NATIONAL INSTITUTE OF ADVANCED STUDIES

COURSE PLANS

January – May 2026

Course Name	Six Dimensions of Artificial Intelligence
Being offered by Which Programme	Complex Systems Programme
Course Credits	2
Course Teacher(s)	Prof. Nithin Nagaraj (nithin@nias.res.in)
Course Objective	The objective of the course is to introduce and explore 6 dimensions of Artificial Intelligence through original sources in which the ideas first appeared (papers, books, research articles, monographs, blogs etc.). The 6 dimensions are: *Historical, Philosophical, Technical/technological, Ethical, Sustainable/Security* and *Societal/cultural*. *Pre-requisite:* A deep interest in reading original articles on AI and also to engage in critical thinking and writing. This will be a reading-heavy and writing-heavy course.
Lecture/Session Plan	**Historical dimension:** The origins of Artificial Intelligence/ Cybernetics/ machine intelligence, The Dartmouth Summer Research Project on AI (1956), Turing's 1950 paper, McCulloch-Pitts 1943 paper, Backprop. paper (1986), 25 years of Convolutional Neural Networks, AI winters, the GenAI/LLM revolution, future prospects **Philosophical dimension:** The Chinese room argument, mind and machines debate, Artificial Consciousness, the simulation hypothesis and argument, Singularity, Strong and Weak AI, Can AI be conscious? Big data epistemology, Computational positivism **Technical/Technological dimension:** Learning theory basics – the learning paradigms, overfitting, underfitting, bias-variance trade-off, problem of explainability and interpretability (black-box nature of most AI models) Neuroscience & AI, causality and AI, Hallucinations in Gen-AI **Ethical dimension:** Can robots feel pain? Self-agency, free will debates, ownership of data, bias and fairness, creativity & AI, misinformation and copyright issues, deepfakes, misuse and abuse of AI, AI and war, The alignment problem **Sustainability & Security dimension:** carbon footprints of training large models, computational and electrical power usage of large models, sustainable AI (learning from biological systems which are highly energy efficient like the brain), system integrity – backdoor attacks on AI, jailbreaking LLMs, transparency and accountability, privacy and data security **Societal & Cultural dimension:** Impact of AI on society & culture, AI citizenship, Human-AI interactions, Does LLMs have a personality? AI and religion, AI and psychotherapy, AI and values, AI & inequality, AI governance, AI policy debates
Course Evaluations	In-class participation & activities – 25% Assignments – 25% End semester exam (closed book) – 50% Assignments will involve writing critical essays and book/paper/article reviews.

Course Readings	1. Turing, A. M. (1950). Computing machinery and intelligence. *Mind*, *59*(236), 33-60. 2. McCarthy, J., Minsky, M. L., Rochester, N., & Shannon, C. E. (2006). A proposal for the dartmouth summer research project on artificial intelligence, august 31, 1955. *AI magazine*, *27*(4), 12-12. 3. McCulloch, W. S., & Pitts, W. (1943). A logical calculus of the ideas immanent in nervous activity. *The bulletin of mathematical biophysics*, *5*(4), 115-133. 4. Rumelhart, D. E., Hinton, G. E., & Williams, R. J. (1986). Learning representations by back-propagating errors. *nature*, *323*(6088), 533-536. 5. Mitchell, M. (2019). *Artificial intelligence: A guide for thinking humans*. Penguin UK. 6. Tegmark, M. (2018). *Life 3.0: Being human in the age of artificial intelligence*. Vintage. 7. Chalmers, D. J. (1995). Facing up to the problem of consciousness. *Journal of consciousness studies*, *2*(3), 200-219. 8. Searle, J. R. (1980). **Minds, Brains and Programs**, *Behavioral and Brain Sciences*, 3: 417–57. 9. Stabinger, S., Rodríguez-Sánchez, A., & Piater, J. (2016, September). 25 years of CNNs: Can we compare to human abstraction capabilities? In *International conference on artificial neural networks* (pp. 380-387). Springer, Cham. 10. Banerjee, S., Agarwal, A., & Singla, S. (2025, August). Llms will always hallucinate, and we need to live with this. In *Intelligent Systems Conference* (pp. 624-648). Cham: Springer Nature Switzerland. 11. Hassabis, D., Kumaran, D., Summerfield, C., & Botvinick, M. (2017). Neuroscience-inspired artificial intelligence. *Neuron*, *95*(2), 245-258. 12. Kitchin, R. (2014). Big Data, new epistemologies and paradigm shifts. *Big data & society*, *1*(1), 2053951714528481. 13. Chalmers, D. J. (2016). The singularity: A philosophical analysis. *Science fiction and philosophy: From time travel to superintelligence*, 171-224. 14. Makridakis, S. (2017). The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms. *Futures*, *90*, 46-60. 15. Christian, B. (2020). *The alignment problem: Machine learning and human values*. WW Norton & Company. 16. Crawford, K. (2021). *The atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press. 17. Mollick, Ethan. *Co-intelligence: Living and working with AI*. Penguin, 2024.

Course Name	Urbanization, Development and Exclusion
Being offered by Which Programme	Inequality and Human Development Programme, School of Social Sciences
Course Credits	2
Course Teacher(s)	Chetan Choithani
Nature of Course	Elective
Course Objective	The course combines theoretical insights with empirical knowledge to critically reflect on urbanization-development relationship. Historically, urbanization has provided a key catalyst for social and economic development. Agglomeration dynamics and scale economies make cities a conducive environment for efficient production of goods and services which foster economic growth. Urban environs also generally promote progressive social ideals, such as women's empowerment. At the same time, urban development processes can be exclusionary, and recent experience of many developing countries shows a disconnect between urbanization and development. This is particularly the case in India where evidence increasingly points to exclusionary urbanization. This course will look at the evolving nature of the cities in their spatial-temporal contexts, urban political economy, the ability of cities to deliver social goods to its inhabitants, and more generally the processes of urbanization and development from the perspective of urban residents. While the focus will be on India, the course will draw on the urban experience from around the world such as that of U.S. to provide a comparative lens. It will also situate India's experience within the wider global context and engage with key urban theories and debates.
Course Evaluations	The course is a seminar course involving discussions of key texts to promote critical thinking. There will be two evaluations: one written exam and one assignment; the assignment could include either an oral presentation or an original term paper or both. The two evaluations carry roughly equal weightage each and students will need to obtain minimum passing marks/grades in both. Attendance carries 10% marks.
Course Readings	Arabindoo, P. (2011). Rhetoric of the 'slum' Rethinking urban poverty. *City*, *15*(6), 636-646.

Benjamin, S. (2008). Occupancy urbanism: Radicalizing politics and economy beyond policy and programs. *International Journal of Urban and Regional Research*, *32*(3), 719-729.
Bhagat, R. B. (2012). A turnaround in India's urbanization. *Asia-Pacific Population Journal*, 27(2), 23-39.
Bhan, G. (2009). Evictions, the urban poor and the right to the city in millennial Delhi. *Environment and Urbanization*, *21*(1), 127-142.
Brenner, N., & Schmid, C. (2014). The 'urban age' in question. *International Journal of Urban and Regional Research*, 38(3), 731-755.
Brenner, N., & Schmid, C. (2015). Towards a new epistemology of the urban?. *City*, 19(2-3), 151-182.
Choithani, C. (2025). Circular male migration, rural-urban linkages and household food security in India. In *Handbook on Rural-Urban Linkages in the Global South* (pp. 192-204). Edward Elgar Publishing.
Choithani, C., Van Duijne, R. J., & Nijman, J. (2021). Changing livelihoods at India's rural–urban transition. *World Development*, *146*, 105617.
Dodman, D., Hayward, B., Pelling, M., Castán Broto, V., Chow, W., Chu, E., ... & Ziervogel, G. (2023). Cities, settlements and key infrastructure. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.
Dyson, J., & Jeffrey, C. (2022). Fragments for the future: Selective urbanism in rural North India. *Annals of the American Association of Geographers*, *112*(4), 1008-1022.
Evans, A. (2018). Cities as catalysts of gendered social change? Reflections from Zambia. *Annals of the American Association of Geographers*, *108*(4), 1096-1114.
Friedmann, J. (1986). The world city hypothesis. *Development and change*, *17*(1), 69-83.
Garschagen, M., & Romero-Lankao, P. (2015). Exploring the relationships between urbanization trends and climate change vulnerability. *Climatic Change*, *133*, 37-52.
Gururani, S. (2020). Cities in a world of villages: Agrarian urbanism and the making of India's urbanizing frontiers. *Urban Geography*, *41*(7), 971-989.
Gururani, S., & Kose, B. (2018). Shifting terrain: Questions of governance in India's cities and their peripheries. *Suburban governance a global view*.
Kundu, A. (2003). Urbanisation and urban governance: Search for a perspective beyond neo-liberalism. *Economic and political Weekly*, 3079-3087.
Logan, J. R., & Molotch, H. L. (1987), "The City as a Growth Machine." In *Urban Fortunes: The Political Economy of Place.* University of California Press, pp. 50-98.
Mukhopadhyay, P., Zerah, M. H., & Denis, E. (2012). Subaltern urbanisation in India. *Economic and Political Weekly*, *47*(30), 52-62.
Nijman, J. (2012). India's urban challenge. *Eurasian Geography and Economics*, *53*(1), 7-20.
Parnell, S., & Robinson, J. (2012). (Re) theorizing cities from the Global South: Looking beyond neoliberalism. *Urban geography*, *33*(4), 593-617.

	Parthasarathy, D. (2011). Hunters, gatherers and foragers in a metropolis: Commonising the private and public in Mumbai. *Economic and Political Weekly*, 54-63. Phadke, S., Ranade, S., & Khan, S. (2009). Why loiter? Radical possibilities for gendered dissent. In M. Butcher and S. Velayutham (eds.) *Dissent and cultural resistance in Asia's cities* (pp. 199-217). Routledge. Pradhan, K C (2013). Unacknowledged Urbanisation: New Census Towns of India. *Economic and Political Weekly*, *48*(36), 43-51. Ramanathan, U. (2006). Illegality and the urban poor. *Economic and Political weekly*, 3193-3197. Robinson, J. (2002). Global and world cities: a view from off the map. *International Journal of Urban and Regional Research*, *26*(3), 531-554. Robinson, J. (2013). *Ordinary cities: Between modernity and development*. Routledge. (Preface and Introduction) Roy, A. (2011). Slumdog cities: Rethinking subaltern urbanism. *International journal of urban and regional research*, *35*(2), 223-238. Roy, I. (2006). Representation and development in urban peripheries: Reflections on governance in Ahmedabad suburbs. *Economic and Political Weekly*, 4363-4368. Sassen, S. (1991). The global city. New York, London, Tokyo. (Chapter 1 and 2). Schmidt-Kallert, E. (2009). A new paradigm of urban transition: tracing the livelihood strategies of multi-locational households. *Die Erde*, *140*(3), 319. Scott, A. J. (2017). The constitution of the city. *Economy, Society, and Urbanization in the Capitalist Era*. (Chapter 1 to 3) Scott, A. J. (2017). The constitution of the city. *Economy, Society, and Urbanization in the Capitalist Era*. (Chapter 4 to 7) Shaw, A. (2005). Peri-urban interface of Indian cities: growth, governance and local initiatives. *Economic and Political Weekly*, 129-136. Simone, A. (2004). People as infrastructure: Intersecting fragments in Johannesburg. *Public culture*, *16*(3), 407-429. Tacoli, C. (1998). Rural-urban interactions: a guide to the literature. *Environment and urbanization*, *10*(1), 147-166. Van Duijne, R. J. (2017). What is India's urbanisation riddle. *Economic and Political Weekly*, *52*(28), 76-77. Van Duijne, R. J. (2019). Why India's urbanization is hidden: Observations from "rural" Bihar. *World Development*, *123*, 104610. van Duijne, R. J., Nijman, J., & Choithani, C. (2022). Injected Urbanism? Exploring India's Urbanizing Periphery. *Economic Geography*, 1-30.
Course structure and contents:	Specific topics that students consider are listed in the course content table below, but these are not definitive or exhaustive.

	Contents
1	**Key urban theories and concepts** - Agglomeration model - Postcolonial urbanism - Planetary urbanization - World City and Global City - The city as a growth machine
2	**Urbanization and development** - Cities as engines of economic growth - Globalization and urban economic restructuring - Comparing urbanization-development experiences of developed and developing world
3	**Rural-urban linkages** - Extended urbanization and complex rural-urban linkages - Circular rural-urban migration and multilocational/stretched households - Urban imaginaries for rural futures
4	**India's early post-independence urban experience** - Industrialization, migration and urbanization in India - Concentrated urbanization and the metropolis - North vs South, East vs West: Spatial patterns of urbanization-development linkages - Urbanization and social change in India?
5	**Economic reforms, urbanization and governance in Indian cities** - India's urbanization riddle: high economic growth but low urbanization - Urbanization and exclusion - Urban growth at India's rural-urban transition - Exclusionary urbanization and policies on housing, water, sanitation - Migrants' right to the city - Gender and the city: Cities as catalysts of gender social change? - Caste and class in India's cities: inequalities, segregation and displacement
6	**Governance/politics in India's urban peripheries** - Peri-urban interface of Indian cities - Governance in India's urban peripheries - Representation and development in urban peripheries
7	**Urban housing and the poor** - The 'slum' rhetoric and illegality and the urban poor - The urban poor's right to the city and

8	**Urbanization, climate change and exclusion** - Cities and climate change: urban heat island, infrastructure vulnerability, public health - Climate migration and cities - Urban (in)equity and climate change's effects

Mandatory readings week-wise

Week 1

Brenner, N., & Schmid, C. (2014). The 'urban age' in question. *International Journal of Urban and Regional Research*, 38(3), 731-755.

Brenner, N., & Schmid, C. (2015). Towards a new epistemology of the urban?. *City*, 19(2-3), 151-182.

Week 2

Scott, A. J. (2017). The constitution of the city. *Economy, Society, and Urbanization in the Capitalist Era*. (Chapter 1 to 3)

Week 3

Robinson, J. (2002). Global and world cities: a view from off the map. *International Journal of Urban and Regional Research*, *26*(3), 531-554.

Robinson, J. (2013). *Ordinary cities: Between modernity and development*. Routledge. (Preface and Introduction)

Parnell, S., & Robinson, J. (2012). (Re) theorizing cities from the Global South: Looking beyond neoliberalism. *Urban geography*, *33*(4), 593-617.

Week 4

Roy, A. (2011). Slumdog cities: Rethinking subaltern urbanism. *International journal of urban and regional research*, *35*(2), 223-238.

Simone, A. (2004). People as infrastructure: Intersecting fragments in Johannesburg. *Public culture*, *16*(3), 407-429.

Week 5

Scott, A. J. (2017). The constitution of the city. *Economy, Society, and Urbanization in the Capitalist Era*. (Chapter 4 to 7)

Week 6

Friedmann, J. (1986). The world city hypothesis. *Development and change*, *17*(1), 69-83.

Sassen, S. (1991). The global city. New York, London, Tokyo. (Chapter 1 and 2).

Week 7: The rural-urban binary

Tacoli, C. (1998). Rural-urban interactions: a guide to the literature. *Environment and urbanization*, *10*(1), 147-166.

Schmidt-Kallert, E. (2009). A new paradigm of urban transition: tracing the livelihood strategies of multi-locational households. *Die Erde*, *140*(3), 319.

Dyson, J., & Jeffrey, C. (2022). Fragments for the future: Selective urbanism in rural North India. *Annals of the American Association of Geographers*, *112*(4), 1008-1022.

Week 8

Kundu, A. (2003). Urbanisation and urban governance: Search for a perspective beyond neo-liberalism. *Economic and political Weekly*, 3079-3087.

Nijman, J. (2012). India's urban challenge. *Eurasian Geography and Economics*, *53*(1), 7-20.

Parthasarathy, D. (2011). Hunters, gatherers and foragers in a metropolis: Commonising the private and public in Mumbai. *Economic and Political Weekly*, 54-63.

Week 9- India's urbanization puzzle (empirics)

Bhagat, R. B. (2012). A turnaround in India's urbanization. *Asia-Pacific Population Journal*, 27(2), 23-39.

Pradhan, K C (2013). Unacknowledged Urbanisation: New Census Towns of India. *Economic and Political Weekly*, *48*(36), 43-51.

Van Duijne, R. J. (2017). What is India's urbanisation riddle. *Economic and Political Weekly*, *52*(28), 76-77.

Van Duijne, R. J. (2019). Why India's urbanization is hidden: Observations from "rural" Bihar. *World Development*, *123*, 104610.

Week 10 - India's urbanization puzzle (theory)

Mukhopadhyay, P., Zerah, M. H., & Denis, E. (2012). Subaltern urbanisation in India. *Economic and Political Weekly*, *47*(30), 52-62.

van Duijne, R. J., Nijman, J., & Choithani, C. (2022). Injected Urbanism? Exploring India's Urbanizing Periphery. *Economic Geography*, 1-30.

Gururani, S. (2020). Cities in a world of villages: Agrarian urbanism and the making of India's urbanizing frontiers. *Urban Geography*, *41*(7), 971-989.

Week 11 – Housing/Poor

Arabindoo, P. (2011). Rhetoric of the 'slum' Rethinking urban poverty. *City*, *15*(6), 636-646.

Ramanathan, U. (2006). Illegality and the urban poor. *Economic and Political weekly*, 3193-3197.

Bhan, G. (2009). Evictions, the urban poor and the right to the city in millennial Delhi. *Environment and Urbanization*, *21*(1), 127-142.

Benjamin, S. (2008). Occupancy urbanism: Radicalizing politics and economy beyond policy and programs. *International Journal of Urban and Regional Research*, *32*(3), 719-729.

Week 12– Governance/politics in India's urban peripheries

Gururani, S., & Kose, B. (2018). Shifting terrain: Questions of governance in India's cities and their peripheries. *Suburban governance a global view*.

Shaw, A. (2005). Peri-urban interface of Indian cities: growth, governance and local initiatives. *Economic and Political Weekly*, 129-136.

Roy, I. (2006). Representation and development in urban peripheries: Reflections on governance in Ahmedabad suburbs. *Economic and Political Weekly*, 4363-4368.

Week 13 – Gender and the city

Evans, A. (2018). Cities as catalysts of gendered social change? Reflections from Zambia. *Annals of the American Association of Geographers*, *108*(4), 1096-1114.

Phadke, S., Ranade, S., & Khan, S. (2009). Why loiter? Radical possibilities for gendered dissent. In M. Butcher and S. Velayutham (eds.) *Dissent and cultural resistance in Asia's cities* (pp. 199-217). Routledge.

Week 14 – Climate change and its impact on the city/urban

Dodman, D., Hayward, B., Pelling, M., Castán Broto, V., Chow, W., Chu, E., ... & Ziervogel, G. (2023). Cities, settlements and key infrastructure. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Week 15 - Presentations/Evaluation

Course Name	People and policy in Indian political economy
Being offered by which Programme	Inequality and Human Development Programme
Course Credits	2
Course Teacher(s)	Prof Narendar Pani
Course Objective	Indian political economy is usually understood from the perspective or economists or policy makers. Yet the working of political economy depends on how people respond to policy, whether they share the government's perceptions or have other priorities. The course will examine the interaction between economic policy and popular values in post-independence India. It will use Hindi cinema to identify popular ways of thinking and then track the interaction between these ways of thinking and official policy. Students will be expected to see the prescribed movies on their own initiative before class.
Lecture/Session Plan	Session 1: People and policy Session 2: Economic options in 1947 [Background film: Awara (1951)] Session 3: Second Plan and suspicion of urbanization [Background film: Jagte Raho(1956)] Session 4: Second plan and ignoring agriculture [Background film: Do Bigha Zameen(1953)] Session 5: India, GATT and global trade [Background film: Pardesi (1957)] Session 6: Green revolution and militarized nationalism [Background film: Upkaar(1967)] Session 7: Family and corruption in Indian political economy [Background film: Yadon ki Barat(1973)] Session 8: Violence as an instrument in Indian political economy [Background film: Deewar (1975)] Session 9: The making of the capital market [Background film: Guru (2007)] Session 10: Liberalization and winner takes all [Background film: Jo Jeetha Wohi Sikander(1992)]

	Session 11: Rise of the global over the local [Background film: Dilwale Dulhaniya Le Jayenge (1995)] Session 12: Inequality as an instrument of economic policy [Background film: Dil Chahta Hai(2001)] Session 13: Informality and power in India political economy [Background film: Dangal(2016)] Session 14: Presentations Session 15: Final exam
Course Evaluations	10 percent of the marks will be for attendance, 40 percent for presentations, and 50 percent for the final exam.
Course Readings	Essential: Francine Frankel, India's political economy 1947-2004 Optional: Jean Dreze and Amartya Sen, An uncertain glory: India and its contradictions Devesh Kapur and Arvind Subramanian, A Sixth of Humanity: Independent India's Development Odyssey

Course Name	A primer to reconstructing climatic and environmental history
Being offered by Which Program	-
Course Credits	2
Course Teacher(s)	P. Ramya Bala
Course Objective	- To introduce basic concepts in reconstruction of climatic and environmental history from natural archives - To expose students to laboratory gold standards and quality control practices - To discuss the use of paleodata in informing policy and management

Lecture/Session Plan	**Module 1: Evolution of Earth systems (6 hours)** - Milankovich cycles, Principles of Stratigraphy, Plate Tectonics - Paleoclimate, Biogeography, Theory of Evolution **Module 2: Geochronology – how do you tell time? (2 hours)** - Introduction to Geochronometers - Radiocarbon dating – principles, instrumentation, uncertainties, interpretation **Module 3: Proxies and Tools in Paleosciences (14 hours)** - 3a. Geochemical: Carbon, Oxygen, Deuterium isotopes (6 hours) - 3b. Biogeochemical: Biomarkers, sedimentary ancient DNA (4 hours) - 3c. Microscopic: charcoal, pollen (4 hours) **Module 4: Introduction to Analytical Techniques in the Laboratory (4 hours)** - Standards, Accuracy and Precision - Commonly used Instrumentation in Paleosciences **Module 5: Laboratory Tour and Instruction (2 hours)** - Advanced Facility for Microscopy & Microanalysis (Indian Institute of Science) - Isotope Ratio Mass Spectrometry (Indian Institute of Science) - Leco CHN Analyzer (National Centre for Biological Sciences) **Module 6: Use of paleodata (2 hours)** - To gain perspective, model validation and potential for prediction
Course Evaluations	Attendance - 10%, 1 assignment - 40%, written examination - 50%

Course Readings	*Mandatory Books (relevant chapters will be provided during the course)* 1. Paleoclimates - Understanding Climate Change Past & Present by Thomas M. Cronin 2. Plate Tectonics: Continental Drift and Mountain Building by Frisch, Meschede and Blakey 3. Instrumental Methods of Analysis by Willard, Merritt and Dean 4. Geochronology and Thermochronology by P.W. Reiners, R.W. Carlson, P.R. Renne, K.M. Cooper, D.E. Granger, N.M. McLean, and B. Schoene. 5. Isotopes: Principles and Applications by G. Faure and T.M. Mensing 6. Using Geochemical Data: Evaluation, Presentation, Interpretation by Hugh R. Rollinson *Additional online reading material* especially important web pages and videos will be provided during the course

Course Name	Perspectives on Technology
Being offered by Which Programme	Inequality and Human Development Programme
Course Credits	2 (two)
Course Teacher(s)	Anant Kamath
Course Objective	1. This course familiarises the student to the central role of technology in development, and to technological change as a controlled, evolving, and often socially-constructed process. 2. To understand how technology and technological change are not straightforward but complex processes, often deeply embedded in sociological processes. 3. To understand individual/social decision-making process around technology.
Lecture/Session Plan	1. **Introduction and Basic Concepts**: this introduces the role of technology and technological change in the process of development, and its role in realising development goals. We analyse the fundamental nature of technological change, including technological paradigms and trajectories, and see how it has evolved through time. Basic terms in technology studies are also introduced. 2. **The Systems of Innovation (SI) Approach**: this unit introduces the first theoretical framework of this course – Systems of Innovation. We understand how

	innovation is a systemic process at national, regional, sectoral, and local levels; and who the actors and processes involved in technological change and innovation are. We also study about technological infrastructure, as well as how innovation and diffusion are measured. 3. **The Diffusion of Innovations:** in this unit, we understand how knowledge and technologies spread. We analyse the fundamentals of networks, the innovation-decision process, as well as attributes of the agents of diffusion. The importance of social networks in the diffusion and development process is a dominant issue in this unit 4. **The Social Construction of Innovation and Diffusion:** this unit presents the theory of the Social Construction of Technological Systems (SCOT) as the second core framework of this course. It demonstrates how sociological and cultural variables shape technologies and their diffusion. We also discuss the feminist understanding of technological change, as well as the lived experience of gender and technology. 5. **Technology and Inequality:** this unit is about the relationship between technology and inequality, in terms of its relationship to modernity, agency, technological inequalities, and mitigation of inequality. 6. **Innovation and Technological Change in India and the Developing World:** the last module takes a vast sweep at critical themes such as building technological capabilities, the digital divide, innovation in the 'South', and finally innovation policy.
Course Evaluations	1. The **written exam** component, where the student would be required to submit a critique of an important science, technology, innovation policy measure. This constitutes 50% of the total assessment, and is conducted at the halfway point of the course. 2. The **response paper** is a written assessment of about 2500 words. The objective here is to explore, disentangle, analyse, and understand the institutional, diffusional, and contextual making of a selected technology (which requires the course

	instructor's approval). This is an exercise in applying the concepts, perspectives, and tools discussed in this course conceptualising a technology. It therefore requires some theoretical reflection with empirical, and is a great opportunity to think creatively and "inter-disciplinarily" about what a technology is. This constitutes 40% of the total assessment and is worked through the entire course, submitted at the end. 3. **Attendance,** which constitutes 10% of the total assessment
Course Readings	See below

Mandatory Readings

Unit 1: Introduction and Basic Concepts

David and Foray (2002) 'An Introduction to the Economy of the Knowledge Society', UNESCO, [pp.9-21]

Unit 2: The Systems of Innovation (SI) Approach

Edquist, C. (2005) 'Systems of Innovation: Perspectives and Challenges', in Fagerberg et al. (eds.)

Unit 3: The Diffusion of Innovations

Rogers, E. (1995) The Diffusion of Innovations, The Free Press, Macmillan, New York**,** chapters 2 (pp.2-35), 4 (pp.136-157), 5 (pp.168-219) and 8 and 9 (excerpts)

Unit 4: The Social Construction of Innovation and Technological Change

Bijker, W.E., and Pinch, T. (1987) 'The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other', in Bijker et al. (eds.) The Social Construction of Technological Systems, The MIT Press, Cambridge, MA

Unit 5: Technology and Inequality

Halford, S., and Savage, M. (2010) 'Reconceptualising Digital Social Inequality', *Information, Communication, and Society*, 13(7): 937-955

Unit 6: Innovation and Technological Change in India and the Developing World

Mani, S. (2009) 'Has India become more Innovative since 1991? Analysis of Evidence and Some Disquieting Features', Working Paper 415, Centre for Development Studies, Trivandrum

Recommended Readings

Unit 1: Introduction and Basic Concepts

UN Millennium Project (2005) Innovation: Applying Knowledge in Development, Task Force on Science, Technology, and Innovation, United Nations, [chap 2,3; pp.20-44]

Unit 2: The Systems of Innovation (SI) Approach

Cowan, David, and Foray (2000) 'The Explicit Economics of Knowledge Codification and Tacitness', Industrial and Corporate Change, 9(2):211-253

Unit 3: The Diffusion of Innovations

Barabasi (2002) Linked: The New Science of Networks, Perseus

Unit 4: The Social Construction of Innovation and Technological Change

Pfaffenberger, B. (1992) 'Social Anthropology of Technology', Annual Review of Anthropology, 21: 491-516

Schwartz Cowan, R. (1976) 'The "Industrial Revolution" in the Home: Household Technology and Social Change in the 20th Century', Technology and Culture, 17(1):1-23
Webster, F. (2006) Theories of the Information Society, Third Edition, Routledge, London and New York

Unit 5: Technology and Inequality

Kamath, A. (2021) 'A Technological Enquiry into Inequality,' Working Paper NIAS/SSc/IHD/U/WP/11/2021, National Institute of Advanced Studies (NIAS), Bangalore
Qiu, J.L. (2009) Working-Class Network Society: Communication Technology and the Information Have-Less in Urban China, MIT Press, Cambridge MA, London

Unit 6: Innovation and Technological Change in India and the Developing World

Nayyar, D. (2010), 'Economic Growth and Technological Capabilities in BRICS', in Fu and Soete (eds.) The Rise of Technological Power in the South, Palgrave [pp.49-67]
Fu and Soete (2010) 'Introduction', in Fu and Soete (eds.) The Rise of Technological Power in the South, Palgrave [pp.1-12]

Course Name	Advanced Energy Systems (Elective Course)
Being offered by Which Program	Energy, Environment, and Climate Change
Course Credits	2
Course Teacher(s)	**Rudrodip Majumdar** and **A.V. Krishnan**
Course Objective	• To introduce the architecture of the energy system. • To impart knowledge regarding advanced firm power generation systems. • To impart knowledge regarding hybrid energy systems and futuristic energy sources (with an emphasis on Hydrogen) • To discuss the Economics and Implications of Advanced Energy Systems

Lecture/Session Plan	❖ **Module -I (3 lectures, 6 contact hours) Basics of Energy System** • Principle of Conservation of Energy → Demonstration of concept through a few practical systems. • Transition Pathway for Clean Energy Generation. ❖ **Module -II (3 lectures, 6 contact hours) Advanced Baseload Generation Pathways** • High-Efficiency Conventional Energy Conversion Systems → Ultra Supercritical (USC) and Advanced Ultra-Supercritical (AUSC) Thermal Power Plants, Integrated Gasification Combined Cycle (IGCC), etc. ❖ **Presentation-I (Evaluation of Students) (1 Lecture, 2 hours)** ❖ **Module -III (4 lectures, 8 contact hours) Hybrid and Futuristic Energy Systems** • **Solar / Wind Hybrid** • **Coal-Concentrated Solar Power (CSP) Hybrid** • **Nuclear- Variable Renewable Energy (Solar) Hybrid System** a) **Nuclear Power Plant (NPP) with Arrangement of Green Hydrogen Production** b) **Cost comparison between Green, Blue and Grey Hydrogen Generation Pathways** ❖ **Presentation-II (Evaluation of Students) (1 Lecture, 2 hours)** ❖ **Module -IV (4 lectures, 8 contact hours) Economics and Implications of Advanced Energy Systems** • Economics and Implications of Advanced Energy Systems • Costs associated with the Decommissioning of Coal-based Power Plants • Reuse and Recycling of Materials Discarded from Energy Installations
Course Evaluations	Assignments (weightage 40%) Final Exam-Written (Weightage 50%) Attendance (10%)
Course Readings	**Educative Primers (Reputed Web Sources)**

	1) Hydrogen Production and Distribution, Alternative Fuels Data Center https://afdc.energy.gov/fuels/hydrogen_production.html **2)** Grey, Blue, Green – why are there so many colours of hydrogen? https://www.weforum.org/agenda/2021/07/clean-energy-green-hydrogen/ **3)** Could Hydrogen Help Save Nuclear? https://www.energy.gov/ne/articles/could-hydrogen-help-save-nuclear **Book Chapters** **4)** K. Saurabh, and R. Majumdar, *'Functional Use-based Positioning of Conventional Vehicles in conjunction with Alternate Low-Emission Fuels'*; In: Shukla P.C. et al. (eds.) Renewable Fuels for Sustainable Mobility: Energy, Environment, and Sustainability (ENENSU) Series. Springer, Singapore, 2023. (https://link.springer.com/chapter/10.1007/978-981-99-1392-3_5) *ISBN 978-981-99-1391-6* ***(Soft copy will be provided personally)*** **5)** K. Saurabh, and R. Majumdar, 'Fuels for Sustainable Transport in India'. In: Di Blasio G. et al. (eds.) Clean Fuels for Mobility: Energy, Environment, and Sustainability (ENENSU) Series. Springer, Singapore, 2022. (https://link.springer.com/chapter/10.1007/978-981-16-8747-1_3) ISBN 978-981-16-8746-4 ***(Soft copy will be provided personally)*** **Journal Articles:** **6)** Gabrielli et al. (2020) The Role of Carbon Capture and Utilization, Carbon Capture and Storage, and Biomass to Enable a Net-Zero-CO_2 Emissions Chemical Industry. https://pubs.acs.org/doi/10.1021/acs.iecr.9b06579 **N.B. Handouts and Class Notes will be provided during the course.**

Course Name	Principles and Method of Archaeology
Being offered by Which Program	Heritage, Science and Society
Course Credits	2
Course Teacher(s)	S. Udayakumar
Course Objective	• **Introduce foundational concepts of heritage and archaeology**: including the nature of archaeological resources, excavation techniques, and exploration methods. • **Interdisciplinary subjects in archaeology:** Includes subjects such as anthropology, geology, environmental science, earth science, art & architecture, technology, zoology and botany. • **Discuss the Prehistory and Protohistory of India**, emphasizing cultural developments and major archaeological findings. • **Examine past technologies and craft traditions**, highlighting their evolution and societal significance. • **Explore ethnographic studies** as a tool for understanding cultural practices and interpreting archaeological data. • **Highlight the importance of experimental archaeology**, including hands-on learning activities that replicate ancient techniques and practices.
Lecture/Session Plan	**Module 1: Introduction to archaeology (5 hours)** - Definition and scope of archaeology - Knowing the Science in Archaeology - Identify the archaeological site in India - Different types of culture sites in India - Craft and Technology of Harapan Civilization **Module 2: Heritage and archaeological reconnaissance (5 hours)**

	- looking into the Historical documents - Understanding the Surface Survey - Methods of identifying the archaeological site in India. **Module 3: People and society in the past (5 hours)** - What is Pre-history and Proto-history of India - Migration of the craftsman society - Religious and ritual beliefs in the society **Module 4: Art and Architecture (5 hours)** - Iconography of South Indian Sculptures - Iconometrey of South Indian Sculptures - Introduction to South Indian temple architecture **Module 6: Craft and past technology (6 hours)** - Introduction to South Indian bronze casting methods -Stone tool knapping and bone tool making technology - Introduction Pottery techniques - Terracotta sculpture techniques **Module 7: Material culture studies (4 hours)** - Introduction to material cultures - understanding typology and technology Past of material
Course Evaluations	• 10% of marks for attendance • 50% of marks for written examination • 40% of marks for assignments
Course Readings	1 Allan, J.W 1979. *Persian Metal Technology, 700-1300 AD.* London.: Ithaca Press. 2. Raman, K.V. 1986. Principle and Methods of Archaeology, Parthajan Publication, Madras. 3. Agrawal, D.P 1971. *The Copper Bronze Age in India*. New Delhi.: Munshiram Manoharlal. 4. Agrawal, P.K 1977. *Early Indian Bronze*. Varanasi.: Prthvi Prakashan. 5. Aitchison, L 1960. *A History of Metals*, Vol. 1. London.: Macdonald & Evans Ltd. 6. Agrawal, D. P 1968. *An Integrated Study of the Copper-Bronze Technology in the Light of*

	Chronological and Ecological Factors. Bombay:. Tata Institute of Fundamental Research. 7. Agrawal, D. P 1969. *The problem of copper hoards: a technological angle*. Asian Perspectives, gvol. iz. 113-119. 8. Chattopadhyay, K. 2000. *India's Craft Tradition*. Publication Division, Ministry of Information and Broadcasting, Government of India. pp. 45-49. 9. Chattopadhyay, P. K. and G. Sengupta. 2011. *History of metals in Eastern India and Bangladesh*. Pentagon Press in association with Infinity Foundation. 10. Gangoly. O.C. 1978. *South Indian Bronze*. Calcutta. 11. Gordon, R.B. 1996. American Iron: 1607-1900, Baltimore. 12. Acharya, P.K. 1946. An Encyclopedia of Hindu Architecture. London. 13. Nagaswamy, R. 1978. South Indian Temple as an Employer, in R. Nagaswamy (ed.) Studies in Ancient Tamil Law and Society, Madras: Government of Tamil Nadu. 14. Michell, George. 2000. Hindu Art and Architecture.Thames And Hudson, World of Art. 15. Sivaramamurti, C. 1996. Indian Painting, National Book Trust, New Delhi. 16. Rao, S.R. 1979. Excavation at Lothal (1955-62). New Delhi: Archaeology Survey of India. Rustam, J. M. 1971. 17. Masterpieces of India Bronze and Metal Sculpture. Bombay Taraporevala Sons and Co. Private Ltd. 18. Agarwal, D.P. 2007. The Indus Civilization An Interdisciplinary Perspective. New Delhi: Aryan Books International. 19. Agrawal, D. P. 2009. Harappan Technology and its Legacy. Delhi: Rupa and Co and Infinity Foundation Series. 20. Possehl, G. L. 1977. The end of a state and continuity of a tradition. In Fox, R. G. (ed.), Realm and Region in Traditional India, Duke University Program in South Asian Studies, Durham, Vol. 4, pp. 234-254. 21. Possehl, G. L. 1990. Revolution in the Urban Revolution: Emergence of Indus Urbanization. Annual Review of Anthropology 19: 261–282 22. Possehl, G. L. 1999. Indus Age: The Beginning. New Delhi: Oxford and IBH Pub-lishing Company.

	23. Possehl, G. L. 2002. The Indus Civilization: A Contemporary Perspective. New Delhi: Vistaar Publications.

Name of the course	Advanced Remote Sensing and GIS (Elective)
Programme Offering the course	Institute-level: Elective
Course credits	2
Course teachers	Sandipta Das and M.B.Rajani
Course objectives	The objective of this course is to introduce students to advanced concepts of remote sensing and GIS with an integrated focus on both theoretical understanding and practical applications. It is desirable that students enrolling in this course have previously completed the basic course "GIS for Spatial Data Visualization and Analysis" offered during the Aug–Dec semester in earlier years. The course aims to develop foundational skills in multispectral, microwave, and thermal remote sensing, image classification, terrain and hydrological analysis, and geospatial modelling using GIS tools. This course also focuses on strengthening students' abilities to analyze, visualize, and effectively present remote sensing and GIS outputs for interdisciplinary research and contemporary spatial challenges.
Lecture/Session Plan	1. Introduction to Advanced Remote Sensing – (Electromagnetic Spectrum, advanced sensors, recent trends). 2. Multispectral Remote Sensing – 1 (Spectral signature, Spectral indices (NDVI, NDWI, NDBI). 3. Multispectral Remote Sensing – 2 (Applications). 4. Microwave Remote Sensing – 1 (Basics principles, scattering mechanisms, SAR satellites and Applications). 5. Thermal Remote Sensing – 1 (Blackbody radiation, thermal properties, TIR sensors and applications). 6. Evaluation – 1 (presentations). 7. GIS for Advanced Remote Sensing Data- (Projections, raster-vector integration). 8. Geospatial Analysis (Extraction, Overlay & Proximity analysis). 9. Geospatial Modelling – Interpolation, Density mapping & hotspot Analysis).

	10. DEM and Terrain Analysis- (Introduction, Terrain Derivatives, 3D Visualisation) 11. GIS-Based Hydrology Analysis – (Introduction to Hydrological GIS, DEM Conditioning for Hydrology, Watershed & Sub-basin Delineation). 12. Visualization of Remote Sensing & GIS Outputs – Thematic maps, Choropleth Maps, Dot maps. 13. Introduction of GPS 14. Introduction of Google Earth Engine 15. Evaluation – 2 (Final Presentations)
Course evaluation	Two assignments (20%); Class project submission (20%) attendance (10%) and written exam (50%)
Course readings	1. Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). *Remote sensing and image interpretation* (7th ed.). John Wiley & Sons. 2. Bhatta, Basudeb. *Remote Sensing and GIS*. 3rd ed., Oxford University Press India, 2020. 3. Joseph G, Jeganathan C (2018) Fundamentals of remote sensing, 3rd edn. Universities Press Pvt Ltd, Hyderabad. 4. M.B.Rajani (2021) Patterns in Past Settlements: Geospatial Analysis of Imprints of Cultural Heritage on Landscapes. Springer Remote Sensing/Photogrammetry. Springer, Singapore. https://doi.org/10.1007/978-981-15-7466-5

Name of the course	Landscape Archaeology and Spatial History: Global and Indian Perspectives (elective)
Programme Offering the course	Heritage Science and Society
Course credits	2
Course teachers	Samayita Banerjee and M.B.Rajani
Course objectives	This course introduces students to landscapes as cultural, historical, and material constructs. Landscape Archaeology investigates how people inhabit, perceive, transform, and remember environments. Spatial History examines how spatial

	relationships, movements, boundaries, and regions shape historical processes. This is a discussion and reading oriented course. Through theoretical readings, case studies, and interpretive exercises (no technical GIS required), students will learn to: ● Understand major theories of landscape archaeology (phenomenology, memory, practice, political landscapes, historical geography). ● Interpret landscapes as texts, narratives, and embodied spaces. ● Analyse spatial patterns of settlement, ritual, mobility, ecology, and power in past societies. ● The role of archaeology and landscapes in nation building ● Develop a small project interpreting a chosen landscape through historical and archaeological lenses.
Lecture/Session Plan	Theme 1 — What is Landscape Archaeology? An Introduction ● Ingold, Tim. "The Temporality of the Landscape." (1993). ● Tilley, Christopher. A Phenomenology of Landscape (1994), selected chapters. Theme 2 — What is Landscape Archaeology? The Indian Context ● Chakrabarti, D.K. Archaeology of Ancient Indian Cities (1995), selected chapters. ● Possehl, Gregory. The Indus Age (2002), selected chapters. Theme 3 — Spatial History and Historical Geography ● Rajani, M. B., & Datta, S. (2025). A Shifting River, Shifting Narratives: The Sacred Landscape of Mahābodhi. *South Asian Studies*, 1-39. ● Chattopadhyaya, B.D. The Making of Early Medieval India (1994), (selected chapters). Theme 4 — Reading Landscapes through Texts, Maps, Material Remains ● Rajani, M. B. (2024). Archaeological landscape of Thotlakonda and Bavikonda near Visakhapatnam, Andhra Pradesh: insights from remote sensing and GIS analysis. *Current Science (00113891)*, *127*(10). ● Beard, Mary (Documentary) Pompeii: Life and Death in a Roman Town. BBC Two, (2010) Theme 5 — Agrarian, Sacred, Ritual, and Mythic Landscapes

	● Sinopoli M. C, From the Lion Throne: Political and Social Dynamics of the Vijayanagara Empire. 2003. ● Settar, S. Inviting Death: Indian Attitudes towards the Ritual Death, (1989) Theme 6 — Unruly Landscapes (+ Class presentations of Assignment) ● Lahiri, N., Rajani, M. B., Sanyal, D., Banerjee, S., & Tiwari, S. (2023). Tracing ancient itinerants and Early Medieval rulers in the forests of Bandhavgarh. *South Asian Studies*, *39*(1), 76-99. ● Hassan, F. A. (1978). Climatic change and the Nile floods. In W. C. Brice (Ed.), *The environmental history of the Near and Middle East since the last Ice Age* (pp. 301–330). Academic Press. **Assignment:** *Landscape Biography Project:* Students selects one landscape (archaeological, sacred, agrarian, urban edge, river, ruin, pilgrimage route, battlefield, memorial site). Write a biography of the landscape across time: ● Formation (natural + cultural) ● Archaeological History: Ritual / political meanings ● Colonial or modern transformations ● Present-day memory or contestation Word limit:1500-2000, can include photos. 15 mins presentation of their work in front of peers. Theme 7 — Global and Indian Case Studies in Landscape Archaeology ● Wilkinson, Tony J. Archaeological Landscapes of the Near East (2003), selected chapters. ● Rajani, M. B. (2021). *Patterns in past settlements*. Springer (for case studies) Theme 8 — Archaeology, Landscape, Heritage and Nation-Building. ● Singh, U. (2017). 'Storage'and 'display': Third world perspectives and practices. in *Museum Storage and Meaning*,Routledge. 120-130. ● Hamilakis Yannis. The Nation and /its Ruins: Antiquity, Archaeology, and National Imagination in Greece, 2007 (selected chapters) Theme 9 — **Landscapes of Memory, Heritage, and the Present** ● Lahiri, N. (ed.). 2017. *Monuments Matter: India's Archaeological Heritage since Independence*. Mumbai: Marg. (selected chapters)

	Theme 10- Examination
Course evaluation	Assignment: 40%; Assignment 2: 20%, Written Exam: 50%, attendance 10%
Course readings	Mandatory Readings: Beard, M. (Presenter). (2010). *Pompeii: Life and death in a Roman town* [Documentary]. BBC Two. Chakrabarti, D. K. (1995). *Archaeology of ancient Indian cities*. Oxford University Press. (Selected chapter) Chattopadhyaya, B. D. (1994). *The making of early medieval India*. Oxford University Press. (Selected Chapter) Hamilakis, Y. (2007). *The nation and its ruins: Antiquity, archaeology, and national imagination in Greece*. Oxford University Press. (Selected chapter) Hassan, F. A. (1978). Climatic change and the Nile floods. In W. C. Brice (Ed.), *The environmental history of the Near and Middle East since the last Ice Age* (pp. 301–330). Academic Press. Ingold, T. (1993). The temporality of the landscape. *World Archaeology, 25*(2), 152–174. https://doi.org/10.1080/00438243.1993.9980235 Lahiri, N. (Ed.). (2017). *Monuments matter: India's archaeological heritage since independence*. Marg. (Selected chapter) Lahiri, N., Rajani, M. B., Sanyal, D., Banerjee, S., & Tiwari, S. (2023). Tracing ancient itinerants and Early Medieval rulers in the forests of Bandhavgarh. *South Asian Studies*, *39*(1), 76-99. Possehl, G. L. (2002). *The Indus age: The beginnings*. University of Pennsylvania Press. (Selected chapter) Rajani, M. B. (2021). *Patterns in past settlements*. Springer. (Selected Chapter) Rajani, M. B. (2024). Archaeological landscape of Thotlakonda and Bavikonda near Visakhapatnam, Andhra Pradesh: insights from remote sensing and GIS analysis. *Current Science (00113891)*, *127*(10). Rajani, M. B., & Datta, S. (2025). A Shifting River, Shifting Narratives: The Sacred Landscape of Mahābodhi. *South Asian Studies*, 1-39.

	Settar, S. (1989). *Inviting death: Indian attitudes towards the ritual death*. Indian Council of Historical Research. (Selected Chapter) Sinopoli, C. M. (2003). *From the lion throne: Political and social dynamics of the Vijayanagara Empire*. Cambridge University Press. Singh, U. (2017). 'Storage'and 'display': Third world perspectives and practices. in *Museum Storage and Meaning*,Routledge. 120-130.(Selected Chapter) Wilkinson, T. J. (2003). *Archaeological landscapes of the Near East*. University of Arizona Press. Additional Readings: David, B., & Thomas, J. (Eds.). (2008). *Handbook of landscape archaeology*. Left Coast Press. Morrison, K. D. (1995). *Fields of victory: Vijayanagara and the course of intensification*. University of California Press. Sharma, R. S. (1983). *Material culture and social formations in ancient India*. Macmillan India. Tilley, C. (1994). *A phenomenology of landscape: Places, paths, and monuments*. Berg. Smith, L. 2006. *Uses of Heritage*. London: Routledge.

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