Course title: Infrastructure Development and Sustainability: Issues & Policy Perspectives

Course code: PPS 157	**No. of credits:** 2	**L-T-P:** 22-08-00	**Learning hours:** 30

Pre-requisite course code and title (if any): None

Department: Department of Policy & Management Studies

Course coordinator(s): Mr. Shri Prakash	**Course instructor(s):** Mr. Shri Prakash

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Course type: Core	**Course offered in:** 2nd Semester

Course description

Transportation, energy and telecommunications infrastructure are essential for effective functioning and growth across various sectors in an economy. Together, they facilitate commerce, enhance connectivity, enable communication, and play a critical role in promoting sustainability and development. The integration of sustainability into infrastructure planning and implementation is crucial for addressing the environmental, social, and economic challenges associated with rapid urbanization, climate change, and resource depletion.

This course examines the critical relationship between infrastructure development and sustainability, focusing on how policies and practices can address contemporary infrastructure challenges while promoting environmental stewardship, social equity, and economic viability. Students will engage with various issues related to infrastructure and explore policy frameworks designed to create sustainable infrastructure solutions.

This course is divided into four modules. The first module introduces the fundamental concepts of infrastructure development, covering its importance in economic growth, social equity, and environmental management. Focusing on the principles of sustainability, the second module examines how infrastructure development can incorporate environmental, social, and economic considerations. It covers sustainable design practices, resource efficiency, climate resilience, and methodologies for assessing infrastructure sustainability. The third module analyses the policy landscapes and regulatory frameworks that govern infrastructure development. It covers key policies at international, national, and local levels, focusing on their implications for sustainability. In the final module, students will examine recent and relevant real-world examples of innovative infrastructure projects that successfully integrate sustainability principles. Through international and Indian case studies, participants will analyse different initiatives, focusing on their design, execution, outcomes, and lessons learned. The module encourages critical thinking about how innovative practices can be scaled and replicated, addressing current industry challenges and contributing to a sustainable future in infrastructure development.

Learning objectives:

- To orient students on the fundamentals of infrastructure development and its role in economic growth and sustainable development, analyzing the interplay between infrastructure, sustainability, and public policy.
- To help students identify and assess the challenges associated with traditional infrastructure development practices.
- To explore and discuss regulatory frameworks and innovative strategies for promoting sustainable infrastructure solutions.
- To assist students to examine case studies to inform discussions on best practices and lessons learned in infrastructure sustainability.

Course content

Module	Topic	L	T	P
1.	**Introduction to Infrastructure Development Issues** • Role of Basic Infrastructure (Transportation, Energy and Telecommunication) in economic development and quality of life. • Changing demands for infrastructure in light of urban growth, climate change, and globalization. • Overview of historical trends and recent patterns in the development of basic infrastructures in India: Transportation (e.g., Roads & Highways, Railways, Shipping, Aviation); Energy (e.g., Power Plants, Transmission Lines, Distribution Networks, Renewable Energy Installations); Telecommunication (e.g., Mobile Networks, Broadband Networks, Data Centers)	10	0	0

	• Challenges of infrastructure development in India: Funding, Land acquisition, Land laws, Public Private Participation, Role of multilateral and bilateral agencies			
2.	**Sustainability in Infrastructure** • Importance of integrating sustainability considerations into infrastructure development. • Introduction to smart technologies and their role in sustainable infrastructure. • Assessing the environmental repercussions of infrastructure projects • Evaluating social equity and community impacts associated with infrastructure development.	6	0	0
3.	**Policy Frameworks and Regulatory Challenges** • Assessment of international, national and state or local-level policies aimed at promoting sustainable infrastructure. • Policy perspectives on sustainable transportation systems. • Innovations in renewable energy and their potential for infrastructure development. • Sustainable practices within the telecommunication sector • Overview of funding mechanisms, incentives, and public-private partnerships. • Understanding regulatory frameworks governing infrastructure projects (e.g., Environmental Impact Assessment). • Navigating compliance challenges and enforcing environmental regulations.	8	0	0
4.	**Case Studies of Innovative Practices & Initiatives** • International Cases, such as, Copenhagen, Denmark: Cycling Infrastructure and Policy; Portland, Oregon, USA: Integrated Transit System; Singapore: Integrated Public Transportation System; Curitiba, Brazil: Bus Rapid Transit (BRT) System; Los Angeles, California, USA: Sustainable Transportation Initiatives; Ottawa, Canada: Light Rail Transit (LRT) Implementation; Sweden: Eco-Friendly Mobile Network Deployment; Canada: Broadband Infrastructure Expansion; Netherlands: 5G Implementation for Sustainable Development; United Kingdom: National Health Service (NHS) Digital Transformation • Indian Cases, such as, Bengaluru: *Namma* Metro Project; Delhi: The Bus Rapid Transit System (BRT); Mumbai: Mumbai Local Train Network and the Suburban Rail Plan; Pune: Smart City Mobility Initiatives; Ahmedabad: *Janmarg* Bus Rapid Transit System (BRTS); Kerala: Sustainable Urban Transport Project (KSTP); Airtel's Green Initiatives; BSNL's Rural Connectivity Projects; Telecom Regulatory Authority of India (TRAI) Initiatives; Telecom and Disaster Management Initiatives	0	6	0
	Total	**24**	**6**	**0**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (30%)
- **Minor Test-2:** Case Study Presentation on select cases based on Module-4 (20%)
- **Major Test:** Written Test/Term Paper Submission & Presentation (50%)

Learning outcomes

Upon completion of this course, candidates will be:

1. having a comprehensive understanding of the challenges and opportunities in integrating sustainability into infrastructure development (All evaluations)
2. equipped with the knowledge and skills necessary to advocate for and implement sustainable infrastructure solutions in their future careers (All evaluations)

Pedagogical approach

Classroom lectures; Student Seminars; Invited talks from Experts in particular domains including Practitioners and Senior/Superannuated Govt. Officers; Case studies.

Suggested Readings

Module 1:

- Babu, A., & Gupta, V. S. N. (2023). *Sustainable Infrastructure: Challenges and Opportunities*. Allied Publishers Pvt. Ltd.
- Indira, A., & Chandrasekaran, N. (2023). Infrastructure development in India: a systematic review. *Letters in Spatial and Resource Sciences*, *16*, 35. https://doi.org/10.1007/s12076-023-00357-5
- The Economist Intelligence Unit Limited (2019). The Critical Role of Infrastructure for the Sustainable Development Goals. https://content.unops.org/publications/The-critical-role-of-infrastructure-for-the-SDGs_EN.pdf.
- Popescu, C. R., Yu, P., & Wei, Y. (Eds.). (2023). Achieving the Sustainable Development Goals Through Infrastructure Development. IGI Global. https://doi.org/10.4018/979-8-3693-0794-6.
- Ascher, W., & Krupp, C. (2010). *Physical Infrastructure Development Balancing the Growth, Equity, and Environmental Imperatives*. New York: Palgrave Macmillan.

Module 2:

- Fenner, R. A., Sykes, J., & Ainger, C. (2022). *Sustainable Infrastructure: Principles into Practice*. Emerald Publishing Ltd.
- Eisinger Balassa, B., Nagy, N. G., & Gyurián, N. (2024). Perception and social acceptance of 5G technology for sustainability development. *Journal of Cleaner Production*, *467*, 142964. https://doi.org/10.1016/j.jclepro.2024.142964.
- Rastvortseva, S., & Kameneva, E. (2024). Development of national specialization in 5G technologies within the European Union. *Journal of Economic Structures*, *13*(1), 1-21. https://doi.org/10.1186/s40008-024-00334-1.
- Marabissi, D., Mucchi, L., Fantacci, R., Spada, M. R., Massimiani, F., Fratini, A., Cau, G., Yunpeng, J., & Fedele, L. (2018). A Real Case of Implementation of the Future 5G City. *Future Internet*, *11*(1), 4. https://doi.org/10.3390/fi11010004.
- Goel, R., & Tiwari, G. (2014). Promoting Low Carbon Transport in India: Case Study on Metro Rails in Indian Cities. https://unepccc.org/wp-content/uploads/2014/08/case-study-of-metro-final.pdf.
- Vijayalakshmi, S., & Raj, K. (2020). Sustainable Urban Transport Indicators: Case of Mega Cities of India. *SDMIMD Journal of Management*, *10*(2), 27–46. https://doi.org/10.18311/sdmimd/2019/24142.

Module 3:

- OECD (2015). Towards a Framework for the Governance of Infrastructure. Public Governance and Territorial Development, Directorate Public Governance Committee Report. https://ppp.worldbank.org/public-private-partnership/sites/default/files/2022-03/Towards-a-Framework-for-the-Governance-of-Infrastructure.pdf.
- Mehta, P. S., & CUTS Institute for Regulation & Competition. (2009). *Developing infrastructure through an ideal regulatory framework*. CUTS Institute for Regulation & Competition. https://catalogtest.lib.uchicago.edu/vufind/Record/8915079.
- Mani, N. (2012). *Infrastructure development and financing in India: An exhaustive analytical account of various policies and programmes for development of infrastructure in India, covering the following areas ...* New Century Publications. https://catalogtest.lib.uchicago.edu/vufind/Record/9291171.
- IC Centre for Governance. (2013). *"Governance issues in infrastructure development": Lecture series, September 2012-February 2013*. IC Centre for Governance. https://catalogtest.lib.uchicago.edu/vufind/Record/10361588.
- Satyanarayana, G., & Madhusudana, H. S. (2017). *Infrastructure development and the role of Public-Private-Partnership (PPP): An exhaustive, descriptive and analytical account of policies and programmes for the development and upgradation of infrastructure in India*. New Century Publications. https://catalogtest.lib.uchicago.edu/vufind/Record/11667974.
- Mehta, P. S., & CUTS Centre for Competition, I. &. E. R. (2010). *Comparative study of regulatory framework in infrastructure sector: Lessons for India*. CUTS Centre for Competition, Investment & Economic Regulation. https://catalogtest.lib.uchicago.edu/vufind/Record/8602829.

- Haldea, G. (2011). *Infrastructure at crossroads: The challenges of governance*. Oxford University Press. https://catalogtest.lib.uchicago.edu/vufind/Record/8854091.
- CUTS Institute for Regulation & Competition. (2005). *Regulatory Framework for Infrastructure Sector in India*. Seminar Report. CUTS Institute for Regulation & Competition. https://cuts-ccier.org/wp-content/uploads/2019/01/Regulatory_Framework_for_Infrastructure_Sector_in_India.pdf.

Module 4:

- Emanuel, M. (2019). Making a bicycle city: infrastructure and cycling in Copenhagen since 1880. *Urban History*, *46*(3), 493–517. https://doi.org/10.1017/S0963926818000573.
- Gössling, S. (2013). Urban transport transitions: Copenhagen, City of Cyclists. *Journal of Transport Geography*, *33*, 196-206. https://doi.org/10.1016/j.jtrangeo.2013.10.013.
- Oh, S., & Wang, X. (2018). Urban Rail Transit Provides the Necessary Access to a Metropolitan Area: A Case Study of Portland, Oregon, USA. *Urban Rail Transit*, *4*, 234–248. https://doi.org/10.1007/s40864-018-0095-3.
- K. Luk, J. Y., & Yang, C. (2001). Impact of ITS measures on public transport: A Case study. *Journal of Advanced Transportation*, *35*(3), 305-320. https://doi.org/10.1002/atr.5670350308.
- Ibrahim, M. F. (2003). Improvements and integration of a public transport system: The case of Singapore. *Cities*, *20*(3), 205-216. https://doi.org/10.1016/S0264-2751(03)00014-3.
- Manifesty, O. R., & Park, J. Y. (2022). A Case Study of a 15-Minute City Concept in Singapore's 2040 Land Transport Master Plan: 20-Minute Towns and a 45-Minute City. *International Journal of Sustainable Transportation Technology*, *5*(1), 1-11. https://unijourn.com/upload/doc/submission/articleFile-1637923321026-main.pdf.
- Varela, E. N., Öhrling, K., & Moscati, A. (2021). Analysis of the Challenges in the Swedish Urban Planning Process: A Case Study about Digitalization. *Sustainability*, *14*(24), 16333. https://doi.org/10.3390/su142416333.
- Rajabiun, R., & Middleton, C. A. (2013). Multilevel governance and broadband infrastructure development: Evidence from Canada. *Telecommunications Policy*, *37*(9), 702-714. https://doi.org/10.1016/j.telpol.2013.05.001.
- Rajabiun, R. (2019). Technological change, civic engagement and policy legitimization: Perspectives from the rise of broadband Internet as an essential utility in Canada. *Government Information Quarterly*, *37*(1), 101403. https://doi.org/10.1016/j.giq.2019.101403.
- Hallstrom, L. K., Heinrich, A., & Pearson, M. (2017). Beyond Infrastructure: Strategies to Support Adoption and Realize Benefits of Broadband in Rural Canada. ACSRC Report Series # 49-17. https://www.ualberta.ca/en/alberta-centre-sustainable-rural-communities/media-library/reports/acsrc/no-49-17.pdf.
- Oughton, E. J., Frias, Z., Van der Gaast, S., & Van der Berg, R. (2019). Assessing the capacity, coverage and cost of 5G infrastructure strategies: Analysis of the Netherlands. *Telematics and Informatics*, *37*, 50-69. https://doi.org/10.1016/j.tele.2019.01.003.
- Hemasree, R., & Subramanian, C. V. (2022). Understanding the impacts and the influences of Metro rail on urban environment Case studies and the Bengaluru scenario. *ArXiv*. https://arxiv.org/abs/2209.14210.
- Mamillapalli, R. S., & Pusarla, H. R. (2023). Dreaming of profit: case of Bangalore Metro Rail Corporation Limited. *Emerald Emerging Markets Case Studies*, *13*(2), 1-12. https://www.emerald.com/insight/content/doi/10.1108/eemcs-08-2022-0281/full/html#case-tab.
- Sehgal, P. C., & Surayya, T. (2011). Innovative Strategic Management: The Case of Mumbai Suburban Railway System. *Vikalp*, 36(1), 61-72. https://journals.sagepub.com/doi/pdf/10.1177/0256090920110105.
- Agarwal, S., Mullick, A., & Ray, G. G. (2013). An Observational Study on Usability Issues in Mumbai Local Trains. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. https://doi.org/10.1177/1541931213571114.
- Shirke, C., Joshi, G., Kandala, V., & Arkatkar, S. (2016). "Transit Oriented Development and Its Impact on Level of Service of Roads & METRO: A Case Study of Mumbai Metro Line-I". *Transportation Research Procedia*, *25*, 3035-3054. https://doi.org/10.1016/j.trpro.2017.05.297.
- Islam, M. R., Brussel, M., Grigolon, A., & Munshi, T. (2018). Ridership and the Built-Form Indicators: A Study from Ahmedabad Janmarg Bus Rapid Transit System (BRTS). *Urban Science*, *2*(4), 95. https://doi.org/10.3390/urbansci2040095.

- Pathak, S., & Upadhyay, R. K. (2023). Macro level performance study of Ahmadabad bus rapid transit system: Janmarg. *Green Energy and Intelligent Transportation*, *2*(3), 100093. https://doi.org/10.1016/j.geits.2023.100093.
- Kumar, R., & Bose, P. (2022). Case Study Telecom industry and competitive landscape in India: will MTNL and BSNL successfully recover? *IIM Ranchi Journal of Management Studies*, 1(1), 82-98. https://www.emerald.com/insight/content/doi/10.1108/irjms-12-2021-0179/full/pdf.
- Kumar, N., & Singh, M. P. (2018). Telecom Regulatory Authority of India. *Indian Journal of Public Administration*. https://doi.org/10.1177/0019556118783097.
- Karonnon, P., & Rajeev, M. (2023). Policy Impacts on Indian Telecom Services Industry: Sales, Connectivity and Usages. ISEC Working Paper No. 563. https://www.isec.ac.in/wp-content/uploads/2024/04/WP-563-Prajeesh-and-Rajeev_Final.pdf.

Student responsibilities

- At least 75% attendance will be necessary to be able to appear for the final exam.
- Active classroom participation; Critical reflections and timely submission according to the evaluation criterion.

Course Outline prepared by: Mr. Shri Prakash, and Dr. Chandan Kumar

Course Reviewers

1. Prof. D. K. Nauriyal, Professor, Department of Humanities & Social Sciences, Indian Institute of Technology Roorkee (IITR), Roorkee, Uttarakhand, India.
2. Mr Subodh Kumar Jain, Former Member, Infrastructure, Railway Board, Govt. of India.

Additional Information

This Course outline was approved in the 60th Academic Council Meeting held on 24th December 2024 at TERI School of Advanced Studies, New Delhi.