RMES 507 Human and Technological Systems

Course Syllabus

Instructor	Office	Office Hours	Email	Telephone
Milind Kandlikar	101B Liu; IRES 417	Monday 10 am to noon (IRES)	mkandikar@ires.ubc.ca rmes.courses.ubc@gmail.com	604 822-5918

Class Time and Place: AERL 107

Course Overview

This course introduces students to the role and influence of science and technology in society, and its relationship to public policy, human development and the environment. The influence of science and technology on public policy is bidirectional. Science and technology (S&T) is influenced by policy decisions (policy for science) and in turn influences public policy (science for policy). The course introduces students to basic models for understanding this bidirectional interaction. The approach is multidisciplinary, drawing upon literature in a wide range of disciplines including environmental studies, philosophy of science, economics of technological change, social studies of science, and history of technology. We will also rely upon the extensive literature written by scientists and engineers in their role as policy observers and advisors. While this literature draws heavily on the North American and European cases, the course will also incorporate findings from the developing world.

Learning Outcomes:

By the end of this course, students should be able to:

- Demonstrate broad understanding of the relationships between science, technology and society;
- Articulate the differences and interconnections between science and technology;
- Describe sources of technological change and their influence on the economy, on society and the local and global environment;
- Explain how government policy, including patent protection and government funded R&D, influences the development of new technologies (including 'green' ones);
- Explain how science-policy advisory systems operate, how technology assessment is conducted, and how it can influence public policy;
- Articulate the basic concepts of public perception of science;
- Explain how social groups are active agents in technological change or resistance to technology;
- Apply course concepts and tools to analyze 'real-world' science-policy controversies.

Course Format:

The course consists of one 3-hour session each week, involving both lectures and seminar-based discussions. Lectures will highlight the basics of S&T concepts, while students will play an active role in discussing specific policy interventions during seminars. Throughout the course, readings will use specific case studies to ground theoretical models of the relationship between science and technology and public policy.

Course Requirements

This course will require that students apply concepts from a variety of disciplines. A background in a scientific or technical field is useful but not necessary. Students are expected to attend each class session, to prepare for each session by completing the weekly readings, and to participate actively and constructively in class discussions.

Evaluation Criteria and Grading

The course is graded on a numeric basis, and evaluation consists of:

In-class participation (10%)
Paper presentation (10%)
Critical Reflections on each week's readings (20%)
Group Policy Report (20%)
Case study involving both in-class presentation (10%) and a written report (30%)

The Paper Presentation and Critical Reflections will allow students to demonstrate their understanding of course concepts and major debates within the literature. The Group Policy Report and Case Study will allow them to integrate their emerging knowledge in addressing important "real-world" policy problems.

In-Class (Participation – 10%; Paper Presentation – 10%)
Students are expected to having thoroughly read the assigned readings and prepared to participate actively in class discussions and debates. Given the interdisciplinary nature of the material, this will contribute strongly to their construction of knowledge and to the negotiation of shared understanding within the group. Each student will lead one short paper presentation during the term worth 5% of the course grade. The paper presentations will each summarize a single reading, highlighting key questions and relating the paper's core concepts to the weekly topic and overarching course themes.

Critical Reflections (20%)
Each week, each student will submit a short, one-page written response summarizing the key ideas and/or questions arising from that week's readings. These written responses will ensure that the students complete the readings in a timely manner, as well as evaluating their progress in understanding and articulating course concepts. There will be ten such Critical Reflections over the course of the term, each contributing 2% to the students' course grade.

Group Policy Report (20%)
Throughout the term, students will work in groups of 3-4 to develop a case study examining the perspectives of different stakeholder groups with reference to a major science and technology policy question. Each group will write a report assessing and contrasting the views, incentives, priorities, etc. of the different stakeholder groups. Each group will select their specific topic with guidance from the instructor – cases that address broad and complex science and technology policy topics are strongly encouraged, and may include such debates as support or opposition of public infrastructure projects (e.g. pipelines) government support for green technologies, or privacy concerns around internet data. The Group Policy Report contributes 20% to each student's course grade.

The policy reports will be judged on a) the quality of their description of the science and technology policy question b) the depth of their assessment (specific criteria above) and c) the depth and quality of the supporting information provided. Policy reports will be due during week 10 of the class.

Case Study (Total 40%: Presentation 10% – Written Report – 30%)
Each student will be asked to select a major science and technology topic as a case study with which to apply and integrate the tools and knowledge acquired throughout the term. Whereas the Group Policy Report examined a major policy debate from the perspectives of multiple stakeholders, the individual Case Study will consist of an in-depth examination of a specific science and technology policy, including inherent values, benefits, costs, effectiveness, stakeholders served, stakeholders ignored, criteria for evaluation of outcomes, etc. Each student will then make a brief (20 minute) presentation of their case in-class at the end of term, after which they will submit a written report elaborating on the case and incorporating feedback from the presentation. The Case Study is an individual assignment, and contributes a total of 40% to each student's course grade – 10% from the presentation and 30% from the written report.

The case studies will be judged on a) the quality of their description of the science and technology policy case b) the depth of the analysis (specific criteria above), c) the depth and quality of the integration of tools and knowledge from the course and d) the overall presentation quality. Case studies will be presented and are due the last two weeks of class (students will sign up for a specific presentation/due date).

Course Schedule

Week #	Topics	Readings
Week 1	Course Organization and Introduction	
Week 2	What is Science? What is Technology? Relationship between Science & Technology	**Mokyr (2002); Brooks (1994), Merton(1973)** Skim: NAS (1995), Bush (1945);
Week 3	Sources of Technological Change; Technological Diffusion	**Grubler (2000a); Arthur (2007);** Skim: TBD
Week 4	Technology and Global Change (Agriculture and Industry)	**Grubler(2000b);** Skim: TBD
Week 5	Technology and Global Change (Services)	**Grubler (2000c**); **TBD**
Week 6	Intellectual Property Emerging and 'Green' Technologies; Innovation Snake Pit;	Auerswald and Branscomb (2003); Audretsch(2013); Basberg (1987), Boldrin & Levine (2013), Graham & Vishnubhakat (2013), Greenhalgh & Rogers (2007), Hunt (2001), Jaffe (2000), Varian (2005)
Week 7	Technology and Development	Attaran & Gillespie-White (2001), Forero-Pineda (2006), Frew et al. (2007), Jasanoff (2002), Kammen & Dove (1997), Lewis (2007), World Bank (2008);
Week 8	Technology Assessment	TBD
Week 9	Experts and Science-Policy Advisory Systems	Jasanoff (1996); Jasanoff & Wynne (1998); Jasanoff (1995), NAS (2009); Edwards and Schneider (2001)
Week 10	Management of Risk and Uncertainty in Scientific Debates	Freudenburg (1988), Funtowicz and Ravetz (1990), NAS (2009)
Week 11	Public Perception of Risk and Risk Communication	Slovic (2000a), Slovic (2000b); Morgan (2002); Pidgeon and Fischhoff (2011)
Week 12	Science Policy Controversies GMOs + Pipelines + ….	Herring (2008), Jasanoff (2005); Qaim (2009); Plus TBD
Week 13	Student Presentations	

Required Readings

Arthur, W.B. 2007. The structure of invention. *Research Policy*, vol. 36, pp. 274-287.

Attaran, A., and L. Gillespie-White. 2001. Do Patents for Antiretroviral Drugs Constrain Access to AIDS Treatment in Africa? *Journal of the American Medical Association*, vol. 286, pp. 1886-1892.

Auerswald, Philip E., and Lewis M. Branscomb. "Valleys of Death and Darwinian Seas: Financing the Invention to Innovation Transition in the United States." *The Journal of Technology Transfer* 28, no. 3–4 (2003): 227–39.

Audretsch, David B. *Public Policy in the Entrepreneurial Society*. Edward Elgar Publishing, 2013.

Basberg, B.L. 1987. Patents and the measurement of technological change: A survey of the literature. *Research Policy*, vol. 16, pp. 131-141.

Boldrin, M., and D.K. Levine. 2013. The Case Against Patents, *Journal of Economic Perspectives*, vol. 27, pp. 3-22.

Bozeman, B. 2000. Technology transfer and public policy: a review of research and theory. *Research Policy*, vol. 29, pp. 627-655.

Brooks, H. 1994. The relationship between Science and Technology. *Research Policy*, vol. 23, pp. 477-486. http://sjbae.pbworks.com/w/file/fetch/38907916/Brooks_1994.pdf

Bush, V. 1945. *Science: The Endless Frontier. A Report to the President.* Washington, DC: U.S. Government Printing Office.

Easterly, W. 2007. The Ideology of Development. *Foreign Policy,* July/August, pp. 31-35.

Edwards, Paul N., and Stephen H. Schneider. "Self-Governance and Peer Review in Science-for-Policy: The Case of the IPCC Second Assessment Report." *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, 2001, 219–46.

Foray, D., DC. Mowrey, and R.R Nelson. 2012. Public R&D and social challenges: What lessons from mission R&D programs? *Research Policy*, vol. 41, pp. 1697-1702.

Forero-Pineda, C. 2006. The impact of stronger intellectual property rights on science and technology in developing countries. *Research Policy*, vol. 35, pp. 808-824.

Freeman, Julia. "How Do' Imagined Farmers' Negotiate Actual Risks? Biosafety Trade-Offs in Bt Cotton Production in Andhra Pradesh, India."Accessed April 14, 201http://jpe.library.arizona.edu/volume_19/Freeman.pdf.

Freudenburg, W. 1988. Perceived Risk, Real Risk: Social Science and the Art of Probabilistic Risk Assessment. *Science,* vol 242, pp. 44-49.

Frew, S.E., R. Rezaie, S.M. Sammut, M. Ray, A.S. Daar, and P.A. Singer. 2007. India's health biotech sector at a crossroads. *Nature Biotechnology*, vol. 25, pp. 403-417.

Fu, X., C. Pietrobelli, and L. Soete. 2011. The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-up. *World Development*, vol. 39, pp. 1204-1212.

Graham, S., and S. Vishnubhakat. 2013. Of Smart Phone Wars and Software Patents. *Journal of Economic Perspectives*, vol. 27, pp. 67-86.

Greenhalgh, C., and M. Rogers. 2007. The value of intellectual property rights to firms and society. *Oxford Review of Economic Policy*, vol. 23, pp. 541-567.

Grubler, A. 2000a *Technology and Global Change*. Cambridge, UK: Cambridge University Press. Chapters 1 and 2.

Grubler, A. 2000b *Technology and Global Change*. Cambridge, UK: Cambridge University Press. Chapters 4-6.

Grubler, A. 2000c *Technology and Global Change*. Cambridge, UK: Cambridge University Press. Chapter 7.

Herring, Ronald J. “Opposition to Transgenic Technologies: Ideology, Interests and Collective Action Frames.” *Nature Reviews Genetics* 9, no. 6 (2008): 458–63.

Hu, M.-C., and J.A. Mathews. 2008. China’s national innovation capacity. *Research Policy*, vol. 37, pp. 1465-1479

Hunt, R.M. 2001. You Can Patent That? Are Patents on Computer Programs and Business Methods Good for the New Economy? *Business Review*, Quarter 1, pp. 5-15.

IPCC. 2014. Climate Change 2014: Mitigation of Climate Change. Geneva: Intergovernmental Panel on Climate Change.

Jaffe, A.B. 2000. The US Patent System in Transition: Policy Innovation and the Innovation Process. *Research Policy*, vol. 29, pp. 531-557.

Jasanoff, S. 1991. Acceptable Evidence in a Pluralistic Society. In *Acceptable Evidence: Science and Values in Risk Management*. New York: Oxford University Press.

Jasanoff, S. 1996. Is Science Socially Constructed -- And Can It Still Inform Public Policy? *Science and Engineering Ethics,* vol. 2.3, pp. 263-276.
http://link.springer.com/article/10.1007%2FBF02583913

Jasanoff, S. 1998. *The Fifth Branch: Science Advisers as Policymakers.* Cambridge, MA: Harvard University Press.

Jasanoff, S., and B. Wynne. 1998. Science and decision-making. In S. Raynor and E.L. Malone (Eds.), *Human choice and climate change.* Columbus, OH: Batelle Institute.

Jasanoff, S. 2002. New Modernities: Reimagining science, technology and development. *Environmental Values*, vol. 11, pp. 253-276.

Jasanoff, S. 2005. *Designs on Nature.* Princeton, NJ: Princeton University Press.

Kahan, Dan M., Ellen Peters, Maggie Wittlin, Paul Slovic, Lisa Larrimore Ouellette, Donald Braman, and Gregory Mandel. “The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks.” *Nature Climate Change* 2, no. 10 (October 2012): 732–35. doi:10.1038/nclimate1547.

King, D.A. 2004. The scientific impact of nations. *Nature*, vol. 430, pp. 311-316.

Kuhn, T.S. 1962. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Kammen, D., and M. Dove. 1997. Virtues of Mundane Science. *Environment*, vol. 39, pp. 10-17.

Lane, J. 2009. Assessing the Impact of Science Funding. *Science*, vol. 324, pp. 1273-1275.

Larsen, M.T. 2011. The implications of academic enterprise for public science: An overview of the empirical evidence. *Research Policy*, vol. 40, pp. 6-19.

Lewis, J.I. 2007. Technology Acquisition and Innovation in the Developing World: Wind Turbine Development in China and India. *Studies in Comparative International Development*, vol. 42, pp. 208-232.

Millar, C.I., N.L. Stephenson, and S.L. Stephens. 2007. Climate change and forests of the future: Managing in the face of uncertainty. *Ecological Applications*, vol. 17, pp. 2145–2151. http://dx.doi.org/10.1890/06-1715.1

Merton, Robert K. *The Sociology of Science: Theoretical and Empirical Investigations*. University of Chicago press, 1973.

Mokyr, J. 2002. Innovation in an Historical Perspective: Tales of Technology and Evolution. In , Steil et al. (Eds.), *Technological Innovation and Economic Performance*. Princeton, NJ: Princeton University Press. pp. 23-46.

Mooney, Chris. *The Republican War on Science*. Basic Books, 2006..

Morgan, Millett Granger. *Risk Communication: A Mental Models Approach*. Cambridge University Press, 2002

Mowrey, D.C., and T. Simcoe. 2002. Is the Internet a US invention – an economic and technological history of computer networking. *Research Policy*, vol. 31, pp. 1369-1387.

NAS. 2009. *Science and Decisions: Advancing Risk Assessment*. National Academy of Sciences Press. Chapters 2 and 3.

Oreskes, Naomi. "The Scientific Consensus on Climate Change." *Science* 306, no. 5702 (2004): 1686–1686.

Pidgeon, Nick, and Baruch Fischhoff. "The Role of Social and Decision Sciences in Communicating Uncertain Climate Risks." *Nature Climate Change* 1, no. 1 (2011): 35–41.

Qaim, Matin. "The Economics of Genetically Modified Crops." *Annual Review of Resource Economics* 1, no. 1 (October 10, 2009):

Slovic, P. 2000a. The Perception of Risk. In *The Perception of Risk.* London: Earthscan.

Slovic, P. 2000b. Perceived Risk, Trust, and Democracy. In *The Perception of Risk.* London: Earthscan.

Simon, Denis Fred, and Cong Cao. *China's Emerging Technological Edge: Assessing the Role of High-End Talent*. Cambridge University Press, 2009.

Varian, H.R. 2005. Copying and Copyright. *Journal of Economic Perspectives*, vol. 19, pp. 121-138.

World Bank. 2008. Technology and Technological Diffusion in Developing Countries. In *Global Economic Prospects 2008: Technology Diffusion in the Developing World*. Washington, DC: World Bank.

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,0.

Access & Diversity:
Access & Diversity works with the university to create an inclusive living and learning environment in which all students can thrive. The university accommodates students with disabilities who have registered with the Access & Diversity unit: [http://www.students.ubc.ca/access/drc.cfm]. Students must register with the Disability Resource Centre to be granted special accommodations for any on-going conditions.

Religious Accommodation:
The university accommodates students whose religious obligations conflict with attendance, submitting assignments, or completing scheduled tests and examinations. Students should let their instructor know in advance, preferably in the first week of class, if they will require any accommodation on these grounds. Students who plan to be absent for varsity athletics, family obligations, or other similar commitments, cannot assume they will be accommodated, and should discuss their commitments with the instructor before the course drop date. UBC policy on Religious Holidays:
http://www.universitycounsel.ubc.ca/policies/policy65.pdf

UBC Statement on Respectful Environment for Students, Faculty and Staff
The University of British Columbia envisions a climate in which students, faculty and staff are provided with the best possible conditions for learning, researching and working, including an environment that is dedicated to excellence, equity and mutual respect. The University of British Columbia strives to realize this vision by establishing employment and educational practices that respect the dignity of individuals and make it possible for everyone to live, work, and study in a positive and supportive environment, free from harmful behaviours such as bullying and harassment.