10 Institutional Area, Vasant Kunj
New Delhi – 110070

MINUTES OF THE THIRTY EIGHTH MEETING OF THE ACADEMIC COUNCIL HELD ON 30 JUNE, 2016 AT 09.30 A.M.

PRESENT

The following members of the Academic Council attended the meeting:

Members

Dr Leena Srivastava	Chairperson
Dr Rajiv Seth	
Dr Prateek Sharma	
Mr Amit Kumar	
Dr Malathi Lakshmikumaran	**Invitees**
Dr Anubha Kaushik	Dr M P Ram Mohan
Dr Vivek Suneja	Dr L N Vankatraman
Dr Basudev Prasad	Mr Shri Prakash
Dr Suresh Jain	
Dr Manipadma Datta	
Dr Chaithanya Madhurantakam	
Dr Suneel Pandey	
Dr Pallavolu Maheswara Reddy	
Dr Shaleen Singhal	
Prof S Sundar	
Mr M.V. Shiju	
Dr Naqui Anwer	
Dr Kaushik R Bandyopadhyay	
Dr Nandan Nawn	
Dr Anandita Singh	
Ms Fawzia Tarannum	
Capt. Pradeep Kumar Padhy (Retd.)	Secretary

Dr Arun Kanasal, Dr Rakesh Khosa, Dr Kanchan Chopra and Prof T C Kandpal could not attend the meeting.

The Vice Chancellor welcomed all the members of the Academic Council and Special Invitees.

At the outset, the Council welcomed the following who had become members of the Academic Council:- Dr.Chaithanya Madhurantakam (Head of Department), Mr.M.V.Shiju (Head of Centre), Dr.Sudipta Chatterjee, Dr.Naqui Anwer and Ms Fawzia Tarannum.

The Council placed on record its deep sense of appreciation of the services rendered by the following during their tenure as members of the Academic Council:- Dr.Sitaraman Ramakrishnan, Dr.Priyanka Kaushal, Dr.C.K.Singh and Dr.Vinay SP Sinha.

ITEM NO. 1 To confirm the minutes of the thirty seventh meeting of the Academic Council held on 26 November 2015. The minutes of the thirty seventh meeting of the Academic Council held on 26 November 2015, were circulated to the members and no comments have been received.

TU/AC 38.1.1 The Council resolved that the minutes of the meeting of the Academic Council held on 26 November 2015 be confirmed.

ITEM NO.2 To consider and approve course outlines of LLM programme. The recommendations of the meeting of the Board of Studies of Centre for Post Graduate Legal Studies held on 13 June, 2016 were placed before the Council. Dr Malathi suggested that in the course on 'Research Methods and Legal Writing' more emphasis be given to legal writing component and recommended that the book Elements of Style, 4th edn by Struck Jr., W and White, E.B. (2000). Boston: Pearson, be made compulsory reading in the course. Regarding the evaluation criteria for all the courses, members suggested that the weightage given to various components be reworked keeping in mind the concept of continuous evaluation followed in the University.

TU/AC 38.2.1 The Council resolved that the Course outline of the following six courses of LLM programme be accepted as amended (vide Annexure 1) and approved:-

Ser	Course Title
1	Research methods and legal writing
2	Comparative public law/systems of governance
3	Law and justice in a globalizing world
4	Economic foundations of infrastructure and natural resource law
5	Environmental law and policy
6	Infrastructure law and policy

ITEM NO. 3 To consider and approve the outline of a course in MA (Sustainable Development Practice) programme. The recommendations of the meeting of the Board of Studies of Department of Policy Studies held on 13 June, 2016 w.r.t. MA (SDP) programmes were placed before the Council. Members agreed that the sociological dimension of the course would help students interested in pursuing research work. Members suggested that module-wise suggested reading be listed for the convenience of the students.

TU/AC 38.3.1 The Council resolved that course outline of the following one course of MA (SDP) programme be accepted (vide Annexure 2) and approved:-

Ser	Course Title
1	Development theories and processes

ITEM NO. 4 To consider and approve the course outlines of MBA (Infrastructure) programme. The recommendations of the meeting of the Board of Studies of Department of Business Administration held on 08 June, 2015 w.r.t. MBA (Infrastructure) were placed before the Council. A detailed discussion was held on the bidding system challenges; Prof Datta submitted that all facets of the subject have been covered in the course. Dr Suneja was of the opinion that the courses 'Business Ethics' & 'Integrated Impact assessment' be taught in both programmes of MBA. Members recommended that common classes could be held on law subjects for both MBA & LLM students. Members further recommended changing the title of 'Business laws and infrastructure projects' to 'Business laws' and suggested that role of NGOs and other stakeholders be covered in the Course 'PPP-Challenges & Opportunities'.

TU/AC 38.4.1 The Council resolved that Course outlines of the following twelve courses of MBA (infrastructure) programme be accepted as amended (vide Annexure 3) and approved:-

Ser	Course Title
1	Bidding system management
2	Business ethics
3	Business Laws
4	Contract Law and Management
5	Introduction to infrastructure business
6	Integrated Impact Assessment
7	Land, environmental and other laws
8	Legal and regulatory aspects of infrastructure
9	Project planning and management
10	Public Private Partnership – Challenges and opportunities
11	Risk analysis and implementation management
12	Strategic planning

ITEM NO. 5 To consider and approve revised programme structure of MA/One Year PG Diploma (Public Policy and Sustainable Development) programme. The recommendations of the meeting of the Board of Studies of Department of Policy Studies held on 13 June, 2016 w.r.t. MA.(PPSD)/One Year PG diploma were placed before the Council. The Council appreciated the initiative taken in the field of sustainable consumption and production.

TU/AC 38.5.1 The Council resolved that the Programme structure and Course outlines of the following five courses of MA (PPSD)/One Year PG Diploma (vide Annexure 4) be accepted and approved:-

Ser	Course Title
1	Macroeconomics for public policy
2	Perspectives in sustainability
3	Methodologies I: Statistical analysis
4	Methodologies II: Decision-making in public policy – Analytical and empirical tools
5	Sustainable consumption and production

ITEM NO. 6 To consider and approve revised programme structure and course outlines of the MTech(WSG) and MSc(WSG) programmes. The recommendations of the meeting of the Board of Studies of Department of Water Science and Governance w.r.t. M.Tech, and MSc programmes held on 10 June, 2016 were placed before the Council. Dr Seth brought out that in the learning outcome of 'water planning and management' course, skills being acquired may be indicated. Prof Prateek suggested inclusion of Elements of Surveying in Geo-informatics and restructuring of course on Hydraulics. Members recommended inclusion of pre-requisites in the Advanced Geo-informatics and Ground Water Quality Modelling courses. Further members also recommended that the 3rd semester projects be re-structured and tutorials be included in certain courses.

TU/AC 38.6.1 The Council resolved that Programme Structures of MTech (WSG) and MSc (WSG) programmes and course outlines of the following fifteen Courses be accepted as amended (vide Annexure 5) and approved:-

Ser	Course Title
1	Water Planning and Management
2	Water Law
3	Water quality monitoring methods and analysis
4	Hydraulics
5	Advanced Hydraulics
6	Water resource economics
7	Applied hydrology and meteorology
8	Geo-informatics for water resources
9	Advanced geo-informatics for water resources
10	Water supply and sanitation
11	Aquatic eco-system management
12	Irrigation water and drainage management
13	Groundwater hydrology and pollution
14	Climate change, water resources and agriculture
15	Groundwater quality modelling

ITEM NO. 7 To consider and approve Postdoctoral Guidelines. The draft guidelines on Postdoctoral positions were placed before the council for discussion.

TU/AC 38.7.1 The Council resolved to approve the guidelines on Postdoctoral positions placed at Annexure 6.

ITEM NO. 8 Extension of maximum period for submission of thesis. The Academic Council was requested to consider allowing Ms Madhubhen Sharma, PhD student, an extension of the maximum period (five years) of submission of the thesis.

TU/AC 38.8.1 The Council discussed and approved one year extension for Ms Madhubhen Sharma.

There being no other items for discussion, the meeting was adjourned with a vote of thanks to the Chair.

Sd/
Capt Pradeep Kumar Padhy (retd.)
Registrar

Enclosures:-

Annexure 1
Annexure 2
Annexure 3
Annexure 4
Annexure 5
Annexure 6

Distribution:-

Electronics Copy
1. Vice-Chancellor, TERI University
2. All members of the Academic Council
3. Website

Printed Copy
4. Registrar, TERI University

Annexure 1
(Refers to Item No 2 of minutes of 38th meeting of AC**)**

Course outlines of six Courses of LLM programme.

1. Course title: Research methods and legal writing		
Course code MPL 173	**No. of credits:** 3	**L-T-P:** 24-9-18
Pre-requisite course code and title (if any): Nil		

Course Description

The course aims to build scientific perspective, attitude and skills for systematic enquiry by developing understanding of philosophical foundations of research, various elements of research design and methods and tools for data collection and analysis.

The course will enable comprehension of principles and elements of research methodology, to formulate research problem, objectives and questions. It will introduce students to various methods, tools and techniques related to social and legal research. The focus of the course would be designing studies for applied research. It will also guide them to deal with various ethical and methodological concerns in doing research. The course will also discuss the limitations, benefits, appropriateness, and challenges of using qualitative and quantitative techniques in applied research.

The course has a strong practical component. Field visit is an essential part, which will help students understand the real challenges of conducting social research.

Course objectives

To provide an understanding of various perspectives, methods and tools in social and legal research

To equip students with tools for data collection

To enable students to undertake independent legal research

Course content

Module	Topic	L	T	P
1.	**FOUNDATIONS OF SOCIAL RESEARCH** Understanding its epistemological roots and methodological Options Introduction to Different Perspectives and types of research Dealing with ethical concerns	**4**		
2.	**DESIGNING RESEARCH** Defining the Research Problem and Objectives Literature Review (both theoretical and empirical) and gap identification Developing Research Questions Hypothesis & Types of hypotheses Research Design and Sampling	**6**	**2**	**2**
3.	**METHODS AND TOOLS** Ethnographic Approaches	**5**	**3**	**6**

	Fieldwork and Participant Observation *Interview* Focus Group Discussion Survey and Questionnaire Design Case Study Participatory Approaches			
4.	**Legal Methods** Qualitative Legal Research Case Study Method of Legal Research Comparative Legal Research Inter-disciplinary Legal Research Empirical and Quantitative Legal Research	**5**		**6**
5.	**DATA ANALYSIS** Quantitative Data Analysis Qualitative Data Analysis *Making sense of multiple perspectives: Approaches and techniques for analysis of qualitative data* *Data validation* *Identifying needs and policy priorities* Identifying limitations of research	**4**	**2**	**2**
6.	**Legal Writing** Elements of legal writing. Purpose of legal writing- research, chamber, courts etc. This covers a practical exercise in writing legal, resulting in writing a research note on a legal topic.		**2**	**2**
	Total	**24**	**9**	**18**

Evaluation criteria
Research Problem, Objectives and Research Question (Practical): 20%
Survey Methods (Practical): 25%
Presentation: 25%
Major Test (end semester):30%

Learning outcomes At the end of the course, students would be able to –
1.Carry out independent research pertaining to any specific legal issue
2. Design a research, justifying use of various methods/tools to carry out the same
3. Collect, analyze and interpret both quantitative and qualitative data

Pedagogical approach
In order to support active learning, the lectures in this course are supplemented with a large number of tutorials and practical work. The emphasis of these tutorials and practical hours (field visits) is to encourage the active involvement of students in undertaking tasks that help them better understand concepts / methods / tools in social and legal research. Students practice and learn by doing. Interviewing, focus groups, participatory exercises and survey method are practiced, and evaluated, in the form of role play, in-class activities and group exercises.

Materials

Suggested Readings:

Bryman, A.,(2008). *Social research methods*. 3rd edition. Oxford: Oxford University Press.
Desai, V. and Potter, R. B. (eds) (2006). *Doing Development Research*. London: Sage.
May T. (1997). *Social research: Issues, methods and process*. Milton Keynes: Open University Press.
Robson C. (1993). *Real world research: A resource for social scientists and practitioner-researchers.*
Oxford: Blackwell.
Scheyvens R. and Storey, D. (eds.) (2003). *Development fieldwork: A practical guide*. London: Sage.
Shirley. White A.(1999). *The Art of Facilitating Participation: Realising the Power of Grassroots Communication.* New Delhi: Sage.
Freire, P. (2005). *Pedagogy of the Oppressed*. New York: Continuum.
Cane, P and Kritzer, H.(2010). *The Oxford Handbook of Empirical Legal Research.*
Oxford Handbooks
Verma, SK & Wani, Afzal V (eds) (2001). *Legal Research and Methodology*. New Delhi: Indian Law Institute.
Strunk, W. and White E.B. (2000). *Elements of Style*. 4th ed., New York: Longman.

Other Readings (for specific modules) :

Foundations of social research

Scheyvens R. and Storey, D., 2003, eds., *Development fieldwork: A practical guide*, London: Sage (chapters 8 and 9).
White, H., 2002, 'Combining quantitative and qualitative approaches in poverty analysis', *World Development*, 30(3): 511-522.

Participatory methods

Cooke, B. and Kothari, U., 2001, eds, *Participation: The New Tyranny?* London: Zed Books (chapters 1 and 9).
Mikkelsen, B., 2005, *Methods for development work and research: A new guide for practitioners*, 2nd edition, New Delhi and London: Sage (chapters 2 and 3)
Mosse, D., 1994, 'Authority, gender and knowledge: Theoretical reflections on the practice of participatory rural appraisal, *Development and Change*, 25(3): 497-526.

Ethnographic approaches

Hammersley, M., 1992, *What's wrong with ethnography?* London: Routledge.
Scheyvens R. and Storey, D., 2003, eds., *Development fieldwork: A practical guide*, London: Sage (chapter 4).
Thapar-Björkert, S. and Henry, M., 2004, 'Reassessing the research relationship: Location, position and power in fieldwork accounts', *International Journal of Social Research Methodology* 7(5): 363-381.

Survey methods

Czaja, R. and Blair, J., 2005, *Designing surveys: A guide to decisions and procedures*, 2nd edition, Thousand Oaks and London: Pine Forge.

Grosh, M. and Glewwe, P., 2000, eds., *Designing household survey questionnaires for developing countries: Lessons from 15 years of the living standards measurement study*. Washington, D.C.: World Bank.
Groves, R. M. et al, 2009, *Survey methodology*, 2nd edition, Hoboken: Wiley.

Analysing data

Coffey, A. and Atkinson, P., 1996, *Making sense of qualitative data: Complementary research strategies*, Thousand Oaks, CA: Sage (particularly chapters 1 and 2).
Robson C. , 1993, Real world research: A resource for social scientists and practitioner-researchers. Oxford: Blackwell (chapter on analysing qualitative data).
Silverman D. 2006, Interpreting qualitative data: Methods for analyzing talk, text and interaction, 3rd edition, London: Sage (sections in part two).

Additional information (if any) – Nil

Student responsibilities
Attendance: At-least 75% attendance will be necessary to be able to appear for the final exam.

Course Reviewers:-
Prof. Bindu Ronald, Professor, Symbiosis Law School, Pune
Dr. Anirban Mazumdar, Associate Professor, The West Bengal National University of Juridical Sciences, Kolkata.

2. Course title: Comparative Public Law/Systems of Governance		
Course code MPL 151	**No. of credits:** 3	**L-T-P:** 42-0-0
Pre-requisite course code and title (if any): Nil		

Course Description
Comparative public law as a discipline has assumed renewed significance especially after the cold war with many states in the erstwhile communist block embarking on framing new constitutions. The purpose of this course is to provide a critical understanding of the main issues, trends and methods in comparative public law. The main areas covered in the course are: Constitutionalism, separation of powers, rights, amendment, and emerging trends and issues. An understanding of the subject would help the students to better appreciate a particular legal system in the wider socio-political context in which it operates. The relevance of this discipline has increased with globalization wherein legal ideas, governance structures and even legal terminologies migrate. An attempt is made not to reduce the course to a mere description of select documents and important judicial decisions, but to use the richness of social science literature and methods in the analysis of various topics.

Course objectives
To provide an overview of the scope, uses and methods of comparative public law
To address key areas of comparative public law like separation of powers, rights, and judicial review to better understand and appreciate one's own legal system
To critically analyse new constitutional movements that are changing the boundaries of constitutionalism and constitutional systems

Course content

Module	**Topic**	**L**	**T**	**P**

1	**Comparative Public Law: Overview, uses and methods** Uses, purposes and challenges of comparative law Different methodological approaches: Classificatory, historical, normative, functional, and contextual. The evolving boundary between public and private law Place of constitutional law and administrative law in a legal system	5		
2	**Constitutions: Making, functions and typology** Constitution making: Constituent power, process and the question of inclusiveness, and substance. Functions: Creating organs, conferring power and protection of individual liberties Typology: On the basis of legal character and on the basis of expression of political ideals Sources Constitutionalism	6		
3	**Separation of power: Horizontal and vertical** Different forms of government: presidential, parliamentary, hybrid systems Federal and unitary states; Concept of quasi federalism The changing role of the state, emergence of the regulatory state	6		
4	**Rights** Similarities and differences Content and scope of rights in different constitutional cultures Overlapping rights Cross-jurisdictional variance in realisation of rights Security of state and individual liberties	5		
5	**Constitutional Interpretation and Judicial review** Courts as the authoritative interpreter of the constitution Origins of judicial review, Judicial Activism Limitations	6		
6	**Amendment of the Constitution** Different methods Limitations, Basic structure theory	6		
7	**Emerging trends and issues** Internationalization of constitutional law: Driving forces, divergent practices and criticisms Militant democracy: concept, history, varieties and contestations On-going projects: Global Administrative Law; Global Constitutionalism; Transnational Law	8		
	Total	**42**		

Evaluation criteria
Minor Test: 25%
Class Discussion: 10%
Presentation: 25%
Major Test: 40%

Learning outcomes

On completion of the course the students should:

Be able to understand the similarities and differences between leading legal traditions in key areas like separation of powers, protection of rights and the role of judiciary

Be familiar with the methodology of comparative public law

Be able to use comparative methodology in public law analysis

Pedagogical approach

The pedagogy adopted would be a mixture of lecture and discussion methods. Students would be asked to come prepared with assigned readings and initiate class discussions. Case study method would be used in certain modules. A lot of emphasis will be given to self-study.

Materials

Textbooks

Rosenfeld, M. and Sajo, A. (2012). *The Oxford handbook of comparative constitutional law*. Oxford: Oxford University Press.

Rose-Ackerman, S. and Lindseth, P. L. (2010). *Comparative Administrative Law*. Cheltenham: Edward Elgar.

Suggested Readings

Books

Menski, W. (2006). *Comparative law in a global context: The Legal Systems of Asia and Africa*. Cambridge: Cambridge University Press. Ch. 1.

Ginsburg, T. (2003). *Judicial review in new democracies: Constitutional courts in Asian cases*. Cambridge: Cambridge University Press. Chs. 1 & 8.

Chemerinsky, E. (2015). *Constitutional law: Principles and policies*. 5th Ed. New York: Aspen Law & Business. Chs. 1 & 2.

Singh, M. P. (2011). *Comparative constitutional law*. 2nd Ed. Lucknow: Eastern Book Company.

Articles

Hirschl, R. (2013). From comparative constitutional law to comparative constitutional studies. *International Journal of Constitutional Law, 11 (1),* 1-12.

Tushnet, M. (1999). The possibilities of comparative constitutional law. *Yale Law Journal, 108,* 1225-1309.

Tushnet, M. (2013). Constitution making: An introduction. *Texas Law Review, 91,* 1983-2015.

Baranger, D. and Murray, C. (2013). Systems of government. In Tushnet, M., Fleiner, T., and Saunders, C.(Eds.), *Routledge Handbook of Constitutional Law*. Oxon: Routledge.

Chibub, J. A., Elkins, Z., and Ginsburg, T. (2013). Beyond presidentialism and parliamentarism. *British Journal of Political Science, 44 (3),* 1-30.

Kennedy, D. (1982). The stages of the decline of the public/private distinction. *University of Pennsylvania Law Review, 130,* 1349-1357.

Alexander, L. and Schauer F. (1997). On Extrajudicial Constitutional Interpretation. *Harvard Law Review, 110 (7),* 1359-1387.

Moran, M. (2002). Understanding the Regulatory State. *British Journal of Political Science, 32 (2),* 391-413.

Additional information (if any) - Nil
Student responsibilities: Students are expected to actively participate in the class discussion. In addition, students are expected to write response papers to some articles discussed in the class.

Course Reviewers:
Dr. Vishnu Konoorayar, Max Planck Institute for European Legal History.
Dr. Jasmine Joseph, The West Bengal National University of Juridical Sciences. Kolkata.

3. Course title: Law and justice in a globalizing world		
Course code: MPL 153	**No. of credits:** 3	**L-T-P:** 42-0-0
Pre-requisite course code and title (if any): none		
Course description: This course builds on the understanding of international law gained by students at the undergraduate level and is intended as an advanced course. It looks at the process of globalization and its impact on law in the light of history. This course will discuss the debates surrounding globalization, justice, its changing meaning and the impact that it has on many fields of law. It will provide an understanding of how law and legal institutions has to change in order to align with the global rules. The shrinking policy space at the national level will also be discussed. The discussions end with the demand for change in international law and global institutions heard from different quarters.		
Course objectives: To understand the process of globalization and its impact on law and justice in a historical perspective. To critically analyse the concept of global justice and the mechanisms designed to achieve it. To better appreciate the demands for change raised by different groups to the international legal order and institutions in the light of globalization.		

Course contents

Module	Topic	L	T	P
1	**History, Making and Content of International Law** History of International Law: The colonial origins Sources Continuity and change Alternative perspectives: Third World, Feminist, Marxist, Critical International legal theory	8		
2	**Globalization: Meaning, Reach and Form** Different dimensions of Globalization: Social, Political, and Economic Emergence of Transnational Law in a Globalizing World; Globalization and Sovereignty of states	8		
2	**Impact of globalization** International economic law: Brettenwood institutions, WTO, Investment laws, RTAs, IPRs. International human rights law	8		
3	**Globalization and Free Market** Impact on welfare state; Natural Resources and Environment;	8		

	Displacement for Development			
4	**Concept of Justice in a Globalizing World** Concept of Global Justice Humanitarianism as an element of the idea of global justice; Inetrnational Human Rights Law; Institutions: UNHCR, OHCHR Global Poverty: MDGs to SDGs Globalization and Social Justice/ Global Distributive Justice Role of international mechanisms to control armed conflicts, crimes against humanity, environment and health, oppressive policies and the threat of terrorism; ICC	6		
5	**Reformation of International Law and global institutions** Demand for change: from Third World, Women, Indigenous people etc. Role and impact of economic, labour and trade institutions: MNCs, UN, WTO,ILO, ICC, etc	6		
	Total	**42**	**0**	**0**

Evaluation criteria
Minor Test: 25%
Class Discussion: 10%
Presentation: 25%
Major Test: 40%

Learning outcomes:
On completion of this course, the students would:
Have acquired an understanding of the concept and theoretical background of globalization, and global justice.
Have developed critical thinking on the process of globalization and its impact on international and municipal law and on institutions.

Pedagogical approach:
The course will be delivered through a mix of classroom lectures and discussions on select readings. Students will be encouraged to read scholarly works from other disciplines.

Materials:
Books

Anghie, A. (2007). *Imperialism, sovereignty and the making of international law*. Cambridge: Cambridge University Press. Ch. 1, 5 & 6.
Pogge, T. (2002). *World poverty and human rights: Cosmopolitan responsibilities and reforms*. Cambridge: Polity. Ch. 4 & 7.
Rajagopal B. (2003). *International law from below: Development, social movements and third world resistance*. Cambridge: Cambridge University Press. Ch. 5 & 7.
Sen, A. (2009). *The idea of justice*. Cambridge: Harvard University Press. Ch. 18.
Fraser, N. (2010). *Scales of justice: Reimagining political space in a globalizing world*. New York: Cambridge University Press. Ch. 2 & 6.
Buchanan, A. (2004). *Justice, legitimacy, and self-determination: Moral foundations for international law*. Oxford: Oxford University Press. Ch. 10 & 11.
Baxi, U. (2002). *The future of human rights*. New Delhi: Oxford University Press. Ch.1 & 7.

Articles

Singh, A. P. (2008). Globalization and its Impact on National Policies with Reference to India: An Overview of Different Dimensions. *Journal of Constitutional and Parliamentary Studies, 42 (1-2),* 62-78.
Sinha, A. K. (2010). Human Rights in the Era of Globalization. *Madras Law Journal, 245 (6),* 124-136.
Chimni, B. S. (2007). A Just World under Law: A View from South. *American University International Law Review., 22 (2),* 199-220.
Chimni, B.S. (2004). International Institutions Today: An Imperial Global State in the Making. *European Journal of International Law,15(1),* 1-37.
Kenendy, D. M. (2003). Two globalizations of law and legal thought: 1850-1968. *Suffolk University Law Review, 36(3),* 631-679.
Kenendy, D. M. (2006). Three globalizations of law and legal thought: 1850-2000. In Trubek, D. M. *The new law and economic development*. Cambridge: Cambridge University Press. 19-73.
Santos, B. S. (2006). Globalizations. *Theory, Culture & Society, 23,* 393-399.
Adam, S. (2011). Distributing Justice. *New York University Law Review, 86 (2),* 500-572.
Developments (2016). The double life of international law: Indigenous peoples and extractive industries. *Harvard Law Review, 119,* 1755-1778.

Additional information (if any):

Student responsibilities: Students are expected to come prepared with the readings for the class. Students will be asked to initiate discussions in the class on a particular topic.

Course reviewers:

Prof. T.V.G.N.S. Sudhakar, Professor, The West Bengal National University of Juridical Sciences, Kolkata.
Dr. Shannu Narayan, Assistant Professor, National Law University, Assam.

4. Course title: Economic Foundations of Infrastructure and Natural Resource Law		
Course code: MPL 141	**No. of credits: 1**	**L-T-P: 14-0-0**
Pre-requisite course code and title (if any): None		

Course description:
As the title suggests, this course will offer economic foundations for a select set of policies and laws related to infrastructure and natural resources. In particular, it will explore theoretical basis, conceptual foundations and principles from the discipline of economics to examine policies and laws, aided by the relevant case studies. Importance of this course arises from the very fact that policy and legal regime functions with the objective of meeting a number of economic objectives, including augmenting rate of economic growth and social net benefit. Unfortunately, the market, however efficiently it may function, fails to deliver either the public goods like infrastructure or take care of externalities like pollution/waste or efficiently allocate or assign the correct prices for natural resources—these instances of 'market failure' makes a strong case of intervention by the State, through appropriate policies and laws, towards achieving a socially beneficial and sustainable outcome, while considering both costs and benefits. Recent instances of the State entering into partnerships with the private players imputes additional challenges to farming of laws, for such instruments to address the matter of profitability, risk taking ability, and uncertainties faced by the private players, along with aiming at social objective.

Course objectives:

To provide a clear understanding on the economic theories, concepts and principles relevant for laws related to infrastructure and natural resources

To connect the theory, concept and principles with the appropriate case studies.

Course contents

Module	Topic	L	T	P
1	**Economic Efficiency** Economic efficiency as a core concept in discipline of economics Variations within 'efficiency': technical, cost, value, material, energy	1		
2	**Market Structures** Perfect competition as an 'ideal' for achieving economic efficiency Cases of imperfect competition: monopolistic competition, monopoly, oligopoly	1		
3	**Market Failures** Cases of market failure Provision of Public Good by the state and private provision Absent markets and role of property rights Externalities and Coase Theorem	2		
4	**Role of the State** Economics of Regulation Economic principles behind public policy Regulation of Natural Monopoly	2		
5	**Instruments: Command and Control vis-à-vis Market based** Command and Control type: tax, subsidies Market Based types Relative efficiency of Command-and-Control and Market Based instruments	1		
6	**Liability, loss and damages** Compensation Principle Efficiency of Liability Rules	1		
7	**Case Studies** Oil and Natural Gas Pricing in India Spectrum Allocation Electricity pricing models Coal pricing and bidding models National Highway Toll pricing Computation of Environmental damages and Ecological Values	6		
	Total	**14**	**0**	**0**

Evaluation criteria:

Assignments/Presentations	50%
Written Test	50%

Learning outcomes:

On completion of this course, the students would:

Have acquired an understanding of the concept and theoretical background of laws related to infrastructure and natural resources.

Have developed critical thinking on possibilities and challenges in balancing the interests of

various stakeholders in these areas.
Pedagogical approach: The course will be delivered through a mix of classroom lectures and discussions around case studies.

Materials:

Core text for Module 1-6

1. Cento Veljanovski, 2007, 'Chapter 2: The Economic Approach' in *Economic Principles of* law, Cambridge University Press, pp. 19-57

Module 1

2. J Stiglitz, 'Chapter 3: Market Efficiency' in *Economics of the Public Sector,* Third Edition, W W Norton, pp. 55-75

Module 3 and 4

3. C T S Ragan and Richard G Lipsey, 1999, 'Chapter 16: Market Failure and Government Intervention and 'Chapter 17: The Economics of Environmental Protection' in *Economics*, Pearson Canada, pp. 415-445 and 449-469
4. Richard Ipotito, 2003, 'Chapter 7: Externalities-the Coase Theorem and Rules of Law,' in *Economics for Lawyers*, George Mason School of Law, mimeo, 168-183
5. J Stiglitz, 'Chapter 1: The Public Sector in a Mixed Economy', in *Economics of the Public Sector*, pp. 3-25
6. J Stiglitz, 'Chapter 4: Market Failure' in *Economics of the Public Sector*, pp. 76-90
7. J Stiglitz, 'Chapter 6: Public Goods and Publicly provided Private Goods', in *Economics of the Public Sector*, pp. 127-152

Module 4 and 5

8. Cento Veljanovski , 2006, 'Chapter 7: Regulation' in *The Economics of Law*, Second edition, The Institute of Economic Affairs, pp. 142-172
9. Kenneth E Train, 1991, 'Introduction: The Economic Rationale and Task of Regulation' in *Optimal Regulation: The Economic Theory of Natural Monopoly*, MIT Press, pp. 1-17.

Module 7: Case Studies

Oil and Natural Gas Pricing in India

10. Paranjoy Guha Thakurta, Jyotirmoy Chaudhuri, 2014, 'How Reliance's Options on Natural Gas Price Hike Narrowed', *EPW*, XLIX (22), pp. 13-16
11. Paranjoy Guha Thakurata, 2015, 'Great Indian Gas Robbery', *EPW*, L (49), pp. 12-15

Additional Reference:

Paranjoy Guha Thakurata, Subir Ghosh and Jyotirmoy Chaudhuri, 2016, *Gas Wars - Crony Capitalism and the Ambanis*, Authorsupfront Publishing Services Private Limited

Spectrum Allocation

12. Upendra Baxi, 2012, 'Good Law, Poor Economics', *Indian Express*, February 24
13. Rohit Prasad, 2010, 'Value of 2G Spectrum in India', *EPW*, XLV (4), pp. 25-28

14. Alok Kumar, 2011, '3G Spectrum Auctions in India: A Critical Appraisal', *EPW*, XLVI (13), pp. 121-129
15. Arun Mehta, Robert Horvitz, 2010, 'Managing and Utilising Spectrum More Efficiently', *EPW*, XLV (9), pp. 26-28
16. Manas Bhattacharya, 2008, 'The International Experience of Auctioning Spectrum', *EPW*, September 13, pp. 33-38

Additional reference:

Claudio Feijóo, José Luis Gómez-Barroso and Asunción Mochón, 2009, 'Chapter III: Reforms in Spectrum Management Policy', in In Lee, eds., *Handbook of research on telecommunications planning and management for business*, Information Science Reference, pp. 33-47

Johannes M. Bauer, 2006, 'A Comparative Analysis of Spectrum Management Regimes', paper presented at the 30th Communications and Internet Research Conference, Alexandira, Virginia, USA. Available online at http://www.ictregulationtoolkit.org/Documents/Document/Document/2299

Electricity pricing models

17. Paranjoy Guha Thakurta, 2016, 'Power Tariff Scam Gets Bigger at Rs.50,000 Crore', *EPW*, LI (21), pp. 12-15

Power (Coal/Nuclear) pricing and bidding models

18. Sumantra Bhattacharya, Rachit Tiwari, 2014, 'Non-Coking Coal Pricing in India', *EPW*, XLIX (3), pp. 20-22
19. E A S Sarma, 2013, 'Myopia on Coal', *EPW*, XLVIII (44), pp. 12-15
20. Suvrat Raju, M V Ramana, 2013, 'Cost of Electricity from the Jaitapur Nuclear Power Plant', *EPW*, XLVIII (26 & 27), pp. 51-60
21. Pranjul Bhandari, Rohit Lamba, 2013, 'The Coal Saga: The Imminent and the Feasible', *EPW*, XLVIII (28), pp. 19-21
22. Rahul Tongia and Rangan Banerjee, 1998, 'Price of power in India', *Energy Policy*, 26 (7), pp. 557Ð 575
23. Kannan Kasturi, 2013, 'Pricing Electricity in Delhi', *EPW*, 58(1), pp. 20-23

Liability

24. Suvrat Raju, M V Ramana, 2010, 'The Other Side of Nuclear Liability', *EPW*, XLV (16), pp. 48-54
25. Michael G. Faure and Karine Fiore, 2009, An Economic Analysis Of The Nuclear Liability Subsidy, *Pace Environmental Law Review*, 26 (2). Available at: http://digitalcommons.pace.edu/pelr/vol26/iss2/5

National Highway Toll pricing

26. Ram Singh, 2010, 'A High-handed Approach to National Highways', *EPW*, XLV (8), pp. 19-21

Environmental Damages and Ecological values

27. L Venkatachalam, 2005, 'Damage Assessment and Compensation to Farmers: Lessons from Verdict of Loss of Ecology Authority in Tamil Nadu', *EPW*, April 9, pp. 1555-60
28. K. Chopra and P. Dasgupta, 2008, 'Assessing the Economic and Ecosystem Services Contribution of Forests: Issues in Modelling, and an Illustration', *International Forestry Review*, 10(2), pp. 376-386

General additional reading: relevant judgments of the Supreme Court

Additional information (if any): Nil
Student responsibilities: Reading financial newspapers like *Mint*, *Economic Times*, *Business Line*, as well magazines like *Economist*, for identifying the relevant topics for the assignment.

Course reviewers:

1. Prabhash Ranjan, South Asian University, New Delhi
2. Daniel Mathew, National Law University Delhi, New Delhi

5. Course title: Environmental Law and Policy		
Course code: MPL 155	**No. of credits:** 2	**L-T-P distribution:** 28-0-0
Pre-requisite course code and title (if any):		

Course Description

Law and policy plays a major role in the conservation and management of natural resources as well as pollution control. This course intends to introduce the students to the vast field of Environmental Law and Policy. The course would be divided into three broad areas. The first part would cover the basic concepts and principles of Environmental Law. This would include judicial precedents, which now forms an essential part of environmental jurisprudence. The second part would be divided into specific introductory modules on forests and wild life including bio-diversity related laws; Air and Water related laws including mega projects and marine laws; and laws relating to hazardous substances. The third part would discuss the role of judiciary including the National Green Tribunal in protecting the environment.

Course objectives

To provide an overview of the law and policies relating to environment both at the national and international level.

To critically analyse the implementation of these laws and the role of adjudicatory bodies in the field of environment.

Course content

Module	**Topic**	**L**	**T**	**P**
1	**Introduction to Environmental Law and Policy** Environment: meaning and components Environment v. Development debates, trigger events, business and environmental law, a brief introduction to SDGs. Introduction to environmental laws in India; Constitutional provisions, an overview of the laws General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine.	6		
2	**Forest, Wildlife and Biodiversity related laws** Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence. Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. *Forest Conservation* case Strategies for conservation–Project Tiger, Elephant, Rhino, Snow	8		

	leopard.			
3	**Air and Water Laws** National Water Policy Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Legal framework on Air pollution: Air Act,1981; EPA, 1986	6		
4	**Environment protection laws and large Projects** Legal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA. Marine laws of India; Coastal zone regulations, Wetland conservation.	4		
5	**Judicial remedies and the role of National Green Tribunal** Role of judiciary in environmental protection; Infrastructure projects and the Indian judiciary. Jurisdiction and powers of NGT, A critical analysis of its role, suggestions to make it an advisory body	4		
	Total	**28**	**0**	

Evaluation criteria
Minor test: 30%
Term Paper and presentations : 30%
Major test: 40%

Learning outcomes
At the end of the course the students will
Have a strong foundation to undertake specialised courses in the field of environmental laws and policy
Develop an inter-disciplinary approach to the issues relating to environment.

Pedagogical approach
A combination of lecture based and problem based learning would be used. Judicial decisions would form the starting point for discussions in the class room. A lot of emphasis is given on self-study.

Materials
Text Books

Divan S. and Rosencranz A. (2005) *Environmental Law and Policy in India***,** 2nd ed., Oxford, New Delhi
Sands P. and Peel J. (2012). *Principles of international environmental law.* 3rd ed, Cambridge: Cambridge University Press.

Suggested Readings
Birnie P. (2009). *International law and the environment*, 3rd ed. Oxford: Oxford University Press.
Dutta, R. (2015). *Commentary on the National Green Tribunal Act, 2010*. New Delhi: Wadhwa Book Company.

Gadgil, M. and Guha, R. (1995). *Ecology and equity***.** New Delhi: Oxford University Press.
Gadgil, M. and Guha, R. (1997). *This fissured land*. New Delhi: Oxford University Press.
Guha, R. (2000). *Environmentalism: A global history*. New Delhi: Oxford University Press.
Kohli, K. and Menon, M. (eds.) (2016). *Business interests and the environmental crisis*. New Delhi: Sage India.
Lele, S. and Menon, A. (eds.) (2014). *Democratizing forest governance in India*. New Delhi: Oxford University Press.
Sahu, G. (2014). Why the underdogs came out ahead. *Economic and Political Weekly, 49 (4),* 52-57.
Sahu, G. (2014). *Environmental jurisprudence and the Supreme Court: Litigation, interpretation, implementation*. New Delhi: Orient Blackswan.
Singh, C. (1986). *Common property and common poverty*. New Delhi: Oxford University Press.
Upadhyay S. and Upadhyay V. (2002). *Hand Book on environmental law- Forest laws, wildlife laws and the environment*. Vols. I, II and III, New Delhi: Lexis Nexis- Butterworths-India.

Additional information (if any) – Nil

Student responsibilities
Students are expected to come to the class after going through the reading material assigned for the class and actively participate in the classroom discussions.

Course reviewers
Shibani Ghosh, Fellow, Centre for Policy Research, New Delhi.
Dr. Jacob Joseph, Assistant Professor, National University of Advanced Studies, Kochi.

6. Course title: : Infrastructure Law and Policy

Course code: MPL 157	**No. of credits:** 2	**L-T-P distribution:** 23-05-0

Pre-requisite course code and title (if any):

Faculty: M P Ram Mohan

Course Description
This course provides an overview of the Constitutional and general legal context in which the infrastructure sector operates. It also covers the legislative and policy framework within which the specific infrastructure activity has to be undertaken. Special emphasis is placed on the regulatory law of different infrastructure sectors, and an attempt is made to undertake a comparative assessment of the regulatory laws and policies of different infrastructure sectors.

Course objectives
To provide an overview of the constitutional and the general legal context in which the infrastructure sector operates
To examine the importance of independent regulation in infrastructure
A general analysis of the laws, policies and the reforms carried out in select infrastructure sectors

Course content

Module	**Topic**	**L**	**T**	**P**
1	**Constitutional aspects** Allocation of jurisdiction over different infrastructure sectors between the Centre and State - law making powers Allocation of natural resources: Judicial review Administrative law	3		
2	**Independent regulation: New Mechanism of Governance in**	2		

	infrastructure Theories of regulation-genesis of Independent regulation-evolution of regulation in different jurisdictions- Design and structure of regulators-scope and functions-regulatory process- regulatory autonomy and accountability-regulatory predictability and certainty			
3	**Land Acquisition** Concepts of eminent domain and public purpose The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013: Social Impact Assessment, Requirement of consent in the case of certain acquisitions, compensation, rehabilitation and resettlement.	2		
4	**Infrastructure Sectoral polices, reforms and laws**			
5	**Power Sector/Electricity** Introduction-evolution of the power sector reforms, polices- Electricity Act, 2003 - National Electricity policy- legal framework- the state electricity boards- licensing framework- Provisions Relating to and working of Electricity Regulatory Commissions-their structure, role and functions	3	1	
6	**Telecommunications** The national telecom policies-the legal framework- regulatory agencies-functioning, power and functions of TRAI and TDSAT	3	1	
7	**Oil, Petroleum and Natural Gas** Reforms, policies and legal framework -New Exploration Licensing Policy (NELP)- production sharing contracts- the Petroleum Regulatory and Natural Gas Board Act – the emerging regulatory reforms	2	1	
8	**Water** Water policy General Legal framework and reforms-Water rights- state jurisdiction-new regulatory reforms in water sector.	2	1	
9	**Transport** Law, policy and reforms relating to Airports-Railways-Road –Port; TAMP; an overview of coastal shipping and Inland Water Transport policy	4	1	
10	**Real estate** The Real Estate (Regulation and Development) Act, 2016	2		
	Total	**23**	**5**	

Evaluation criteria
Minor Test: 25%
Class Discussion: 10%
Presentation: 25%
Major Test: 40%

Learning outcomes
At the end of the course it is expected that the students will:
Have a strong foundation in infrastructure laws to undertake advanced courses in the field

Be conversant with the relevant laws, policies, judicial pronouncement, and reforms in the field.
Pedagogical approach A combination of lecture based and problem based learning would be used. Case studies would be used for initiating discussions in the module on specific sectors.
Materials Suggested theoretical Readings Baldwin, R. and C. McCrudden (1987). *Regulation and Public Law.* London: Weidenfeld & Nicolson. Joshi, Piyush (2003), *Law Relating to Infrastructure Projects*. 2nd Edn. New Delhi: Butterworths. National Transport Development Policy Committee Report (Rakesh Mohan Committee) Sarkar, S K , and Srivastava L. (eds.) (2002), *Reforms in the Infrastructure Sectors: Next Steps*, TERI Press, New Delhi. Sundar, S. and Sarkar S. K . (2000). *Framework for Infrastructure Regulation.* New Delhi: TERI Press. Shapiro, S. and Tomain, J. (2003). *Regulatory law and policy: Cases and materials.* New Delhi: LexisNexis. Philippe Cullet and Sujith Koonan, 2012, Water Law in India: An Introduction to Legal Instruments Ramaswamy R Iyer, 2009, Water and the Laws in India, Sage Talat Fatima, 2012, Transport Law in India, Kluwer Law International S. K. Chatterjee, 2013, Commentary On The Electricity Laws of India, Delhi Law House Vikram Raghavan, 2007, Communications Law in India (Legal Aspects of Telecom, Broadcasting and Cable Services, Lexis Nexis Mohammad Naseem, 2010, Energy Law in India, Kluwer Law International
Additional information (if any):- Important sector specific reports, articles, laws, and court cases will be part of sector modules. The list will be circulated much before each module is taken up
Student responsibilities Students are expected to come prepared with readings and actively participate in the discussions.

Course reviewers
Nishant Beniwal, Counsel, Kahitan & Co., New Delhi.
Avijeet Lala, Partner, HSA Advocates, New Delhi.

Annexure 2
(Refers to Item No 3 of minutes of 38th meeting of AC**)**

Course Outline of 'Development Theories & Processes' in MA (Sustainable Development Practice) programme.

1. Course title: Development Theories and Processes				
Course code PPS 132 | **No. of credits:** 3 | **L-T-P:** 30-12-00				
Instructor: Dr. L N Venkataraman, *Department of Policy Studies*, TERI University.				
Pre-requisite course code and title:				
Course Description The course intends to provide theoretical perspectives in Development Studies. This will be an advanced course to introduce the interdisciplinary standpoints to consolidate the diverse development discourses.				
Course objectives The course aims (1) to provide an understanding of development theories (2) in highlighting the complexities of development processes (3) to discuss the nuances of social justice.				
Course content				
Module	**Topic**	**L**	**T**	**P**
1.	**Introduction** Overview of development; Theoretical and methodological issues; Globalisation and the structural adjustments; Governance and welfare state; Social institutions, structure; agency and the development triad; Knowledge society and the political-economy of development	8	2	0
2.	**Theories of Development** Modernization Theory; Dependency Theory; Human Capital Approach; Basic Needs Approach; Entitlement Analyses; Human Development; Capabilities Approach	14	7	0
3.	**Development processes and social justice** Social inequality as a global challenge; Reservation and Affirmative Action policies Intersectional inferences of inequalities; Narratives of justice Dignity and Development; International dimensions (*Ubuntu* and *Bildung*).	8	3	0
	TOTAL	**30**	**12**	**0**
Evaluation criteria Evaluation is based on three aspects namely: Assignments (25%); Group Presentations (25%) and the Examination (50%). The weightage of these aspects are inclusive of active learning; critical engagements; and other disposition skills such as academic interactions				

and discussions.
Learning outcomes At the end of the course, the participants would be able to (1) know diverse theories of development; and (2) critically reflect on the development processes and social justice.
Pedagogical approach Instructions will be facilitated through lectures, interactive sessions and critical readings. Theories will be dealt in light of relevant thinkers in elaborating the diverse perspectives. As pedagogical tools are interdisciplinary, each module will be followed by an assignment and group presentations by the participants. Thus, the learning expectation is to enhance critical and informed understanding.

Readings: (Module 1) Introduction

1) Buch-Hansen, Mogens & Laurids S. Lauridsen (2012), "The Past, Present and the Future of Development Studies", *Forum for Development Studies*, Vol. 39, No. 3, (pp. 293-300).
2) Clark, D A (2006), *The Elgar Companion to Development Studies*, Edward Elgar, UK.
3) Corbrdige, Stuart (2007), "The (im)possibility of development studies", *Economy and Society*, Vol. 36, No. 2, (pp. 172-211).
4) Dreze, Jean & Amartya Sen (1997), *Indian Development: Selected Regional Perspectives*, Oxford University Press, Delhi.
5) Escobar, Arturo (1995), *Encountering Development: The making and unmaking of the Third World*, Princeton University Press, New Jersey.
6) Harriss, John (1998), ''Development Studies and the Development of India: An Awkward Case?'', *Oxford Development Studies*, Vol. 26, No. 3, (pp. 287-309).
7) Jackson, William A. (2009), *Economics, Culture and Social Theory*, Edward Elgar, UK.
8) Nkurunziza, Emmanuel (2007), "An Overview of Development Studies: Background Paper", *International Development Department Working Paper 2*, University of Birmingham, UK.
9) Pieterse, Jan Nederveen (1996), "The Development of Development Theory: Towards Critical Globalism", *Review of International Political Economy*, Vol. 3, No. 4, (pp. 541-564).
10) Woolcock, Michael (2009), "The next 10 years in development studies: From modernization to multiple modrnities, in theory and practice", *European Journal of Development Research*, Vo. 21, No. 1, (pp. 4-9).

Readings: (Module 2) Theories of Development

1) Becker, Gary S. (Oct., 1962), ''Investment in Human Capital: A Theoretical Analysis'', *The Journal of Political Economy*, Vol. 70, No. 5, (pp. 9-49).
2) Bernstein, Henry (1971), "Modernization Theory and the Sociology of Development", *Journal of Development Studies*, Vol. 7, Issue 2, (pp. 141-160).
3) Frank, André Gunder (1966), "The development of underdevelopment", *Monthly Review*, Vol. 41(2), (pp. 4-17).
4) Fukuda-Parr, Sakiko and A. K. Shiva Kumar (ed.,), (2003), *Readings in Human Development: Concepts, Measures and Policies for a Development Paradigm*, Oxford University Press, New Delhi.
5) Gasper, Des (1996), ''Needs and Basic Needs: A Clarification of Meanings, Levels, and different streams of work'', Working Paper Series 210, *Institute of Social Studies*, The Hague.
6) Haq, Mahbub ul (1999), *Reflections on Human Development*, Oxford University Press, New Delhi.
7) Robeyns, Ingrid (2005), ''The Capability Approach: a theoretical survey'', *Journal of*

Human Development, Vol. 6, No. 1, (pp. 93-114).
8) Schultz, Theodore W. (Mar., 1961), ''Investment in Human Capital'', *The American Economic Review*, Vol. 51, No. 1 (pp. 1-17).
9) Sen, A K (1983), *Poverty and Famines: An Essay on Entitlement and Deprivation*, Oxford University Press, UK.
10) Sen, A K (1999), *Development as freedom*, Oxford University Press, New Delhi

Readings: (Module 3) Development processes and social justice

1) Beteille, Andre (1991), "Distributive Justice and Institutional Well-being", *Economic and Political Weekly*, Vol. 26, No. 11/12, (pp. 591-600).
2) Chandhoke, Neera (2008), "Quest for Justice: The Gandhian Perspective", *Economic and Political Weekly*, Vol. 43, Issue 8, (pp. 37-46).
3) Follesdal, Andreas & Thomas Pogge (Ed). (2005), *Real World Justice: Grounds, Principles, Human Rights and Social Institutions*, Springer, The Netherlands.
4) Fraser, Nancy (2010), *Scales of Justice: Reimagining Political Space in a Globalising World*, Columbia University Press, New York.
5) Gupta, Dipankar (2006-2007), Towards Affirmative Action, India International Centre Quarterly, Vol. 33, No. 3/4, (pp. 150-161).
6) Morvaridi, Behrooz (2008), *Social Justice and Development*, Palgrave Macmillan, New York.
7) Nussbaum, Martha C. (2006), *Frontiers of Justice: Disability, Nationality, Species membership*, The Belknap Press of Harvard University Press, Cambridge, Massachusetts
8) Rawls, John (2001), *Justice as fairness: A Restatement*, The Belknap Press of Harvard University Press, Cambridge, Massachusetts.
9) Sen, A K (2009), *Idea of Justice*, The Belknap Press of Harvard University Press, Cambridge, Massachusetts.
10) Wolff, Jonathan & Avner De-Shalit (2007), *Disadvantage*, Oxford University Press, New York.

Journals (1) Oxford Development Studies; (2) Journal of Human Development and Capabilities; (3) Journal of Development Studies; (4) Forum for Development Studies; (5) European Journal of Development Research; (6) Economy and Society

Learning responsibilities Participants are expected to be active in learning and critical in their engagements. They need to have a minimum of 75% physical attendance for the Course.

Course Reviewers:

1. Prof. Des Gasper, *International Institute of Social Studies*, Netherlands [gasper@iss.nl]
2. Prof. William Jackson, *University of York*, UK [william.jackson@york.ac.uk]

Annexure 3
(Refers to Item No 4 of Minutes of Meeting of 38th AC**)**

Course Outlines of MBA(Infrastructure) Programme.

1. Course title: Bidding System Management			
Course code: BSI 181	**No. of credits:** 1	**L-T-P distribution:** 14-0-0	**Learning hours:** 14
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr Kaushik R Bandyopadhyay		**Course instructor (s):** Mr. Mohit Sinha	
Contact details: mohitsinha@hotmail.com			
Course type	Core	**Course offered in:** Semester 1	

Course description

The course is divided into eight modules. Planning for infrastructure projects is a multi-stage process and bidding is an important as well as a challenging stage in this process. This course is designed to apprise students of the complete bidding management system. The course would help them to understand various aspects of bidding management including legislative and regulatory framework for procuring projects, planning for inviting bids, standard bidding documentation as well as evaluation and final acceptance.

Course objectives

- To help students learn the procedures as well as practices of bidding process for infrastructure projects.
- To make the students understand institutional and legislative framework for bidding management in the Indian context.
- To ensure that the students become aware of and capable of handling problems encountered in bidding management.

Course content

Module	Topic	L	T	P
1.	**Module 1: Need for a robust bidding system** Infrastructure projects in India: sources of finance, parliamentary control International infrastructure projects: mechanisms, procedures, principles Legislative and institutional framework in Indian context for procuring infrastructure projects; transparency in public procurement	2	0	0
2.	**Module 2: Infrastructure projects– packets of uncertainties** Factors contributing to high uncertainty: large scope, myriad of stakeholders resulting in social and geographical dislocations of populations, long lead/gestation, negative surprises including natural disasters	1	0	0

	Government rules, procedures and legislative framework for dealing with the same			
3.	**Module 3: Planning for inviting bids (key driver for on-time project implementation)** Planning from drawing board to commissioning: land acquisition, mining, forest, environmental clearances, scanning the market for possible companies with relevant experience, skills and resources for the work/project; differences between state level and union level of bidding.	1	0	0
4.	**Module 4: Standard bidding documents and some essential ingredients** International best practices; International Federation of Consulting Engineers (FIDIC); Introduction to drawing standard bidding documents; eligibility requirements; qualifying criteria; preparation of bidding document; definitions and interpretations; scope of project; obligations of contractors; obligations of authority; representations and warranties of contractor and authority; performance security; right of way; design and construction of project – design and drawings; utilities / roads/trees and new utilities; quality assurance, monitoring and supervision; completion certificate; change of scope; defect liability; financial covenants – contract price, advance payment; form of bank guarantee; stage payment, procedure for estimating payment for works, payment for damages, final payment certificate; price variation clauses; change of law; General Conditions of Contract; special Conditions of Contract; mechanism for resolution of disputes; legal vetting of draft contract documents etc.	2	0	0
5.	**Module 5: Invitation of Expressions of Interest** Advertising - expression of interest and publishing draft bid documents for interested bidders; joint site visits, geological and other technical data viz geotechnical date, meteorological specifics, flood date, etc, Prebid conference, interacting with bidders and addressing of their concerns / anxieties. Due consideration of points raised and issue of suitable amendments / corrigenda. Empirical price variation clauses, etc.	2	0	0
6.	**Module 6: Invitation of bids** Notice inviting tenders/bids in newspapers, websites, emails; sufficient time to bidders; Earnest money- amount & forms in which accepted; Opening of tenders- Public opening; Tender Opening Committee; Attendance of persons attending bid opening, Single packet vs double packet systems.	2	0	0
7.	**Module 7: Evaluation of bids – technical bids and price bids** Nominations of Bid / Tender Evaluation Committee; Members to declare conflict of interests - if any; Free and fair evaluation; Verification of credentials of bidders; Non-material nonconformities and material nonconformities; List of qualified bids; Opening of 2nd	2	0	0

	packet - price bid; Advance notice to bidders; Date, time, venue; Public opening of bids by nominated bid opening committee; Evaluation of lowest bid by bid evaluation committee; Discussions of reasonableness of rates; selection of L1 bid; Selection of lowest bid; non L1 acceptance criteria.			
8.	**Module 8: Acceptance of bid– signing of contract agreement** Letter of acceptance (LOA); Contract agreement; Signing of contract-formats, Mobilisation and other Advances; Publishing on internet; Right to Information Act.	2	0	0
	Total	**14**	**0**	**0**

Evaluation criteria

- Quizzes / Assignments 40%
- End-term 60%

Pedagogical approach

A combination of class-room interactions and assignments with special emphasis on case studies and real life examples.

Materials

1. Fast Track Bid Management by Lee Lister
2. The Bid Manager's Handbook by David Nickson

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. P Ghosal, AmarUjala
2. Mr. C Das Gupta, Former ED, IOL

2.Course title: Business Ethics			
Course code: **BSI 157**	**No. of credits:** 1	**L-T-P distribution:** 14-0-0	**Learning hours:** 14
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr. Annapurna Vancheswaran		**Course instructor (s):** Dr. Annapurna Vancheswaran	
Contact details: avanche@teri.res.in			
Course type	Core	**Course offered in:** Semester 1	

Course description

An important element of any corporate organisation during its interactions with its environment is how it deals with ethical issues. What does it consider as acceptable /unacceptable and the extent to which a business accepts its responsibility are some key issues for study. From time to time corporate scandals have demonstrated that managerial decision-making invariable has ethical implications. However, these ethical implications are seldom given any serious thought and get viewed as just byproducts of mistaken action, instead of understanding that they comprise the

prime ingredients of business decisions.

This one credit course will be designed for students of Infrastructure Management. The discussion will be based on the outline that the volume of construction is expected to grow exponentially worldwide in the next decade and will amount to $15 trillion. This growth is expected to be concentrated in three countries: China, the US and India.

In this context sustainable urbanisation and ethics based governance will be a major challenge in the infrastructure sector. Hence the course is Business Ethics will focus on the perspective of managers who must formulate policies to address issues with ethical dimensions. The principal objective of the course is to infuse a basic ethical intuition among the next generation managers on issues such as well-being, rights, and justice. City and assessment skills by making them work through actual/simulated scenarios.

Course objectives

The course will encourage the students to reason about issues from multiple perspectives. Further it will:

- expose the students to a diverse and important set of ethical systems
- increase the knowledge and awareness on ethics and ethical behaviour
- apply ethical systems to specific business problems.

Course content

Module	Topic	L	T	P
1.	Course Introduction, Pedagogy and evaluation pattern discussion followed by an ice-breaker session. This will include a class quiz.	2	0	0
2.	**Corporate Social Responsibility** Its evolution, the CSR models and social performance theories.	2	0	0
3.	**Introduction to Business Ethics** An appreciation of the challenges businesses struggle with to be ethical. Basic ethical theory: Duty based Utilitarian	2	0	0
4.	**Ethics of business culture** The two conflicting set of morals. Morality in personal lives and morality in professional lives. (Case study)	2	0	0
5.	**The Global Business Standards Codex (GBS Codex).** These sessions will be based on Case Study discussions on the 8 principles that make up the GBS Codex. The case studies will attempt to analyse each of the aspects within the code of conduct. This will include: The Fiduciary Principle ; The Property Principle ;The Reliability Principle ;The Transparency Principle ; The Dignity Principle , ;The Fairness Principle; The Citizenship Principle ;The Responsiveness Principle	4	0	0

	[4 case studies (finance, child labour, environment and health)]			
6.	**The Environment** Understand new trends in environmentalism, environment codes, the emerging role of interest groups and government codes.	2	0	0
	Total	**14**	**0**	**0**

Evaluation criteria

- Group presentation 20%
- Case analysis/Tutorials 20%
- Mid-term examination 30%
- End term examination 30%

Pedagogical approach

Most of the classes will be mixed session comprising (a) a lecture that will introduce the topic (b) an interactive discussion of the general conceptual material (c) followed by a group quiz. Session 5 (Case Study presentations) will include issue based cases to which the ethical concepts would be applied. The class will be divided in groups and the groups will be asked to prepare a common case study and present it to the class. The other two groups will be asked to judge the presentations and score them. In Session 5, study-group presentations will play an important role as it will allow the students to articulate their views of what is defensible and non-defensible in each case.

Materials

Required text

1. Corporate Social Responsibility: Doing the Most Good for Your Company and Your Cause: By Philip Kotler & Nancy Lee, 2008
2. Corporate Ethics, Governance and Social Responsibility: Precepts and Practices, By A C Fernanco,(Ed), 2009
3. Managing Corporate Citizenship and Sustainability in the Age of Globalization, Andrew Crane and Dirk Matten, 2010

Reference and reading material will be provided for each of the sessions during classes.

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Dr. Santosh Pande, Cofounder, Nihilent Technologies
2. Dr Rjat Katharia, ICRIER

3. **Course title:** Business Laws			
Course code: BSI 151	**No. of credits:** 2	**L-T-P distribution:** 20-08-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			

Department: Department of Business Sustainability			
Course coordinator (s): Mr. M V Shiju			**Course instructor (s):** Mr. M V Shiju
Contact details: mvshiju@teriuniversity.ac.in			
Course type	Core	**Course offered in:** Semester 1	

Course description

Business works under a defined set of laws and a predictable legal regime provides a stable environment conducive for overall business development. The course covering Companies Act; the Industries (Development and Regulation) Act 1951; Industrial Disputes Act; the Competition Act, 2002; the Arbitration and Conciliation Act, 1996; the Foreign Exchange Management Act (FEMA),1999; introduction to taxation system; Polices relating to Foreign Direct Investment, FIIs; Multilateral Guarantee System , taught through various case studies expose students to various sets of laws and regulatory regime that interact with business on a day to day basis

Course objectives

Law and legal institutions play a major role in the conduct of infrastructure sector. The purposes of laws relating to business in India are mainly twofold: To create an environment conducive to the growth of business; and to make sure that business operates within the larger framework of governance in the country. There are a number of laws that have a bearing on the conduct of business. These cover broadly areas relating to corporate legal framework; business transactions; etc. In this course an attempt is made to introduce the students to certain important legal aspects of infrastructure business.

The course taught through various case studies expose students to various sets of laws that interact with infrastructure business on a day to day basis.

Course content

Module No	Topic	L	T	P
1.	**Companies law** Definition-features-concept of limited liability- different types of companies. Formation-Memorandum and Articles- commencement of business-registration- conversion of companies already registered. Prospectus and allotment of securities- Public offer and Private placement.-role of SEBI	4	0	0
	Share Capital and Debentures- kinds of shares and debentures- variation of shareholders' rights sweat equity-bonus-buyback-buyback prohibition- Management and Administration of companies-declaration of beneficial interests	4	0	0
	AGM-Report on AGM-EGM- ascertaining the sense of the meeting –ordinary and special resolution and their scope–notice, quorum, proxies, voting, poll. Appointment and remuneration of managerial personnel- key managerial personnel (KMP)- independent directors	2	0	0
	Case studies	0	2	0

2.	**Competition Law** Competition Act, 2002 - Anticompetitive agreements; Abuse of dominance; Combinations; CCI; Role of sectorial regulators Case studies	4	 2	0 0
3.	**Law relating to Taxation and FDIs** Foreign Exchange Management Act (FEMA),1999; introduction to taxation system; Polices relating to Foreign Direct Investment, FIIs Case studies	4	0 2	0 0
4.	**Resource Mobilization and laws** Equity (sponsor, private equity) - debt - Multilateral Investment Guarantee Agency Case studies	2 0	0 2	0 0
	Total	**20**	**8**	**0**

Evaluation criteria

- Minor test:
  - Case presentation (group wise): 25%
  - Essay (2000 words): 25%
- Major test:
  Final test: 50%

Learning outcomes

1. Learn how infrastructure sector operates within a defined legal framework
2. Developing skills through case studies to critically look at projects that have high legal compliance
3. Learn the institutional systems like RBI, Competition Commission, SEBI and other regulatory bodies play a role in infrastructure business
4. Appreciate the kind of dispute settlement mechanisms that exist and how to organize business transaction that minimizes disputes

Pedagogical approach

The course will be taught through combination of theoretical and practical approaches. Industry experts and lawyers will be part of the course delivery. All the modules will have a strong case study component that critically looks in to how infrastructure business interacts with law and legal institutions

Materials

Suggested readings

Singh, Avatar, (2015), Company Law, Eastern Book House,
Ramaiya, A. (2006), Guide to Companies Act, Wadhwa, Nagpur.

Agarwal, S & Baby RC, (2011), Agrawal & Baby on SEBI Act, Taxmann
Ramappa, A. (2006) Competition Law in India, Oxford,New Delhi.
Kumar, Ravinder (2011), Legal Aspects of Business, Cenage Learning, Andover
Kannan, S & Geetha, V (2015), FDI in India Law Policy and Procedure, Thomson Reuters
Khilnana, D T (2015), FEMA Ready Reckoner, Taxmann
K S Anantharaman, K S (2013), Company Law and the Competition Act, Lexisnexis
Singh, A (2013), Law of Arbitration and Conciliation, Eastern Book House

Case studies

Additional information (if any)

Student responsibilities
Attendance, feedback, discipline, guest faculty etc.

Course reviewers:
1. Mr. S Sinha,CEO, ICSI
2. Mr. Nishant Beniwal, Associate Partner at Khaitan & Co

4. Course title: Contracts law and management (negotiation, management and conflict resolution)			
Course code: **BSI 141**	**No. of credits:** 2	**L-T-P distribution:** 20-08-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr M P Rammohan		**Course instructor (s):** Dr. M P Rammohan	
Contact details: mprmohan@teri.res.in			
Course type	Core	**Course offered in:** Semester 1	

Course description
Contracts form the basis of infrastructure projects. This course provides a basic understanding of contract laws. Students will be exposed to right-duty correlate at the base of a contract. One of the major aims of a contact is the clear prescription of rights and duties, and the settlement of disputes that may rise from the contacts. The course will go in depth into understanding of possible conflict scenarios in project cycle and conflict resolution through case studies.

The course taught through various case studies expose students to various sets of contract laws in infrastructure business.

Course objectives
- To provide an overview of the constitutional and the general legal context in which the infrastructure sector operates
- To examine the importance of independent regulation in infrastructure
- To analyse the laws and policies and the reforms carried out in select infrastructure sectors

Course content

Module	Topic	L	T	P
1.	**Contract law** General principles- Formation of Contract -Essential elements; Voidable contracts and void agreements - Discharge of contracts -Specific Contracts: Agency, Indemnity, Guarantee, Bailment - Doctrine of Caveat emptor Case studies	4	2	0
2.	Sale of Goods (Sale of Goods Act, 1930) -Negotiable Instruments Act, 1881-international contracts-choice of law-choice of forum- Consumer Protection Act, 1986- service related regulations Case studies	6	2	0
3.	**Formation Negotiation and Management** Contract drafting- wording and intent- risk management clauses-contract negotiation process –learning skills, tools, and best practices for contract planning and negotiations- management of contracts Case studies	6	2	0
4.	**Disputes Resolution** Alternative dispute resolution mechanisms -Settlement; Mediation; Conciliation and Arbitration- Arbitration and Conciliation Act, 1996 -International commercial arbitration; Case studies	4	2	0
	Total	**20**	**8**	**0**

Evaluation criteria

- Minor test:
  - Case presentation (group wise): 25%
  - Essay (2000 words): 25%
- Major test:
  - Final test: 50%

Learning outcomes

1. Students will learn about the fine print of contracts law applicable in India and also about international contracts
2. Will able to understand the requirements of specific contacts clauses that are important in structuring the contracts
3. Develop skills with respect to management and negotiation of contacts
4. Able to appreciate dispute settlement in contracts.

Pedagogical approach

The course will be taught through combination of theoretical and practical approaches. Industry experts and lawyers will be part of the course delivery. All the modules will have a strong case study component.

Materials **Suggested readings** Pollock and Mulla (2005), Indian Contract Act and Specific Relief Act, Lexis Nexis Butterworths, New Delhi Pathak, Akhileshwar, (2015), Legal Aspects of Business: Text and Cases, Tata McGraw-Hill, New Delhi Mani, N (2014), Infrastructure Development and Financing in India Piyush Joshi(2003), Law Relating to Infrastructure Projects, New Delhi: Butterworth's Case studies
Additional information (if any)
Student responsibilities Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. S Sinha,CEO, ICSI
2. Mr. Nishant Beniwal, Associate Partner at Khaitan & Co

5. **Course title: Introduction to infrastructure business**			
Course code:	**No. of credits:** 2	**L-T-P distribution:** 16-12-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s):		**Course instructor (s):**	
Contact details:			
Course type	Core	**Course offered in:** Semester 1	

Course description

This is a basic course that defines and outlines the various forms of infrastructure, their need and relevance to economic growth and development particularly in the context of an emerging economy. It would also give an exposure to the different policy and regulatory issues that would help in ensuring infrastructure growth in India.

Course objectives

Introduce the participants to the basic concepts and definitions of infrastructure and help improve an understanding of the infrastructural needs and challenges from a developing country's perspective.

Course content

Module	Topic	L	T	P
1.	Definition of infrastructure – relationship of economic development with infrastructure growth - Issues related to	2	0	0

	infrastructure development such as funding, technology, costs, sustainability, etc.			
2.	Exploring how infrastructure growth has happened in India across different sectors (transport, energy and telecommunication) Evolution of infrastructure policy in India Role of central, state and local governments for infrastructure development	2	0	0
3.	Issues and options of infrastructure growth in India	3	2	0
4.	Funding of infrastructure Public vs. private investments, Growing role of public private participation in infrastructure development	2	2	0
5.	International experiences in development of major infrastructure projects - Role of multilateral and bilateral agencies in infrastructure growth in developing countries	2	2	0
6.	Sustainability issues in infrastructure development - Land, forest and environmental concerns – Judicious use of natural resources	2	2	0
7.	Role of regulation and regulatory agencies, civil society and national dialogues for implementing infrastructure projects/programs	2		0
8.	Formulation of government policies assisting infrastructure growth – methods of infrastructure policy formulation and current policies relating to different sectors of infrastructure (activity based)	1	4	0
	Total	**16**	**12**	**0**

Evaluation criteria

Assignment 50%

End-term exam 50%

Learning outcomes

Develop an understanding of:

- Definition and classification of various kinds of infrastructure
- Links between development and economic growth with infrastructure requirements
- Issues related to infrastructure development in India and current policy imperatives to hasten its growth
- Infrastructure development internationally with a particular reference to developing economies
- Sustainability issues and need for resource efficiency in infrastructure business

Pedagogical approach

The course will be delivered through class room lectures, discussion of case studies from original relevant research articles and field visits.

Materials

Handouts to be distributed by the faculty.

Additional information (if any)

Student responsibilities Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

Mr. S. Sunder, TERI

Dr. Santosh Pande, Cofounder, Nihilent Technologies

6. **Course title:** Integrated Impact Assessment			
Course code: BSI 145	**No. of credits:** 3	**L-T-P distribution:** 34-08-0	**Learning hours:** 42
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr. Suresh Jain		**Course instructor (s):** Dr. Suresh Jain	
Contact details: sureshj@teriuniversity.ac.in			
Course type	Core	**Course offered in:** Semester 1	

Course description

There is growing realization that the multi-dimensional nature of sustainable development targets requires the use of different disciplinary approaches, in an integrated framework, to the impact assessment of development projects/programmes. Integrated Impact Assessment (IIA) provides such a framework for a balanced consideration of the economic, environmental, and social and health impacts of development interventions at the project, sector and economy levels. The course in Integrated Impact Assessment (IIA) is designed to build detailed knowledge, understanding and skills among students for conducting IIA, so that they are able to identify sustainable modes of environmental operation. The course starts with an overview of IIA–the different methodologies on which it draws the state of the art, current practices, constraints and future directions. This is followed by in-depth exposure to the key approaches to IIA-environmental, social and health–with a focus on methodology and tools in the key discipline areas. Social CBA is introduced as a possible tool for the integrated analysis of the environmental, social and health impacts of development projects or programmes. AHP is introduced as an easily understood multiple-criteria decision-making technique. Technology assessment, risk assessment, etc. are discussed at the conceptual level to provide students with a flavour of the emerging dimensions of IIA. The final module of the course is intended to strengthen students' analytical capacity and assessment skills by making them work through actual/simulated scenarios.

Course objectives

- Exposure to the key approaches to integrated impact assessment (environmental, social and health) with a focus on methodology and tools in the key discipline areas.
- To provide a basic understanding of the Environmental Impact Assessment (EIA) process as it is used for research, planning, project or program evaluation, monitoring, and regulatory enforcement.

To relate the uses of scientific research to practical situations in project planning and decision making using various impact assessment tools such as Health/Social/ Strategic environmental impact assessment

Course content				
Module	**Topic**	**L**	**T**	**P**
1.	**Introduction & an Overview of IIA** Defining IIA; Sustainable Development challenges and need for IIA; Key Approaches of IIA: Environment, Social Health and Economic; Current Practices, Changing Perspectives & Debate in IIA **Assessing Environmental Impacts: The EIA Approach** Environmental Impacts–examples, need for assessment, difficulties; The EIA Approach–Background, Objectives, Components & Techniques, Impact prediction & analysis, Treatment of Risk and Uncertainty, EIA inputs to the project cycle and development planning; EIA in India–Legislative aspects, Current practices & Constraints, EIA case study	5	2	0
2.	**Assessing Environmental Impacts: Biodiversity Impact Assessment (BIA)** Role of BIA in the existing EIA process, Identification, prediction and evaluation of impacts on biodiversity, techniques of biodiversity impact assessment and monitoring, threat reduction methods; Case study	2		0
3.	**Incorporating Health Concerns: the HIA Approach** Impact of environment on health, Morbidity Pattern in India; Developing framework for HIA Analysis, Changing concept and approach in Health Impact Assessment; Health Need Assessment, tools and techniques in HIA, HIA Case Study **Handling Social Issues: the SIA Approach** Overview and scope of Social Impact Assessment (SIA), SIA and community, marginalized/vulnerable groups, indigenous people, resettlement & rehabilitation and development; SIA and Gender Impact Assessment, SIA and NRM; SIA Case Studies	3	1	0
4.	**Integrated Analysis of Environmental, Social & Health Impacts** Challenges for IIA: Removing inconsistencies and differences between different approaches; other methodological and practical issues; Scope for integrated approach in economic analysis: concept of economic analysis, Cost-Benefit Analysis (CBA), Social CBA, Cost Effectiveness Analysis (CEA); The Analytic Hierarchy Process (AHP) based approach to project appraisal **Public Participation in IIA and its relevance to decision-making** Contribution of IIA to decision-making–prospects & constraints; Stakeholder participation in IIA–importance, methodological and practical issues	5	2	0
5.	**Mapping Tools and Techniques in IIA** Role and relevance of GIS Techniques in IIA	2	0	0

6.	**Emerging Dimensions & Future Directions** Strategic Environmental Assessment (SEA), Technology Assessment, Risk Assessment	4	1	0
7.	**Monitoring and Evaluation** Basic concepts of monitoring and evaluation, guidelines tool for M&E (logic model, monitoring plan, evaluation plan), measures and indicators, evaluation designs and its applications–case study	4	1	0
8.	**IIA Case Studies** Infrastructure projects such as transport, building; Hydro-electric projects; Thermal power plants etc.	5	0	0
9.	**Introduction & an Overview of IIA** Defining IIA; Sustainable Development challenges and need for IIA; Key Approaches of IIA: Environment, Social Health and Economic; Current Practices, Changing Perspectives & Debate in IIA **Assessing Environmental Impacts: The EIA Approach** Environmental Impacts–examples, need for assessment, difficulties; The EIA Approach–Background, Objectives, Components & Techniques, Impact prediction & analysis, Treatment of Risk and Uncertainty, EIA inputs to the project cycle and development planning; EIA in India–Legislative aspects, Current practices & Constraints, EIA case study	4	1	0
	Total	**34**	**08**	**0**

Evaluation criteria

- Minor test 1: 15%
- Minor test 2: 15%
- Assignments/Tutorials/field visit: 20%
- Final examination: 50%

Learning outcomes

1. After attending the course the students shall have acquired knowledge to conduct integrated impact assessment, so that they are able to identify sustainable modes of environmental operation.
2. Students would be able to understand the key elements of EIA and its processes by which they can apply to relevant projects.
3. Able to understand various tools and techniques used in identification and analysis of impacts suggest appropriate mitigation measures and prepare environmental management plans.

Pedagogical approach

The course will be delivered through class room lectures, discussion of case studies from original relevant research articles and field visits.

Materials

Required text

1. Bathwal R.R. (1988) *Environmental Impact Assessment*, New Age, International Publishers.
2. Canter L.W. (1996) *Environmental Impact Assessment*, 2nd Edn. New York, McGraw Hill.
3. Dale R. (2004) *Evaluating Development Programme and Project*, Second Edition, Sage Publication.

4. Lee N. and Kirkpatrick C. (Eds) (2000) *Integrated Appraisal and Sustainable Development in a Developing World*, Cheltenham, Edward Elgar.
5. Vanclay F. and Bronstein D.A. (1995) *Environmental and Social Impact Assessment*, Wiley Publishers.

Suggested readings

1. Asian Development Bank (1997)*Environmental Impact Assessment for Developing Countries in Asia*, Vol I & II, ADB Publication.
2. Briggs D., Corvalan C. andNurminen M. (Edited)(1996) *Linkage Methods for Environment and Health Analysis–General Guidelines*, World Health Organization, Geneva.
3. British Medical Association (1998)*Health and Environmental Impact Assessment-An Integrated Approach*, Earthscan.
4. CISHME (2011)*Environmental Feasibility Report of Hirong H.E. Project on Siyom River in Arunachal Pradesh*, New Delhi, CISMHE.
5. Dahlgren G. and Whitehead M. (1991) *Policies and Strategies to Promote Social Equity in Health*, Stockholm.
6. Glasson J., Therivel R. and Chadwick A. (1994) *Introduction to Environmental Impact Assessment*, London, UCL Press.
7. Goodland R. and Mercier J.R. (1999) *The Evolution of Environmental Assessment in the World Bank: From 'Approval' to Results*, Environment Department Papers No. 67, World Bank, Washington D.C.
8. Kemm J. (2000) *Can Health Impact Assessment Fulfill the Expectations it Raises*? Public Health, 114, 431-433.
9. Morrison-Saunders A. and Arts J. (2004) (eds.) *Assessing Impact: Handbook of EIA and SEA Follow-up*, Earthscan James & James, London.
10. The World Bank (2009) *Strategic Environmental Assessment in East and Southeast Asia, A Progressive and Comparison Country Systems and Cases,* Washington D.C.

Journals

1. Journal of Environmental Impact Assessment Review
2. Journal of Journal of Environmental Management

Additional information (if any)

Student responsibilities
Attendance, feedback, discipline, guest faculty etc.

Course reviewers:
1. Dr. A K Nema, IIT Delhi
2. Dr. Anubha Kaushik, Guru Govind Singh, Indraprasatha University

7. Course title: Land, Environmental and other Laws			
Course code: **BSI 153**	**No. of credits:** 1	**L-T-P distribution:** 12-02-0	**Learning hours:** 14
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			

Course coordinator (s): Dr. M P Rammohan		**Course instructor (s):** Dr. M P Rammohan
Contact details: mprmohan@teriuniversity.ac.in		
Course type	**Core**	**Course offered in:** Semester 1

Course description

Laws relating to land acquisition, environment, labour etc. have an important role to play in the various phases of an infrastructure project. This course tries to analyse these laws and their application in infrastructure projects during the development, construction, operation and demobilization phases.

Course objectives

- To introduce the laws relating to land acquisition, environment and labour that have a bearing on the infrastructure sector
- To analyse the application of these laws during the development, construction, operation and demobilization phases.

Course content

Module	Topic	L	T	P
1.	**Land Acquisition** Concepts of eminent domain and public purpose – The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013: Social Impact Assessment, Requirement of consent in the case of certain acquisitions, compensation, rehabilitation and resettlement. Impact on infrastructure projects, recent changes.	4	1	0
2.	**Environmental Aspects** An overview of Indian environmental laws – Impact on infrastructure projects: requirement of consent; EIA; Forest clearance, clearance under the wildlife protection laws; Forest Rights; Coastal Zone Management Regulation – Role of NGT and higher judiciary.	4	1	0
3.	**Industrial and Labour laws** Industrial Disputes Act, 1947; Industrial Employment (Standing Orders) Act, 1946; Contract Labour (Regulation and Abolition Act) 1970; Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979; Factories Act, 1948; Workmen's Compensation Act, 1923; Employees State Insurance Act, 1948; Minimum Wages Act, 1948; Specific Relief Act, 1963; Hours of Employment Rules (HOER).	4	0	0
	Total	**12**	**2**	**0**

Evaluation criteria

- Term paper and presentations 50%
- Major Test 50%

Learning outcomes

3. The students will be able to understand the laws applicable to the infrastructure sector
4. The students would have acquired the skill to interpret the relevant legislation and judicial pronouncements.

Pedagogical approach
A combination of lecture based and problem based learning would be used. Case studies would be used for initiating discussions in the module on specific sectors.

Materials
Required text

1. National Transport Development Policy Committee Report (Rakesh Mohan Committee)
2. Jain, M. P. (2014), *Indian Constitutional Law*, 7th Edn., LexisNexis, New Delhi.
3. Baldwin, R. and C. McCrudden (1987), *Regulation and Public Law*, Weidenfeld & Nicolson, London.
4. Basu, D. D. (2003), *The Constitutional Law of India*, 7th Edn, Wadhwa and Company, New Delhi.
5. Massey, I.P (2008), *Administrative Law*, 7th Edn, Eastern Book Company, Lucknow.
6. Joshi, Piyush (2003), *Law Relating to Infrastructure Projects*, 2nd Edn, Butterworths, New Delhi.
7. S K Sarkar, Leena Srivastava (ed) (2002), *Reforms in the Infrastructure Sectors: Next Steps*, TERI Press, New Delhi.
8. Sarkar, S. K. and Srivastava, Leena (ed) (1999), *Transition to a liberalized environment: experiences and issues in regulation*, TERI Press, New Delhi.
9. Sundar, S. and Sarkar S. K . (2000), *Framework for Infrastructure Regulation*, TERI Press, New Delhi.
10. Shapiro, Sidney and Tomain, Joseph (2003), *Regulatory law and policy: Cases and Materials*, LexisNexis, New Delhi.
11. India Infrastructure Reports

Case studies
Websites
Journals

Additional information (if any)

Student responsibilities
Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. S. Sinha, CEO, ICSI
2. Mr. Nishant Beniwal, Associate Partner, Khaitan and Company

8. Course title: Legal and Regulatory Aspects of Infrastructure			
Course code: **BSI 167**	**No. of credits:** 2	**L-T-P distribution:** 20-08-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Mr M V Shiju		**Course instructor (s):** Mr. M V Shiju	
Contact details: mvshiju@teriuniversity.ac.in			
Course type	Core	**Course offered in:** Semester 1	
Course description			

This course provides an overview of the Constitutional and general legal context in which the infrastructure sector operates. It also covers the legislative and policy framework within which the specific infrastructure activity has to be undertaken. Special emphasis is placed on the regulatory law of different infrastructure sectors, and attempts to undertake a comparative assessment of the regulatory laws and policies of different infrastructure sectors.

Course objectives

- To provide an overview of the constitutional and the general legal context in which the infrastructure sector operates
- To examine the importance of independent regulation in infrastructure
- To analyse the laws and policies and the reforms carried out in select infrastructure sectors

Course content

Module	Topic	L	T	P
1.	**Constitutional aspects** Indian Constitution – Salient features – Fundamental Rights - Allocation of jurisdiction over different infrastructure sectors between the Centre and State - law making powers Allocation of natural resources: Judicial review Administrative law	3	1	0
2.	**Independent regulation: New Mechanism of Governance in infrastructure** Theories of regulation-genesis of Independent regulation-evolution of regulation in different jurisdictions- Design and structure of regulators-scope and functions-regulatory process-regulatory autonomy and accountability-regulatory predictability and certainty	3	0	0
3.	**Infrastructure Sectoral polices, reforms and laws**			
	Power Sector/Electricity Introduction-evolution of the power sector reforms, polices-Electricity Act, 2003 - National Electricity policy- legal framework- the state electricity boards- licensing framework-Provisions Relating to and working of Electricity Regulatory Commissions-their structure, role and functions	3	2	0
	Telecommunications The national telecom policies-the legal framework- regulatory agencies-functioning, power and functions of TRAI and TDSAT	3	2	0
	Oil, Petroleum and Natural Gas Reforms, policies and legal framework -New Exploration Licensing Policy (NELP)- production sharing contracts- the Petroleum Regulatory and Natural Gas Board Act – the emerging regulatory reforms	2	1	0
4.	**Water** Water policy and General Legal framework and reforms-Water rights- state jurisdiction- new regulatory reforms in water sector-	2	1	0
5.	**Transport** Law, policy and reforms relating to Airports-Railways-Road – Port; TAMP; an overview of coastal shipping and Inland Water	3	1	0

	Transport policy			
	Waste Management: Legal and regulatory framework	1	0	0
	Total	**20**	**8**	**0**

Evaluation criteria

- Term paper and presentations 50%
- Major Test 50%

Learning outcomes

1. The students will be able to understand the laws applicable to the infrastructure sector
2. The students would have acquired the skill to interpret the relevant legislation and judicial pronouncements.

Pedagogical approach

A combination of lecture based and problem based learning would be used. Case studies would be used for initiating discussions in the module on specific sectors.

Materials

Required text

1. National Transport Development Policy Committee Report (Rakesh Mohan Committee)
2. Jain, M. P. (2014), *Indian Constitutional Law*, 7th Edn., LexisNexis, New Delhi.
3. Baldwin, R. and C. McCrudden (1987), *Regulation and Public Law*, Weidenfeld & Nicolson, London.
4. Basu, D. D. (2003), *The Constitutional Law of India*, 7th Edn, Wadhwa and Company, New Delhi.
5. Massey, I.P (2008), *Administrative Law*, 7th Edn, Eastern Book Company, Lucknow.
6. Joshi, Piyush (2003), *Law Relating to Infrastructure Projects*, 2nd Edn, Butterworths, New Delhi.
7. S K Sarkar, Leena Srivastava (ed) (2002), *Reforms in the Infrastructure Sectors: Next Steps*, TERI Press, New Delhi.
8. Sarkar, S. K. and Srivastava, Leena (ed) (1999), *Transition to a liberalized environment: experiences and issues in regulation*, TERI Press, New Delhi.
9. Sundar, S. and Sarkar S. K . (2000), *Framework for Infrastructure Regulation*, TERI Press, New Delhi.
10. Shapiro, Sidney and Tomain, Joseph (2003), *Regulatory law and policy: Cases and Materials*, LexisNexis, New Delhi.
11. India Infrastructure Reports

Case studies

Websites

Journals

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. Nishant Beniwal, Associate Partner at Khaitan & Co
2. Mr. Mohit Abraham, Consultant

9. Course title: Project Planning and Management			
Course code: **BSI 156**	**No. of credits:** 2	**L-T-P distribution:** 20-08-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr. Kaushik R Bandyopadhyay		**Course instructor (s):** Dr. Gireesh Tripathy	
Contact details: gireeshctripathi@gmail.com			
Course type	Core	**Course offered in:** Semester 1	

Course description

The objective of this course is to make the students familiar with the entire life cycle of projects; Planning, Execution and Operation. This would help students prepare themselves for the working in various projects right from conceptualization to delivery. It would help optimize usage of country's resources on various projects; especially in infrastructure domain.

Course objectives

- To develop skills for project scheduling;
- To develop skills for proper execution and monitoring of projects.

Course content

Module	Topic	L	T	P
1.	**Introduction**: Definition of projects, Concept of Project Life Cycle: Application in real life, Need for Planning	2	0	0
2.	**Planning Stage**: Planning needs of different projects, Objectives, Idea generation to fulfill these objectives, Scoping the boundaries,	2	0	0
3.	**Stakeholder Management**: Project owners, regulators, executors, line-managers, suppliers, financers/lenders, users and Project Affected People, Role of each stakeholder and interactions amongst them; Contracts and their importance for such interactions.	3	3	0
4.	Work Breakdown Structure, Project costing, and budgeting, scheduling, selection of stakeholders, structuring, assigning and managing them to plan for smooth execution of projects.	2	0	0
5.	**Execution Stage**: Sequencing activities and mobilizing relevant stakeholders, Project management consultants, Bringing all the stakeholders together, contracting and awarding work packages. Resource management	2	0	0
6.	Execution and control–Network techniques, CPM v/s PERT, Project performance appraisal, Monitoring and controlling; Variance Analysis; Earned Value Analysis including schedule project and corrective actions. Time over-run issues and associated penalties/rewards	3	3	0
7.	Cost, Quality and Dispute Control mechanism, Arbitration and legal recourse, Quality management system, Activity based costing etc. Cost over-run and necessary control mechanism	2	2	0

8.	**Operation Stage**: Project completion audit. Objectives: targeted v/s achieved. Learning for future projects.	2	0	0
9.	Application of technology enablers i.e. ERP, use of project planning, management and evaluation softwares	2	0	0
	Total	**20**	**8**	**0**

Evaluation criteria

- Minor test 25%
- Class participation 15% (Including Surprise Quizzes)
- Presentation 20% (Case/term paper including submitting the hard as well soft copy)
- Major exam 40%

Materials

Suggested readings

1. Prasanna Chandra (2011). Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill
2. Lewis, James (2002). Fundamentals of Project Management, 2nd ed., American Management Association. ISBN 0-8144-7132-3.
3. Project Management Institute (2003). A Guide to the Project Management Body of Knowledge (PMBOK), 3rd ed., Project Management Institute. ISBN 1-930699-45-X.
4. Berkun, Scott (2005). Art of Project Management. Cambridge, MA: O'Reilly Media. ISBN 0-596-00786-8.
5. Comninos D &, Frigenti E (2002). The Practice of Project Management - a guide to the business-focused approach. Kogan Page. ISBN 0-7494-3694-8
6. Finnerty (2012). Project Financing, John Wiely and Sons
7. Meredith, Jack R. and Mantel, Samuel J. (2002). Project Management: A Managerial Approach, 5th ed., Wiley. ISBN 0-471-07323-7.

Journals

1. Project Management Journal
2. International Journal of Project Management

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. S C Gupta, Former CEO, Reliance Infrastructure Limited
2. Prof. V.M. Mathur, FORE Professor, Lal Bahadur Shastri Institute of Management

10. Course title: Public Private Partnership – Challenges and Opportunities			
Course code: BSI 161	**No. of credits:** 2	**L-T-P distribution:** 20-08-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			

Course coordinator (s): Mr. Shri Prakash		**Course instructor (s):** Mr. Shri Prakash
Contact details: shri.prakash@teri.res.in		
Course type	Core	**Course offered in:** Semester 1

Course description

This is a basic course that provides a comprehensive understanding of the different kinds of PPP projects, the need for PPP in infrastructure development and the issues involved in developing and implementing PPP projects.

Course objectives

Develop a comprehensive understanding of developing, financing and building infrastructure projects through the PPP mechanism; issues involved and how they need to be addressed.

Course content

Module	Topic	L	T	P
1.	PPP – a mechanism for bringing in private investments into public projects for development and delivery of infrastructure and bundled services – how it is unique compared to other modes	2	0	0
2.	Risk identification, risk sharing and risk mitigation for PPP projects	2	1	0
3.	Contracting of PPP projects and management of long term concession agreements - what concession agreement should typically cover; how long term contracts are managed to accommodate significant changes in contract conditions and the methods of managing the changes	4	2	0
4.	Options available for financing of PPP projects	3	2	0
5.	PPP models and selection criteria; Current status of PPP in India; Government policy initiatives and guidelines	3	0	0
6.	Case studies of PPP projects in India (transport, energy)	2	2	0
7.	Capacity requirements among stakeholders to promote and successfully complete PPP projects – stakeholder requirements in terms of technical competence, risk appetites, financing, etc.	2	0	0
8.	Need for policy and regulatory reforms to further PPP in India	2	1	0
	Total	**20**	**8**	**0**

Evaluation criteria

- Assignments 50%
- Minor 25%
- Major 25%

Learning outcomes

- PPP as a mechanism to attract private investment for development and delivery of infrastructure and services
- Risk identification, risk sharing and risk mitigation for PPP projects
- Contracting for and contract management of PPP contracts during their lives
- Financing instruments available for PPP projects
- Role of and initiatives by the government in promoting and supporting PPP projects
- Capacities amongst stakeholders to develop and implement PPP projects

Pedagogical approach

The course will be delivered through class room lectures, discussion of case studies from original

relevant research articles and field visits.
Materials Joshi, RN, "Public Private Partnership in Infrastructure Perspectives, Principles, Practices" Rao, JN and Sisodiya, AS, "Public- private Partnership Model in India: Concepts, Issues and Outlook" Ramesh, G., Nagadevara, V.P., Naik, G. and Suraj, S., "Public-Private Partnerships" Website: http://www.pppinindia.com/
Additional information (if any)
Student responsibilities Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Mr. S. Sunder, TERI
2. Dr. Santosh Pande, Cofounder, Nihilent Technologies

11. Course title: Risk analysis and implementation management			
Course code: BSI 185	**No. of credits:** 3	**L-T-P:** 36-06-0	**Learning hours:** 42
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator:	**Course instructor:**		
Contact details:			
Course type: Elective	**Course offered in:** Semester		

Course description

This course provides a holistic view of risks associated within and across infrastructure projects, including the emergent and resource-based sectors. The content focuses on strategies and implementation management that can be utilized to create a strong risk culture across projects and evaluate potential risks to ensure problems are identified at an early stage to avoid reworks and delays which can cause cost blow- outs!

Course objectives

Public and private sector executives tasked with the delivery of major infrastructure projects will have the answers to the problems they face when looking to integrate risk into the design and delivery of their infrastructure project.

Course content

Sr No	Topic	L	T	P
1.	**Risk management process**	**2**	**0**	**0**
	▪ Risk identification			
	▪ Risk assessment			
	▪ Risk allocation			

	▪ Risk mitigation			
2.	**Risk measures techniques**	**3**	**1**	**0**
	▪ Sensitivity analysis			
	▪ Scenario analysis			
	▪ Break even analysis			
	▪ Simulation analysis			
	▪ Decision tree analysis			
	▪ Network analysis			
	▪ Value at Risk (VaR)			
	▪ Risk modelling			
	▪ Risk-software			
3.	**Strategy implementation**	**3**	**1**	**0**
	▪ The concept of strategy			
	▪ Goals, values and performance			
	▪ Business and industry environment: The fundamentals			
	▪ Analyzing resources and capabilities: Understanding the internal environment			
	▪ Developing resources and capabilities			
	▪ Organization structure and management systems: The fundamentals of strategy implementation			
4.	**Implementation management**	**3**	**0**	**0**
	▪ Transformation processes			
	▪ Operations strategy and competitiveness			
	▪ Product design			
	▪ Process analysis			
	▪ Facility location			
	▪ Facility layout			
	▪ Strategic capacity management			
	▪ Project management			
	▪ Operations technology			
5.	**How project structures create value**	**2**	**1**	**0**
	▪ Structural Attributes			
	▪ Project Organization Structure			
	▪ Contracts and Models			
	▪ Economic Impact of Infrastructure Project – The ERR			
	▪ Complexities in Valuing Large Projects			
6.	**Managing risks in infrastructure sector**	**3**	**0**	**0**
	▪ Construction Risk-Time overrun, Cost overrun			
	▪ Operating Risks			
	▪ Market Risks			
	▪ Interest Rate Risks			
	▪ Foreign Exchange Risks			
	▪ Payment Risks			
	▪ Regulatory Risks			
	▪ Political Risks			

	▪ Right of way			
7.	**Managing cost risk and uncertainty in infrastructure projects**	**3**	**1**	**0**
	▪ Exploring the challenges			
	▪ The project life cycle and risk			
	▪ Useful tools and approaches			
	▪ Forward program			
	▪ Risk breakdown structures			
	▪ Recommendations			
8.	**Common language is essential to communications about uncertainty and its management**	**3**	**0**	**0**
	▪ Overview			
	▪ Glossary listing			
	▪ Case study			
9.	**Project and emerging risks in infrastructure financing**	**3**	**1**	**0**
	▪ Risk management in project finance			
	▪ Nature of credit risk and project finance			
	▪ Refinancing risk			
	▪ Institutional sharing of risk origination and risk taking-syndicated loan market			
	▪ Emerging risk and garret's ranking			
	▪ Debt rating criteria			
	▪ Key issues in emerging markets			
10.	**Risk management in resource sector infrastructure projects**	**3**	**0**	**0**
	▪ Planning and conducting risk assessments in advance of appropriate project milestones or activities to allow identification and resolution of risks without disrupting the project schedules			
	▪ The integration of risk and value management as inputs into a robust decision making process			
	▪ Understanding the effects of uncertainty on project objectives			
	▪ Approaches taken to manage the project planning and controls on a project			
11.	**Risk sensitive investment and resilient infrastructure**	**2**	**1**	**0**
	▪ RISE initiative – Risk sensitive investment			
	▪ UN disaster resilient scorecard			
	▪ Integrating climatic risk into infrastructure projects			
	▪ Pricing risk and resilience into design			
12.	**An integrated approach to a successful infrastructure project – initiation, financing and execution**	**3**	**0**	**0**
	▪ Challenges for large scale projects			
	▪ Some typical causes of failure			
	▪ Project risk across the Infrastructure Life Cycle - (ERM)			
	▪ Selecting, planning and design phase			
	▪ Procurement and contractual design choices			

	▪ Construction delivery			
	▪ Asset operation			
13.	**Cutting through barriers to infrastructure project success**	**3**	**0**	**0**
	▪ Innovation (and its barriers)			
	▪ Finance			
	▪ Procurement practices			
	▪ Policy and planning risk			
	▪ Skills availability			
		36	**6**	**0**

Evaluation criteria

- Class participation 10%
- Project 30%
- Minor tests 20%
- Major test 40%

Learning outcomes

An understanding of the risk management processes and techniques in today's context. An understanding of project risks and emerging risks in infrastructure financing. The capability to be able to assess and suggest ways and means to address the practical challenges around the financial estimation of risk in infrastructure projects.

Pedagogical approach

A combination of class-room interactions, tutorials, assignments and projects.

Materials

Suggested readings

Project Finance in Theory and Practice by Stefano Gatti, Academic Press , ISBN-978-81-312-1664-4

Project Finance by Fresh fields

Additional Reading -Corporate Finance by Ross,Westerfield & Jaffe

Journals

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline: as per university rules.

Course reviewers:

Dr Madhu Vij, MDI

Mr SC Gupta, Former Director, Reliance Infrastructure

Module – wise Teaching Plan

Module 1- Risk Management Process

Success of infrastructure projects is greatly influenced by proper management of risk associated with the projects through adoption of appropriate risk management frame-work. This module wise the awareness among students about different stages of risk management process.

Module 2- Risk Measure Techniques

Though the awareness of risk management process is necessary but is not sufficient enough. In order to do appropriate project risk analysis, students need to understand various techniques applied for measurement of risk. This module facilitates to understand the perspective and quantum of risk associated with projects and how is risk analyzed and assessed in practice.

Module 3 - Strategy implementation

Strategy is about winning. The role of strategy in success has to be understood carefully. Strategy implementation is inherent in project implementation. This module provides the basic understanding of the role of various component of strategy in project implementation.

Students of exposed to them in order to comprehend the theoretical framework of project implementation.

Module 4 - Implementation management

A transformation process uses resources to convert inputs into some desire outputs. Physical as well as service infrastructure projects involved transformation process, for example, physical (in manufacturing), location (In transportation), exchange (in retailing),storage (in warehousing), physiological (in health care), informational (in telecommunication). This model provides understanding of various businesses in order to identify the risk involved in these businesses.

Module 5 - How projects structure create value

The structural attributes or infrastructure projects enable them to find financial and other resources students to needs to master the various structure the features of projects that enable lenders an equity holders to invest substantial funds. In this modules student shall develop rationale for, and various types of contracts and models that form the backbone of project financing transaction.

Module 6 – Managing Risk in Infrastructure Projects

This module looks at various risks like construction risk involving cost overrun, time overrun, And other risks like operating risk, market risk, interest risk, foreign exchange risk, payment risk, regulatory risk, political risk students in this module shall understand various types of risks involved and how to manage them.

Module 7 - Managing Cost Risk and Uncertainty in Infrastructure Projects

This module looks at the management of cost risk and uncertainty throughout the project life cycle for mitigating of risks. It also addresses the practical challenges around the financial estimation of risk. Students, in this module shall realize to feel the challenges related to risks in real practical words of infrastructure projects.

Module 8 - Common Language is Essential to Communications about Uncertainty and its Management

It is essential to communicating students, the concepts clearly and unambiguously. In this module attempt has been made to set of "defined terms" to ensure clarity to this course. We shall start with explanatory overview and then present a definition for each specialist term. This module provides the meaning and understanding to students of about fifty definitions and terminologies used in this course.

Module 9 - Project and Emerging Risks in Infrastructure Financing

Arranging cross-border infrastructure financing requires that projects participant assume certain risks, in addition to those common to infrastructure projects including currency risk, political risk, effects of tax policies, economic sensitivity, limited remedies and others, the students in module are made to understand emergent risks along with project risk involved in cross – border infrastructure projects

Module 10- Risk Management in Resource Sector Infrastructure Projects

Resource sector is termed as infrastructure sector dealing with natural resources like coal, metal and mining. This module deals with conducting risk assessments and integration of risk and value management for resource sector infrastructure projects. Students are exposed to assimilate risk assessment methodology used for sector-specific projects.

Module 11- Risk Sensitive Investment and Resilient Infrastructure

This module deals with risk rating criteria of projects. It also deals with disaster management and effect of climate risk in infrastructure projects. The students shall be required to add the said aspects in their knowledge of risk management of infrastructure projects.

Module 12- An Integrated Approach to a Successful Infrastructure Project-Initiation, Financing and Execution

Major infrastructure projects have a history of problems. Cost overruns, delays, failed procurement all unavailability of private financing or common. In this module a picture is painted about good risk - informed project management across the value chain in order to give clear picture to students about the difference with good and badly design infrastructure projects.

Module 13- Cutting through Barriers to Infrastructure Project Success

Various to success have been identifying in this module and exploring the ways to breakthrough has been mentioned. The content in this module provides the holistic view of key infrastructure projects and latest thinking to manage various and risk. Students are required to become familiar with latest thinking and trend in this area.

12. Course title: Strategic Planning			
Course code: BSI 183	**No. of credits:** 2	**L-T-P distribution:** 28-0-0	**Learning hours:** 28
Pre-requisite course code and title (if any):			
Department: Department of Business Sustainability			
Course coordinator (s): Dr. Sapna Narula			**Course instructor (s):** Dr. Sapna Narula
Contact details: sapna.narula@teriuniversity.ac.in			
Course type	Core		**Course offered in:** Semester 1

Course description

Strategic Planning is defined as a set of managerial decisions and actions that determines the long-term performance of a corporation. It includes strategy formulation, implementation and evaluation and control. The study of strategic management therefore emphasizes the monitoring and evaluation of environmental opportunities and constraints in light of corporation's strengths and weaknesses.

Strategic planning is an extremely important step for both short-term and long-term infrastructure projects. So for the successful execution of infrastructure projects, managers must have an understanding of all the tools and techniques of strategic planning and implementation. The potential managers of infrastructure industry must gain hands on exposure of these skills through case applications and practice exercises.

Course objectives

This course is a basic strategic management course covering all aspects of strategy i.e. environmental analysis, internal analysis, strategic advantage analysis, strategy formulation, implementation and control. The course has been designed for MBA (Infrastructure) students keeping in view the increasing need for skill development in planning, management and execution of infrastructure projects. Accordingly, the course has been designed with special focus on infrastructure industry

Course content

Module	Topic	L	T	P
1	**Strategic Management Process**			
	Introduction to strategic planning process: its evolution, The strategic Management Model, Applications of Strategic Management, Types of Strategies Importance of Strategic Planning for Infrastructure firms/projects	2	0	0
2	**Strategy Formulation (A) : Environmental Analysis**			
	Defining Mission, Vision, Objectives and Policies,	2	0	0

	Roles and responsibilities of CEOs in defining vision Case 1 : Vision Mumbai			
3	The Business Environment: External PESTEL Framework Porter's Industry Analysis The External factor Evaluation (EFE)Matrix and Competitive Profile Matrix Stakeholder analysis and Engagement Case 2 : Cochin International Airport: Gateway to God's own country Case 3: New Delhi Water & power ,2009	4	0	0
4	The Business Environment: Internal Analysis Key Internal Forces Building Value in Infrastructure Projects : Evolution and Analysis; ecological and social efficiency and effectiveness The Internal factor Evaluation Matrix The Resource Based View of Organization and The Theory of Core Competencies Case 4: The Hyderabad Metropolitan Water Supply & Sewage Board, 2006	4	0	0
5	**Strategy Formulation (B): Strategic Options**			
	Financial vs Strategic Objectives ,Levels of Strategies, Types of Strategies: Integration Strategies, Intensive Strategies, Diversification strategies, Defensive Strategies, Porter's Generic strategies Mergers & Acquisitions Strategic Alliances Turnaround strategy Sustainability strategies , Networks, Models for Infrastructure alliances, partnerships and collaborations, Public Private Partnerships Case 5: Indus Towers: Collaborating with Competitors on infrastructure, Gulati et al, 2010	6	0	0

6	**Strategic Analysis & Choice**			
	The Nature and Process of Strategic analysis and choice: A comprehensive Strategy-Formulation framework Tools and Matrices Cultural Aspects of strategic Choice, The Role of Board of Directors, Strategy and Social responsibility, Role of values in Strategic Choice	4	0	0
7	**Strategy Implementation**			
	Issues in Strategy Implementation: Policies, Resource allocation, managing conflict, 7S Framework Matching structure with strategy: restructuring and Reengineering, creating a strategy –supportive culture, Functional and technological issues in strategy implementation Preparing organization for managing infrastructure projects: Culture, Structure, resources and Technologies	2	0	0
8	**Strategy Review, Evaluation and Control**			
	The Strategic Evaluation, Process and Framework Balanced Scorecard Strategic Audit Exercise : Project Presentations Case 6: Tata Motors in Singur: Publ;ic Purpose and Private Property ,2009 Case 7: Taiwan's High speed rail: A Public partnership hits a speed bump , 2009	4	0	0
	Total	**28**	**0**	**0**

Evaluation criteria

- Case Presentations (3) (Evaluation through presentation) 15%
- Project/ Assignments (Evaluation through presentation) 15%
- Minor Exam(s) (Closed Book Objective Type) 25%
- End-term Exam (Open Book Case based) 45%

Learning outcomes

- To familiarise the students with factors affecting the infrastructure firm and industry in long run and also with the tools and techniques of external as well as internal environmental analysis

- To develop their analytical as well as decision-making skills to formulate and evaluate strategy with reference to infrastructure projects under a given set of environmental factors
- To develop a practical understanding of strategy formulation and implementation process

To develop an understanding of role of stakeholders' analysis and engagement in infrastructure planning and management

Pedagogical approach

The course will have a mix of theory and applied coursework with more practical approach. The teaching shall be done mainly through lectures/ case discussions/case presentations/exercises etc. The entire course has been divided into seven modules. There will be 28 sessions (One hour each) as per the course outline. The students are also expected to work out cases based on infrastructure industry as well as assignments given at the end of each module which will help them develop their analytical as well as conceptual skills. The students would also be asked to do a field project on infrastructure projects.

Both case study presentations as well as exercises are group assignments. Students are expected to work in the group of 4-5 for working out case solutions. The alternative solutions from all the groups will then be discussed in class.

A list of reading materials shall be provided to each student. Students are also expected to come prepared before every class. The topics are largely based on the book on Strategic Management by Fred R. David.

Materials

Suggested Reading:

The course-contents (REFERRALS) refer to the book Strategic Management: concepts and cases (10th Edition) by Fred R. David and students are expected to read these chapters before coming to the class . There will be some handouts on class lectures covering only the main points and hence it is imperative to be attentive in the class.

The following readings shall be provided by the course instructor:

Chapter 1 Readings: Closing the capability Gap: strategic Planning for Infrastructure Sector Dominguez et al, California Management Review, 2009

Chapter 3 Reading: A Note on Porter's Industry Analysis

Chapter 4 Readings: Exploring the Concept of Fit in Strategic Management by Venkatraman and Camillus
(Academy of Management Review, 1984)

The Core Competence of Corporation by C.K. Prahalad & Gary Hamel, (Harvard Business Review,May-June,1990)

Chapter 5 Reading: Towards a comprehensive Understanding of Public Private partnership for Infrastructure Development Kwak et al, California Management Review, 2009

Chapter 6 Reading: A Strategy Evaluation Model for Management by Simon Hastings

Chapter 7 & 8 Reading: A Proposed Framework for Strategy Implementation in Indian Context by Azhar Kazmi
(Management Decision, 2008)

Chapter 9 Reading: Strategy Focused organisations: How balanced Scorecard thrive in New Business Environment
Kaplan & Norton, HBSP, 2001

Additional Readings:

- Thomson & A.J. Strickland: Strategic Management :Concepts and Cases, Tata McGraw-Hill, New Delhi (2003)
- T.L. Wheelen , J. Hunger, K.Rangarajan: Concepts in Strategic Management & Business Policy, Pearson Education, Delhi- (2005)
- Gerry Johnson & K. Scholes: Exploring Corporate Strategy: Text and Cases, PHI, New Delhi (2002)
- V. Gupta, K. Gollakota, R. Srinivasan: Business Policy and Strategic Management-Concepts and Applications; Prentice-Hall of India, New Delhi (2005)
- Michael.E.Porter, Competitive Advantage, Free Press
- The Elegant Solution: Toyota's Formula for Mastering Innovation by Matthew E. May

Additional information (if any)

Student responsibilities
Attendance, feedback, discipline, guest faculty etc.

Course reviewers:

1. Dr. Sonu Goyal, Professor, IMI
2. Mr. P. Das Gupta, IMI

Annexure 4
(Refers to Item No 5 of minutes of 38th meeting of AC**)**

Programme Structure and Course Outlines of MA (Public Policy and Sustainable Development) Programme.

Semester 1

Course	**Core/Elective (Number of Credits)**
Public policy processes and institutions	Core (4)
Fundamental paradigms of economics and the concepts and practice of economic regulation	Core (4)
Normative ethics	Core (4)
Methodologies I: Statistical Analysis	Core (2)
Organisational behaviour	Core (2)
Introduction to policy formulation paper	Core (1)
Total Credits	**17**

Semester 2

Course	**Core/Elective (Number of Credits)**
Society development and social policy	Core (4)
Macroeconomics for Public Policy	Core (4)
Perspectives in sustainability	Core (2)
Strategic communication	Core (2)
Sustainable consumption and production	Core (4)
Policy formulation paper (2 Credits)	Core (2)
Methodologies II: Decision-making in Public Policy – Analytical and Empirical Tools	Core (2)
Electives	Electives (2)
Total Credits	**22**

Summer Semester (Total Credits 4)

Existing Course	**Proposed Changes**
International exposure/Summer project	Core (2)
NGO Attachment	Core (2)

Third/Fourth Semesters (Total credits 27)

Existing	**Revised**
Major Project (27)	No changes

Minimum credit requirements
MA (Public Policy and Sustainable Development): 70 Credits

Semester I: 17 credits
Semester II: 22 credits
Summer Semester: 4 credits
Third and Fourth semester: 27 credits

One Year P.G. Diploma in Public Policy and Sustainable Development: 43 Credits
Semester I: 17 credits
Semester II: 22 credits
Summer Semester: 4 credits

1. Course title: Macroeconomics for Public Policy					
Course code: PPS 148	**No. of credits: 4**	**L-T-P: 48-8-0**			
Pre-requisite course code and title (if any): None					
Course description: This course will cover the standard economic analysis of the behaviour of economic aggregates like Gross Domestic Product, employment and the price level in a market economy characterized by the use of money and credit, bringing in also the open economy context. Issues like fiscal deficit, inflation, volatile exchange rate, etc. shall be covered along with an assessment of the role government (fiscal and monetary) policy that can play in mitigating or creating such phenomena. In addition, the role of financial markets and institutions that can influence the (fiscal and monetary) policy outcomes will be covered with a focus on Indian economy in the recent times.					
Course objectives: To provide a clear understanding on the macroeconomic theories, concepts and principles To connect the theory, concept and principles with the fiscal and monetary policies					
Course contents					
Module	**Topic**		**L**	**T**	**P**
1	**Introduction** Production, Consumption, Investment and Exchange of Goods and Services Macroeconomic Aggregates, Circular Flow of Income and its Criticism Methods of Calculating National Income—income, expenditure, value added Nominal and Real GDP Limitations of GDP as a measure of well-being Price indices for temporal comparisons		4		
2	**Introduction to Schools of Macroeconomics and role of government** Keynesian Revolution as a critic of Classical School Rise of Monetarism New Classicals and New Keynesians Old and New Growth Theories		3		
3	**The Short Run** The Goods Market: determination of equilibrium output Financial Markets: demand for money and interest rates Goods and Financial markets: IS-LM Model General Overview of Fiscal and Monetary Policies		5		

	Monetary and Fiscal Policies--relative effectiveness			
4	**Module 4: The Medium Run** Labour Market: Wage determination and wage Rigidity Natural Rate of Unemployment Philips Curve AD-AS model	5		
5	**Module 5: The Long Run** Economic Growth: Solow Model Determinants of Economic Growth in Short, medium and long run	3		
6	**Module 6: Macroeconomics of the Open Economy** Openness in Goods and Financial Markets Depreciation, Trade Balance and Marshal-Lerner condition International Transactions and exchange rates—nominal and real Exchange rate management, the international and Indian experience Equilibrium in an Open Economy Public Policies and Events affecting Open Economy Capital Flight	6		
7	**Module 7: Looking back at New Classical and New Keynesian theories** Rational Expectations Question of Persistence Auction Market versus Contractual views of Labour market Real Business Cycle Models Sticky Price (Menu Cost), Efficiency Wage, Insider-outsider models, Hysteresis	6		
8	**Module 8: Summing Up of Fiscal and Monetary Policies** Policymaking under Uncertainty and Expectations	2		
9	**Module 9: Indian experience: Fiscal Matters** Independence or calibration between fiscal and monetary policies Expansion, contraction, prudence and austerity Fiscal Deficit targets and FRBM Act Goods and Services Tax	6	4	
10	**Indian Experience: Monetary Matters** Deregulation and Regulations Inflation targeting Taylor Rule—trade-offs Autonomy of Central Bank in an era of foreign capital inflow	6	4	
11	**Module 11: Indian Experience: Growth of GDP and its impacts** Drivers of economic growth and lack of it Opening up—precautions and checks Can growth reduce poverty?	2		
	Total	**48**	**8**	
Evaluation criteria: Assignments/Presentations 50% Written Test 50%				

Learning outcomes: On completion of this course, the students would: Have acquired an understanding of the basic macroeconomic concepts and theories Have developed an ability to connect the macroeconomic events with the theories
Pedagogical approach: The course will be delivered through a mix of classroom lectures and discussions around recent events from Indian economy.

Materials:

Texts: (selected chapters from)
J R Hicks, M Mukherjee and S K Ghosh, 1984, *The Framework of the Indian Economy*, OUP
Richard T. Froyen, 2004, Macroeconomics: Theories and Policies, 8th Edition, Pearson
Olivier Blanchard and David R. Johnson, 2013, *Macroeconomics*, Sixth Edition, Pearson
C. T. Kurien, 2012, *Wealth and* Ill*fare: an expedition into Real Life Economics*, Books for Change, Bangalore
Brian Snowdon and Howard R. Vane, 2005, *Modern Macroeconomics*, Edward Elgar
NCERT, 2012, *Macroeconomics*, NCERT
N Gregory Mankiw, 2008, *Principles of Macroeconomics*, South-Western Cengage Learning

Module 1: Introduction
Text: Hicks, Chapter 1-2; NCERT, Chapter 1 and 2; Mankiw, Chapter 11
[Debate: J Dennis Rajakumar, S L Shetty, 2016, 'Some Puzzling Features of India's Recent GDP Numbers', *EPW*, LI (2)]

Module 2: Introduction to Schools of Macroeconomics and role of Government
Text: Snowden and Vane Chapter 1: 3-35; Blanchard and Johnson, Chapter 25; Mankiw, Chapter 23; NCERT Chapter 5

Module 3: The Short Run
Text: Blanchard and Johnson, Chapter 3-5; Froyen Chapter 6: 109-131, Chapter 7; NCERT Chapter 3; Kurien Chapter 5; Musgrave and Musgrave, Chapter 1, 12-16

Module 4: The Medium Run
Text: Froyen, Chapter 8, 10; Blanchard and Johnson, Chapter 6-8
Additional Reading: Froyen Chapter 9

Module 5: The Long Run
Text: Blanchard and Johnson, Chapter 10-13; Kurien, Chapter 12

Module 6: Macroeconomics of the Open Economy
Reference: Blanchard and Johnson 18-21, NCERT Chapter 6

Module 7: Looking back at New Classical and New Keynesian theories
Text: Froyen Chapter 11-12

Module 8: Summing Up of Fiscal and Monetary Policies

Text: Blanchard and Johnson 22-24; Mankiw Chapter 21

Module 9: Indian experience: Fiscal Matters
Articles:
EPW Research Foundation, 1995, 'Need for Review of Monetary and Fiscal Policies', *EPW*, June 10
EPW Research Foundation, 1999, 'Monetary Policy Hampered by Fiscal Inaction', *EPW*, March 20
EPW Research Foundation, 2000, 'Need for Expansionary Fiscal and Monetary Policies', *EPW*, February 19-26
Pinaki Chakraborty, Lekha Chakraborty, 2016, 'Beyond Fiscal Prudence and Consolidation', *EPW*, April 16
Prabhat Patnaik, 2015, 'A Note on the Elementary Macroeconomics of Austerity' *EPW*, December 19
Sashi Sivramkrishna, 2015, 'Decentring the Fiscal Deficit Target Numbers', *EPW*, May 9
Siddhartha K Rastogi, 2015, 'Recalibrating Fiscal Deficit Numbers for India' *EPW*, September 19
Kavita Rao, 2016, 'Income Tax Policy: Critique of the Economic Survey 2015–16', *EPW*, April 2
Arun Kumar, 2015, Macroeconomic Aspects of Goods and Services Tax, *EPW*, July 18

Module 10: Indian Experience: Monetary Matters
Articles:
Y V Reddy, 2012, 'Society, Economic Policies and the Financial Sector' *EPW*, August 18
V M Dandekar, 1986, 'Monetary Policy for Independent Monetary Authority', *EPW*, January 25
Rakesh Mohan, 2005, 'Financial Sector Reforms in India: Policies and Performance Analysis', *EPW*, March 19
Y V Reddy, 2009, 'India's Financial Sector in Current Times', *EPW*, November 7
R H Patil, 2010, ''Financial Sector Reforms: Realities and Myths', *EPW*, May 8
Y V Reddy, 2010, 'Financial Sector Regulation in India', *EPW*, April 3
Alok Sheel, 2014, 'A Monetary Policy Rule for Emerging Market Economies The Impossible Trinity and the Taylor Rule', *EPW*, January 25
Alok Sheel, 2015, 'Deconstructing Indian Monetary Policy through the Taylor Rule', *EPW*, August 22
Alok Sheel, 2016, 'Monetary Policy Dilemmas at the Current Juncture', *EPW*, March 19
C P Chandrasekhar, 2014, 'Off-target on Monetary Policy', *EPW*, March 1

Module 11: Indian Experience: Growth of GDP and its impacts
Articles:
Rakesh Mohan, 2008, 'Growth Record of the Indian Economy, 1950-2008: A Story of Sustained Savings and Investment', *EPW*, May 10
Alok Sheel, 2013, 'Macroeconomic Policies for India's Growth Crisis', *EPW*, May 11.
Pulapre Balakrishnan, 2014, 'The Great Reversal: A Macro Story', *EPW*, May 24.
C P Chandrasekhar, 2013, 'Macroeconomic Vulnerability and the Rupee's Decline', *EPW*, September 21
S Subramanian, D Jayaraj, 2016, 'The Quintile Income Statistic, Money-metric Poverty, and Disequalising Growth in India: 1983 to 2011–12', *EPW*, January 30

Additional information (if any):
Student responsibilities: Reading financial newspapers like *Mint*, *Economic Times*, *Business Line*, as well magazines like *Economist*, for identifying the relevant topics for the assignment.

Course reviewers:
Dr. Mausumi Das, Associate Professor, Delhi School of Economics
Dr. Sabyasachi Kar, Associate Professor, Institute of Economic Growth, Delhi

2. Course title: Perspectives in Sustainability			
Course code: PPS 131	**No. of credits:** 2	**L-T-P:** 16-12-0	**Learning hours:** 28
Pre-requisite course code and title (if any): none			
Course description: This course explores environmental sustainability in some of its ecological, social, economic and political dimensions. The concept has become important for policy-making. The aim of the course is to review some of the key concepts and debates on sustainability, with special reference to the Indian context. By the end of the course, students should command comprehensive knowledge of the subject matter of the course and a critical understanding of the theory of sustainable development.			
Course objectives: To equip the students with knowledge of ecological, social and economic sustainability and need for resource efficiency, particularly in Indian context. To create awareness of global scenario, sustainable development goals, climate change and the steps taken by other countries.			
Course contents			

Module	**Topic**	**L**	**T**	**P**
1	**Module 1: Introduction** What is sustainability? Sustainability of what, for whom, for how long? Historical background and contemporary context: How did we get there? A short history of (un)sustainability Is the Indian economy sustainable?	2		
2	**Module 2: Ecological aspects of sustainability** The economy as an open system with limited resources Biodiversity losses Weak vs. strong sustainability New directions: industrial ecology and agro ecology	2	2	
3	**Module 3: Social aspects of sustainability** Differentiating social groups and the relationship to "sustainability": Social groups and their impacts ("too poor to be green"?) Science vs. informal knowledge (traditional, local, activist): what implications for sustainability? Institutions and governance Environmental governance (decentralization, role of judiciary)	2	2	

	State property, commons or private property? The example of forests in India			
4	**Module 4: Economic aspects of sustainability** Elements of environmental and resource economics Sustainable consumption climate change INDCs, COP 21 and after	3	2	
5	**Module 5: Political aspects of sustainability** The political economy of the environment: Power, conflicts, and the uneven distribution of socio environmental costs and benefits The example of India: cities, water, plantations and forests and mining	3	2	
6	**Module 6: Global perspective** Global sustainability policies Sustainable development goals	2	2	
7	**Module 7: Integration** Towards a sustainable India: Sustainability goals and economic development Role of Governments and civil society organizations as potential forces for sustainability Win-win solutions rarely exist: the need for innovations and courageous initiatives	2	2	
	Total	16	12	0

Evaluation criteria:

Weightage (%)

Presentation of one article : 30%

Assignment : 30%

Final Examination : 40%

Learning outcomes:

By the end of the course students should:

command comprehensive knowledge of the subject matter of the course, and a critical understanding of the relevant theory and practice of sustainable development.

Pedagogical approach:

The course will be delivered through a mix of classroom lectures and case studies discussions

Materials:

Suggested Readings:

Lélé, S. (1991) Sustainable development: A critical review. World Development 19(6): 607-621

Haberl, H. M. Fischer-Kowalski, F. Krausmann, J. Martínez-Alier & V. Winiwarter (2011) A sociometabolic transition towards sustainability? Challenges for another Great Transformation. SustainableDevelopment 19: 1-14. [The "big picture", as provided by a cutting-edge team at the Institute of Social Ecology, Austria]

Martínez-Alier, J. (2002) Ecological economics: 'Taking Nature into account' (chap. 2). In: The environmentalism of the poor: A study of ecological conflicts and valuation, pp. 16-38. Cheltenham: Edward Elgar.

Gadgil, M. & R. Guha (1994) Ecological conflicts and the environmental movement in India. Development and Change 25: 101-136.

Gerber, J.-F. (2011) Conflicts over industrial tree plantations in the South: Who, how and why? Global Environmental Change 21(1): 165-176.
Jain, L.C. (2012) Poverty, environment, development: A view from Gandhi's window. In: R. D'Souza (ed.) Environment, Technology and Development. New Delhi: Orient BlackSwan.
Kothari, A. (2013). India 2100: Towards radical ecological democracy**.** Future 56: 62-72.

Additional information (if any): NA

Course Reviewers:
Dr. Prodipto Ghosh, TERI, New Delhi.
Dr. Mala Narang Reddy, DMI, Patna.

3. Course title: Methodologies I: Statistical Analysis

Course code: PPS 171	**No. of credits:** 2	**L-T-P:** 22-3-6

Pre-requisite course code and title (if any): Nil

Course Description

The course introduces students to statistical concepts and techniques essential to the analysis of public policy issues. The course will provide an introduction to statistics and regression based methods for quantitative evaluation of causal effectiveness of public policies. The objective of the course is for students to learn how to conduct (and how to critique) empirical studies in quantitative policy analysis and in social sciences more generally. Accordingly, the emphasis of the course is on empirical applications. Empirical problems will largely focus on different survey rounds of NSSO data. The course also provides students an opportunity to become proficient in the use of STATA widely used in analyzing quantitative data.

Course objectives:

To learn how to conduct (and how to critique) empirical studies in quantitative policy analysis and in social sciences more generally.

Course content

Module	**Topic**	**L**	**T**	**P**
1.	**Basic Statistics and Causal Inference**			
	1.1 Discrete and Continuous Random variables	1		
	1.2 Probability Distribution Functions	1	0	0
	1.3 Estimation (Point Estimates and their properties)	3	0	0
	1.4 Hypothesis Testing (testing hypotheses about a single population parameter (one and two sided alternatives); confidence intervals; testing hypotheses about a single linear combination of parameters; testing multiple linear restrictions.)	3 5	2 0	0 2
	1.5 Nature of Socio-Economic Data and Tools for Data Analysis (Descriptive Statistics, Quintile-decile plots, Correlation, Analysis of Variance (ANOVA)).	3	0	2
	1.6 Need for Empirical Analysis and Causality		0	0
2.	**Linear Regression**			
	2.1 Introduction to Ordinary Least Squares	4	1	2

	2.2 Violation of OLS assumptions	2		0
	Total	**22**	**3**	**6**

Evaluation criteria:
Project : 50%
Major exam : 50 %

Learning outcomes :
Able to understand and interpret empirical results relevant for policy making
To become proficient in the use of software like STATA

Pedagogical approach
Concepts in basic statistics will be motivated with reference to real world policy situation and through practical problems. Students will be encouraged to bring data sets in the class and rigorously discuss problems of interest in their particular field of interest. Mathematical proofs will be discussed in tutorials, if there is interest.

Materials

Textbooks
Hogg, Robert V., Joseph W. McKean, and Allen Thornton Craig (2013). Introduction to mathematical statistics. 7th ed. Boston: Pearson.
Das, R. K., and Nagar A. L.. Basic statistics. 2nd ed. Oxford, 1985.

Suggested Readings
Angrist, J.D., and Pischke, J. (2009). Mostly harmless econometrics: An empiricist's companion. Princeton: Princeton University Press.

Additional information (if any)- NA

Student responsibilities
Students are expected to come prepared for class, having done the required reading and be able to participate in class discussions.

Course reviewers
Dr. Prodipto Ghosh, Distinguished Fellow, TERI, New Delhi.
Dr. Subir Sen, Department of Humanities and Social Sciences, IIT Roorkie.

4. Course title: Methodologies II: Decision-making in Public Policy – Analytical and Empirical Tools

Course code: PPS 172	**No. of credits:** 2	**L-T-P:** 22-4-4

Pre-requisite course code and title: PPS 171 Methodologies I: Statistical Analysis

Course Description
Effective decision-making by public administrators is the key to successful formulation and implementation of public policy. Recently, new insights have come from diverse fields such as behavioral economics, psychology, neuro-science, and organizational theory to help us better understand the influence of heuristics and biases on decision-makers' choices. The practice of decision-making in public policy needs to incorporate these insights and, accordingly, the course

seeks to acquaint participants with the relevant models, methods and tools. Thus, in choosing the "right" intervention, institution and policy instrument to address specific policy goal(s) in a specific context, the course expects to provide guidance on the relevant approach – for example, in dealing with climate change, what information do integrated assessment models provide to policy makers towards the design of mitigation mechanisms? Or, in dealing with a potential public health epidemic with trans-boundary origin, why does it help to have scenario-based planning of interventions? Or, how is complexity in a policy challenge addressed through strategic engagement of stakeholders to have their 'buy-in' for the decision?

Course objectives

To acquaint the participants with various models, methods and tools of decision making and to provide guidance in the relevant approach in a specific public policy context.

To introduce to single criterion and multi-criteria based evaluation of the alternatives that a decision maker may be facing in a given policy context.

Course content

Module	Topic	L	T	P
1.	**Models of decision-making in public policy** Overview: Rational choice; Incrementalism; Organizational process (SOPs); Systems theory; Collective choice Intuition and behaviour in decision-making: Book discussions of "Blink" by Malcolm Gladwell and "Nudge" by Richard Thaler and Cass Sunstein	4	0	0
2.	**Importance of data and analytics** "Evidence-based" decision-making – what kind of evidence? Example: opinion polls Models and Decision Support Systems (DSS): Example of GIS-based urban planning; Example of the use of IAMs in climate policy making Tutorial: Introduction to a DSS software	2	0	0
3.	**Optimization in planning** Mathematical programming concepts (linear, integer, non-linear): Examples of some strategy generation/evaluation tools from operations research: *planning of urban services, inventory management in public health, and resource allocation* Tutorial: Data Envelopment Analysis	4	2	2
4.	**Evaluation methods** Integrated impact assessment: key concepts, use of indicators, and the example of Lake Chilika Tutorial on index construction, Factor Analysis, etc: software based Strategic Environmental Assessment: key concepts and the example of Power Sector Reforms in India Cost benefit analysis: basic theory and a case study Multi-criteria decision making: an introduction to AHP and a case study Tutorial on CBA and MCA: software based	8	2	2
5.	**Risk and uncertainty** Typology of uncertainty in public policy: illustrative case studies from	4	0	0

	public health, rural development, nuclear energy, and climate change Use of model-generated and 'what if' scenarios: Example of India's energy futures (TERI, 2010)			
	Total	**22**	**4**	**4**

Evaluation criteria
Quiz – 25%
Individual presentations of case studies in application of decision making/ evaluation methodologies in public policy – 65%
Contribution to discussions (through-semester): 10%

Learning outcomes
By the end of the course, it is expected that the students will develop
Ability to appreciate various decision making tools and use the relevant tool in a specific public policy context
Ability to appreciate analytical literature and develop a critical and rigorous approach to policy making

Pedagogical approach
In addition to lectures, a lot emphasis will be given on discussions on identified books, reports and articles. Hands on experience will be provided in various decision making software.

Materials

Suggested Readings

Books
Ayres, I. (2007). Super crunchers: Why thinking-by-numbers is the new way to be smart. New York: Bantam Dell.
Allison, G.T. (1971). Essence of decision making. Boston: Little, Brown and Co.
Gladwell, M. (2005). Blink: The power of thinking without thinking. New Delhi: Penguin.
Stone, D. (2002). Policy paradox: The art of political decision-making. New York: W.W.Norton &Company.
Thaler, R. and Sunstein C. (2008). Nudge: Improving decisions about health, wealth, and happiness. New Haven: Yale University Press.

Journal articles
Lindblom, C.E. (1959). The Science of 'Muddling Through'. Public Administration Review, 19 (2), 79-88.
Kahneman, D. (2002). Maps of bounded rationality: A perspective on intuitive judgment and choice. Nobel Prize Lecture, 8.
Davenport, T.H. (2009). Make better decisions. Harvard Business Review.
Bond, R., Curran, J., Kirkpatrick, C., Lee, N., and Francis, P. (2001). Integrated impact assessment for sustainable development: A case study approach. World Development, 29 (6), 1011-1024.

Arrow, Kenneth, Maureen Cropper, George Eads, Robert Hahn, Lester Lave, Roger Noll, Paul Portney, Milton Russell, Richard Schmalensee, Kerry Smith, and Robert Stavins (1996). Is there a role for benefit-cost analysis in environmental, health, and safety regulation? Science, 272(5259), 221-222.
Barberis, Nicholas C. 2013. Thirty years of prospect theory in economics: A review and

assessment. Journal of Economic Perspectives, 27(1): 173-96.
Wiktorowicz, Mary ;Deber, Raisa (May 1997). Regulating biotechnology: A rational political model of policy development". Health Policy Journal 40 (2), 115–138.
Morgan M.G., Kandlikar M., Risbey J., Dowlatabadi H. (1999). Why conventional tools for policy analysis are often inadequate for problems of global change". Climatic Change, 41 (3-4), 271–281.
Ryan L., Convery F., Ferreira S. (2006). Stimulating the use of biofuels in the European Union: Implications for climate change policy. Energy Policy, 34 (17), 3184–94.

Additional information (if any) - NA

Student responsibilities
Students are expected to come prepared for class, having done the required reading and be able to participate in class discussions.

Dr. Prodipto Ghosh, Distinguished Fellow, TERI, New Delhi.
Dr. Subir Sen, Department of Humanities and Social Sciences, IIT Roorkie.

5. Course title: Sustainable Consumption and Production

Course code: PPS 127	**No. of credits: 4**	**L-T-P: 42-6-12**

Course description:

Countries in South Asian region are witnessing rapid transformation. It is evident that future prosperity and transition to sustainability in this region will be highly influenced by changes in development of the countries and businesses as well as in consumption patterns and lifestyles. There are noticeable awareness generation and capacity building initiatives aiming to promote a shift towards sustainable consumption and production (SCP) patterns and resource efficiency for green growth and poverty reduction in South Asian region. The enabling policy environment needs to be strengthened through enhanced capacity of future decision makers in order to ensure balance between demand and supply side towards SCP. Advanced knowledge, skills and commitment of policy makers and graduates today are critical constituents necessary to structure and successfully implement sustainable development policies in future. India in particular, with its young population is likely to rise from twelfth-largest consumer market today, to become world's fifth-largest consumer market by 2025. While the significance of SCP and resource efficiency is well accepted in India, imparting knowledge to policy and decision makers shall facilitate an enabling environment for comprehensive integration of SCP into policy making. This is being aimed through the first-of-its-kind post graduate course in India for young policy and decision makers.

Course objectives:
To impart knowledge on SCP concepts, significance and advancements within India and wider South Asia region in order to create a pool of better informed future policy makers.
To equip young policy makers with knowledge on demand side and supply side challenges and opportunities relating to SCP
To equip young policy makers for policy analysis of select sectors targeting to mainstream SCP into policy.

Course Contents

Module	Topic	L	T	P
1	**Introduction to Sustainable Consumption and Production (SCP) Significance** SCP and its significance for Sustainable Development Linking SCP with Sustainable Development Goals Review of SCP Targets under SDG and crosscutting targets and indicators Internalizing SCP elements in development goals of poverty reduction, resource efficiency, sustainable livelihoods, climate change mitigation/adaptation **Theoretical context** Sustainable Consumption in conjunction with Sustainable Production Life Cycle Thinking and Systems Approach Customize policy discussion for India's economic/environmental scenario with specific reference to consumption, production and links with economic growth **Contemporary thinking** Reviewing SCP and SDG's transformative indicators. Gap analysis relating to achieving SDGs (policy, practice, financing, technology gaps) International approaches: Global SCP Policies and Practices (Cases examples from countries which have adopted SCP goals). Innovative ideas for SCP that can integrate with existing policy features. *(Brainstorming tutorial on framework for gap analysis for identified sectors)* **Initiation for framework for policy analysis.*	6	2*	
2	**SCP in Regional, National and Local Policy Frameworks** SCP and Collective Impact - governance and advocacy principles Challenges and opportunities for SCP in emerging economies Regional focus on European Union, ASEAN and South-Asian sub-regional integration of SCP into public governance frameworks National focus on India State level focus and progress across Indian states on SCP topics *(Case example such as Sikkim state advancing as a fully organic state; Community forest user groups in Nepal; Slum dwellers in Karachi, Nairobi, and Pune shall be discussed)*	6		
3	**Demand-side: Sustainable Behaviours and Lifestyles** Consumer Choices and Behaviours: How do consumers determine eco-friendliness of products? Consumer value-action gap, behavioural vs. regulatory obstacles to sustainable consumption choices, consumption 'hot spots', 'choice editing' and its effectiveness, advertisement control, etc.	6	4**	

	Mechanisms for promoting behavioral changes, Promotional activities to attract consumers Roles, responsibilities, and rights of consumers Sustainable Public Procurement 'Green procurement' in government and private sector targeted through awareness and education campaigns on sustainability for consumers Production optimization based on prevailing consumption patterns Learning from success and failures *(Case example such as Eco-labelling, Star Rating and corporate product information disclosure, green rating of products, Right to Repair, Education for Sustainable Consumption (ECS), initiatives like Green School in China, Eco-citizen Programme in Brazil and other global, regional and local exemplars and new approaches)* ***1st Minor poster presentation*			
4	**Supply-side: SCP for Resource Efficiency and Cleaner Production** Designing for sustainability: Process, product and systems innovation – improved production processes, eco-friendly products, innovative low-impact technologies, supply chain management Zero waste / Circular economy across interlinked sectors Adoption of cleaner production processes (efficiency in production, resources management including energy, water and materials) *(Case examples relating to sustainable energy production, resource efficiency and urban planning like social aspects of sustainability: construction products from mining waste in South Africa; new products and reuse: Ragbag in India, product innovation – solar lantern for the Cambodian market shall be discussed)* **Study visit*	6		6*
5	**Mainstreaming SCP I - Development and Implementation of Policies** Existing SCP elements/practices in development goals Regional, national and sectoral specificities Identifying the target policies and instruments for implementing SCP Current policy provisions: Enhancement for effectiveness Cross ministry interface Need for alternatives Planning and implementation: SCP integration into existing policy structures. Exploring stakeholder engagement in policy-making Monitoring and Evaluation: Assessment of sustainable production (upstream) and sustainable consumption (downstream) activities and policies. Ensuring implementation of SCP practices in production and consumption activities, adherence to directives as well as effectiveness and efficacy of said practices.	6		

	(Case examples examining the process of mainstreaming SCP like application of environmental fiscal reforms and charges in Cambodia, sustainable public procurement in Philippines, strategic environmental assessment in Vietnam, social protection instruments in Bolivia, green innovation policies in China etc., shall be discussed)			
6	**Mainstreaming SCP II – Sectoral Strategies for Urban Settlements** Urban and rural development planning Infrastructure for resource efficient cities Waste management Innovations through renewable electricity grids Legal codes and standards for resource efficiency in: Food Production Buildings Transportation Tourism *(Case examples focusing on sectoral initiatives from cities in India and South Asia shall be discussed)* **Study visit*	6		6*
7	**Mainstreaming SCP III - Economic and Fiscal instruments** Financial models for SCP: Government based taxes and subsidies and user fees Green public procurement Using polluter pays principle – such as air, water pollution tax, carbon tax etc. Green investment loan Conditional cash transfer programmes SCP in MSMEs: Internalizing SCP in business strategies and supply chains Depreciation rules for efficient technology and investment allowance for energy-efficient / green technologies Engage in designing and enforcing new laws and regulations regarding EFR Reduction of environmentally harmful subsidies (like reduce fuel subsidies *(Case examples and case studies relating to urban services such as water and waste management, micro-irrigation, financing for MSMEs and community initiatives, agribusiness financing and green retail addressing trade-offs in designing economic and fiscal instruments shall be discussed)*	6		
	Policy analysis report final presentation			
	Total	**42**	**6**	**12**

Evaluation criteria:

Course assessment will be conducted through:

Minor I: Essay and poster presentation (Individual assignment)

Essay (around 1500 words) and poster presentation focused on cross cutting thematic areas such as - Sustainable Public Procurement; Resource Efficiency and Cleaner Production; Behavioral aspects

of Consumer Choices ; Production optimisation based on prevailing consumption pattern; Green Budgeting and Macroeconomics; Sustainable Energy Access, Policy and Management; Strategic Planning and Investment for Resource Efficient Cities; and Sustainable Tourism and Environmental Services. These shall be examined for India and other countries.
(Essay and poster presentation shall be structured through literature review and content analysis of select case studies/ best practice examples from different sectors).

Minor II: Policy analysis report (Group based assignment)
Policy analysis for preparedness to achieve SDGs in select sectors. A framework for analysis shall be developed through the tutorial sessions during the course. Written report (around 3500 words) and presentation to the panel.

Learning outcomes:
On successful completion of this course, the students shall,
Have an improved understanding of SCP and interrelationship between sustainable consumption and sustainable production
Be able to compare and contrast effective applications and business case for SCP in sustainable development with reference to specific countries and economic sectors
Be able to examine the potential synergy of SCP with existing plans and policies
Have learned the significance of various policy instruments, strategy options and institutional arrangements to mainstream SCP for effective sustainable development governance.

Pedagogical approach: The course will be delivered through a mix of classroom lectures, brainstorming tutorial and presentation sessions, study visits and exposure to national, regional and global case studies on the theme.

Materials (To be listed):

Reading List

Module 1 – Introduction to Sustainable Consumption and Production (SCP)

Essential Readings

Akenji, L. and Bengtsson, M., 2014. Making Sustainable Consumption and Production the Core of the Sustainable Development Goals, Sustainability, 6 (2014): 513-529. Available at: http://www.mdpi.com/2071-1050/6/2/513

Chiu, S.F., Ward, J. V., and Massard, G., 2009. Introduction to the special issue on Advances in Life-Cycle Approaches to Business and Resource Management in the Asia-Pacific Region, Journal of Cleaner Production, 17(14): 1237-1240. Available at: http://www.sciencedirect.com/science/article/pii/S0959652609001383

Rebitzer, G., Ekvall, T., Frischknecht, R., Hunkeler, D., Norris, G., Rydberg, T., Schmidt, W. –P., Suh, S., Weidema, B.P., and Pennington D.W., 2004. Life cycle assessment: Part 1: Framework, goal and scope definition, inventory analysis, and applications, Environment International, 30 (5): 701-720. Available at: http://www.sciencedirect.com/science/article/pii/S0160412003002459

Sustainable Consumption and Production in the Proposed Sustainable Development Goals – A paper from the Inter-Agency Coordination Group (IACG) of the 10 Year Framework of Programmes on SCP (10YFP). June, 2014. Available at: www.unep.org/10yfp/Portals/50150/10YFP%20IACG.pdf

UNEP, 2012. Global Outlook on SCP Policies: Taking action together. Available at: http://www.unep.org/pdf/Global_Outlook_on_SCP_Policies_full_final.pdf

Recommended Readings

Le Blanc, D., 2015. Towards integration at last? The Sustainable Development Goals as a network of targets, UN Department of Economic and Social Affairs (UN DESA) Working Paper No. 141. Available at: www.un.org/esa/desa/papers/2015/wp141_2015.pdf
Lorek, S. and Spangenberg, J. H., 2014. Sustainable consumption within a sustainable economy – beyond green growth and green economies, Journal of Cleaner Production, 63 (2014): 33-44. Available at: http://www.sciencedirect.com/science/article/pii/S0959652613006008
SWITCH-Asia Projects, Case studies. See: http://www.switch-asia.eu/publications/?tx_switchasia_publications[category]=3&cHash=187075de03e4a5e1f168fb8ab798b9fb
SWITCH-Asia Project Impact Sheet: Green Retail India – Greening the food and beverage supply chain in India. Available at: http://www.switch-asia.eu/publications/greening-the-food-and-beverage-supply-chain-in-india/
UNEP, 2010. ABC of SCP – Clarifying Concepts on Sustainable Consumption and Production: Towards a 10-Year Framework of Programmes on Sustainable Consumption and Production.
UNEP, 2012. Sustainable Consumption and Production for Poverty Eradication. Available at: http://www.unep.org/10yfp/Portals/50150/downloads/publications/poverty/SCP_for_Poverty_full.pdf
UNEP, 2015. Sustainable Consumption and Production Indicators for the Future SDGs. Available at: http://www.scpclearinghouse.org/upload/publication_and_tool/file/440.pdf

Module 2 – SCP in Regional, National and Local Policy Frameworks
Essential Readings

Brizga, J., Mishchuk, Z., and Golubovska-Onisimova, A., 2014. Sustainable Consumption and Production Governance in Countries in Transition. Journal of Cleaner Production, 63 (2014): 45-53. Available at: http://www.sciencedirect.com/science/article/pii/S0959652613003922
Chandel, S.S., Shrivastava, R., Sharma, V., and Ramasamy, P., 2016. Overview of the Initiatives in Renewable Energy Sector under the National Action Plan on Climate Change in India, Renewable and Sustainable Energy Reviews, 54: 866-873. Available at: http://www.sciencedirect.com/science/article/pii/S1364032115011363
UNDP-UNEP, 2014. Building Inclusive Green Economies – Stories of Change from the Poverty-Environment Initiative in Asia-Pacific.
Zhao, W. and Schroeder, P., 2010. Sustainable consumption and production: Trends, challenges and options for the Asia-Pacific region, Natural Resources Forum, 34(1): 4-15. Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1477-8947.2010.01275.x/pdf

Recommended Readings

(2013) Low-Carbon Green Growth in Asia Policies and Practices: A Joint Study of the Asian Development Bank and the Asian Development Bank Institute. Available at: http://www.adb.org/publications/low-carbon-green-growth-asia-policies-and-practices
Decoupling 2: technologies, opportunities and policy options. A Report of the Working Group on Decoupling to the International Resource Panel. von Weizsäcker, E.U., de Larderel, J, Hargroves, K., Hudson, C., Smith, M., Rodrigues, M.

Module 3 – Demand-side: Sustainable Behaviours and Lifestyles
Essential Readings

Biswas, A. and Roy, M, 2015. Green products: an exploratory study on the consumer behaviour in emerging economies of the East, Journal of Cleaner Production, 85: 463-468. Available at:

www.sciencedirect.com/science/article/pii/S0959652614010142
Fruntes, C., 2014. Ecolabels – Important Tools in Developing a Sustainable Society. A Global Perspective, Economic Sciences, Series V, 7(2): 267-274. Available at: http://search.proquest.com/docview/1658463165
Mehta, P.S., 2007. Why was India's Ecomark Scheme Unsuccessful?, Research Report, CUTS CITEE, Jaipur. Available at: http://www.cuts-citee.org/pdf/RREPORT07-01.pdf
Tseng, S. and Hung, S., 2013. A framework identifying the gaps between customers' expectations and their perceptions in green products, Journal of Cleaner Production, 59: 174-184. Available at: http://www.sciencedirect.com/science/article/pii/S0959652613004411

Recommended Readings

Akenji, L., 2014. Consumer scapegoatism and limits to green consumerism, Journal of Cleaner Production, 63: 13-23. Available at: http://www.sciencedirect.com/science/article/pii/S0959652613003405
Chekima, B., Wafa, S.A., Igau, O.A., Chekima, S., and Sondoh Jr., S.L., 2016. Examining green consumerism motivational drivers: does premium price and demographics matter to green purchasing?,
Journal of Cleaner Production, 112(4): 3436-3450. Available at: http://www.sciencedirect.com/science/article/pii/S095965261501330X
Green Public Procurement in Bhutan (GPP Bhutan), 2015. Executive Summaries of Year 1 Activity Reports. Available at: http://gppbhutan.bt/project-publications
Johnstone, M-L., and Tan, L.P., 2015. An exploration of environmentally-conscious consumers and the reasons why they do not buy green products, Marketing Intelligence & Planning, 33 (5): 804-825. Available at: http://www.emeraldinsight.com/doi/full/10.1108/MIP-09-2013-0159
Ritter, A.M., Borchardt, M., Vaccaro, G.L.R., Pereira, G.M., and Almeida, F., 2015. Motivations for promoting the consumption of green products in an emerging country: exploring attitudes of Brazilian customers, Journal of Cleaner Production, 106: 507-520. Available at: http://www.sciencedirect.com/science/article/pii/S0959652614012736
UNEP, 2013. Redefining Ecolabels to Improve Sustainability and Trade in Developing Countries: Lessons and Recommendations from the UNEP project.
Vermeir, I. and Verbecke, W., 2006. Sustainable Food Consumption: Exploring the Consumer "Attitude –Behavioural Intention" Gap, Journal of Agricultural and Environmental Ethics, 19(2): 169-194. Available at: http://link.springer.com/article/10.1007/s10806-005-5485-3

Module 4 – Supply-side: SCP for Resource Efficiency and Cleaner Production
Essential Readings

Ahi, P. and Searcy, C., 2013. A comparative literature analysis of definitions of green and sustainable supply chain management, Journal of Cleaner Production, 52 (2013): 329-341. Available at: http://www.sciencedirect.com/science/article/pii/S095965261300067X
Rathi, A.K.A., 2003. Promotion of cleaner production for industrial pollution abatement in Gujarat (India), Journal of Cleaner Production, 11(5): 583-590. Available at: http://www.sciencedirect.com/science/article/pii/S095965260200094
Valdivia, S., Bajaj, S., Sonneman, G., Quiros, A., and Ugaya C.M.L., 2015. Mainstreaming Life Cycle Sustainability Management in Rapidly Growing and Emerging Economies Through Capacity-Building. In Sonneman, G. and Margni, M. (eds.), Life Cycle Management, LCA Compendium – The Complete World of Life Cycle Assessment: 263-277. Available at: http://link.springer.com/chapter/10.1007/978-94-017-7221-1_19/fulltext.html

Tanaka, K., 2011. Review of policies and measures for energy efficiency in industry sector. Energy Policy, 39 (10) (6532-6550). Available at: http://www.sciencedirect.com/science/article/pii/S0301421511005933
Tseng, M., Chiu, S. F., Tan R. R., and Siriban-Manalang, A. B., 2013. Sustainable Consumption and Production for Asia: Sustainability through Green Design and Practice, Journal of Cleaner Production, 40 (2013): 1-5. Available at: http://www.sciencedirect.com/science/article/pii/S0959652612003538

Recommended Readings

Almeida, C. M. V. B., Agostinho F., Giannetti, B. F., and Huisingh D., 2015. Integrating cleaner production into sustainability strategies: an introduction to this special volume, Journal of Cleaner Production, 96 (2015): 1-9. Available at: http://www.sciencedirect.com/science/article/pii/S0959652614013845
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Narasalagi, V.M. and Hegade, G.A., 2013. A Comparative Study on Profitability of Supply Chain Formats in Vegetable Marketing in Karnataka, Journal of Supply Chain Management Systems, 2(1): 33-36.
Available at: http://www.publishingindia.com/GetBrochure.aspx?query=UERGQnJvY2h1cmVzfC8xNDYzLnBkZnwvMTQ2My5wZGY=
Rasul, G., Managing the Food, Water, and Energy Nexus for Achieving the Sustainable Development Goals in South Asia, Environmental Development, 18, April 2016: 14-25. Available at: http://www.sciencedirect.com/science/article/pii/S2211464515300646
SWITCH-Asia Case Study: Up-scaling Biogas Technology for Sustainable Development and Mitigating Climate Change in Sri Lanka. Available at: http://www.switch-asia.eu/publications/bio-gas-case-studies/
UNEP, 2009. Mainstreaming Sustainable Consumption and Production and Resource Efficiency into Development Planning. Available at: http://www.unep.fr/shared/publications/pdf/DTIx1235xPA-MainstreamingSCPintoDevPlanning.pdf
UNEP, 2014. The Business Case for Eco-Innovation.
UNEP, 2015. Indicators for a Resource Efficient and Green Asia and the Pacific - Measuring progress of sustainable consumption and production, green economy and resource efficiency policies in the Asia-Pacific region. Schandl, H., West, J., Baynes, T., Hosking, K., Reinhardt, W., Geschke, A., and Lenzen, M. United Nations Environment Programme, Bangkok. Available at: http://www.switch-asia.eu/fileadmin/user_upload/RPSC/Publications/Indicator-for-a-RE_Low-resolution_.pdf
Wuppertal Institute for Climate, Environment and Energy, 2013. Lighting: Energy Efficient Lighting for Sustainable Development.

Module 5 – Mainstreaming SCP I: Development and Implementation of Policies
Essential Readings

Mont, O., Neuvonen, A., and Laehteenoja, S., 2014. Sustainable Lifestyles 2050: Stakeholder Visions, Emerging Practices and Future Research. Journal of Cleaner Production, 63 (2015): 24-32. Available at: http://www.sciencedirect.com/science/article/pii/S095965261300601X
SWITCH-Asia SCP E-book Module 2 (3rd Edition) - Designing and Implementing National SCP Policies: The Policy Cycle and SCP in National Governance Structures

UNEP, 2012. Sustainable Consumption and Production: A Handbook for Policy Makers with Cases from Asia and the Pacific (First Edition)
UNEP, 2015. Sustainable Consumption and Production: A Handbook for Policymakers, Second Edition – Asia-Pacific Region.

Recommended Readings
Castro-Hallgren, S., 2016. UNEP Background Paper to Inform National Policy Activities in India on Sustainable Consumption and Production in 2016
UNEP, 2013. SWITCH-ASIA Regional Policy Support Component, Capacity Building and Policy Needs Assessment for Sustainable Consumption and Production. Available at: www.switch-asia.eu/.../policy-assessment/Needs-Analysis-Final-report.pdf

Module 6 – Mainstreaming SCP II: Sectoral Strategies for Urban Settlements
Essential Readings
Bhattacharyya, S.C. and Palit, D., 2016. Mini-grid based Off-grid Electrification to Enhance Electricity Access in Developing Countries: What Policies May be Required?, Energy Policy, 94 (2016): 166-178. Available at: http://www.sciencedirect.com/science/article/pii/S0301421516301781
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Hassan, A. M. and Lee, H., 2015. Toward the sustainable development of urban areas: An overview of global trends in trials and policies. Land Use Policy, 48 (2015): 199-212. Available at: http://www.sciencedirect.com/science/article/pii/S0264837715001398
Raghupathy, L. and Chaturvedi, A., 2013. Secondary Resources and recycling in developing economies. Science of The Total Environment, 461-462: 830-834. Available at: http://www.sciencedirect.com/science/article/pii/S0048969713005846
Singhal, S., Berry, J., and McGreal, S., 2010. Linking Regeneration and Business with Competitiveness for Low Carbon Cities: Lessons for India. In *India Infrastructure Report 2010: Infrastructure Development in a Low Carbon Economy*: 374-389. Available at: http://www.idfc.com/pdf/report/Chapter-23.pdf
SWITCH-Asia Briefing, 2015: Sustainable Tourism in Asia. Available at: http://www.switch-asia.eu/publications/switch-asia-briefing-sustainable-tourism-in-asia/

Recommended Readings
Arora, K., Kumar, A., and Sharma, S., 2014. Energy from Waste: Present Scenario, Challenges, and Future Prospects towards Sustainable Development. In Sustainable Practices: Concepts, Methodologies, Tools, and Applications (pp. 1519-1543). Available at: http://www.igi-global.com/chapter/energy-from-waste/95010
Anantharaman, M., 2014. Networked ecological citizenship, the new middle classes and the provisioning of sustainable waste management in Bangalore, India. Journal of Cleaner Production, 63 (173-183). Available at: http://www.sciencedirect.com.ezproxy1.bath.ac.uk/science/article/pii/S0959652613005921
Bhattacharyya, S. C. and Palit, D., 2016. Enabling Policies for Advancing Sustainability of Electricity Access Programs. In A. Goswami, & A. Mishra (Eds.) Economic Modeling, Analysis, and Policy for Sustainability (pp. 177-193). Hershey, PA: Business Science Reference. Available

at: http://www.igi-global.com/chapter/enabling-policies-for-advancing-sustainability-of-electricity-access-programs/150101
Choudhary, P., 2016. 17 – Vernacular Built Environments in India: An Indigenous Approach for Resilience, In Shaw, R., Rahman, A., Surjan, A., and Parvin, G.A. (eds.), Urban Disasters and Resilience in Asia: 269-286. Available at: http://www.sciencedirect.com/science/article/pii/B9780128021699000173
Dimitriou, H. T., 2006. Towards a generic sustainable urban transport strategy for middle-sized cities in Asia: Lessons from Ningbo, Kanpur and Solo. Habitat International, 30(4): 1082-1099. Available at: http://www.sciencedirect.com/science/article/pii/S0197397506000166
Gouldson, A., Colenbrander, S., Sudmant, A., Papargyropoulou, E., Kerr, N., McAnulla, F., and Hall, S., 2016. Cities and climate change mitigation: Economic opportunities and governance challenges in Asia Journal of Cleaner Production, 54: 11-19. Available at: http://www.sciencedirect.com/science/article/pii/S0264275115001638
Joshi, R. and Pathak, M., 2014. Decentralized Grid-connected Power Generation Potential in India: From Perspective of Energy Efficient Buildings, Energy Procedia, 57 (2014): 716-724. Available at: http://www.sciencedirect.com/science/article/pii/S187661021401594X
Singhal, S. McGreal, S., and Berry, J., 2013. Application of a hierarchical model for city competitiveness in cities of India, Cities 31: 114-122. Available at: http://www.sciencedirect.com/science/article/pii/S0264275112000911
Wamsler, C., Brink, E., and Rivera, C., 2013. Planning for Climate Change in Urban Areas: From Theory to Practice, Journal of Cleaner Production, 50, July 2013: 68-81. Available at: http://www.sciencedirect.com/science/article/pii/S095965261200652X

Module 7 – Mainstreaming SCP III: Economic and Fiscal Instruments
Essential Readings

Access to Finance for Sustainable Consumption and Production in Asia – An Overview of Finance Trends and Barriers in India. Available at: http://www.switch-asia.eu/fileadmin/user_upload/Publications/2016/Green_Finance_Study_-_2016_-_India.pdf
Dulal, H.B., Dulal, R., and Yadav, P.K., 2015. Delivering green economy in Asia: The role of fiscal instruments. Futures, 73 (61-77).Available at: http://www.sciencedirect.com/science/article/pii/S0016328715001019
Kumar, S. and Managi, S., 2009. Compensation for Environmental Services and Intergovernmental Fiscal Transfers: The Case of India, Ecological Economics, 68 (2009): 3052-3059. Available at: http://www.sciencedirect.com/science/article/pii/S0921800909002948
Nand Gopal, E. and Ramesh, D., 2014. Resource Efficiency for Sustainability in Ferrous Foundry - A Case of Kolhapur MSME Cluster. Indian Foundry Journal, 60(2) (30-39). Available at: http://www.indianfoundry.org/onlinelibrary/?p=8355
Silvestre, B. S., 2015. A hard nut to crack! Implementing supply chain sustainability in an emerging economy. Journal of Cleaner Production, 96 (2015): 171-181. Available at: http://www.sciencedirect.com/science/article/pii/S0959652614000183
SWITCH-Asia, 2014. Access to Finance for SMEs – Engaging in Sustainable Consumption and Production Practices. Available at: http://www.switch-asia.eu/fileadmin/user_upload/Switch-AsiaMAG_Winter14-15_Screen.pdf

Recommended Readings

(2009) Best Environmental Practices of Marks & Spencer: A Case Study. Greening Retail - Best Environmental Practices of Leading Retailers from Around the World

FICCI/UNEP, 2015. Designing a Sustainable Financial System for India: Interim Report. Available at: http://ficci.in/spdocument/20546/UNEP-Interim-Report.pdf
Nathadwarawala, J.M., and Nathadwarawala, K.M., 2011. Sustainable Business Initiatives in the Context of Emerging Economies, In B. Unhelkar (Ed.), Handbook of Research on Green ICT: Technology, Business and Social Perspectives: 265-281.
Available at: http://www.igi-global.com/chapter/sustainable-business-initiatives-context-emerging/48433
Pal, P., Sethi, G., Nath, A., and Swami, S., 2008. Towards cleaner technologies in small and micro enterprises: a process-based case study of foundry industry in India. Journal of Cleaner Production, 16(12) (1264-1274). Available at:
http://www.sciencedirect.com/science/article/pii/S0959652607001667
Perera, O., 2012. The Case for Pursuing Sustainable Public Procurement in Lower Income Countries, The International Institute for Sustainable Development (IISD). Available at:
https://www.iisd.org/pdf/2014/spp_lower_income_countries.pdf
Shakir, M., 2011. A Framework for the Implementation of Eco-Efficient Business Systems. In Green Technologies: Concepts, Methodologies, Tools and Applications: 220-235. Available at:
http://www.igi-global.com/chapter/framework-implementation-eco-efficient-business/51699
The Energy and Resources Institute (TERI) Policy Brief (2013). Engagement with Sustainability Concerns in Public Procurement in India: Why and How. Available at:
http://www.teriin.org/policybrief/index.php?a=9
UNEP, 2010. Pre-SME – Promoting Resource Efficiency in Small & Medium Sized Enterprises.
UNEP, 2013. Sustainable Public Procurement: A Global Review.
Venkatesh, V. and Luthra, S., 2016. Role of Sustainable Procurement in Sustainable Manufacturing Operations: An Indian Insight. In R. Dubey, & A. Gunasekaran (Eds.), Strategic Management of Sustainable Manufacturing Operations: 132-148. Available at: http://www.igi-global.com/chapter/role-of-sustainable-procurement-in-sustainable-manufacturing-operations/152395

Web links:

Intended Nationally Determined Contributions to UNFCCC; Online at:
http://unfccc.int/focus/indc_portal/items/8766.php

SCP Clearinghouse

The Global SCP Clearinghouse is a unique one-stop hub dedicated to Sustainable Consumption and Production (SCP) and convened by the United Nations Environment Programme (UNEP) acting as the Secretariat of the 10 Year Framework of Programmes on SCP (10YFP on SCP); Online at:
http://www.scpclearinghouse.org/

SCP Policies and the 10 Year Framework Programme, UNEP; Online at:
http://www.unep.org/resourceefficiency/Policy/SCPPolicies/tabid/55539/Default.aspx

SWITCH-Asia projects funded by the European Union; Available at: http://www.switch-asia.eu/projects/

UNDP projects on environmental aspects related to SCP in India; Available at:
http://www.in.undp.org/content/dam/india/docs/UNDP%20Fact%20Sheet%20-%20MEFCC.pdf

UNEP's Resource Efficiency Programme; Online at:
http://www.unep.org/resourceefficiency/Home/Society/tabid/55529/Default.aspx

UNIDO projects on cleaner production topics; Available at: http://www.unido.org/en/where-we-work/asiaandthepacific/selected-projects.html

Additional information (if any):
This first-of-its-kind post graduate course on Sustainable Consumption and Production is being developed for young policy and decision makers as part of the SWITCH-Asia Regional Policy Support Component supported by UNEP and European Union.
Student responsibilities:
Attendance, feedback and discipline: As per university rules.

Course reviewers:
This course on Sustainable Consumption and Production (SCP), part of the MA Public Policy and Sustainable Development programme (M.A. PP&SD), was developed and reviewed in two consultation workshops on SCP Course Curriculum Development held at TERI University. The course reviewers present at the two workshops are as follows.

1st Consultation Workshop on SCP Course Curriculum Development, September 18, 2015
Dr. Shaleen Singhal, Head, Department of Policy Studies, TERI University
Ms. Sara Castro, Programme Officer, 10YFP and SWITCH-Asia, UNEP
Dr. Kaushik R. Bandyopadhyay, Associate Professor, Department of Business Sustainability, TERI University
Prof. Arabinda Mishra, Senior Social Scientist, International Centre for Integrated Mountain Development
Prof. Subhasis Ray, Xavier Institute of Management, Bhubaneswar
Prof. Nazmul Ahsan Kalimullah, Department of Public Administration, University of Dhaka
Mr. Rajan Gandhi, Mg. Trustee and CEO, Society in Action Group
Dr. Sanjeevan Bajaj, CEO, FICCI Quality Forum
Dr. R. Gopichandran, Director, Vigyan Prasar
Mr. Sanjay Kumar, Manager, Indian Railways
Dr. Nandan Nawn, Associate Professor, Department of Policy Studies, TERI University
Dr. Ritika Mahajan, Assistant Professor, Department of Business Sustainability, TERI University
Dr. Sapna Narula, Associate Professor, Department of Business Sustainability, TERI University
Ms. Shilpi Kapur, Fellow, The Energy and Resources Institute (TERI)
Prof. Chettiyappan Visvanathan, Dean (R&D), Asian Institute of Technology
Prof. Shrawan Acharya, Centre for the Study of Regional Development, Jawaharlal Nehru University
Ms. Sunita Singh, Director, Ministry of Environment and Forest, GoI
Prof. Lakshmi Raghupathy, Visiting Faculty, TERI University
Prof. C.K. Varshney, Visiting Faculty, TERI University
Mr. Uwe Becker, Senior Adviser, GIZ
Mr. Rajat Batra, CEO, STENUM Asia Sustainable Development Society
Dr. Suneel Pandey, Adjunct Faculty, Centre for Regulatory and Policy Research, TERI University
Dr. Chubamenla Jamir, Assistant Professor, Department of Natural Resources, TERI University
Dr. Suresh Jain, Head, Department of Natural Resources, TERI University
Ms. Minni Sastry, Associate Director, The Energy and Resources Institute (TERI)

2nd Consultation Workshop on SCP Course Curriculum Development, April 21, 2016
Dr. Shaleen Singhal, Head, Department of Policy Studies, TERI University
Ms. Sara Castro, Programme Officer, 10YFP and SWITCH-Asia, UNEP

Prof. Lakshmi Raghupathy, Visiting Faculty, TERI University
Dr. Zinaida Fadeeva, United Nations University, Institute for the Advanced Study of Sustainability
Mr. Gamini Senanayake, SWITCH-Asia SCP NPSC, Sri Lanka
Mr. Rajan Gandhi, Mg. Trustee and CEO, Society in Action Group
Dr. Sanjeevan Bajaj, CEO, FICCI Quality Forum
Dr. Ritika Mahajan, Assistant Professor, Department of Business Sustainability, TERI University
Ms. Shilpi Kapur, Fellow, The Energy and Resources Institute (TERI)
Mr. Rajat Batra, CEO, STENUM Asia Sustainable Development Society
Mr. Rajan Gandhi, Mg. Trustee and CEO, Society in Action Group
Prof. C.K. Varshney, Visiting Faculty, TERI University
Mr. Sanjay Kumar, Manager, Indian Railways
Ms. Neha Sami, Consultant, Academics & Research, Indian Institute for Human Settlements
Dr. Malini Balakrishnan, Adjunct Faculty, Department of Energy and Environment, TERI University
Mr. Rumi Aijaz, Senior Fellow, Observer Research Foundation

Annexure 5
(Refers to Item No 6 of minutes of 38th meeting of AC**)**

Programme structure of MTech(WSG) & MSc(WSG) programmes and Course Outlines of 15 courses.

Semester	M.Sc – Courses with credit	M.Tech – Courses with Credit	
First	Gender, Rights and Equity perspective for sustainable water management(3)	Gender, Rights and Equity perspective for sustainable water management(3)	
	Water Quality Monitoring Methods and Analysis (3)	Water Quality Monitoring Methods and Analysis (3)	
	Applied Hydrology and Meteorology(3)	Applied Hydrology and Meteorology (3)	
	Geo-informatics for Water Resources (4)	Geo-informatics for Water Resources (4)	
	Water Planning and Management(3)	Water Planning and Management(3)	
	Social Research Methods (4)	Social Research Methods (4)	
	Water Resources Institutions and Governance(3)	Water Resources Institutions and Governance (3)	
	Hydraulics (3)	Advanced Hydraulics (3)	
	Environmental Statistics(3)	Stochastic Modelling (4)	
	Field Trip (1)		
	30 Credits	**31 Credits**	
Second	**M.Sc (with credits)**	**M.Tech (with credits)**	
	Technical Writing (A)	Technical Writing (A)	
	Water Resource Economics (4)	Water Resource Economics (4)	
	Water Security and Conflict Management (2)	Water Security and Conflict Management(2)	
	Irrigation Water and Drainage Management (4)	Irrigation Water and Drainage Management (4)	
	Water Audit and Demand Management(3)	Optimization Techniques for Water Management (4)	
	Aquatic Eco-system Management(3)	Water Quality Modelling and Application (4)	
	Integrated Watershed and River basin management (3)	Advanced Geo-informatics for Water Resources (3)	
	Water Supply and Sanitation(3)	Design of Water Supply and Sanitation Systems (4)	
	Field Trip (1)		
	23 Credits	**26 Credits**	
Third *	**M.Sc (with credits)**	**M.Tech (with credits)**	**Elective/ Core**
	Water Law (3)	Water Law (3)	Core
	Industrial Pollution Control (3)	Industrial Pollution Control (3)	Elective
	Glacier Hydrology (3)	Glacier Hydrology (3)	Elective
	Integrated Impact Assessment	Integrated Impact Assessment (4)	Elective

	(4)		
	Climate Change Water Resources and Agriculture (3)	Climate Change Water Resources and Agriculture (3)	Elective
	Groundwater Hydrology and Pollution (3)	Groundwater Quality Modelling (4)	Elective
	Project Work Report (6)	Project Work Report (6)	Core
Fourth	Project Work Dissertation(16)	Project Work Dissertation (16)	Core

1. Students who have not studied Hydraulics in B.Tech shall opt for the subject along with M.Sc students while others have an option of taking Advanced Hydraulics
2. **Field Trip 1:** This will cover "Traditional knowledge and water management" and will carry one credit. Evaluation will be done based on presentation.
3. **Field Trip 2**: Visit to successful case sites – Coastal Area Adaptation, Jain Irrigation, Siddhi Ralegaon, Hiware Bazar, River Bank Filtration, ICRISAT Hyderabad. The field trip shall carry one credit. Evaluation will be done based on presentation.

1. Course title: Water planning and management			
Course code: WSW 181	**No. of credits:** 3	**LTP distribution:** 42-0-0	**Learning hours:** 42
Pre-requisite course code and title (if any): None			
Department: Department of Regional Water Studies			
Course coordinator(s): Ms. Ranjana Ray Chaudhuri		**Course instructor(s):** Ms. Ranjana, Ms. Fawzia, Dr Nirupam	
Contact details:			
Course type: Compulsory Core		**Course offered in:** Semester 1	

Course description

World population is set to increase further in the coming decades and shift of population from rural to urban areas will make urban areas more stressed in terms of water demands and sanitation needs. Intensive planning is required in the water sector to meet future water needs, restore water quality of fresh water reserves many of which are currently compromised. In addition climate change is likely to modify the current precipitation patterns, thereby putting more pressure due to extreme events of drought or floods on rising urban sprawls. Together with all comprehensive water resource planning, efficient water management tools and decision making involving all stake holders shall play a key role if long term planning is to succeed, only then will sustainable water use and equitable water distribution become a reality. This course is a stepping stone towards that direction and the various modules included are chosen so as to give an insight into the nature of current challenges faced by water planners and water managers

Course objectives

- Introduce students to the stages/evolution of water planning
- To explore critically river basin planning strategies and assess whether the planning process could meet the expected water demands in various fields.
- To understand the participatory and integrated water resource planning process, to critically examine the planning processes and understand how planning responds to water related disasters.

Course content				
Module	**Topic**	**L**	**T**	**P**
1A	**Role of Planning Commission in Planning and Management of Water Resources in India- Initial Years (1952-early 70s)** Assessment of existing water resources and planning for development of water resources – implementation of multipurpose river valley projects, major and medium canal irrigation projects, green revolution, gradual development of tube-well irrigation, issues with plan implementation, technical and economic performance, equity, accountability and institutional issues, case studies	4	0	0
1B	**Role of Planning Commission in Planning and Management of Water Resources- Later Years (1974 onwards)** Setting up of Command Area Development Programme in 1974 as a "last mile" approach, major vs. minor irrigation debate, groundwater vs. surface water irrigation debate, focus on development of water resources for dryland agriculture (watershed), increasing project overruns	4	0	0
2	**Reforms in the Water Planning and Management Processes – (Late 1990s onwards)** Need for fast completion of delayed major and medium projects-Accelerated Irrigation Benefits Programme (AIBP), concerns for over-exploitation of groundwater resources, impact of climate change on available water potential, stress on development of water resources for non-agricultural sectors, restructuring of guidelines for major and medium irrigation projects, participatory watershed development programmes, water user organisations, micro-irrigation-more crop & income per drop, proposed project on interlinking of rivers for redistribution of water resources	6	0	0
3.	**Traditional Methods of water management and sustainability** Critical discussion of various (traditional) knowledge systems for water management in different ecological zones in South Asia Traditional knowledge and conflict resolution	6	0	0
4.	**Disaster Management** Conceptual issues - hazards, vulnerabilities, risks, exposure, capacities, disasters – Types of disasters ,Trends of disasters and their impacts – catastrophic disasters - disaster management cycle , Disaster Management in India **Hydro-meteorological disasters and its management** Water related disasters – Trends of water related disasters-Floods, Droughts, Cyclones, Other water related disasters - rain-induced landslides-cloudbursts-sea and river erosion – avalanche – GLOFs, Disasters arising out of water pollution and water	8	0	0

	borne diseases , Climate change and its impact on hydro-meteorological disasters Global, regional and national trends			
5.	**Regional planning and planning for sustainable habitat-** River basin planning (water allocations to different sectors), land use planning, city water and sanitation plans, tier I and tier II cities	6	0	0
6.	**Water and energy** Energy requirement for water in urban, agriculture and industry sector Generation of energy from water-waves, currents, tides, hydro Water usage in industries, pollution-Impact on water resources	8	0	0
	Total	**42**	**0**	**0**

Evaluation criteria

Minor 1	20%
Minor 2	20%
Tutorial and Quizzes	10%
End-term exam	50%

Learning outcomes

- Students by the end of the course will be aware of evolution in planning and management process for water resources as envisaged and formulated by the state on the advice of Planning Commission.
- They will understand the evolution of water planning from the development phase to strategic planning phase, the need for sustainable economic development of water, assessment of coping strategies for disaster management.
- They will be able to evaluate alternate water management strategies and suggest methods to protect ecologically sensitive areas.
- They will develop an understanding of water use allocation.

Pedagogical approach

Course shall be conducted using black board, power point presentations, MS Excel. Effort shall be made to through case studies to highlight the incorporation of adaptability and resilience in water planning for various parts of the water use system as it is this vision of long term planning and management which will assist in handling crises scenarios in the future.

Materials

Textbooks

Jain S.K. and Singh V.P. (2006). *Water Resources Systems Planning and Management*, Reed Elsevier India Pvt. Ltd., New Delhi.

Agarwal, A., & Narain, S. (1997). *Dying Wisdom: Rise, fall and potential of India's traditional water* harvesting *systems* (Vol. 4): Centre for Science and Environment New Delhi. Chapter 2. Pp 25-268.

Suggested Readings

1. Five Year Plan Documents (1st Five Year Plan- 12th Five Year Plans)
2. Evaluation Studies of Different National Programmes for development of water resources
3. David S. (1998). *Water Supply Management*, Kluwer Academic Publisher, Dordrecht
4. Terminology on Disaster Risk reduction, International Strategy on Disaster Reduction, 2009

5. National Policy on Disaster Management, 2009
6. Tenth Five Year Plan 2002-2007, Chapter on Disaster Management- A Development Perspectives
7. Report of the High Powered Committee on Disaster Management, National Centre of Disaster Management, 2001
8. Disaster Management in India, Ministry of Home Affairs, Government of India, 2011

Journals

1. Economic and Political Weekly
2. Journal of Water Resources Planning and Management

Additional information (if any)

Student responsibilities

Attendance and class participation will be given utmost importance. All assignments should be submitted as per the given timeline. Students will be expected to take up assignments which will compare implications of planning and management on water infrastructure between different states, cities and countries.

Course reviewers

1. Dr. S.K. Jain, Scientist, National Institute of Hydrology, Roorkee, Uttarakhand, India
2. Prof V.P.Singh, Professor of Biological and Agricultural Engineering, Texas A&M University, College Station, Texas, USA

2. **Course title: Water Law**			
Course code: WSW 153	**No. of credits:** 3	**L-T-P distribution:** 34-8-0	**Learning hours:** 42
Pre-requisite course code and title (if any)			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr M P Ram		**Course instructor(s):** Dr M P Ram	
Contact details:			
Course type: Compulsory Core		**Course offered in:** Semester 3	

Course description

This course is intended to introduce concepts, laws and policies relating to water at the national, regional and international level. The course specifically covers water rights and human rights to water; water pollution; legal aspects of ground water; national and international water sharing agreements and disputes; conflict resolution and liability; and regional initiatives at the South Asian region. Institutional and governance issues are not covered as a separate course deals with these issues.

Course objectives

1. To introduce the students to various concepts, laws relating to water at the international, regional and national level
2. To explore the causes for water conflicts, different methods of conflicts resolution and principles used in such resolution
3. To critically analyse the initiatives taken at the South Asian region to address issues relating to water

Course content

Module	**Topic**	**L**	**T**	**P**

1	**An Introduction to the Legal Framework on Water** An Introduction to the legal system: Difference between municipal law and international law. Sources of law An Introduction to International Law: Sources, Subjects, Enforcement, Dispute Resolution An introduction to legal issues in the field of water; constitutional provisions; role of courts	3	0	0
2	**Water Rights and Right to Water** Various doctrines and their application: Riparian rights; Prior appropriation; territorial sovereignty; natural water flow, equitable apportionment; equitable utilization Ownership of water, state's power: Common law doctrines Indian Easement Act, 1882; Various irrigation statutes (Case Study) Doctrine of Public Trust Human Right to Water	6	2	0
3	**International Water Law** An overview of International water law: Diffused nature of International Water Law; Treaties at the global, regional and bilateral level; Soft law instruments Customary principles of international law in the field of water: limited sovereignty (equitable utilization), no harm, and peaceful resolution of disputes; Principles of polluter pays, prevention, precaution, sustainability and subsidiarity. UN Convention on the Law of the Non-Navigational Uses of International Watercourses, Helsinki Rules on the Uses of Waters of International Rivers; Seoul Rules on International Ground Waters; various UN Resolutions	6	2	0
4	**Ground Water** Treaties and other instruments at the international level: United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa 1992, Regional Treaties; Non-Governmental instruments: Helsinki Rules, Berlin Rules, The Seoul Rules on International Ground waters [1986] etc. International Law relating to Transboundary Aquifers: The Guarani Aquifer Agreement; ILC Draft Articles on the Law of Transboundary Aquifers National Laws on Ground Water: Issues relating to ownership; State control; Case Study India: Various state laws; Model Ground Water Bill; Central Ground Water Commission	6	1	0
5	**Water Pollution** Customary and general principles of International Law National Laws: India: Water (Prevention and Control of Pollution) Act, 1974; Environment (Protection) Act, 1986	3	1	0

	Bangladesh: Water Act, 2013			
6	**Initiatives in the South Asian Region** Bilateral treaties: Indus Water Treaty; Mahakali Treaty; Sharing of Ganga Waters (Bangladesh); Other Initiatives An overview of National Water policies	4	1	0
7	**Conflict Resolution and Liability** Nature of conflicts; Different modes of dispute resolution National Level (Case Study India): Inter-State Water Disputes Act, 1956; Role of judiciary; Mullaperiya dispute; Narmada Water Disputes Tribunal (NWDT) gave its award Liability: Nature; Tortious liability; Plachimada Tribunal Bill, 2011 International Tribunal: Kishanganga Arbitration	6	1	0
	Total	**34**	**8**	**0**

Evaluation criteria

Assignment (Including Presentation): 50%
End-term Exam: 50%

Learning outcomes

By the end of the course, it is expected that the students will:
1. Demonstrate the ability to understand key concepts in water law
2. Be able to critically appreciate and practically analyse various water laws and policies in India and South Asia

Pedagogical approach

Predominantly based on classroom teaching. It is expected that the students come prepared with the readings, thus leading to a healthy discussion in the class.

Materials

Suggested readings:

Dellapenna, Joseph W. and Gupta, Joyeeta (eds.). (2008). *The Evolution of the Law and Politics of Water*. Springer.
FAO. (1998). *Sources of International Water Law*. Rome: FAO Legal Service
Verghese, B G (2007). *Waters of Hope*.4th ed. New Delhi: India Research Press.
Iyer, Ramaswamy R. (ed). (2009). *Water and the Laws in India*. New Delhi: Sage.
Singh, Chhatrapati (ed.). (1992). *Water Law in India*, New Delhi: Indian Law Institute.
Iyer, Ramaswamy R. (2003). *Water Perspectives, Issues , Concerns*, New Delhi: Sage.

In addition to these, module wise list will be distributed before the classes
Case studies
Websites
www.ielrc.org
http://www.internationalwaterlaw.org/

Journals

Law, Environment and Development Journal
The Journal of Water Law

Additional information (if any)

Student responsibilities

The students are expected to submit assignments on time and come prepared with readings when

provided.

Course reviewers

1. Dr. Vishnu Koonorayar: Fiji National University.
2. Ms. Loveleen, Bullar Teaching Fellow, Law, Environment and Development Centre (LEDC), SOAS.

3. Course title: Water quality monitoring methods and analysis			
Course code WSW 145	**No. of credits** 3	**L-T-P distribution:** 17-0-50	**Learning hours:** 42
Pre-requisite of the course (if any):			
Department: Department of Regional Water Studies			
Course coordinator(s):Dr Arun Kansal		**Course instructor(s):Dr Arun Kansal**	
Contact details:			
Course type: Compulsory Core		**Course offered in: Semester 1**	

Course description

The course intends to prepare a student in acquiring skills on the art of water monitoring and quantitative analysis of critical water quality parameters. It also brings in those aspects of chemistry which are important for water quality management and pollution control.

Course objectives

- To enable students to understand the principles and the practical approaches and techniques required to effectively monitor the chemical, hydrological and microbiological elements of water quality.
- To build understanding of water quality parameters and their relation to public health and environment.

Course content

Module	Topic	**L**	**T**	**P**
1	Introduction**, sampling techniques, basic concept of quantitative techniques, instrument methods of analysis, standard solutions, water quality standards for different applications**	7	0	0
2	Acidity and Alkalinity: **Sources and nature, environmental significance, methods of measurement, Application of data**	1	0	4
3	**Hardness:** General considerations; causes and source, environmental significance, methods of determination, application of data in environmental science	1	0	4
4	**Chlorides:** General considerations; causes and source, environmental significance, methods of determination, application of data in environmental science	1	0	4
5	**Residual chlorine and chlorine demand:** Chemistry of chlorination, methods of measurement	1	0	6
6	**Dissolved oxygen**: General considerations, environmental significance of dissolved oxygen, collection of samples for determination of dissolved oxygen, methods of determination.	1	0	4
7	**BOD:** General consideration, nature of BOD reaction, method of measurement, application of data	1	0	4
8	**COD:** General consideration, methods of measurement, application	1	0	6

	of data in environmental science			
9	**Sulphates, Nitrates and Phosphates:** General considerations; causes and source, environmental significance, methods of determination, application of data in environmental science	1	0	6
10	**Jar test:** Optimum coagulant dose estimation through turbidity measurement.	1	0	6
11	**Bacteriological analysis:** Plate count test for E-coli/MPN	1	0	6
		17	**0**	**50**

Evaluation criteria

- Major Practical exam 50%
- Viva 50%

Learning outcomes

1. Understand meaning of important parameters for measuring water quality;
2. Water quality criteria and standards, and their relation to public health, environment and urban water cycle;
3. Learn how to run accurate water quality tests and to determine how the parameters relate to each other;
4. Plan water quality surveillance for a given aquatic environment and to understand what a test result means in terms of the health of the ecosystem.

Pedagogical approach

Classroom teaching, field work and laboratory work.

Materials

1. Standard methods for the examination of water and wastewater published by APHA 15th ed.
2. Keith, L.H. [Ed.] 1988 *Principles of Environmental Sampling.* American Chemical Society.

Additional information (if any)

Student responsibilities

The course has chemistry, laboratory experiments, and field visits. Opportunity to repeat laboratory experiments will be very limited and hence regular attendance is important.

Course Reviewers:

1. Prof Ram Karan Singh, Department of Civil Engineering, King Khalid University, Saudi Arabia.
2. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.

4. Course title: Hydraulics			
Course code: WSW 131	**No. of credits** 3	**L-T-P distribution:**28-14-0	**Learning hours:** 42
Pre-requisite course code and title (if any) : None			
Department: Department of Regional Water Studies			
Course coordinator(s):Ranjana Ray Chaudhuri		**Course instructors(s):Fawzia Tarannum**	
Contact details:			

Course type	**Core**	**Course offered in: Semester 1**

Course description

Water specialists need to understand the behaviour of fluid flow in different conditions in pipes, channels, canals, notches, weirs etc. The basic knowledge about hydraulics and fluid mechanics will be useful in subjects like Irrigation, Water Resources Management and Public Health Engineering. In this course, basics of hydraulics and its application oriented content has been kept with a focus that students should be able to solve practical problems. Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Water resources / Irrigation/PHE and Environmental Engineering.

Course objectives

- Apply fundamental principles of fluid mechanics for the solution of practical engineering problems of water conveyance in pipes, pipe networks, and open channels.
- Describe the operating characteristics of hydraulic machinery (pumps and turbines), and the factors affecting their operation and specifications, as well as their operation in a system.

Course content

Module	**Topic**	**L**	**T**	**P**
1.	**Properties of Fluids** Introduction, Density, Specific Weight, Viscosity, Newtonian and Non Newtonian Fluids, Kinematic Viscosity, Surface Tension, Capillary and their units, dimensions and significance. Classification of fluids as ideal and real fluids, Newtonian and non-Newtonian fluids, incompressible and compressible fluids,solve numericals.	4	2	
2.	**Fluid Statics and Kinematics** Introduction, Variation of Static Pressure, Absolute and Gauge pressure, Pressure measurement by Manometers, Forces on plane surfaces, Forces on curved surfaces, Buoyant Forces, Classification of flow, Laminar and Turbulent Flows, Acceleration of flow in one direction, Continuity Equation,solve numericals	4	2	
3.	**Dynamics of Fluid Flow** Introduction, Transport Phenomenon, Laws affecting fluid motion, Euler's Equation, Bernoulli's Equation, limitation and modification of Bernoulli's equation, application of Bernoulli's equation-venturimeter,orifice meter and pitot tube,solve numerical	4	2	
4.	**Flow through Pipes** Characteristics of flow through pipes, Major and Minor Energy (Head) losses in pipe flow- frictional loss, loss of head at entry, exit, sudden enlargement and contraction and at bend, Darcy Weisbach Equation, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), Flow through pipes in series, parallel and equivalent pipes, solve numerical.	4	4	
5.	**Flow through open channel** Characteristics of open channel flow , Comparison of pipe flow and channel flow, Hydraulically efficient channel cross section, Analyse uniform flow , Froud's number and its significance, Hydraulic mean depth- concept & computation, Use of Chezy's and Manning's formulae, Most economical sections of channel Rectangular,	6	4	

	Trapezoidal and circular shapes, solve numericals.			
6.	**Flow Measurement** Definition and types of orifice, Various Hydraulic Coefficient and its relation - Coefficient of Contraction, Velocity, Discharge, Types of notches and weirs, Computation of discharge through notches- Rectangular Notch, V -Notch. Computation of Discharge through narrow crested and broad Crested weir, Discharge through Cipolletti weir,solve numericals	4	2	
7.	**Pumps and Turbines** Classification, description and general principles of operation of pumps, work done and efficiencies of centrifugal pumps Hydraulic Turbines: Working Principles of Pelton, Francis and Kaplan turbines	4	2	
	Total	**30**	**18**	

Evaluation criteria

Minor 1	25%
Minor 2	25%
End-term exam	50%

Learning outcomes

- Solve the problems related to properties of fluids.
- Apply the concepts of fluid statics and dynamics.
- Apply the concepts of flow measurement
- Solve the problems related to flow through pipes and channels.
- Solve the problems based on flow through weirs, notches and orifices

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics. Extensive examples shall be solved during the tutorial classes.

Materials

1. Cengel, Y.A., and J.M. Cimbala, (2010) Fluid Mechanics: Fundamental and Applications, Tata McGraw Hill.
2. Fluid Mechanics Modi& Seth Standard Book House, New Delhi
3. Fluid Mechanics A.K.JainKhanna Publishers, New Delhi
4. Fluid Mechanics & Machinery H. M. Raghunath CBS Publishers, New Delhi
5. Fluid Mechanics and Fluid Machines S. K. Som& G. Biswas, Tata McGraw Hill
6. Fluid Mechanics, Hydraulics and Fluid Machines S. Ramamrutham, DhanpatRai

Additional information (if any)

Student responsibilities

Attendance and class participation will be given utmost importance. All assignments should be submitted as per the given timeline.

Course reviewers

1. Prof NarenderKanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.

2. Mr Sundeep Singh, Sr Environmental Engineer (Scientist-D), CPCB, India.

5. Course title: Advance Hydraulics			
Course code: WSW 133	**No. of credits** 3	**L-T-P distribution:**28-14-0	**Learning hours:** 42
Pre-requisite course code and title (if any) : Basic Hydraulics			
Department: Department of Regional Water Studies			
Course coordinator(s): Ranjana Ray Chaudhuri		**Course instructors(s):Fawzia Tarannum**	
Contact details:			
Course type	**Core**	**Course offered in: Semester 1**	

Course description

Water specialists need to understand the behaviour of fluid flow in different conditions in pipes, channels, canals, notches, weirs etc. The basic knowledge about hydraulics and fluid mechanics will be useful in subjects like Irrigation, Water Resources Management and Public Health Engineering. In this course, basics of hydraulics and its application oriented content has been kept with a focus that students should be able to solve practical problems. Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Water resources / Irrigation/PHE and Environmental Engineering.

Course objectives

- To understand advanced hydraulic concepts and apply in practical engineering problems of water conveyance in pipes, pipe networks, and open channels.
- Describe the operating characteristics of hydraulic machinery (pumps and turbines), and the factors affecting their operation and specifications, as well as their operation in a system.

Course content

Module	Topic	L	T	P
1.	**Review of Fluid Mechanics** Properties of Fluids and classification of fluids **Fluid Statics and Kinematics** Pressure measurement by Manometers, Classification of flow, Laminar and Turbulent Flows, Equation for Acceleration, Continuity Equation,including Circulation and Vorticity, Irrotational and rotational flow, Velocity potential **Dynamics of Fluid Flow** Laws affecting fluid motion, Euler's Equation, Bernoulli's Equation, Pressure variation across a uniform conduit, Pressure variation across a uniform bend, Energy Equation, Pitot Tube, Venturimeter, Flow through reservoir opening, Cavitation, Momentum principle and equation	6	4	
2.	**Uniform Flow** Characteristics of flow through pipes, head losses, Darcy Weisbach Equation, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), Flow through pipes in series parallel and equivalent pipes. Hardy Cross method-method of balancing heads, single and multiple source pipe networks with known resistances. Newton Raphson	10	5	

	method-basic concepts Characteristics of open channel flow , Comparison of pipe flow and channel flow, Froud's number, Hydraulic mean depth- concept & computation, Use of Chezy's and Manning's formulae.			
3.	**Varied Flow** Gradually varied flow-dynamic equation, characteristics and classification of flow profiles Rapidly varied flow: momentum principle, Hydraulic Jump, hydraulic jump in a rectangular channel, loss of energy in a hydraulic jump	6	5	
4.	**Dimensional Analysis** Dimensional analysis and model simulation-Buckhingham-pi theorem and its application, model studies	4	2	
5.	**Water Power Engineering** Electrical Load on Hydro Turbines, Types of hydro-power plants,Turbines- Working Principles of Pelton, Francis and Kaplan turbines, Cavitation, Examples of Hydro-Power Projects	6	4	
	Total	**32**	**20**	

Evaluation criteria

Minor 1	25%
Minor 2	25%
End-term exam	50%

Learning outcomes

- Apply the concepts of fluid statics and dynamics.
- Be able to analyse problems of flow in pipes and open channels
- Be able design pipe flow networks, including location of pumps and valves.
- Solve problems based on flow through weirs, notches and orifices
- Analyse flood routing problems in urban areas

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics.Extensive numerical/tutorial classes will be held which shall be compulsory

Materials

1. Cengel, Y.A., and J.M. Cimbala, (2010) Fluid Mechanics: Fundamental and Applications, Tata McGraw Hill.
2. Fluid Mechanics Modi& Seth Standard Book House, New Delhi
3. Fluid Mechanics A.K.Jain,Khanna Publishers, New Delhi
4. Fluid Mechanics & Machinery H. M. Raghunath CBS Publishers, New Delhi
5. Computer Modeling of Water Distribution Systems. AWWA MANUAL M32Third Edition. Publisher: American Water Works Association
6. Analysis of Water Distribution Networks by Pramod Bhave, R Gupta. Publisher: Narosa Publishing House
7. Flow in open channels, Subramanya, K.,– Tata McGraw Hill
8. Open Channel Hydraulics, Chow,V.T.- McGraw Hill .
9. Applied Hydrology, Chow, V.T.,Maidment, D.R. and Mays L.W, McGraw Hill

Additional information (if any)
Student responsibilities Attendance and class participation will be given utmost importance. All assignments should be submitted as per the given timeline.

Course reviewers

1. Prof NarenderKanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.
2. MrSundeep Singh, Sr Environmental Engineer (Scientist-D), CPCB, India.

6. Course title: Water resource economics			
Course code WSW 122	**No. of credits:** 4	**L-T-P distribution: 45-11-0**	**Learning hours:** 56
Pre-requisite course code and title (if any): Familiarity with calculus and mathematical formalization.			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr. Nirupam Datta		**Course instructor(s):** Dr. Nirupam Datta	
Contact details:			
Course type: Compulsory Core		**Course offered in:** Semester 2	

Course description

The course introduces theory, principles and techniques of economics relevant to water resources and water services in decision-making. The focus is on fundamentals of theory and their application to a range of challenges in water resources management including water-service tariffs, pollution charges and other economic instruments, value of water, cost-benefits analysis of water projects and policies, valuation of non-market based aquatic ecosystem services and allocation of water across competing uses.

Course objectives

The course aims to instil a critical understanding of major economic and financial principles as relevant in the management of water in developing and developed country contexts and enable students to be able to apply these principles in example settings.

Course content

Module	**Topic**	**L**	**T**	**P**
1	**Introduction to water economics** Characteristics of water as an economic good, what determines its demand and supply, relevance and interaction of different streams of economic theory to water resources management and service provision	5	0	0
2	**Market failure in the water sector** Variety of market failures originating in the absence (concepts of externalities and public goods) or inadequate functioning (concepts of property rights, transaction costs, information asymmetry, market structures, uncertainty and risk) of markets. Case Studies. Use of economic instruments in theory and practice to address some of these failures with a focus on water pollution. Equity and efficiency issues of	10	3	0

	economic instruments- alternative measures of social welfare.			
3	**Economic value of water** The concept of total economic value of water; principles and techniques for assigning value to market and non-market water resources and services: hedonic pricing, travel cost, contingent valuation, , choice experiments, preference elicitation – stated and revealed replacement cost, damage avoidance, and market prices	10	3	0
4	**Financial and economic evaluation** Theory and methods of CBA and their application to evaluation of alternative water projects and policies. Concepts covered include financial, economic and social CBA, shadow prices, opportunity costs, time preferences and discounting, net present value, internal rate of return, benefit cost ratio, and sensitivity analysis	8	3	0
5	**Water pricing** Economic and financial principles that guide water tariffs in different end-use sectors. Concepts of marginal pricing, price elasticity of demand, opportunity cost, shadow prices, cost-recovery, and water markets/trading subsidies. Case studies: pricing of water in agriculture, residential, and industrial sectors. Political economy of water pricing and its implication for water use. Estimation of explicit and hidden subsidies in the water sector.	8	3	0
6.	**Financing Mechanisms for Infrastructure Projects With Applications to Water Sector - Seminar-Based Lectures**	3	0	0
	Total	**44**	**12**	**0**

Evaluation criteria

Class participation	5%
2 minor tests	15% each
End-term exam	50%
Assignment	15%

Learning outcomes

1. Understand the importance of an economics perspective on water and its management
2. Apply economic concepts to understanding, designing, and evaluating water projects and policies
3. Distinguish between economic and financial approaches to water resources management and discern the relevance and need for each
4. Appreciate the varied and inter-disciplinary nature of water management and be able to interact with professionals in various water management positions

Pedagogical approach

The course will be delivered through class room lectures, discussion of case studies from relevant research articles and hands-on exercises based on simulated/actual case studies

Materials

Textbooks

Conrad, Jon M. 1999 Resource Economics. Cambridge University Press.

Griffin, R.C. 2006. Water Resource Economics: The Analysis of Scarcity, Policies, and Projects. MIT Press, Cambridge, MA

Hanley, N., Shogren, J.F. and White, B. (2006) Environmental Economics: In theory and practice. Oxford University Press
Kolstad, C. 2000 Environmental Economics. Oxford University Press
Tietenberg, T. 2001 Environmental and Natural Resource Economics. Addison Wesley Publication

Suggested Readings

Brouwer R and Pearce D. 2005. Cost-Benefit Analysis and water resources management, Edward Elgar, Nirthampton. (Selected parts)
Briscoe, J. 1996. Water as an economic good: The idea and what it means in practice. A paper presented at the World Congress of the International Commission on Irrigation and Drainage, Cairo, September 1996
Coase, R. H. 1960. "The problem of social cost". Journal of Law and Economics, Vol. 3. (Oct., 1960), pp. 1-44.
Hanemann, "The Economic Conception of Water" in Peter P. Rogers, M. Ramon Llamas and Luis Martinez-Cortina (eds) Water Crisis: Myth or Reality Taylor & Francis, 2006.
Jalan J, Somanathan E and Chaudhuri S 2009. Awareness and the demand for environmental quality: survey evidence on drinking water in urban India. *Environment and Development Economics* Volume 14 / Issue 06 / December 2009, pp 665-692
Young, RA 2005. Determining the economic value of water, Concepts and methods, Resources for the Future, Washington DC. (Selected parts)
United Nations 2012. Managing Water under Uncertainty and Risk, The United Nations World Water Development Report 4 (2012), Volume 1, Chapter 10, pp 276-288.

Journals

Water Resources and Economics
Environmental and Resource Economics
Environment and Development Economics
Journal of Environmental Economics and Management
Resource and Energy Economics

Additional information

This is a preliminary reading list. A detailed list will be provided in due course

Student responsibilities

Classes will be interactive. Students are expected to be regular in attendance, participation, and submission of assignments. They must come prepared with readings when required.

Course reviewers:

Prof. Rajesh Gupta, Department of Civil Engineering, VNIT, Nagpur
Ms Divya Datta, Fellow, TERI

7. Course title: Applied hydrology and meteorology			
Course code: WSW 167	**No. of credits** 3	**L-T-P distribution:** 29-13-0	**Learning hours:** 42
Pre-requisite course code and title (if any): None			

Department: Department of Regional Water Studies	
Course coordinator(s): Ms. Ranjana Ray Chaudhuri	**Course instructor(s):** Ms. Ranjana Ray Chaudhuri
Contact details:	
Course type: Compulsory Core	**Course offered in:** Semester 1

Course description

This course will introduce the concepts of hydrology and understanding the basic methods and techniques to analyze the different factors governing the hydrological cycle. It would provide the students with an overview of monitoring and evaluation of hydrologic elements and accurately analyze the parameters involved. A field-trip or a large-scale laboratory experiment in the current semester or subsequent semesters will provide an exposure to the monitoring of hydro-meteorological parameters in practice. It would prepare the students to take up future water resource management courses.

Course objectives

- Introduce students to various methods of estimation and analysis of rainfall data.
- Use techniques to assess stream flow both in natural conditions and in times of flood.
- Prepare students to take up any advanced course in water resources engineering and management.
- Expose students to estimate all parameters and characteristics related to hydrological aspects of catchment studies.

Course content

Module	Topic	L	T	P
1	**Introduction:** Definition and scope of the subject, world water resources, the Indian scenario, the hydrologic cycle, global atmospheric and ocean circulation, meteorology, air masses and frontogenesis.	4	0	0
2	**Precipitation:** process, types, monsoon and jet streams, mechanism of Indian monsoon and rainfall pattern, southern ocean oscillation and influence on monsoon, cyclones, measurement, assessment of precipitation in gauged and un-gauged basins, hydrological data. Global climate change and influence on precipitation	4	2	0
3	**Analysis of Precipitation data**: requirement of rain gauges, data consistency check and data gap estimation, supplementing missing precipitation records, presentation of rainfall data–mass curve and hyetograph, precipitation variability, estimation of mean precipitation over an area, depth area relationship, intensity-duration-frequency relationship, moving average curve, probable maximum precipitation	4	2	0
4	**Infiltration:** Definition and factors affecting infiltration, infiltrometers, infiltration indices, infiltration equations, infiltration curves, determination of infiltration rates, phi index and Horton's equation. **Estimation of losses from precipitation**: evaporation and transpiration. Measurement and estimation of evaporation, evaporation formulae. Measurement and estimation of	3	1	0

	evapotranspiration, depression storage, interception.			
5	**Runoff**: components, water yield, flow duration curve, flow mass curve, rainfall runoff correlations, hydrograph, factors affecting flood hydrograph. Unit Hydrograph (UH)-definition, assumptions, limitation, derivation of UH from storm hydrograph, derivation of UH of longer duration from UH of shorter duration, derivation of UH of shorter duration from UH of longer duration, derivation of storm hydrograph from UH. Synthetic unit hydrograph and instantaneous unit hydrograph	4	4	0
6	**Estimation and measurement of discharge** Requirement of a stream gauging station, measurement of stage	2	0	0
7	**Flood studies**: Estimation of flood peak, classification of hydrological modelling-Rational method, empirical formulae, Unit Hydrograph techniques, SCS method. Hydrologic processes, continuity equation, momentum and energy equations, for hydrologic routing. Flood Routing concept and techniques, hydrologic reservoir routing using Modified Puls method, hydrologic channel routing using Muskingum method, introduction to hydraulic routing. Flood frequency analysis, estimation of magnitude, empirical formulae, importance of flood studies.	4	4	0
8	**Groundwater hydrology**: Introduction to basic concepts of groundwater hydrology: Aquifers & their properties, hydraulics of wells	4	0	0
	Total	**29**	**13**	**0**

Evaluation criteria

Minor 1	15%
Minor 2	15%
Tutorial and Quizzes	20%
End-term exam	50%

Learning outcomes

Students will be capable of performing spatial and temporal analysis of rainfall and runoff data at all scales of planning and management involving watersheds and river basins.

Students will be to assess drought situations, flood scenarios and normal flows in streams and catchments using the skills developed during this course

Real life field application challenges like differences in urban and rural hydrologic processes due to human intervention can be identified and inputs can be provided for design of hydraulic structures.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, derivations and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics. These will be from the modules of the syllabus.

Materials

Textbooks

Chow V.T. (1988). *Applied Hydrology,* Tata McGraw Hill Publishing Co.
Patra K.C. (2011). *Hydrology and Water Resources Engineering,* Narosa Publishing House.
Subramanya K. (2004). *Engineering Hydrology*, Tata McGraw-Hill, New Delhi.

Suggested Reading

Black P.E. (1996) *Watershed Hydrology,* Lewis Publishers.
Jain S.K., Agarwal P.K. and Singh V.P. (2007) *Hydrology and Water Resources of India,* Springer, The Netherlands.
Raghunath H.M. (2006) Hydrology, Newage International (P) Ltd.,New Delhi.
Shaw E.M (2004) *Hydrology in Practice,* 3rd Ed, Routledge.
Singh G., Venkataraman C., Sastry G. and Joshi B.P. (1990) *Manual of Soil and Water Conservation Practices,* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
Singh V.P. (1993) *Elementary Hydrology,* Prentice Hall, Englewood, New Jersey.
Suresh R. (2005) *Watershed Hydrology,* Standard Publishers Distributors, New Delhi.
Ward A.D. and Elliot W.J. (eds.) (1995) *Environmental Hydrology***,** Lewis Publishers.

Journals

Journal of Atmospheric Research
Journal of Hydrology
International Journal of Climatology
Water Resources Research
Advances in Water Resources

Additional information (if any):

Student responsibilities

The nature of the course demands that the students shall attend all lectures and tutorials. It is expected that students will submit assignments on time, take all class tests. Discipline will be maintained in class at all times.

Course reviewers

1. Prof N.K. Goel, Professor of Hydrology, Department of Hydrology, IIT Roorkee, Uttarakhand, India
2. Prof. Narendra. Kanhe, Principal, Guru Nanak Institute of Engg. and Management, Dahegaon, Near Radha Soami Satsang Place, Katol Road, Nagpur

8. Course title: Geo-informatics for water resources			
Course code: WSW 172	**No. of credits:** 4	**L-T-P distribution:** 34-11-22	**Learning hours:** 56
Pre-requisite course code and title (if any):			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr Rinki Deo		**Course instructor(s):** Dr. Rinki Deo	
Contact details:			
Course type: Compulsory Core		**Course offered in:** Semester 1	
Course description: This course introduces the participants to the fundamentals of geospatial technology (Remote sensing, GIS and GPS) .This course is intended to introduce the application RS&GIS techniques in water resources management			
Course objectives: To provide a strong fundamental understanding of the GIS and remote sensing technologies.			

To understand the basic principle underlying the GIS/model-based management of water resources and environment

Course contents

Module	Topic	L	T	P
1	Elements of Surveying- Basic Principle of Surveying, Types of surveying, Levelling, Minor Instruments of surveying, Introduction to Remote Sensing: Electromagnetic Radiation (EMR), EMR Spectrum and its Properties EMR wavelength regions and their Applications, Atmospheric windows, Interaction of EMR with Atmosphere and the Surface, Sensors and satellites, Resolutions: Spectral, Spatial, Temporal and Radiometric, Digital Image: display and its properties, Spectral signatures, Vegetation and Bare soil, Introduction to Photogrammetry.	14	2	6
2	Introduction to Geographical information system, concept of spatial and non-spatial data, GIS data model: Raster and Vector, Map: Scale, Projection and Datum, Map design, Map: Rectification and Geo-referencing, Introduction to GPS, Spatial data: Entry and editing (Digitization)	12	2	6
3	GIS and Remote Sensing Applications for the Water Sector: Digital elevation models and its applications, Map algebra: Local, Neighbourhood, Zonal operations, Extraction of water info using band combination, Extraction of water info from topographical maps, Digital Image Classification: land use / land cover mapping.	8	4	10
4	Application of RS/GIS in water resource management Case studies (national/international initiatives)	0	3	0
	Total	**34**	**11**	**22**

Evaluation criteria

2 minor tests: 10% each
Practical: 30%
Tutorial: 10%
End-term exam: 40%

Learning outcomes:

Upon completion of this course, a fully-engaged student will be able to understand the fundamentals of geoinformatics water resources studies.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and students will be expected to make presentations. Lab activities and demonstration for better understanding of theory

Materials

Suggested Readings:

Jensen J. R, Remote Sensing of the Environment: An Earth Resource Perspective, Pearsons, 2009.
Lillesand T, Kiefer RW and Chipman J, Remote Sensing and Image Interpretation, Wiley

&Sons. 2009.
Chang K., Introduction to Geographic Information Systems, McGraw-Hill, New York, 2006.
Ebgman, E.T., and R.J. Gurney. (1991) Remote sensing in hydrology. London, Chapman and Hall
Shamsi UM, GIS Applications for Water, Wastewater, and Stormwater Systems, Taylor and Francis, 2005
Lyon JG GIS for Water Resources and Watershed Management
Chen Y, GIS and Remote Sensing in Hydrology, Water Resources and Environment, 2004

Additional information (if any)

Student responsibilities
Classes will be interactive. Students are expected to be regular in attendance, participation, and submission of assignments. They must come prepared with readings when required.

Course reviewers:

1. Dr. S.P.Aggarwal, FIE, Scientist/Engineer "SG" & Head, Water Resources Department, ,Indian Institute of Remote Sensing, ISRO| Dept. of Space| Govt. of India, 4, Kalidas Road, Dehradun, Uttarakhand - 248 001 | India

2. Dr. Vaibhav Garg, Scientist/Engineer 'SD' Water Resources Department, Earth Resources & System Studies Group, Indian Institute of Remote Sensing-Dehradun, Indian Space Research Organization, 4, Kalidas Road | Dehradun | Uttarakhand - 248 001 | India

9 Course title: Advanced geo-informatics for water resources

Course code: WSW 173	**No. of credits:** 3	**L-T-P distribution:** 34-0-16	**Learning hours:** 42

Pre-requisite course code and title (if any):

Department: Department of Regional Water Studies

Course coordinator(s): Dr Rinki Deo	**Course instructor(s):** Dr Rinki Deo

Contact details:

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

Course description:
This course introduces the participants to the fundamentals of advanced geospatial technology (Remote sensing, GIS). It prepares the candidate for the geospatial modelling and analysis for water resources.

Course objectives:
The course provides skills in use of geospatial techniques and related technologies required for solving real-world problems in context of water resources management. This course provides an overview of cutting edge remote sensing and GIS (Geographical Information Systems) techniques that is by and large being used by water professionals. The students will be equipped with unique knowledge and skills necessary sustainable management of water resources. This course will be offered to students of M.Tech. (Water Science and Governance) and pre-Ph.D. Students from other programs willing to pursue doctoral studies in water resources. The students are suggested to read different books, magazines and peer reviewed journals.

Course contents

Module	Topic	L	T	P
1	Advance Remote Sensing: introduction to thermal, hyper spectral and microwave remote sensing. Advance	12	0	4

	Geographical information system: spatial analysis, geospatial modeling.			
2	Application of Remote Sensing and GIS in water resource engineering, Watershed hydrology, Factors influencing watershed hydrology, physical processes in watershed and basic concepts of hydrological modelling, DEM application in Water Resources (ArcHydro tools)	10	0	6
3	Terrain indices for Water Resources Application: DEM derivatives; slope, aspect, flow direction, flow accumulation, drainage network extraction, Watershed delineation using DEM, Spatial modelling using RS/GIS in hydrology**:** snow melts runoff modelling, rainfall run-off modelling, and groundwater modelling.	12	0	6
	Total	34	0	16

Evaluation criteria

2 minor tests: 10% each
Practical: 30%
Tutorial: 10%
End-term exam: 40%

Learning outcomes :

1. The student will get equipped to analyse geo-information problems encountered in professional practice and develop appropriate methods for studying and/or solving the problems, develop and design appropriate methods for geospatial framework data collection and processing.
2. The student would be able to provide geo-information science and earth observation technology to generate, integrate, analyse and visualize spatial data.
3. The student would be able to formulate and carry out independent research in the general field of Geo-informatics, possibly as part of a multi-disciplinary research and development project

Pedagogical approach

Predominantly based on classroom teaching and outdoor activities for data collection.

Materials

Suggested Readings:

Jensen J. R, Remote Sensing of the Environment: An Earth Resource Perspective, Pearsons, 2009.
Lillesand T, Kiefer RW and Chipman J, Remote Sensing and Image Interpretation, Wiley &Sons. 2009.
Lo, C.P. and Yeung, A.K.W., Concepts and Techniques of Geographic Information Systems, PHI Leaning Private Limited 2011.
Bedient B. Philip and Huber C. Wayne (2002). Hydrlogy and floodplain analysis, Prentice Hall, Upper saddle river, New Jersey. USA.
Bastiaanssen, W.G.M. 1998. "Remote sensing in water resources management: the state of the art." Colombo, Sri Lanka: IWMI
Ebgman, E.T., and R.J. Gurney. (1991) Remote sensing in hydrology. London, Chapman and Hall
Shamsi UM, GIS Applications for Water, Wastewater, and Stormwater Systems, Taylor and Francis, 2005
Lyon JG GIS for Water Resources and Watershed Management

Chen Y, GIS and Remote Sensing in Hydrology, Water Resources and Environment, 2004

Journals
Water resources Management, International Journal of Applied Earth Observation, Hydrological Processes,
Remote Sensing of the Environment

Additional information (if any)

Student responsibilities
Classes will be interactive. Students are expected to be regular in attendance, participation, and submission of assignments. They must come prepared with readings when required.

Course reviewers:

1. Dr. S.P. Aggarwal, FIE, Scientist/Engineer "SG" & Head, Water Resources Department, Indian Institute of Remote Sensing, ISRO| Dept. of Space| Govt. of India, 4, Kalidas Road, Dehradun, Uttarakhand - 248 001 | India
2. Dr. Vaibhav Garg, Scientist/Engineer 'SD' Water Resources Department, Earth Resources & System Studies Group, Indian Institute of Remote Sensing-Dehradun, Indian Space Research Organization, 4, Kalidas Road | Dehradun | Uttarakhand - 248 001 | India

10. Course title: Water supply and sanitation

Course code	**No. of credits**	**L-T-P distribution:** 42-0-0	**Learning hours:** 42
WSW 185	3		

Pre-requisite of the course (if any): Passed the course on Water quality monitoring and assessment

Department: Department of Regional Water Studies

Course coordinator(s): Prof Arun Kansal	**Course instructor(s):**Prof Arun Kansal

Contact details:

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

Course description
The course will deal with technical aspects of drinking water supply and sanitation in an integrated way, pay attention to the choice of technologies and tools, ranging from low cost to advance options.

Course objectives
The course will deal with water supply and distribution, design and operation of conventional water treatment plants for ground and surface water, advance water treatment options, sewage treatment and disposal, planning for water supply projects and pollution control strategies.

Course content

Module	**Topics**	**L**	**T**	**P**
1	**Introduction:** Impact of water pollutants on environment and public health; self-purification of waste in streams; zones of purification; eutrophication; disposal standards and philosophy of MINAS Status of water supply and sanitation sector; key challenges	7	0	0
2	**Public water supply and sanitation schemes:** Planning and preparing water supply projects; water demand; population	7	0	0

	forecasting; and factors effecting demand; components of water supply schemes; water treatment flow-sheet; estimation of sewage quantity and characteristics; discharge variation; sewage treatment plant flow-sheet; components of water distribution and sewerage systems			
3	**Water treatment:** Aeration and types of aerators; purpose and mechanism of flocculation; coagulants used in water treatment; factors influencing coagulation; estimation of coagulant dose; types of flash mixers and flocculators; sedimentation; analysis of discrete and flocculent settling; sedimentation tanks; filtration; types and design of filters; operational issues in filtration; chemical and non-chemical methods of disinfection; factors effecting efficiency of filtration; chick's law; tertiary treatment methods for removal of colour, salinity, hardness, fluorides, Arsenic, iron and manganese (using adsorption, RO; Electro-dialysis; ion-exchange; chemical; and distillation techniques)	15	0	0
4	**Sewage treatment:** Physical treatment methods- screen chamber; grit separators; primary and secondary settling tanks. Biological treatment: Biology of sewage treatment; BOD growth curve and analysis; estimation of BOD rate constant; types of biological treatment processes; process description and design principals; removal of nitrogen and phosphorus. Sludge stabilization and dewatering systems; Low cost sewage treatment technologies- septic tanks; reed bed; oxidation ponds and lagoons. Urban waste management and sanitation challenges.	13	0	0
	Total	**42**	**0**	**0**

Evaluation criteria

2 minor tests	20% each
Assignments	10%
End-term exam	50%

Learning outcomes

1. Understand water quality concepts and their effect on treatment process selection
2. Appreciate the importance and methods of operation and maintenance of water supply systems;
3. Judge options for centralised and urban systems versus decentralised and rural systems;
4. Define and evaluate project alternatives on basis of chosen selection criteria;
5. Communicate effectively in oral and written presentations to technical and non-technical audiences.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and use of scientific calculators in class is essential.

Materials

1. CPHEEO 1999. Manual on water Supply and treatment. 3rd Edition
2. Metcalf & Eddy (2003) Wastewater engineering: treatment and reuse, 4th ed. New Delhi: Tata

McGraw-Hill.
3. Nathanson, Jerry A. (2009) Basic environmental technology: water supply, waste management and pollution control, 4th ed. New Delhi: PHI Learning.
4. Qasim, Syed R., Motley, Edward M., and Zhu, Guang (2000) Water works engineering: planning, design and operation. New Jersey: Prentice Hall.
5. Garg, S. K. (2007) Water supply engineering, 18th ed, Vol. I. New Delhi: Khanna Publisher.
6. Garg, S.K. (2007) Sewage disposal and air pollution engineering, 20th ed, Vol. II. New Delhi: Khanna Publisher.
7. Chatterjee, A. K.2010.Water supply, Waste disposal and environmental Engineering, 8th ed. New Delhi: Khanna Publisher.
8. CPHEEO Manual on Sewerage and Sewage treatment, latest edition

Additional information (if any)

Student responsibilities

The course is highly technical so attendance and class participation will be given utmost importance. All assignments should be submitted as per the timeline.

Course reviewers

1. Prof Ram Karan Singh, Department of Civil Engineering, King Khalid University, Saudi Arabia.
2. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.

11 Course title: Aquatic eco-system management			
Course code: WSW 168	**No. of credits:** 3	**L-T-P distribution:** 22-6-28 (including 4 days of field visit)	**Learning hours:** 42
Pre-requisite course code and title (if any): Ecology/Biodiversity and Conservation			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr Sudipta Chatterjee		**Course instructor(s):** Dr Sudipta Chatterjee	
Contact details:			
Course type	Compulsory Core	**Course offered in:** Semester 2	

Course description:

Aquatic Eco-system play an important role in ecosystem functioning. Their management, governance and conservation however remain neglected not because of lack of awareness but due to lack of capacity and complexities involved in their assessment of management needs. Wetlands categorized as Protected Areas in India are mostly governed by the Wildlife Protection Act of 1972. Biodiversity studies on aquatic eco-systems are mostly restricted to a few charismatic fish species, aquatic plants, water birds etc. This course on Aquatic Eco-system Management shall focus on the needs and approaches to aquatic eco-system management and their conservation in India.

Course objectives

- To understand the ecology of the aquatic ecosystems, their contribution to human well-being.
- To develop hands on ability to undertake rapid biodiversity monitoring of wetlands.
- To develop an ability to understand issues related to best practices in aquatic ecosystems management, and preparation of management plans for conservation action.

Course content

Modules	Topic	L	T	P
1	**Basic Concepts on Ecology of Aquatic Systems** **An introduction to ecology of Aquatic Ecosystems: Fresh water and Marine. Definition and classification of Wetlands**: Wetlands as Ecosystems and part of River Basin. Distribution and typology. Wetland Habitat and Ecology. Physico-chemical parameters Hydrology and Soils. Unusual and Extreme habitats **Biodiversity in Wetland Systems**:. Aquatic Organisms: Microbes, Phyto and zooplanktons, Plants and Invertebrates and Vertebrates. **Wetland Functions and Values**; Ecosystem services. Nutrient cycling in aquatic systems. Productivity, trophic states and eutrophication. Freshwater ecosystems **Tutorial:** *Ecosystem services by Wetlands. Case study of a wetland system in Delhi* **Practical**: Basics on Taxonomy and Enumeration of Phyto and Zooplanktons. Estimation of Chlorophyll.	6	2	2
2	**Issue of Wetlands Conservation and Management** **Threat analysis and management Planning :** Natural and Human impacts; major threats to wetlands. Indexes of biological integrity. Setting management objectives and priorities. **Integrated Coastal Zone management.** **Key aspects of Wetland management planning**; Preparing a Management Plan. Collating baseline information using assessment tools approaches to assessment of aquatic bio-diversity. Management for migratory water fowl, fisheries, amphibians, reptiles and mammals. Management of aquatic weeds. Monitoring of Wetlands. Managing hydrology; Control of Siltation and Pollution. Involvement of local communities in conservation of Wetlands. **Environmental Flows**: The River ecosystems and their natural flow regimes. Concept and History of environmental flows, Methodologies for the assessment of Environmental Flows. Impact of flow alteration on biota. Environmental flow assessment in India. *Case studies on Environmental Flows : Experiences of South Asia*	8	2	0
3	**Wetland Conservation in India and the World** **Wetlands in India**,: Wetlands of Ramsar significance in India; Wetland policy . National Wetland Rules 2010. Wetland related Institutional arrangements : Functioning of Lake Development Authorities. Trans-boundary waters	5	2	0

	Major Wetlands of the World: Ramsar Convention;. Wetland conservation *vis a vis* other Conventions (CBD, CMS. CITES, UNFCCC). Conservation issues of major wetlands of the World. *A case study on Environmental Impact Assessment related to a Wetland in India. Preparation for the assignment on a Wetland Conservation*			
4	**Field study on revival and restoration of a Wetland** Wetlands Restoration. Field visit to a Wetland in India (Chilka /Keoladeo Birds Sanctuary, Bharatpur Rajasthan / Any other Ramsar Site): to study restoration and revival efforts. In field lectures.	3	0	2 6
	Total	**2 2**	**6**	**2 8**

Evaluation criteria

Minor tests 1:	10%
Minor test II :	10%
Assignment report :	30%
Presentation based on assignment :	20%
End-term exam:	30%

Learning outcomes

Students undertaking this course will develop an understanding of values and functioning of Wetland Ecosystems and different aspects of Wetland management planning that will aid governance. Will be useful to students aspiring higher studies and career paths that involves assessment of aquatic biodiversity and governance of Wetland management

Pedagogical approach

The course will be an amalgamation of theory on aquatic biology interspersed with a deeper understanding of management needs of fresh water aquatic systems. Students will delve through case studies in India, undertake monitoring of biological and physico -chemical parameters of wetlands, undertake root cause analysis to the threats wetland are subjected to and learn preparation of management plans as per the national and global best practices guidelines guide-lines. The course will apprise the students of the national and global policy environment *vis a vis* wetland management conservation and priorities.

Materials

Dodds. Walter K. (2002). *Freshwater Ecology. Concepts and Environmental Applications*. Elseiver Science. Academic Press. California.

Gopal B. (1995). *Handbook of Wetland Management* ., World Wide Fund for Nature India. New Delhi

(Revised Edition being planned by author)

Gopal B. (2013). *Environmental Flows. An introduction for water resource managers*. National Institute of Ecology. New Delhi

Wetzel, Robert G and (2010). *Limnological analysis*. Springer Science. New York.

Wetzel Robert G. .2001. *Lake and river ecosystems*. Elseiver. Academic Press. USA.

An integrated Wetland assessment toolkit. IUCN.

Ramsar Convention Handbooks

Handbooks on Wetland Management by Convention on Biological Diversity.

Standard methods for examination of water and waste water. (1998) .20th edition. American Public

Health association (AHPA), American Water Works Association.
Integrated Coastal Zone management.

Case studies: Environmental Impact assessment (EIA) : Studies nf the Teesta River basins.(Eg.)
Websites: www.ramsar.org, www.cbd.int,

Suggested Readings

Fraser, L.H. and P.A. Keddy (Eds). *The World's largest wetlands: Ecology and Conservation*. Cambridge University Press, UK
Kar, Devashish. (2013). *Wetlands and lakes of the world*. Springer. New Delhi.
Krishnamurthy, J., Sharachchandra Lele and R. Jayakumar. (2006). *Hydrology and watershed services in the Western Ghats of India*. Tata McGraw – Hill Publishing Company Limited. New Delhi.

Journals

Biological Conservation
Diversity and Distributions
Journal of Wetland Ecology
Journal of Applied Ecology
Lakes and Reservoirs: research and management
Landscape Ecology
Wetland Ecology and Management

Additional information (if any)

Guest Lectures will be organized on specialized topics as mentioned in course content.

Student responsibilities

Classes will be interactive. Students are expected to be regular in attendance, participation in class and field, and submission of assignments. They must come prepared with readings when required.

Course reviewers

1. Prof Brij Gopal, School of Environmenmtal Sciences, Jawahar lal Nehru University, New Delhi.
2. Dr. Joachim Schmerbeck.. Associate Professor, TERI University, New Delhi
3. Dr. Parikshit Gautam, ex Director, Wetland Conservation Division , WWF – India
4. Trans-boundary Water initiative, International Union for Conservation of Nature-(IUCN) India.

12. **Course title: Irrigation water and drainage management**			
Course code: WSW 166	**No. of credits:** 4	**L-T-P distribution:** 49-0-14	**Learning hours:** 56
Pre-requisite course code and title (if any)			
Department: Department of Regional Water Studies			
Course coordinator(s): Ms Ranjana Ray Chaudhuri		**Course instructor(s):** Ms Ranjana Ray Chaudhuri	
Contact details:			
Course type: Compulsory Core		**Course offered in:** Semester 2	
Course Description			

Agriculture serves as the backbone of economy where water is key input for food production. Agriculture depends upon the timely monsoon and the amount of rainfall in any year. To overcome the uncertainty and vagaries of the monsoon, farmers resort to various methods of irrigation. Irrigated agriculture is the biggest consumer of water in the world. About 70% of the world's freshwater is used for agriculture. Sustainable water use for food production, human consumption and industrial use are prime global challenges at present. Agriculture as the biggest water users will have to accept the challenge of becoming far more efficient in a food secure world. Water scarcity and stiff competition for water between different sectors has resulted in reduced water availability for irrigation. Hence, production of food, fibre, fuel and other industrial inputs with less water availability is major challenge for both rainfed and irrigated agriculture. Considering these facts, this course is designed to give thorough knowledge of water, agriculture and their multifaceted relationships so that associated challenges can be overcome.

Course objectives

- To familiarize students with concepts and fundamentals of agricultural production system
- To enable students, thorough understand soil-water-plant relationships
- To give students comprehensive knowledge of crop water requirement and its estimations
- To introduce students with basic criterions of irrigation project evaluation

Course content

Module	Topic	L	T	P
1	**Genesis, Water Resources, Principle Crops and Irrigation** Introduction: Need for sustainable development; Global water resources; India: water budget; Irrigation: Impact of irrigation on human environment; Some major and medium irrigation schemes of India; Sources of irrigation water; Present status of development and utilization of different water resources of the country; Principle crops in India: Classification of crops; Principle crop seasons; Resource conservation crop production technology; Field Visit-1	6	0	2
2	**Module Soil-plant-water relationship:** Soil Properties: Soil physical properties influencing irrigation such as soil texture, soil structure, bulk density; capillary and non-capillary pores; soil profile; Soil taxonomy; Volume and mass relationships of soil constituents; Water relations of soil: Kinds of soil water; Movement of water into soils: Infiltration; Factors affecting infiltration rate; measurement of infiltration; Infiltration equations; Soil moisture constants: Saturation capacity, field capacity, moisture equivalent; Permanent wilting percentage, available water; Soil moisture characteristics curves; Plant water relations; Practical 1 & 2	6	0	4
3	**Water Requirement of crops** Evapotranspiration: Evaporation; Transpiration; Consumptive use; Evapotranspiration concept and Standard terminologies; Measurement of evapotranspiration: Lysimeter experiment; Field experimental plots; Soil moisture depletion studies; Water balance method; Estimation of evapotranspiration from climatological data: Thornthwaite Method; Hargreaves Method; Modified Penman Method; Selection of crop coefficient for estimation of ET_{crop}; Practical 3 & 4	8	0	4
4	**Irrigation management including micro-irrigation methods**	10	0	0

	Measures for irrigation: Net irrigation requirement; gross irrigation requirement; Irrigation frequency; Irrigation period; Irrigation efficiencies; Irrigation methods: Surface irrigation methods: Border irrigation; Check basin irrigation; Furrow irrigation; Water saving irrigation technologies(micro irrigation system design); Sub-irrigation; Pressurised irrigation methods (drip and sprinkler): Merits and demerits of micro-irrigation system; Types and components of micro-irrigation system; Basic variables involved in design; Past, present and future need of micro-irrigation systems; Role of Govt. for the promotion of micro-irrigation in India			
5	**Design of irrigation and drainage management structures** Reservoir planning, design capacity of reservoirs, reservoir sedimentation-causes and control, useful life of reservoir. Water losses and control Design of small earthen dams, check dams, low gravity dams, selection criteria of spill ways and energy dissipators. Alignment of canals, design of unlined canals in alluvial and non-alluvial soils and design of lined canals, comparisons and limitations Techniques for drainage management and design of agricultural returnflow including nitrogen and phosphorus management	10	0	4
6	**Economic evaluation of Irrigation Projects and Water Pricing** Basic terminology and concepts; Economic and Financial Analysis; Irrigation Project Costs; Study of actual evaluation of Irrigation Project; In class written assignment; Water pricing and current scenario of water pricing in different states of India;	9	0	0
		49	**0**	**14**

Evaluation criteria

- Practical's: 20%
- Assignments: 20%
- Minor Test: 20%
- End-term exam: 40%

Learning outcomes

After successful completion of course, student will:

- Be able to identify, discuss and evaluate principle crops, seasons & production and their interrelated set-up in agriculture
- Properly understand, critically analyse and quantitatively evaluate weather parameters, natural resources input, artificial inputs and their contribution and importance in agriculture
- Professionally developed for irrigation water estimation under various conditions of data availability, scales and proper methodologies and master the skills for their applications
- Technically understand, design of irrigation structures including for drainage management and comment on irrigation project evaluation

Pedagogical approach

With focused approach on thorough understanding of subject, various educational techniques will be used. Main emphasis of teaching will be on using traditional method of black board teaching which will be supported by frequent multimedia presentations. In addition to this, field visits and demonstrations (seeing is believing), practical's (learning by doing), assignments (practise and

analytical techniques) will be used. To give scope for imagination and creative skills, use of short subject related documentaries, discussions, and presentation by renowned subject matter specialist will be done. To check writing, memorization and subject related knowledge one major examination will be conducted.

Materials

Text books

Michael A.M. (2008). Irrigation: Theory and Practice (2nd Edition). Vikas Publishing House Pvt. Ltd, New Delhi.
Hillel Daniel (1998). Environmental Soil Physics (1st edition). Academic Press.
Brady N. C. and Weil R. R. (2008). The Nature and Properties of Soils (14th Edition). Pearson-Prentice Hall,NJ.

Singh Bharat, Fundamentals of Irrigation Engineering, Nemchand and Bros,Roorkee,Uttarakhand
Garg,S.K.,(2006), Irrigation Engineering and Hydraulic Structures, Khanna Publishers, Naisarak, New Delhi

Suggested readings

Majumdar D. K. (2004). Irrigation Water Management Principles and Practice. Prentice-Hall of India Pct. Limited. New Delhi.
S. S. Singh (1995) Crop Management (5th Edition). Kalyani Publishers, New Delhi.

Case studies

Any one major or medium irrigation project in India

Websites

1) http://www.fao.org/home/en/
2) http://www.iwmi.cgiar.org/
3) http://agricoop.nic.in/

Journals

- The Indian Journal of Agricultural Sciences
- Indian Journal of Soil and Water Conservation
- Water Resources Research
- Agricultural Systems
- Journal of Irrigation and Drainage Engineering

Additional information (if any)

This course contains basics as well as advanced knowledge of agricultural and other related engineering in practise. It offers opportunity by combining interesting theory, practise and field visits. Guest Lecturer : Once At least

Practical's:

1) Measurement of soil moisture by gravimetric method
2) Irrigation scheduling by tensiometer/ gypsum block
3) Measurement of infiltration using double ring infiltrometer
4) Estimation of evapotranspiration based on climatological data

Field Visits 1) Identification of crops, cropping systems and crop cultural operations 2) Visit to automatic weather station, lysimeter and green house 3) Visit to Irrigation Project to understand canal system, water distribution system and irrigation project management (At the end of course, Optional)
Student responsibilities Attendance (Minimum 75%). Practical cannot be repeated.

Course reviewers:

1. Prof Ram Karan Singh, Department of Civil Engineering, King Khalid University, Saudi Arabia.
2. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.

13. Course title: Groundwater hydrology and pollution			
Course code WSW 134	**No. of credits** 3	**L-T-P distribution:** 32-10-0	**Learning hours:** 42
Pre-requisite course code and title (if any): Applied hydrology			
Department: Department of Regional Water Studies			
Course coordinator(s): Ms Ranjana Ray Chaudhuri		**Course instructor(s):** Ms Ranjana Ray Chaudhuri	
Contact details			
Course type	**Elective**	**Course offered in: Semester 3**	

Course description

This course will introduce the concepts of groundwater hydrology and its management. The students will have the knowledge to interpret groundwater data, conduct surface and subsurface investigations. The course would provide the students with an overview of monitoring and evaluation of contamination of groundwater and analyze the parameters involved and remediation thereof. The concepts would equip students to take better informed decisions in groundwater management.

Course objectives

- To learn basics of groundwater flow and well hydraulics.
- To understand contaminant transport, salt water intrusion phenomenon in groundwater.
- To gain knowledge about remediation and restoration techniques for better aquifer management.

Course content

Module	Topic	L	T	P
1	**Introduction:** Theory of groundwater flow, Darcy's law, types of confined and unconfined aquifers, geo-hydrological factors, governing equations of groundwater flow, flow nets. Hydrologic equilibrium, surface and groundwater interactions and basin management by conjunctive use	4	0	0
2	**Well Hydraulics** Dug well, Tube wells, bore wells yield from wells, Dupuit's, Theim's equilibrium formulae**,** development of observation and production wells	4	2	0

3	**Groundwater investigations** Geophysical methods, drilling methods, bore hole investigations, ground water basin investigation, ground water monitoring	4	0	0
4	**Salt Water Intrusion:** Saline water intrusion, fresh water saline water interface, control of saline water intrusion, salt balance	4	2	0
5	**Fundamental Concepts and Theory of Water and Chemical Movement** in the saturated zone and unsaturated zone.	4	2	0
6	**Groundwater contamination** –contaminant transport, illustrative Case Histories of Groundwater Contamination, Arsenic Contamination, Cleanup operations. Aquifer restoration and remediation techniques, including natural attenuation, bioremediation, augmentation. Application of Advanced Treatment Technologies to Aquifers and Unsaturated Zones. Successful management hazardous waste sites.	4	0	0
7	**Well head protection** techniques, rainwater harvesting and aquifer recharge	4	0	0
8	**Groundwater Modelling:** Purpose of Groundwater Modelling, conceptual model of aquifer-aquitard systems; specification of boundary conditions; hydrological stresses, modelling of surface- and ground water interactions in heterogeneous geologic systems.	4	4	0
	Total	**32**	**10**	**0**

Evaluation criteria

Minor 1	15%
Minor 2	15%
Tutorial and Quizzes	20%
End-term exam	50%

Learning outcomes

Students will be capable of interpreting groundwater field data, identify contamination, salt water intrusion. They will be able to conduct sub surface investigation and identify aquifer distress using latest technology and methods. Students will be able to allot groundwater usage according to sustainable yield; they will be able to carry out groundwater quantification of aquifers. They will be able to suggest remediation techniques for contaminated aquifers.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, derivations and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics. These will be from the modules of the syllabus.

Materials

Textbooks

Raghunath H.M. (2007) Groundwater, Newage International (P) Ltd.,New Delhi.
Todd D.K.. (1980). Groundwater *Hydrology, John Wiley and Sons*
Fetter C.W. (2001). Applied H*ydrogeology, CBS Publishers and Distributors, New Delhi*

Suggested Reading

Black P.E. (1996) *Watershed Hydrology,* Lewis Publishers.

Rastogi A.K. (2008), Numerical Groundwater Hydrology, Penram International Publishing Pvt.Ltd, Bombay
Singh V.P. (1993) *Elementary Hydrology,* Prentice Hall, Englewood, New Jersey.
Suresh R. (2005) *Watershed Hydrology,* Standard Publishers Distributors, New Delhi.

Journals
Journal of Hydrology
International Journal of Climatology
Water Resources Research
Advances in Water Resources

Additional information (if any)

Student responsibilities
The nature of the course demands that the students shall attend all lectures and tutorials. It is expected that students will submit assignments on time, take all class tests. Discipline will be maintained in class at all times.

Course reviewers
1. Prof Brijesh Yadav, Professor of Hydrology, Department of Hydrology, IIT Roorkee, Uttarakhand, India
2. Prof. Narendra. Kanhe, Principal,Guru Nanak Institute of Engg. and Management,Dahegaon, Near RadhaSoamiSatsang Place, Katol Road,Nagpur

14. Course title: Climate change, water resources and agriculture			
Course code WSW 174	**No. of credits** 3	**L-T-P distribution:** 42-0-0	**Learning hours:** 42
Pre-requisite course code and title (if any) :			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr. Nirupam Dutta		**Course instructor(s):** Dr Nirupam Dutta	
Contact details:			
Course type: Elective		**Course offered in:** Semester 3	

Course description
Globally, climate variability as witnessed by changes in long-term climatic conditions is adversely affecting the outcomes in the agricultural sector especially with respect to distribution of water resources leading to extended periods of moisture stress. This has serious implications for food security, social stability and welfare of the general population. Keeping this in mind, this course plans to introduce to the inter-linked topics in climate change, water resources and agriculture by building up on the basic concepts and issues pertaining to climate change and their implications for water resources and thereby agriculture. The course further develops theoretical as well as empirical models/approaches for assessing impacts of climate change in agriculture through variability in spatial and temporal distribution of water resources as well as those for adaptation and mitigation strategies for counteracting the same. These will be further followed by examining important cross-country empirical studies using different approaches. The course, with an essentially economic perspective will have a substantial focus on water resources.

Course objectives
- Introduce students to perspectives on inter-linkages between climate change, water resources

and agriculture

- Introduce them to theoretical and empirical models of climate change in agriculture by building up on basic concepts
- Enable the students to explore the extent of impact on agricultural sector through possible effects on water resources and the possible adaptation and mitigation strategies being employed
- Familiarise the students with various empirical studies to help them grasp the concepts

Course content

Module	Topic	L	T	P
1	**Introduction- Main Issues in Climate Change, Water Resources and Agriculture:** Definition and scope, the global scenario, role of climate in affecting the reliability in distribution of water flows and agricultural production, uncertainties, distributional effects, social and economic implications	6	0	0
2	**Tools for Assessing Climate Change Impacts on Agriculture:** Agro-Economic Models**,** Economic Management Models, Inter-temporal Net Revenue Approach, Ricardian Analysis, Empirical Yield Models, Agro-ecological Zone Based Modeling, vulnerability and sensitivity analysis	10	0	0
3	**Tools for Assessing Adaptation to Agricultural Impacts of Climate Change:** Micro-behavioral economics model of global warming**,** Geographically Scaled Micro-econometric Models of Adaptation (G-MAP),	6	0	0
4	**Adaptation and Mitigation Strategies:** Conservation tillage, watershed development, micro-irrigation, system of rice intensification, portfolio diversification, GHG emissions, biofuels, rainfall insurance, technological innovations, improvisation	10	0	0
5	**Political Economy of Climate Change, Water and Agriculture:** Regulatory and Institutional Challenges, Water Rights, Community Participation, Subsidies and Incentives, Conflict Resolution, Institutional Design, Risk, Reliability and Ambiguity	10	0	0
	Total	**42**	**0**	**0**

Evaluation criteria

Mid-Term	35%
End-Term Exam	35%
Paper Presentation	15%
Quizzes	15%

Learning outcomes

Students will be able to appreciate the core issues related to climate change, water resources and agriculture

Using real world data and appropriate tools, students will be to assess the impacts of climate change on various agricultural parameters and the significance of the associated factors.

Based on the exposure to the course work the students will develop skills needed to devise and fine-tune appropriate adaptation and mitigation measures for agricultural activities with specific focus on water resources under field conditions.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, building up on basis concepts,-derivations and empirical study analysis. The sessions will be interactive.

Materials

Textbooks (Tentative)

1) Mendelsohn Robert (ed.) (2001) *Global Warming and the American Economy*, Edward Elgar, Cheltenham
2) Markandya Anil, Galarraga Ibon & de Murieta Elisa Sainz (2014) *Routledge Handbook of The Economics of Climate Change Adaptation*, Routledge, Oxon and New York.
3) Shreshtha Sangam (2014) *Climate Change Impacts and Adaptation in Water Resources and Water Use Sectors*, Springer, Switzerland
4) Ruth Matthias & Ibarraran Maria E. (2009) *Distributional Impacts of Climate Change and Disasters, Edward Elgar*, Cheltenham
5) Rosenzweig Cynthia and Hillel Daniel (2008) *Climate Variability and the Global Harvest*, Oxford University Press, New York.
6) Seo S. Noggol (2015) *Micro-Behavioral Economics of Global Warming*, Springer, Switzerland.
7) Dinar Ariel & Mendelsohn Robert (eds.) (2011) *Handbook on Climate Change and Agriculture*, Edward Elgar, Cheltenham
8) Mendelsohn, Robert & Dinar Ariel (2009) *Climate Change and Agriculture*, Edward Elgar, Cheltenham

Some Suggested Reading (For a better understanding of the issues and perspectives in finer details)

1) Hillel Daniel & Rosenzweig Cynthia (eds.) (2011) *Handbook of Climate Change- Impacts, Adaptation and Mitigation*, Imperial College Press, London.
2) Ludwig Fulco, Kabat Pavel, van Schaik Henk & van der Valk Michael (2009) *Climate Change Adaptation in the Water Sector*, Earthscan, London.
3) Sinnott Armstrong Walter & Howarth Richard B. (eds.) (2005) *Perspectives on Climate Change: Science, Economics, Politics and Ethics*, Elsevier Limited, Oxford.
4) OECD (2009) *The Economics of Climate Change Mitigation: Policies and Options for Global Action Beyond 2012*, OECD, Paris
5) Patt Anthony G., Schroter Dagmar, Klein Richard J.T. & de laVega-Leinert Christina A. (2009) *Assessing Vulnerability to Global Environmental Change*, Earthscan, London.

Journals

American Economic Review
American Journal of Agricultural Economics
Agricultural Economics
Global Environmental Change
Ecological Economics
World Development

Additional information (if any)

Student responsibilities

The nature of the course demands that the students shall attend all lectures. It is expected that students will submit assignments on time, take all class tests. Discipline will be maintained in class at all times.

Course Reviewers:

1. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.
2. Prof Ram Karan Singh, Department of Civil Engineering, King Khalid University, Saudi Arabia.

15. Course title: Groundwater quality modelling		
Course code: WSW 171	**No. of credits:** 4	**L-T-P: 42-14-0**
Pre-requisite course code and title (if any): NIL		
Department: Department of Regional Water Studies		
Course coordinator(s): Prof Prateek Sharma	**Course Instructor(s):** Dr Brijesh Yadav	
Contact details		
Course type: Elective	**Course Offered in: Semester 3**	

Course Description

The goal of this course is to impart a general understanding of fate and transport processes of contaminants in groundwater. In the first part, the natural and anthropogenic sources of nutrients, heavy metals, organic pollutants, and radionuclides are treated, along with their physicochemical characteristics and toxicity in subsurface. The second part provides an introduction to the mathematical modelling of processes of transport, exchange, and transformation, such as advection, dispersion, diffusion and kinetics of adsorption and decay. The spatial and temporal patterns of pollutants in groundwater and their treatment techniques are explained subsequently. During the lectures, the basic theory will be presented and illustrated with examples from practical and simulation studies. The theory will be applied in problems to be solved during tutorials. After the course the student will have the required knowledge to qualitatively assess soil and groundwater contamination problems and will have the skills to tackle simple problems in a quantitative manner.

Course objective: This course aims at exposing the student to basic concepts and principles related to the fate and transport of pollutants in soil and groundwater systems under various environmental conditions. The specific objectives of this course are to understand: 1) Physical and chemical behaviour of pollutants, 2) Modelling of transport and transformation processes and 3) Pollutant patterns in soil, groundwater and their remediation techniques.

Course content

Module	**Topic**	**L**	**T**	**P**
1.	Sources and causes of groundwater pollution; Various ways of classification of pollutants; groundwater quality parameters; Site specific groundwater quality problems in Indian context	4	1	
2.	Concepts and principles related to the movement of solutes in aquifer systems; continuity equation and Ficks' law, mass transfer; mass transport, Solute transport in double-porosity media	8	3	
3	Description of adsorption: linear and nonlinear isotherms, kinetic adsorption, Determination of adsorption coefficients, Determination of flow velocity and dispersivity coefficients, Hydrodynamics dispersion, longitudinal and lateral dispersivity	6	2	
3.	Degradation processes, Biodegradation, Factors affecting biodegradation, Radioactive decay, Reactive processes, Multiphase contamination, NAPLs, VOCs; density driven flow, Ghyben-Herzberg	5	2	

	principle, concepts of fresh saline interface			
4.	Direct and inverse problems, Analytical solution of classical advection-dispersion equation, Finite difference methods, Numerical modeling of steady and transient flows in variably saturated domain, Contaminant transport modeling, Numerical dispersion, Discussion of initial and boundary conditions, Regional aquifer quality simulation, matrix solution techniques and iteration methods	10	3	
5.	Concepts of pollution control and remediation measures; pump-and treat; Permeable reactive barriers and their design, Soil vapor extraction, Air sparing, bioremediation and phytoremediation processes	6	2	
6.	Development and optimization based management of aquifer systems, Stochastic models, Random field concepts in groundwater models; planning of groundwater development in coastal aquifers	3	1	
		42	**14**	

Evaluation criteria

- **Minor test 1: 15%**
- **Minor test 2: 15%**
- **Tutorials: 20%**
- **Major test: 50%**

Learning outcomes

- Characterization of groundwater quality
- Develop models based on the continuity and Fick's law approaches
- Predict the movement of pollutants in subsurface under varying environmental conditions
- Quantity spatial and temporal loads of pollutants in subsurface
- Forecasting future conditions under various loading scenarios or management/intervention action alternatives
- Remediation strategies for polluted groundwater systems

Pedagogical approach

The course will be delivered through class room lectures, discussion of case studies from original relevant research articles and hands on simulation experiments.

Materials

Textbooks

Fetter, C.W., Contaminant hydrogeology, Macmillan, New York, (2nd ed.).

Domenico, P.A. and Schwartz, F.W. Physical and chemical hydrogeology (2nd ed.). John Wiley & Sons, New York. ISBN 0-471-59762-7

Schwartz, F.W. and Zang, H., "Fundamentals of Ground Water", John Wiley & Sons

Freeze, R.A., Cherry, J.A., 1979. Groundwater. Prentice-Hall, Englewood Cliffs: 604 pp

Suggested Readings

Bear, J., 1972. Dynamics of Fluids in Porous Media. Am. Elsevier Publishing Co., New York: 764 pp

Todd D.K. (1980) Groundwater Hydrology, John Wiley and Sons.

Dunnivant F.M. and Anders E. (2006) *A Basic Introduction to Pollutant Fate and Transport*, John Wiley & Sons, Inc., New Jersey.

Rastogi A.K. (2008) Numerical Groundwater Hydrology, Penram International Publishing Pvt.

Ltd., Bombay.
Schnoor, J.L. (1996). *Environmental Modeling*. John Wiley & Sons, Inc., New York.

Journals
Journal of contaminant Hydrology
Water Resources Research
Journal of Irrigation and Drainage Engineering
Water Air and Soil Pollution
Advances in Water Resources
CLEAN - Soil, Air, Water

Additional information (if any)

Course reviewers
1. Dr Arun Kansal, Head and Professor, Department of Regional Water Studies, TERI University
2. Dr Brijesh Yadav, Department of Hydrology, IIT Roorkee

Annexure 6
(Refers to Item No 7 of minutes of 38th meeting of AC**)**

TERI University Policy on Postdoctoral Positions

Preamble

1. The TERI University aspires to become a research-led global institution with the finest repository of knowledge in the field of sustainability and development. The research work undertaken shall strive for innovative and inclusive solutions for the benefit of the society, while encouraging intellectual growth. To facilitate the desired platform, the University actively encourages Post-Doctoral Fellows to join TU in specific areas of research.

Scope

2. These rules may be called the **TERI University Policy on Postdoctoral Positions**. The rules embodied in this policy shall apply to all categories of Postdoctoral scholars working in the TERI University and shall include the following:-

(a) Post-docs who earn a fellowship of their own via a funding agency and indicate TERI University as their host institution.

(b) Post docs recruited as Fellows under extramurally funded research projects that the University is awarded with.

(c) Post Docs recruited by the University for internally funded projects.

Eligibility

3. Person who possesses a Doctoral (Ph.D) degree and has significant publication research work/patents to their credit.

4. An individual who has submitted the thesis and awaiting the award of PhD degree can also be admitted with a lessor fellowship till he/she qualifies for the eligible degree. The candidate Full fellowship shall be admissible from the date of degree, on submission of the relevant PhD degree document.

5. The Fellowship is open to Indian and International candidates.

Selection

6. Interested individuals who intend to use TERI University as the host institution (Para 2(a)) should make their inquiries directly to the appropriate academic department/faculty member. Faculty members shall respond to correspondence regarding possible postdoctoral research, after

determining whether the area of interest is appropriate for study, and whether there is sufficient office/laboratory space and other resources needed to support the scholar exist.

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7. Where the Post doc is to be recruited under other categories the concerned Department/Centre shall forward complete details including eligibility criteria to the Office of the Registrar 60 days in advance of the proposed start date for the fellowship. On account of Visa processing and other government statutory clearances, longer period may be required for International fellows.

8. Candidates shortlisted by Faculty/PI will be required to appear for an interview before the Selection Committee. University is at its discretion to pay for the travel in connection with the interview.

9. Selection for the fellowship shall be approved by a selection committee consisting of the following members:-

(a) Dean (Academic)/Nominee of Dean
(b) The Head of the Department in which a candidate intends to carry out research work.
(c) Advisor (Faculty under whom the Postdoctoral Fellow wishes to work).

10. Once approved by the selection committee the list of names shall be forwarded to the Office of the Registrar for initiating the offer of appointment/attachment to the candidate. A standard offer letter is to be generated by the Office of the Registrar and communicated electronically.

Tenure

11. The tenure of a Postdoctoral Fellow for category 2(a) shall be governed by the terms and conditions of the funding agency as specified.

12. For all others the following rules shall be applicable:-

(a) In the first instance, the appointment shall be made for one year beginning from the date of joining.

(b) The tenure can be extended on consideration of the research work carried out in the preceding year by the Department Research Committee (DRC) but not more than one year at a time.

(c) Reappointment approval will not be granted without submission of the annual evaluation by the Advisor.

Termination

13. Contract for Postdoctoral positions can be terminated under the following circumstances:-

(a) **Lack of Funding.** If the sponsoring agency stops funding the fellowship/project, the appointment may be terminated.

(b) **Unsatisfactory Performance.** The University may terminate the appointment of a person at any time on the basis of a report from the DRC for reasons of unsatisfactory performance.

(c) **Disciplinary Ground**. Should a violation of research integrity and/or research misconduct appear to occur it has to be forwarded to the University Disciplinary Committee to establish the degree of breach and in cases of expulsion; termination process is to be initiated.

14. The post doc shall have the right to appeal to the Vice chancellor, whose decision shall be final in all the cases.

Resignation

15. If a Postdoctoral Fellow wishes to resign his or her appointment prior to the ending date indicated in the appointment letter or subsequent written understandings, he/she is expected to provide a minimum of one month's notice in writing.

Fellowship

16. Postdoctoral Fellow funded by external agency shall be eligible for fellowship as per the norms of the sponsoring/funding agency. For candidates recruited by TERI University the norms/rates set by the University shall be applicable.

Responsibilities of the Advisor

17. A faculty member shall be designated to monitor and evaluate the program undertakenby the Postdoctoral fellow who will be termed as the Advisor. The Advisor shall:-

(a) Provide training experience that will foster the individual's intellectual, technical and professional development.

(b) Treat the Postdoctoral Fellow as a colleague while at the same time mentor him/her in the performance of high quality research leading to timely publication.

18. Postdoctoral Fellow shall not be exploited nor their research compromised in the service of other sponsored research or for the financial gain of the Advisor.

19. Annual performance evaluation must be conducted by the Advisor for each Postdoctoral Fellow.

Responsibilities of the Postdocs

20. The Postdoctoral Fellow will be attached to the Department/Centre and devote himself/herself to full time research & teaching in an approved area. Post joining the department she/he shall submit a joining report to the Registrar office and complete the formalities as per the funding/ sponsoring agency guidelines for release of fund.

21. He/She shall not accept or hold any appointment, paid or otherwise or receive any emoluments, salary, stipend, consultancy etc., from any other sources other than the sources approved by the TERI University.

22. The Postdoctoral fellow shall have obligations to their Advisors, and to the TERI University such as:-

(a) Adherence to the highest standards of responsible conduct and professional integrity in research.

(b) Conscientious and ethical efforts to accomplish the research.

(c) Compliance with good laboratory practice, including the maintenance of adequate research records and care for unique facilities, equipment etc.

(d) Discuss research findings with the Advisor and avoid disclosures of confidential or proprietary information without the Advisor's consent.

(e) Behave with congeniality and respect for colleagues.

(f) Present and submit a comprehensive progress report at the end of each semester to the Advisor**.**

(g) Lab records are TERI University property. Postdoctoral Fellow may take a copy of the record with the written consent of the Advisor at his/her own cost.

(h) The Advisor and the Postdoctoral Fellow must jointly complete an Annual Evaluation form.

23. The Head of Department/Centre may assign academic responsibilities (lectures, tutorial classes, laboratory demonstration work, conduct of seminar, symposia etc.) not exceeding 10 hours per week with the consent of the Advisor.

Leave

24. The tenure of a Postdoctoral Fellow for category 2(a) shall be governed by the terms and conditions of the funding agency as specified.

25. Post doc fellows who are not governed by leave rule of the sponsoring agencies and all other fellows shall be entitled to 30 days leave per academic year, including leave on medical grounds. He/she will not be entitled to mid-semester breaks, summer and winter vacations. Women research

scholars will be eligible for maternity leave for a period not exceeding 135 days once during the tenure of their programme.

26. In exceptional cases Fellows may be allowed leave without fellowship for a period not exceeding three months during the total tenure (3 years) of the award on the recommendation of the Head of the Department/Centre.

27. A proper leave account of each fellow shall be maintained by the Office of the Registrar.

28. Any leave not availed of, shall not accumulate. Any unauthorized absence may be treated as leave without fellowship.

Traveling Allowance

29. A Postdoctoral Fellow may be permitted on the recommendation of the Head of the Department/Centre to attend a conference/seminar/workshop/training programme in India once a year for which he/she will be treated on duty and shall be entitled to the payment of allowances as per TU rules. Travel entitlement in India will be 2nd AC by Rail or as specified by the funding agency(as applicable).

International Fellow

30. Candidates not holding Indian citizenship are required to apply for the requisite visa on receipt of the offer letter and follow the procedure as applicable.

31. The office of Registrar shall inform the concerned Govt. Office about the termination/resignation cases and request the foreign national to complete the necessary formalities.

Other Policies

32. Postdoctoral Fellows are subject to the applicable rules, regulations and policies of the University, including but not limited to, those relating to intellectual property, sexual harassment, equality and discipline.

Publication

33. The results of the research work may be published in standard peer refereed journals at the discretion of the Advisor. It should be ensured that the assistance provided by the TERI University and the funding agency is acknowledged in all such publications.

Certificate

34. Upon satisfactory completion of the postdoctoral program as certified by the Advisor, each postdoctoral fellow will be issued a certificate signed by the Registrar. This certificate will indicate

the field or fields of postdoctoral study, the name of the Advisor, and the period for which the postdoctoral fellow was appointed.

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