ports and harbour including the codal requirements for designing the various components of port and harbour structures.

Objectives

1. To make the students understand the basic principles of design of port and harbour structures.
2. To cover the design aspects of areas such as vessel types, types of harbours, design of entrance channel, turning circle, breakwaters, berthing structures etc.
3. To understand the importance of load consideration and will enable the students to calculate the different loads in designing the various components.
4. To introduce the international practices and construction technologies in order to design the foundation and fenders of ports and harbour.
5. To appreciate the design principles and codal requirements for designing a breakwater with the help of model studies.
6. To enable the students in understanding the concept, types and differences of docks and locks in order to navigate safely.

Detailed Syllabus		
Module	Content	Hours
1	Introduction: Ports and harbours – an infrastructure layer between two transport media. Introduction to navigation channel, entrance channel and turning circle.	08

	Design issues: Sea port layout with regards to - wave action- siltation - navigability, berthing facilities.-Vessel type and size	
2	Wind rose and wave rose as per IS 4651, Operational and design wave as per return period, seismic, sidescan and bathymetry charts	08
3	Load consideration and calculations: Environmental Loads: Wind, Currents, Waves. Mooring Loads: Mooring Lines Arrangement, Mooring Line Materials, Mooring Forces. Loads From Cargo Handling and Hauling Equipment and Uniform Distributed Loads. Design Load Assumptions, Uniform Distributed Cargo Loads and Miscellaneous Live Loads, Rubber Tire and Crawler Track Mounted Equipment, Rail-Mounted Cargo, Fixed-Base Equipment, Ship Impact.	12
4	Foundation Design: Vertical Loads on Piles or Piers Due to Changes in Water Level Ice Load of Thermal Origin, Other Ice-Induced Loads design methodology for pier , girder, slab, foundations and fenders - codes and standards	10
5	Design of breakwater and physical model studies on stability. Introduction to effect of breakwater on shoreline, dredging and disposal	06
6	Docks and Locks: Tidal basin, wet docks-purpose, design consideration, operation of lock gates and passage, repair docks - graving docks, floating docks	08
	Total	52

Contribution to Outcomes

After successful completion of the course the students shall be able to

1. Understand the different terminologies and components of port and harbour and will enable the students to understand the design issues.
2. Embrace the concept and principle behind load consideration and will enable the students to determine the different loads as well.
3. Design the foundation of different structures of ports and harbour and explore the codal requirements while designing.
4. Understand the concept of breakwater and will enable the students to design a breakwater.
5. Discuss the various international practices and modern construction technologies introduced in ports and harbour in order to design the foundation and fenders.
6. Understand the purpose of docks and locks with the major differences between them.

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.**

References:

1. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications.
2. Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels by J. W. Gaythwaite, Van Nostrand.
3. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
4. Agerschou, H., Lundgren, H., Sorensen, T., Ernst, T., Korsgaard, J., Schmidt, L.R. and Chi, W.K., (1983). "Planning and Design of Ports and Marine Terminals", A Wiley-Interscience Publication.
5. Per brun (1983). "Port Engineering" Gulf Publishing Co.
6. Docks and Harbour Engineering: Bindra, S. P.; Dhanpat Rai and Sons, New Delhi.
7. Harbour, Dock and Tunnel Engineering: Shrinivas, R.; Charotar Publishing House, Anand
8. Design and Construction of Ports and Marine Structures: Quinn, A. D., Tata Mc-Graw Hill India Publishing House

Additional Reading

IS-4651 Indian standard Code of practice for planning and design of ports and harbour, Bureau of Indian Standards, New Delhi.

Waterways Transportation Engineering : Semester VII		
Course Code	Course Name	Credits
HWTC701	Port and Harbour Operations and Services	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 Hrs.	-	-	-	100

Rationale

Today 80% of the world's cargo is being transported by waterways. The boom in e-commerce has led to the thinning of borders between countries and goods being exchanged seamlessly. Thus, ports have become the bedrock of today's global economy and India is no exception. Thus it's imperative for students to understand how seaport operates and apply the best practices along with the latest industrial developments. This course is designed in line with the contemporary developments. The syllabus covers global port management practices at the regulatory, commercial, technological, operational and financial levels. The shipping industry has myriad complexities and the syllabus provides students wide-ranging and up-to-date understanding required to thrive in today's highly competitive and evolving environment.

Objectives

1. To study History of Ports, its evolution, Governance and Ownership structure.
2. To Understand different types of logistic integration, Port operations and services.
3. To study planning of vessel movements and improvement of Port capacity.
4. To study the different types of International agreements which are the tools for growth in Indian ports.
5. To study and analyze traffic forecasting in order to plan the port operations effectively.
6. To study port authorities and regulatory framework

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Introduction	08
	1.1 The History of Ports: Ports history, Planning, and Development.	
	1.2 Port Ownership, Structure, and Organization. Port Governance and Structural Type.	
	1.3 Port Workforce: Productivity, Growth, and Empowerment Strategies. Measuring Productivity, Throughput, and Growth.	
	Connecting Hub port Gateways to the Inland Infrastructure	

2	2.1	Logistics Integration of Port Activities: The Five Stages of Integration for the Maritime Industry.	08
	2.2	Strategic Location and Market Accessibility for Existing and Emerging Seaports.	
	2.3	Ports' Success Factors. Supply Chain Opportunities, Competition, and Conflict Prevention	
3	Port Operations		14
	3.1	Terminal Operators; Property Leasing Opportunities. Port Management Services and Operations. The Harbourmaster's Department and Functions, Terminal Manager, Vessels' Planning.	
	3.2	The Four Stages of Port Management and Operations: Leasing Opportunities, Marine Terminal Operator (MTO) Agreements and Leasing Opportunities and MTO case studies	
	3.3	Charter Party Types, Charter Party Clauses and Areas of Dispute, The Port and Charter Party Terms	
	3.4	The Components of Shipbuilding, Intellectual Property Rights, The History of Shipbuilding, Reasons for Shipyards Losing Market Share, Contemporary Shipbuilding Trends, Shipbuilding and Oil Market Analysis, Global Market Analysis.	
	3.5	Liner Services, Tramp Trade, and Offshore Support Agents. Agency Selection and Practices, Port Agency Responsibilities. General Agency Duties, for Tramp, Liner, and Logistics Services.	
4	International Trade and Port capacity		06
	4.1	The General Agreement on Tariffs and Trade. The World Trade Organization. Ports' Growth and the Global Trade Agreements Matrix.	
	4.2	Traffic Forecasting, Ports and the Principles of Derived Demand, Shipping, Ports, and the Ripple Effect. Optimum Size and Economies of Scale	
	4.3	Port Capacity Utilization, Capacity Management, Capacity Planning and Ports' Technology and Innovation.	
5	Strategic Planning		08
	5.1	Strategic Planning, Development, and Management: Corporate Objectives and factors considered in planning, developing and management	
	5.2	Port Pricing Strategies: Tariff Changing and Competitiveness. Port Pricing. Pricing Systems and Price-Setting Considerations.	
	5.3	KPIs: Measuring Financial and Operational Performance.	
	5.4	Port Equipment and Berth Facilities: Operations and Maintenance, Port Cargo Handling Equipment (CHE). Performance Management and the Human Factor	
6	Port Regulations and Future of Ports		08
	6.1	ISM: International Safety Management ISPS: International Ship and Port Facility Security Code OHSAS and OSHA: Occupational Safety and Health Administration VGP: Vessel General Permit by the US Environmental Protection Agency	
	6.2	ISO 14001: Environmental Management System HAZMAT: Hazardous Materials; HAZWOPER: Hazardous Waste Operations and Emergency Response BWM: Ballast Water Management	
	6.3	Incident Investigation and Root Cause Analysis; Inspections, Surveys, and Audits; Global and National Regulatory Compliance for Ships	

	6.4	Port Development Strategy: Elements of Long-Term Strategic Planning, Strategic Port Planning and Tactical Port Planning, Port Planning and the Factors of Production	
	6.5	Forecasting the Market: Port Management and Forecasting Areas. The Risk Element in Forecasting, Forecasting Methods and Tools	

Contribution to Outcome

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

1. Port operations and planning
2. Port capacity Planning and Forecasting
3. Understand the Key Performance Indicators (KPIs) for strategic planning and management in port operations
4. Understand the different types of International agreements which are the tools for growth in Indian ports
5. Understand the regulatory framework involved in running a port.
6. Understand the traffic forecasting in order to plan the port operations effectively

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 Maria G. Burns , "Port Management and Operations "1st Edition,2015
- 2 Muir Wood, A.M., and Fleming. C.A., "Coastal Hydraulics Sea and Inland Port Structures", 1st Edition, Hallstead Press, 2002.
- 3 Ozha&Ozha, "Dock and Harbour Engineering", 1 st Edition, Charotar Books, Anand., 1990

Reference Books:

- 1 S. Seetharaman, "Construction Engineering and Management", 4 thEdition ,Umesh publications, New Delhi, 1999.
- 2 Richard L. Silister, "Coastal Engineering Volume I & II, Elsevier Publishers, 2000.
- 3 PeraBrunn, "Port Engineering", 1 st Edition, Gulf Publishing Company

Waterways Transportation Engineering : Semester VII		
Course Code	Course Name	Credits
Lab 1: HWTSBL701	Port and Harbour Operations and Services	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

Rationale

This subject is designed to give the basic understanding of ports and harbour structures. The course will also cover wide areas such as design of entrance channel, turning circle, breakwaters, berthing structures etc. Thus it's imperative for students to understand how seaport planned, designed, operates and apply the best practices along with the latest industrial developments. The course equips students with necessary field exposure and makes them aware of complex administration and structural reforms and acquaints them with necessary precautions and precision of this profession.

Course Objectives

- To study and understand all the important facilities required at the port for the efficient planning.
- To make the students to understand design and analysis of port and harbour structures using conventional approach as well as software.
- To understand the importance of load consideration and will enable the students to calculate the different loads in designing the various components.
- To study and analyse traffic forecasting in order to plan the port operations effectively
- To understand organizational behavior and management techniques for management of port.
- To study human resource management skills required at port.

List of Experiments(Any Six)

Exp.No.	Detailed Content	Lab Session / Hr.
1	The visit of any harbour and port to understand the various structures, its construction and operations-Report	02
2	Effect of earth quake and Tsunami on port structures - Case studies	02
3	IT System and Port Planning	02

4	Design of Jetties using STAAD Pro and Midas	02
5	Design of Jetties using Sacs	02
6	Design of breakwater using STAAD Pro and Midas	02
7	Design of breakwater using Sacs	02
8	Planning and Designing of Storage, warehouse using STAAD Pro or any other designing software's.	02
9	Planning of placing the components of Port and estimating its capacity.	02
10	Current Issues in Port Management: Report on Case Study	02
11	Marine Structure, Navigation Aids	02
12	Docks and Repair Facilities, Port Facilities	02
13	Dredging, Coastal Protection	02

Contribution to Outcomes

- Develop a strong fundamental related to waterways transportation Engineering. Understand the different terminologies and components of port and harbour and will enable the students to understand the design issues.
- Understand the concept and principle behind load consideration and will enable the students to determine the different loads as well.
- Understand the concept of design the foundation and breakwater of different structures of ports and harbour and explore the codal and software requirements while designing.
- Understand the Port operations, planning and process of Dredging
- Understand skill required for effective organizational behavior, project management and port management skills.

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 and design 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

The oral examination shall be based upon the entire theory and laboratory syllabus.

Reference Books:

1. Docks and Harbour Engineering: Dr. S.P Bindra, Dhanpatrai Publications, India
2. Docks and Harbour Engineering: Hasmukh P. Oza, Gautam H. Oza, Charotar Publication, India.

3. Port Design - Guidelines and recommendations by C. A. Thoresen, Tapir Publications.
4. Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels by J. W. Gaythwaite, Van Nostrand.
5. Handbook of Offshore Engineering by S.K. Chakrabarti, Elseviers, 2005.
6. Maria G. Burns, "Port Management and Operations "1st Edition,2015
7. Detnorskeveritas, Rules for the Design, Construction and Inspection of Fixed Offshore Structures
8. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
9. SCI/SCOPUS Indexed Refereed International Journals (For Case Studies) 2 Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi. 3 Departmental Laboratory Manual
10. Standard Geotechnical Engineering Handbook
11. NPTEL Video lectures on Practical.

Waterways Transportation Engineering : Semester VIII		
Course Code	Course Name	Credits
HWTC801	Construction and Management of Port and Harbour	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 is a course which deals with various construction equipment and processes of various structures involved in the port and shipping business as well as teaching capable administration strategies for the same. The course equips students with necessary field exposure and makes them aware of complex administration and structural reforms and acquaints them with necessary precautions and precision of this profession.

Objectives

1. To study the various construction equipment and process of Port and harbor structures.
2. To study the construction and maintenances of Fishing Harbor.
3. To understand the process of Dredging
4. To understand organizational behavior and management techniques for management of port.
5. To study human resource management skills required at port.
6. To understand health, safety, security and environment concerns related to port activities.

Detailed Syllabus		
Module	Course Module / Contents	Hours
1	Marine and offshore construction equipment: Basic motions of Barges, crane barges, Offshore derrick barges, semisubmersible barges, Jack-up construction barges, launch barges, pipe laying barges, floating concrete plant. Pile driving equipment.	10
2.	Fishing Harbour Construction	12

	Fishing Harbour and Fish landing centres – Types, Various components of fishing Harbour and landing centre. Land side and water side facilities and structures of fishing Harbour. Small and medium fishing Harbour, Deep sea fishing Harbour, Environmental auditing for fishing Harbour. Dredging and breakwater construction. Layout and construction of Jetties, quays and slipways. Use of different construction materials for shore based and seaside structures. Fishing Harbour maintenance and waste disposal, Water treatment plant in fishing Harbour. Status of fishing Harbours in India.	
3	Dredging General ,Classification of dredging works, Types of dredgers, Uses of dredged material ,Execution of dredging work	06
4	Introduction to Port management: Organizational behavior: Definition, diversity in workplace, Ethics and ethical behavior in organizations. Project Management: Principles of management, Project definition, Project manager skills, Stages of project, Scheduling, Contract Strategy, selection and appointment of contractors, project implementation and execution, closure of project. Port and terminal operations, types of ports and terminals, terminal ownership, port and cargo movements, competition and other challenges facing the industry	08
5	Port Labour, People Management and Port master planning: Historic and current port labour environment, effective management of staff on ports, Labour reforms and social issues, employment framework and employee relations. Introduction to post master planning, land parcelisation, development phasing strategy, developing 30 year masterplan. Terminal Ownership: Impact of port ownership, Privatization benefits and concerns, BOT, BOOT and BOO, Concession agreement, Tariff setting, role of port regulators.	08
6	Health, Safety, Security and the Environment (HSSE) in Ports: Importance of HSSE culture, HSSE concepts, HSS on Ports, safety and security indicators, regulations related to HSSE. Risk awareness and risk management, system approach to port safety and security. Environment management: Introduction, Environment impact, Environment regulations and governance.	08

Contribution to Outcome

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

- 1 Understand the various methods and equipment for the construction of Port and harbor structures
- 2 Understand the construction and maintenances of Fishing Harbor.
- 3 Understand the process of Dredging.

- 4 Understand skill required for effective organizational behavior, project management and port management skills.
- 5 Carry out human resource management in accordance to labour laws and to develop master plan for port.
- 6 Understand the importance of health, safety, security and environment concerns at port and to suggest measure.

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 S. Seetharaman, "Construction Engineering and Management", 4th Edition , Umesh publications, New Delhi, 1999.
- 2 Detnorskeveritas, Rules for the Design, Construction and Inspection of Fixed Offshore Structures.
- 3 R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand
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