TERI SAS (Deemed to be University)

10, INSTITUTIONAL AREA, VASANT KUNJ, NEW DELHI

MINUTES

59TH MEETING OF ACADEMIC COUNCIL

Meeting No. : 59th (Fifty Nine)

Date : **04 June 2024 (Tuesday)**

Venue : **Conference Room, TERI School of Advanced Studies**

Time : **10.30 AM**

TERI SAS (Deemed to be University)
MINUTES FOR THE 59th MEETING OF THE ACADEMIC COUNCIL
04 June 2024 (10.30 AM ONWARDS)

ITEMS AT A GLANCE

Item No.	Particulars

Item No.59.1: Welcome and opening remarks by the Vice Chancellor

Confirmation of Minutes

Item No. 59.2: To confirm the minutes of the Fifty Eighth (58th) Meeting of the Academic Council held on 08 January 2024.

Action Taken Report

Item No. 59.3: Action Taken Report on the 58th Academic Council Meeting.

Agenda items for Information

Item No. 59.4: Matters of information

59.4.1 Joining of Prof Suman Kumar Dhar, Vice Chancellor.

Agenda items for Consideration

Item No. 59.5. Agenda Items

59.5.1 To consider and approve restructuring of MSc (Geoinformatics), MSc (Climate Science and Policy) and MSc (Environmental Studies and Resource Management) programmes, realigning of the courses and revision of Major & Minor project credits in the Department of Natural and Applied Sciences

59.5.2 To consider and approve review of the complete course framework for four years UG programme and approve third semester courses of Four-Year Undergraduate programmes in Environmental Studies and Data Science offered by the Department of Natural and Applied Sciences

59.5.3 To consider and approve aligning the learning outcomes and credit requirements of following programmes as per NHEQF offered by the Department of Sustainable Engineering

59.5.4: To consider and approve five Course Outlines of the 1st semester courses of M.Sc. (Energy Studies and Management) offered by the Department of Sustainable Engineering

59.5.5: To consider and approve three Course Outlines of the 1st semester courses of M.Tech (Urban Development Management)) offered by the Department of Sustainable Engineering

59.5.6: To consider and approve including B.Sc in Energy and B.Voc in relevant stream as eligibility criteria for admission to M.Sc (ESM) offered by the Department of Sustainable Engineering

59.5.7 To consider and approve revision of programme structure of MSc (Water Science and Governance)

59.5.8 To consider and approve revision of the programme outline of MSc Economics offered by the Department of Policy and Management Studies

59.5.9 To consider and approve revision of the course structure of MBA (SM) programme offered by the Department of Policy and Management Studies as per the AICTE Credit norms

59.5.10 To consider and approve review of the following two new core courses to be introduced in BBA Semester -3

59.5.11 To consider and approve revision of the course structure of LLM Programme as per the NHEQF Guidelines and increase the Credit value along with number of teaching and learning Hours in both the Semesters

59.5.12 To consider and approve review the suggested modifications and additions in Four Courses of LLM First Semester

59.5.13 To consider and approve revision of the programme outline of MA (SDP) and align with the NHEQF

59.5.14 To consider and approve the new credit alignment of Minor and Major Projects for MA (SDP)

59.5.15 To consider and approve the revised core courses for the 1st Semester for MA (SDP)

59.5.16 To consider and approve the new course outline of elective courses to be offered to 3rd Semester students for MA (SDP)

59.5.17 To consider and approve revision of the programme outline of MA (PPSD) and align with the NHEQF

59.5.18 To approve the new/revised core courses for the 1st Semester in MA (PPSD)

59.5.19 To consider and approve aligning the credit requirement of M.Sc (Biotechnology) programme as per NHEQF

59.5.20 To consider and approve National Eligibility Test (NET) as an Entrance Test for Admission to Ph.D.

59.5.21 To consider and approve preparedness for NEP 2020 in respect of UG / Integrated programmes.

59.5.22 To consider and approve guidelines for nominating Honorary Distinguished Professor at TERI SAS.

59.5.23 To consider and approve recruitment of faculty members.

Item No. 59.6: Any other item with the permission of the Chair

TERI SAS (Deemed to be University)

MINUTES FOR THE 59th MEETING OF THE ACADEMIC COUNCIL 04 June 2024 (10.30 AM ONWARDS)

DETAILED AGENDA ITEMS

The Fifty Ninth meeting of the Academic Council was held on 04 June 2024 at 1030 hours. The following were present:-

Members Present

Prof. Suman Kumar Dhar, VC, Chairperson
Prof P.S.N. Rao
Prof Chander Kumar Singh
Prof Anandita Singh
Prof Naqui Anwer
Dr Amit Singh
Dr Sanyyam Khurana
Dr Amit Kaur
Dr Adwitiya Sinha
Dr Swarup Dutta
Dr Gopal Sarangi (online)
Dr Ramkishore Singh
Dr Shruti Sharma Rana
Mr Manoj Chugh
Mr Sudhir Vadehra
Prof. Ramkishore Singh
Prof Shashi Bhushan Tripathi
Dr Ranjana Ray Chaudhuri
Dr Chandrashekhar Azad
Dr Moumita Mandal
Dr Moumita Acharya
Dr Ramakrishna Sitaraman
Dr Anand Madhukar
Dr Adil Masood
Dr Priyanka Arora
Dr Ayushi Vijhani
Col B Venkat, Registrar

DETAILED AGENDA ITEMS

Item No 59.1: Welcome and opening remarks by the Vice Chancellor.

Prof. Suman Kumar Dhar welcomed all memebrs to the meeting and thanked them for their presence. He briefly shared an overview of the current admissions status as well as outlined several initiatives aimed at generating additional revenue to address the financial challenges currently confronting the institution.

Confirmation of Minutes

Item No. 59.2: **To confirm the minutes of the Fifty Eighth (58th) Meeting of the Academic Council held on 08 January 2024.**

The minutes of the Fifty Eighth Meeting of the Academic Council, held on 08 January 2024, were circulated to the members and no comments were received.

The Academic Council may, therefore, consider confirming the minutes, as circulated.

Academic Council confirmed the minutes.

Action Taken Report on the 58thAcademic Council Meeting.

Item No. 59.3: **Action Taken Report on the 57thAcademic Council Meeting**

Sr.No.	Agenda	Action taken
Item No.1	**58.4.1 The following courses have been approved at the level of BoS, wherein detailed presentation followed by analysis and vetting by external experts was carried out. Academic Council is requested to consider and approve Course outlines of second semester for UG / Integrated and PG programmes.** **58.4.1.1** Seeking approval for 2 Course outlines for FYUP Economics from the Department of Policy and Management Studies**.** a. Basic Mathematics for Economics b. Introductory Statistical methods **58.4.1.2** Seeking approval for 3 course outlines for PG programme of MBA (Sustainability Management) from the Department of Policy and Management Studies**.** a. Introduction to Negotiation skills, b. Organisational Change Management c. Climate, Energy and Carbon Markets **58.4.1.3** Seeking approval for 1 course outline for BBA from the Department of Policy and Management Studies. a. Organisational Behaviour **58.4.1.4** Seeking approval of following course structures under second semester at undergraduate level from current academic year from the Department of Natural and Applied Sciences**.** a.Problem-Solving and Python Programming b.Fundamentals of Information Technology c. Database Management System d. Sustainability Communication e. Environmental Physics f. Environmental Biology g. Environmental Chemistry h.Introduction to Remote Sensing i.Modern Indian Language - 1 j.Ancient Indian Sustainable Practices k. Personality Development for Success l..Constitutional Values and Fundamental Duties	**The same has since been implemented.**
Item No.2	**58.4.1.5** Approval for addition of the following course structure under first semester at postgraduate level from subsequent	**The same has since been implemented.**

	academic year from the Department of Natural and Applied Sciences. a. Holistic Personality Development Course **58.4.1.6** Approval for the shifting of following two courses from 3rd semester to 2nd semester under MSc. Climate Science and Policy (CSP) program from current academic year from the Department of Natural and Applied Sciences. a. Aerosol Science b. Economics of Climate Change	
Item No.3	**58.4.2 Seeking approval for changing the minimum eligibility criteria for admissions in the BSc Economics programme.** For students taking Economics as minor, 1st Semester math course 'Introductory Mathematical Methods for Economics' may be made mandatory/ a pre-requisite or equivalent courses in 'National Institute of Open Schooling (NIOS)' may be considered as mandatory.	**The same has since been implemented.**
Item No.4	**58.4.3 To consider and approve the framework and programme structure of Masters programme M.Sc (Energy Studies and Management)** Academic Council is requested to consider and approve the framework and programme structure of Master's programme M.Sc (Energy Studies and Management) from the Department of Sustainable Engineering.	**The same has since been implemented.**
Item No.5	**58.4.4 To consider and approve proposal of online programme of M.A. (Public Policy and Sustainable Development (PPSD)).** The MA (Public Policy & Sustainable Development) offered by the TERI SAS is a two years Masters Programme that is founded on a consolidated and well organised curriculum focusing on multiple angles of public policy making. It revolves around the concepts of formulation, analysis, evaluation and practical implications while incorporating them into the developmental needs of the society. The program has a direct bearing on the policy decisions by government officials at all levels and private not-for-profit and for-profit business entities. It is proposed to offer the program in online mode. Necessary approval shall be sought from UGC for the same to commence from the academic year 24 – 25.	**Higher Educational Institution shall not offer its programmes or other related activities through franchising arrangement for the purpose of offering programmes through Open and Distance Learning mode/Online mode. At present, TERI SAS is not in a position to apply this to UGC DEB due to the reuired IT infrastructure. The same shall be**

		taken up post in house IT development.
Item No.6	**58.4.5 To consider and approve intake / increase in MBA (SM) programme from 60 to 90 (AICTE approval).** The M.B.A. (Sustainability Management) at the TERI SAS equips students with acumen to lead in a resource-sensitive world amid increasing competition and concern for sustainable development. Different courses such as Principles and Concepts of Sustainability, Climate Change and Development, Sustainability Reporting, Corporate Social Responsibility, Strategies for sustainable business, Business, Natural Ecosystems and Community, Accounting and Finance for Sustainability taught in the programme help the students recognize the need, challenges and ways to approach long-term viability of businesses through management and optimization of resources without compromising on profitability and competitiveness. It is proposed to increase the number of seats from the existing 60 to 90. Necessary approval shall be sought from AICTE for the same to be effective from the academic year 24 – 25.	**Approval from AICTE for the same has since been received.**
Item No.7	**58.4.6 To consider and approve adoption of University Grants Commission (Minimum Standards and Procedures for award of Ph.D. Degree) Regulations, 2022.** The minimum standards and procedure for the award of, Ph.D have been revised according to the recommendations of National Education Policy 2020 and the UGC has notified the new UGC (Minimum Standards and Procedure for award of Ph.D.) Regulations, 2022 in the official Gazette on 7th November 2022. These new regulations are framed to encourage research scholars to become well trained researchers and inquisitive explorers. It is proposed to adopt UGC (Minimum Standards and Procedure for award of Ph.D.) Regulations, 2022 at TERI SAS.	**Committee to implement the guidelines is under constitution.**
Item No.8	**58.4.7 To consider and approve award of Degrees and other academic titles in the 16th Convocation ceremony scheduled for the 08 Feb 2024.** 16th Convocation ceremony of TERI SAS has been scheduled for the 08 Feb 2024. Prof. Ajay Kumar Sood, PSA Govt of India has kindly consented to be the Chief Guest.	**The same has since been implemented.**

	A total of 249 students across various disciplines and the programs are eligible for the grant of degrees/titles. The list of students declared qualified vide the processes laid down by Academic Council are as per following details. (i) Doctoral - 13 (ii) Masters - 230 (iii) P.G.Diploma (PPSD) -06	
Item No.9	**58.5.1 Proposal for in-principle approval for restructuring M Tech Urban Development Management (UDM) Programme as an MBA UDM Programme.** M Tech Urban Development Management (UDM) Programme in its present state requires restructuring to be relevant. Over the last few years, M Tech programs in general have not been able to be as relevant as earlier. The changes to M Tech programs in terms of course restructuring, curriculum revision, alignment to international and industrial norms have occurred across the country. On similar lines, it is proposed to restructure the existing M Tech UDM and launch it as an MBA UDM Programme from the Academic year 24 – 25.	**Rejuvenation of M Tech Urban Development Management (UDM) Programme was proposed to include offering certificate courses.**

Agenda items for Information

Item No. 59.4: Matters of information

59.4.1 Joining of Prof Suman Kumar Dhar, as Vice Chancellor TERI SAS

Prof Suman Kumar Dhar, took over the duties of Vice Chancellor, TERI SAS w.e.f .01 April 2024 (F/N).

Col B Venkat introduced and welcomed Prof Suman Kumar Dhar as the Vice Chancellor, TERI SAS. All members welcomed him to TERI SAS.

Agenda Items for Consideration

Item No. 59.4 Agenda items

59.5.1 To consider and approve restructuring of MSc (Geoinformatics), MSc (Climate Science and Policy) and MSc (Environmental Studies and Resource Management) programmes, realigning of the courses and revision of Major & Minor project credits in the Department of Natural and Applied Sciences

59.5.1.1. Review of the current programme structure of MSc Geoinformatics, MSc Climate Science and Policy (CSP) and MSc Environmental Studies and Resource Management (ESRM), in the context of aligning it to the National Higher Education Qualifications Framework (NHEQF) and the new proposed system of 20 credits per semester (minimum 80 credits for a 2-year PG programme). The courses are placed in **Enclosures 1, 2 and 3**.

59.5.1.2. Realigning of courses across from one semester to the other, changes in course types (credit/audit/core/elective), changes in course codes, removing certain courses (NRE 165 - Introduction to Sustainable Development, PPM 179 - Design Thinking, NRE105 Independent Study and NRE 102 Seminar Course in Global Change) and change in number of credits (NRG 178 - Principles of remote sensing, as placed in **Enclosure 4**).

59.5.1.3. Revision of Minor Project and Major Project credits, as per requirement of NHEQF.

To increase the Minor project credits to 8 and add to 3rd semester credits. In addition, Major project credits to be revised to 20 in the 4th semester.

The Academic Council discussed, gave inputs and approved the agenda.

59.5.2 To consider and approve review of the complete course framework for four years UG programme and approve third semester courses of Four-Year Undergraduate programmes in Environmental Studies and Data Science offered by the Department of Natural and Applied Sciences

59.5.2.1 To consider and approve review of the complete course framework for four years Undergraduate programme for Data Science (DS) and Undergraduate programme for Environmental Studies (ES) offered by the Department of Natural and Applied Sciences as placed in **Enclosure 5**.

59.5.2.2 To consider and approve below mentioned third semester courses of Four-Year Undergraduate programmes in Environmental Studies and Data Science as placed in **Enclosure 6**.

(i) Data Wrangling and Visualization (major for DS)
(ii) Cybersecurity for Data Science (major for DS)
(iii) Data Mining and Data Analysis (major for DS)
(iv) Biodiversity Conservation (major for ES)
(v) Soil Conservation and Management (major for ES)
(vi) Sustainable Built Environment (major for ES)
(vii) Conventional and Renewable Energy Resources (minor for ES)
(viii) Environmental Statistics (MDC)
(ix) Introduction to Geographic Information System (SEC)
(x) Modern Indian Language 2 (AEC)

The Academic Council discussed, and proposed renaming the course - Cybersecurity for Data Science (major for DS) as Cybersecurity (major for DS) and approved the agenda.

59.5.3 To consider and approve aligning the learning outcomes and credit requirements of following programmes as per NHEQF offered by the Department of Sustainable Engineering

(i) M.Tech (Renewable Energy Engineering and Management) – M.Tech REEM)
(ii) M.Sc. (Energy Studies and Management) – M.Sc (ESM)
(iii) P G Diploma in Renewable Energy Management – PGDREM
(iv) M.Tech (Urban Development Management) –M.Tech (UDM)
(v) P G Diploma in Urban Development Management – PGDUDM

The Department of Sustainable Engineering offers five programmes. There are two PG Diploma, one M.Sc and two M.Tech programmes which falls at level 6, level 6.5 and level 7, respectively as per NHEQF (National Higher

Education Qualification Framework-2023). As per NHEQF, each of these programmes requires minimum of 40 credits every year (which may spread over two semesters) to be earned by any individuals enrolled in the programmes. It is, therefore, required to align the programme structures to accommodate recommendations as per NHEQF so that the credit requirements and learning outcomes of all the programmes can be aligned accordingly. Placed as **Enclosure 7**

The Academic Council discussed, proposed the following and approved the agenda-

(a) Additional and niche' areas such as Carbon Credit, Energy storage system, Hydrogen Engineering & Electric vehicles be introduced as subjects to be taught as part of the credits.

(b) Present offering of courses as 01 credit be increased to minimum 02 to be seen as a viable learning.

(c) Possibility of involving Professors of Practice / Honorary professors be explored for this niche' areas.

59.5.4: To consider and approve five Course Outlines of the 1st semester courses of M.Sc. (Energy Studies and Management) offered by the Department of Sustainable Engineering

M.Sc (Energy Studies and management) [M.Sc (ESM)] is a new programme which shall be started from the session 2024-25. There are 8 core courses in the 1st semester. Out of 8 courses, the course outline of 3 courses doesn't require fresh approval. The remaining 5 new course are as listed below, which is presented for discussion and approval.

(i) Introduction to Energy Resources, Systems and Technologies – placed as **Enclosure 8**
(ii) Energy System Infrastructure & Operations - placed as **Enclosure 9**
(iii) Energy Policy, Planning and Programmes - placed as **Enclosure 10**
(iv) Energy Conservation, Audit and Management – placed as **Enclosure 11**
(v) Energy Science Lab – placed as **Enclosure 12**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.5: To consider and approve three Course Outlines of the 1st semester courses of M.Tech (Urban Development Management)) offered by the Department of Sustainable Engineering

The M.Tech (UDM) programme has been restructured. One course of the 1st semester, listed below, is presented for discussion and approval.

(i) Theories of Urbanisation and their application for urban development – placed as **Enclosure 13**

Two courses of 1st semester of M.Tech (UDM) has been updated. Both the courses have been presented for discussion and approval.

(ii) MEU 167 Urban Development Policies and Programmes placed as **Enclosure 14**
(iii) MEU 179 Geoinformatics for urban development management placed as **Enclosure 15**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.6: To consider and approve including B.Sc in Energy and B.Voc in relevant stream as eligibility criteria for admission to M.Sc (ESM) offered by the Department of Sustainable Engineering

To expand the eligibility criteria for admission to M.Sc (ESM) programme, it is proposed that candidates with B.Sc degree in Energy domain and B.Voc in relevant stream be allowed to take admission in this programme.
The Academic Council approved the agenda.

59.5.7 To consider and approve revision of programme structure of MSc (Water Science and Governance).

To consider and approve revision of programme structure of MSc (WSG), offered by the Coca Cola Department of Regional Water Studies to align the course structure with the National Higher Education Qualification Framework (NHEQF), as placed in **Enclosure 16**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.8 To consider and approve revision of the programme outline of MSc Economics offered by the Department of Policy and Management Studies

59.5.8.1 To align the programme outline of M.Sc Economics in line with the NHEQF guidelines, the proposal was that the Mathematical Methods of Economics (now offered in the 1st Semester) may be divided into two new courses: (a) 'Real Analysis and Optimization' and (b) 'Linear Algebra and Dynamic Optimization'. However, BoS members suggested that including both these courses in Semester 1 would be too heavy content wise, hence shall be spread across the Semesters. The revised Programme Outline of MSc (Economics) Programmeis is placed as **Enclosure 17**. The revised course outlines are placed as **Enclosure 18**.

59.5.8.2 To approve the following new courses for BSc Economics Programme for the third Semester.

(i) Intermediate Macroeconomics 1
(ii) Intermediate Microeconomics 1
(iii) Intermediate Microeconomics 2
(iv) Introduction to Development Economics

The revised course outlines are placed as **Enclosure 19**.

The Academic Council discussed, gave inputs and approved the agenda.

59.5.9 To consider and approve revision of the course structure of MBA (SM) programme offered by the Department of Policy and Management Studies as per the AICTE Credit norms

Vide AICTE's Model curriculum for MBA dated Jan 2018, program structure and credits have been defined as follows-

(i) First year (I and II semester) – 54 credits of core courses
(ii) Second year (III and IV semester) - 42 credits of electives
(iii) Internship / Field work – 06 credits
Total – 102 credits

Further, one credit equals to 10 hours.

It is proposed that the same be adopted for the MBA (SM) program and the courses be revised to be offered from the next semester commencing Jan / Feb 2025, with 06 credits for internship / field work be equated to the minor internship under offer at TERI SAS.

The Academic Council discussed, gave inputs and approved the agenda. It was unanimously agreed upon to explicitly state that one credit for teaching equates to 10 hours.

59.5.10 To consider and approve review of the following two new core courses to be introduced in BBA Semester -3

(i) Marketing Management II
(ii) Operation Management

The revised course outline is placed as **Enclosure 20.**

The Academic Council discussed, gave inputs and suggested that Operation Management be changed to Operations Management. The Academic Council approved the agenda.

59.5.11 To consider and approve revision of the course structure of LLM Programme as per the NHEQF Guidelines and increase the Credit value along with number of teaching and learning Hours in both the Semesters

NHEQF Guidelines for LLM Program recommend that one semester must carry 20 credits however current LLM structure indicates that the total credit size in each Semester is 16 credits per semester. It is proposed that based on the NHEQF Guidelines, credit size be increased to 20 credits per semester.

Further, the contact hours for credit shall be as follows: 1 credit is equal to 15 hours of teaching and learning. Accordingly, necessary changes have been incorporated. The revised Programme Outline of the Programme is placed as **Enclosure 21.**

The Academic Council discussed and approved the agenda.

59.5.12 To consider and approve review the suggested modifications and additions in Four Courses of LLM First Semester

(i) MPL 101- Seminar/Clinic on Contemporary Issues in Infrastructure and Environment (From Zero Audit Course to 1 Credit Course)
(ii) MPL 141- Economic Foundations of Environmental and Infrastructure Law (From 1 Credit Course to 2 Credit Course)
(iii) MPL 155- Environmental Law and Policy (From 2 Credit Course to 3 Credit Course)
(iv) MPL 157- Infrastructure Law and Policy (From 2 Credit Course to 3 Credit Course)

The revised course outline of the Programme is placed as **Enclosure 22**.

The Academic Council discussed, gave inputs and approved the agenda.

59.5.13 To consider and approve revision of the programme outline of MA (SDP) and align with the NHEQF

The MPEC, MA (SDP) Programme, in view of the institutional mandate of adhering to the National Higher Education Qualification Framework

(NHEQF) as a part of the National Education Policy 2020 has suggested aligning the courses as per its guideline. Necessary changes in the credit assignments are done in the first Semester courses. BoS members agreed to the above agenda point considering the NEP requirements. The revised course outline of the Programme is placed as **Enclosure 23**.

The Academic Council discussed, gave inputs and approved the agenda.

59.5.14 To consider and approve the new credit alignment of Minor and Major Projects for MA (SDP)

It is proposed to have 8 credits for the minor project in the 3rd semester and 20 credits for the Major project in the 4th semester for MA (SDP).

The Academic Council discussed, gave inputs and approved the agenda.

59.5.15 To consider and approve the revised core courses for the 1st Semester for MA (SDP)

The following courses of the 1st Semester were revised/modified as per the NHEQF requirements and presented below.

(i) **Themes and Perspectives of development**
Revised course outline is placed as **Enclosure 24.**
(ii) **Law, society and Sustainable Development**
Revised course outline is placed as **Enclosure 25.**
(iii) **Principle of Economics**
Revised course outline is placed as **Enclosure 26.**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.16 To consider and approve the new course outline of elective courses to be offered to 3rd Semester students for MA (SDP)

The following elective courses of the 3rd Semester were revised and presented below-

(i) **Climate Change and Development**
Revised course outline is placed as **Enclosure 27.**
(ii) **Energy Economics, Policy and Finance**
Revised course outline is placed as **Enclosure 28.**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.17 To consider and approve revision of the programme outline of MA (PPSD) and align with the NHEQF

The MPEC, MA (PPSD) Programme, in view of the institutional mandate of adhering to the National Higher Education Qualification Framework (NHEQF) as a part of the National Education Policy 2020 suggested aligning the courses as per its guideline.

Necessary changes in the credit assignments in the first Semester courses are placed as **Enclosure 29.**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.18. To approve the new/revised core courses for the 1st Semester in MA (PPSD)

Following courses of the 1st Semester were introduced/revised/modified and the details are provided below-

(i) **Public Policy: A Concise Exposure**
Revised course outline is placed as **Enclosure 30.**
(ii) **Social Policies & Sustainable Development**
Revised course outline is placed as **Enclosure 31.**
(iii) **Public Administration and Systems Management**
Revised course outline is placed as **Enclosure 32.**
(iv) **Research Methods & Tools for Public Policy and Administrative Decision Making**
Revised course outline is placed as **Enclosure 33.**
(v) **Globalisation and Changing Geopolitics: Implications for Economic & Foreign Policies**
Revised course outline is placed as **Enclosure 34.**
(vi) **Economics for Public Policy**
Revised course outline is placed as **Enclosure 35.**
(vii) **International Collaborative Studio on Public Policy**
Revised course outline is placed as **Enclosure 36.**
(viii) **Policy Lab – I: Sectoral Policy Scoping**
Revised course outline is placed as **Enclosure 37.**

Dr. Chandan Kumar, Programme Coordinator, addressed the queries related to the MA-PPSD Programme restructuring process and its requirements. He informed the AC members that from the upcoming Academic Session, the MA-PPSD Programme is also offering admissions to fresh graduate candidates, in addition to mid-career/senior professionals joining the Programme through DoPT or any non-governmental organizations. Hence, the courses have been modified and realigned in the Programme to cater for the requirements of all the stakeholders, including the feedback/suggestions received from the DoPT.

The Academic Council discussed, proposed to include think tanks also as part of stake holders and approved the agenda.

59.5.19 To consider and approve aligning the credit requirement of M.Sc (Biotechnology) programme as per NHEQF

The BoS of the MSc (Biotechnology) Programme, in view of the institutional mandate of adhering to the National Higher Education Qualification Framework (NHEQF) as a part of the National Education Policy 2020 approved aligning the courses as per its guideline as placed in **Enclosure 38.**

The Academic Council discussed, gave inputs and approved the agenda.

59.5.20 To consider and approve National Eligibility Test (NET) as an Entrance Test for Admission to Ph.D.

UGC vide their notification dated 28 March 2024, has informed that from the academic session 2024-25 onwards, the NET score may be used for admission to Ph.D. programmes in place of entrance tests conducted by the different universities / HEIs.

At present the Ph.D intake at TERI SAS is based on NET (JRF & LS) qualification as well as its own Ph.D entrance test followed by interview. This is keeping into consideration the uniqueness of programs being offered in the domain of sustainability.

In the light of recent UGC notification, TERI SAS proposes to use the National Eligibility Test (NET) scores/PhD entrance test for admission to Ph.D. Programs.

Guidelines for admissions to Ph.D. for academic session 2024-2025:

1. Based on the scores obtained in NET, the candidates will be eligible in three categories.

Qualified for	**Eligible for**		
	JRF	**Assistant Professor**	**Ph.D. Admission**
Category-1: Award of JRF and appointment as Assistant Professor	Yes	Yes	Yes
Category-2: Appointment as Assistant Professor and admission to Ph.D.	No	Yes	Yes
Category-3: Admission to Ph.D. only	No	No	Yes

2. Admission under JRF Category will be done as per UGC Notification dated 7. November, 2022 published in the Gazette of India: Extraordinary no. 544.
3. As per UGC Notification dated 27.03.2024, for students who qualify in Categories 2 and 3, 70% weightage will be given for test scores 30% weightage for the interview for admission to Ph.D. program. The Ph.D. admission will be based on the combined merit of NET marks and the marks obtained in the Interview.
4. The marks obtained in the NET by the candidates in Category 2 and 3 will be valid for a period of one year for admission to Ph.D. Programs.
5. The University may hold entrance examination for those Ph.D. programs where NET examination in the concerned subjects/disciplines are not conducted by UGC.
6. Entrance examination for applicants who have not cleared NET cat 1,2 and 3 but still would like to pursue the PhD program in any of the discipline (including disciplines covered under NET) that our Institute hosts. This will be followed by regular interview.
7. For Category 2 & 3, a minimum cut off to be set in the NET score for interview at department level.
8. Number of seats be defined for admission in Ph.D. programmes for NET qualified candidates and non-NET qualified candidates at department level.

Prof. Dhar provided a comprehensive overview of the recent UGC regulations concerning the National Eligibility Test (NET) as an entrance examination for Ph.D. admissions.

The guidelines for admission to Ph.D. programs for the academic session 2024-2025, were discussed and approved by the Academic Council.

59.5.21 To consider and approve preparedness for NEP 2020 in respect of UG / Integrated programmes.

Keeping into consideration of various guidelines and directives issued from UGC on preparedness and implementation of NEP 2020 (focussed on UG / Integrated), it is proposed that irrespective of the current status, each department shall plan to offer UG / Integrated programme(s) from the academic year 25 - 26.

This further should be broadly aligned to the thematic areas of the respective departments so as to enable a smooth transition from more Masters oriented programmes to the UG / Integrated programmes.

Prof. Dhar informed that under the National Education Policy (NEP) framework, major emphasis has been given to undergraduate programme and there will be a requirement to offer one-year Masters programs.

He further informed that Department of Biotechnology and Legal Studies are planning to launch UG level programmes from Academic Session 2025. The Academic Council approved the agenda.

59.5.22 To consider and approve guidelines for nominating Honorary Distinguished Professor at TERI SAS.

TERI SAS offers academic programmes at UG and PG level both in the domain of sustainability. All the programmes offered have a unique blend infused as aligned to UN SDGs.

To enable a greater exposure to faculty members and students alike, it is proposed that a retired Professor or Eminent Academic of repute of any University/Research/Academic Organization having an authoritative standing in a field of interest to a Department of TERI SAS may, on the recommendation of a duly constituted committee, be selected for appointment as Honorary Distinguished Professor. Proposed scheme for appointment of Honorary Distinguished Professor at the TERI SAS is as **Enclosure 39**.

Academic Council members discussed the need, detailed guidelines of proposed scheme for appointment of Honorary Distinguished Professor at the TERI SAS. Professor Dhar further highlighted that in addition to application-based selection, nominations of esteemed academicians and individuals of eminence by former/present Vice Chancellors, former/present Directors of National Institutes, Fellows of the National Academies shall be considered as Honorary Distinguished Professors at TERI SAS.

Further, the scheme shall be notified as per the requirement.

The Academic Council approved the agenda.

59.5.22 To consider and approve recruitment of faculty members.

Recruitment of regular faculty members as proposed by various departments have been considered and the same shall be routed through a rationalisation

committee (constituted at university level). The recommendations of the same with concurrence of Finance Committee shall be put up for consideration and approval in the Executive Council.

Considering the shortage of faculty members alongside a surge in admissions and the introduction of new courses for the upcoming academic session, the Academic Council discussed, gave inputs and approved the agenda regarding regular faculty recruitment across various departments as proposed.

Item No.59.6 Any other item with the permission of the Chair.

59.6.1 To consider and approve 12 credits in the 3rd semester to fulfil a minimum of 20 credits norms per semester including a 8-credit minor project in alignment.

Dr. Chander Kumar Singh informed the members that an 8-credit minor project in alignment with the NHEQF guidelines is being proposed during the semester break between 2nd and 3rd semesters. Consequently, the students shall be undergoing only 12 credits in the 3rd semester to fulfil a minimum of 20 credits norms per semester.

The Academic Council members recommended that students be encouraged to take elective courses as per their schedule, beyond the 12-credit requirement during the 3rd semester. The programs should allow flexibility for students to manage their time according to their preferences, without imposing additional credit burdens.

With no other agenda under discussion, the meeting came to an end with vote of thanks.

MSc Geoinformatics Programme Outline **Enclosure 1**

Year	Courses	Credits	Duration*		Remarks
First Year					
1st Semester	8 core courses of 2 - 4 credits each	21	15 weeks		1st semester total credits to be changed; Some courses to be approved as Core; Course to be shifted from semester 3 of ESRM to semester 1 GEO; Course code to be changed
2nd Semester	6 core courses of 2 - 4 credits each	20	15 weeks		Electives have been added to Sem 2 from ESRM to provide increased credit Options

Second Year					
3rd Semester	2 core courses of 4 credits each and 2 elective courses of 3 credit each	14	15 weeks		3rd semester total credits to be changed; credits of minor project proposed as 8
	Minor project	8	8 weeks		
	Total	22			
4th Semester	Major project	20			4th semester total credits of major project proposed as 20

Semester 1					
Course Code	**Course Title**	**Type**	**Old Number of Credits**	**New Number of Credits**	**Remarks**
NRE 106	Communication skills and	**Core**	2		Course to be approved as Core as it is already offered

	technical writing				as Core for ESRM and CSP
NRE 113	Applied mathematics	Core	0	No change	
NRG 106	Fundamentals of computers and programming	Core	2		
NRG 171	Principles of Cartography	Core	3		
NRG 176	Principles of GIS & GNSS	Core	4		
NRG 178	Principles of remote sensing	Core	**3**	**4**	Course to be approved for 4 credits
NRG 103	Project management	**Core**	3	No change	Course to be shifted from semester 2 to semester 1and approved as Core
NRG XXX	Satellite Meteorology	**Core**	3		Course shifted from ESRM to sem1 GEO; and approved as Core. The course code to be changed to NRG
		Total	**20**	**21**	

Semester 2					
Course Code	**Course Title**	**Type**	**Old Number of Credits**	**New Number of Credits**	**Remarks**
NRE 115	Environmental statistics	Core	4	No change	

NRG 108	Programming in geoinformatics	Core	3		No change
NRG 162	Law and policy for maps and remote sensing	Core	2		
NRG 163	Spatial data modelling and its applications	Core	4		
NRG 172	Digital image processing and information extraction	Core	4		
NRG 170	Photogrammetry	Core	3		
NRE 123	Biodiversity Assessment and Conservation	Elective	3		Electives have been added, for more options
NRE 162	Hydrology	Elective	3		
NRE 173	Research methodology and thesis writing	Elective	2		
		Total	**20**		

Semester 3					
Course Code	**Course Title**	**Type**	**Old Number of Credits**	**New Number of Credits**	**Remarks**
NRG 110	Minor Project	Core	**6**	**8**	To be approved
NRG 179	Advances in GIS and current trends	Core	4	No change	
NRG 181	Advances in remote sensing: Thermal, Hyperspectral, Microwave, LIDAR and UAV	Core	4		

NRG 167	Geocomputation	Elective	3		
NRG 183	Geoinformatics for water resources	Elective	3		
NRG 182	Geoinformatics for land resources	Elective	3		
NRG 184	Geoinformatics for atmosphere	Elective	3		
NRC 142	Spatio temporal data analysis	Elective	3		
NRC 162	Climate change and disaster risk reduction	Elective	3		
NRE 112	Multivariate data analysis	Elective	3		
NRE 145	Integrated impact assessment	Elective	4		
NRE 167	Integrated watershed management	Elective	3		
NRE 171	Environmental modelling	Elective	4		
		Total	**20**		

Semester 4					
Course Code	**Course Title**	**Type**	**Old Number of Credits**	**New Number of Credits**	**Remarks**
NRG 112	Major Project	Core	**16**	**20**	To be Approved

MSc Climate Science and Policy Programme Outline **Enclosure 2**

Semester	**Courses**	**Credits**	**Duration***
First Year			
Semester 1	Eight core courses of 19 credits, one elective of 3 credits, and bridge courses	22	15 weeks
Semester 2	Six core courses of 17 credits and elective courses of minimum 3 credits	20	15 weeks
Second Year			
Semester 3	One core course of 3 credits and elective courses of minimum 9 credits	12	15 weeks
	Minor project	8	8 weeks
Semester 4	Major project	20	
Semester 1			
Course No.	**Course Title**	**Type**	**Credits**
NRC 103	Basic computer programming	Core	**1**
NRC 105	Concepts and theories of development	Core	3
NRC 107	Climate lab	Core	2
NRC 131	Basics of climate science	Core	3
NRC 136	Earth system sciences	Core	3
NRC 183	Energy: Science, technology and policy	Core	2
NRE 106	Communication skills and technical writing	Core	2
NRE 155	Environmental law and policy	Core	3
NRC 143	Basic course in economics	Bridge	1 (Audit)
NRE 113	Applied mathematics	Bridge	3 (Audit)
NRE 189	Solid and hazardous waste management	Elective	3
NRG 103	Project management	Elective	3
NRGXXX	Satellite meteorology	Elective	3
	Total Credits		**22**
Semester 2			
Course No.	**Course Title**	**Type**	**Credits**
NRC 122	Introduction to climate modelling	Elective	3
NRC 132	Mitigation of climate change	Core	3
NRC 133	Aerosol science	Elective	3
NRC 135	Climate change vulnerability and adaptation	Core	3
NRC 138	Climate change and water	Elective	3
NRC 139	Climate change and public health	Elective	3
NRC 185	Impacts of climate change	Core	2
NRE 115	Environmental statistics	Core	4
NRE 123	Biodiversity assessment and conservation	Elective	3

NRE 134	Air quality management	Elective	3
NRE 142	Water quality management	Elective	4
NRE 144	Environment health and risk assessment	Elective	3
NRE 162	Hydrology	Elective	3
NRE 172	Principles of geoinformatics	Core	3
NRE 173	Research methodology and thesis writing	Core	2
NRG 162	Law and policy for maps and remote sensing	Elective	2
MPL 134	Climate change and law	Elective	2
ENR 167	Energy and carbon markets	Elective	**1**
	Total Credits		**20**
Semester 3			
Course No.	**Course Title**	**Type**	**Credits**
NRC 141	Governance of climate change	Elective	3
NRC 142	Spatio temporal data analysis	Elective	3
NRC 162	Climate change and disaster risk reduction	Elective	3
NRC 172	Advance climate modelling	Elective	3
NRC 184	Renewable energy technologies	Elective	3
NRC 186	Energy system modelling	Elective	3
NRE 102	Seminar course in global change	Core	3 dropped from Outline
NRC 151	Eco-system and climate change	Elective	3
NRC 145	Economics of climate change	Core	3
NRE 103	**Minor project**	**Core**	**8** (to be approved for all programmes)
NRE 105	Independent study	Elective	3 dropped from Outline
NRE 112	Multivariate data analysis	Elective	3
NRE 129	Industrial ecology	Elective	3
NRE 136	Glacier hydrology	Elective	3
NRE 145	Integrated impact assessment	Elective	4
NRE 151	Wildlife conservation and management	Elective	3
NRE 167	Integrated watershed management	Elective	3
NRE 168	Food security and agriculture	Elective	3
NRE 175	Geoinformatics for resource management	Elective	4
BSI 125	Accounting and finance for sustainability	Elective	3
MPD 122	Public health and development: Issues and methods	Elective	3
	Total Credits		**20**
Semester 4			
Course No.	**Course Title**	**Type**	**Credits**
NRE 104	Major Project	Core	20 (to be approved for all programmes)

MSc ESRM Programme Outline **Enclosure 3**

Year	Courses	Credits	Duration	Remarks
First Year				
1st Semester	Seven core courses of 20 credits, one compulsory audit course	20	15 weeks	**1st semester total credits to be changed; one course to be shifted from Sem 2 to 1 and its type to be changed from elective to core; one core audit course to be removed**
2nd Semester	Two core courses of 6 credits and five elective courses of minimum 15 credits	21	15 weeks	**2nd semester total credits to be changed; one course to be shifted from Sem 1 to 2**
Second Year				
3rd Semester	One core course of 4 credits and three elective courses of minimum 9 credits	13	15 weeks	**3rd semester total credits to be changed; three courses to be removed; minor project credits to be changed and to be added to Sem 3 credits**
	Minor Project	8	8 weeks	
4th Semester	Major project	20		**4th semester total credits to be changed; major project credits to be changed**

Semester 1

Course Code	Course Title	Type	Credits	Remarks
NRE 106	Communication skills and technical writing	Core	2	No change
NRE 113	Applied mathematics	Core	0	No change
NRE 121	Ecology	Core	3	No change
NRE 131	Environmental chemistry and microbiology	Core	3	No change
NRE 138	Environmental monitoring laboratory	Core	3	No change

NRE 139	Environmental geosciences	Core	3	No change
NRE 155	Environmental law and policy	Core	3	No change
NRE 165	Introduction to sustainable development	Core	0	**Course to be removed from outline**
NRE 189	Solid and hazardous waste management	Core	3	**Course to be shifted from Sem 2 to Sem1, type to be changed to Core**
Semester 2				
Course Code	**Course Title**	**Type**	**Credits**	**Remarks**
NRE 114	Advanced analytical techniques for environmental application	Elective	3	No change
NRE 115	Environmental statistics	Core	4	**Course to be shifted from Sem 1 to Sem 2**
NRE 123	Biodiversity assessment and conservation	Elective	3	No change
NRE 130	Soil science	Elective	3	No change
NRE 134	Air quality management	Elective	3	No change
NRE 141	Basic course in environmental and resource economics	Elective	3	No change
NRE 142	Water quality management	Elective	3	No change
NRE 144	Environment health and risk assessment	Elective	3	No change
NRE 162	Hydrology	Elective	3	No change
NRE 170	Advanced geosciences	Elective	3	No change
NRE 172	Principles of geoinformatics	Elective	3	No change
NRE 173	Research methodology and thesis writing	Core	2	No change
Semester 3				
Course Code	**Course Title**	**Type**	**Credits**	**Remarks**
PPM 179	Design thinking	Core	0	**Course to be removed from outline**
NRE 105	Independent study	Elective	3	**Course to be removed from outline**
NRE 102	Seminar course in global change	Elective	3	**Course to be removed from outline**
NRE 103	Minor project	Core	8	**Minor project credits to be changed from 2 to 8 and to be added to Sem 3 credits**

NRC 162	Climate change and disaster risk reduction	Elective	2	
NRE 112	Multivariate data analysis	Elective	3	
NRE 133	Environmental management system	Elective	4	
NRE 136	Glacier hydrology	Elective	3	
NRE 145	Integrated impact assessment	Core	4	
NRE 147	Environmental economics	Elective	3	
NRE 149	Governance and management of natural resources	Elective	3	
NRE 151	Wildlife conservation and management	Elective	3	
NRE 163	Groundwater hydrology and management	Elective	3	
NRE 167	Integrated watershed management	Elective	3	
NRE 168	Food security and agriculture	Elective	3	
NRE 171	Environmental modelling	Elective	4	
NRE 174	Water and wastewater treatment processes and design	Elective	4	
NRE 175	Geoinformatics for resource management	Elective	4	
NRE 178	Satellite meteorology	Elective	3	
Semester 4				
Course Code	**Course Title**	**Type**	**Credits**	**Remarks**
NRE 104	Major project	Core	20	**To be approved across programmes**

Enclosure 4

Course Title: Principles of Remote Sensing			
Course code:	**No. of credits: 4**	**L-T-P: 36-08-32**	**Learning hours: 60**
			L: Lectures**; T:** Tutorials**; P:** Practicals
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description

It introduces the participants to the basic concepts and the operational skills necessary to acquire remote sensing data and extract geo-information from them. The course links the theoretical physical principles and interpretation in form of remotely sensed images, and thereafter develops understanding of different applications in resource management. The course will provide the insights in wider domain of monitoring and applications in environmental sciences and studies.

Course objectives

- To congregate the basic concepts and fundamentals of physical principles of remote sensing and EM radiations
- To develop technological understanding of different remote sensing platforms- ground, air-borne and satellite
- Processing of Remote sensing data and some studies in various domains of remote sensing applications

Course content

Module	Topic	L	T	P
1				
	The objective of this module is to gain familiarity with remote sensing. The module introduces evolution of the discipline as science. The students are made aware of space programs around the globe. How development of various scientific inventions led to the discipline of remote sensing. The topics in this module are: 1. Introduction to Remote Sensing, 2. History of Remote Sensing. 3. History of Space programs of India and World	4		
2	**Physical Basis of Remote Sensing: Concepts and Principles of Electromagnetic Radiation**			
	This module introduces the concepts of electromagnetic radiation, its interaction with atmospheric components. Laws associated with matter and energy are detailed and discussed. The students are made to understand use of EM radiation in remote sensing. They are introduced to concepts of various kinds of resolutions and image interpretation. This module addresses the concepts of: 1. EMR wavelength regions and their applications, 2. Atmospheric windows, 3. Interaction of EMR with matter 4. Fundamentals of Radiometry: Concept & Laws, radiance, reflectance, emittance 5. Resolutions–spatial, spectral, radiometric, temporal 6. Elements of image interpretation	10		
3	**Remote Sensing Platforms and Sensors**			
	The details of different remote sensing platforms are discussed along with different types of remote sensing data acquisition sensors. The operation of sensors and technology used in data capture are introduced. Different satellite	6	4	

	data products and sensors are discussed. The following topics are introduced in this module: 1. Remote Sensing Systems (Active & Passive; Imagining & Non-imaging), Orbit and Platforms of earth Observation, sensors, and scanners; Cameras and Sensor classification: Opto-Mechanical & Push-broom. 2. Introduction to commonly used multi-spectral remote sensing satellite systems (IRS Series of satellites, Landsat, Spot, Ikonos, Quickbird, MODIS, Radarsat, NOAA, TERRA, Sentinel Family, RISAT, Resourcesat etc)			
4	**Remote Sensing of Vegetation, Soils, Minerals and Geomorphology**			
	The module creates a discussion around application of remote sensing in the domains of forestry, vegetation, agriculture, soil, and geological and geomorphological landscapes. The students will be exposed to reflectance characteristics of various components of earth surface. 1. Understanding vegetation spectra and factors affecting it, temporal characteristics of vegetation, vegetation indices 2. Soil spectral characteristics, remote sensing of soil properties, rocks, and minerals. 3. Landforms-fluvial, karst, glacial, igneous, horizontal, and folded strata, fault-controlled landform	10	4	
5	**Advanced Technologies in Remote Sensing: LiDAR, Hyperspectral and Microwave and UAV**			
	Some advanced technologies would be discussed in the module and the students would be exposed to basic understanding of LIDAR and Drone and UAV (UAS, RPA, RPAS, and Drone) techniques is remote sensing. 1. LiDAR principles, Laser and scanning system, Laser location, Orientation, first, intermediate, and last return. Applications for DSM and DEM. 2. Principles of Hyperspectral and Microwave remote sensing 3. Imaging History of manned and unmanned aircraft, platforms, sensors aerial mapping- manned and unmanned aircraft systems (UAV, UAS and others)	6		
	Total	36	8	32
Practical Modules				
Lab 1. Introduction to ERDAS IMAGINE 2011				4
Lab 2. Plotting Spectral Signature using spectroradiometer data				2
Lab 3. Exploring earth explorer and Copernicus for various data sources				2
Lab 4. Satellite image; season, location, sensor, download				4
Lab 5. Display, analysis and interpretation of black & white images, grey image, pseudo image and FCC				2
Lab 6. File formats. Import / Export of files using ERDAS IMAGINE				2
Lab 7. Pre-processing satellite data (stacking, subsetting, mosaicking)				4
Lab 8. Map rectification of Toposheet using Keyboard or GPS data and Geo-referencing of the toposheet and imageries				4
Lab 9. Collection of GPS points. Ground data collection.				2
Lab 10. Image analysis for urban pattern, vegetation, geomorphology.				6
		36	**8**	**32**
Evaluation criteria • Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 15% • Minor Test 2: Written test [at the end of teaching of module 3 and 4] -- 15%				

- Major Test: Written test [at the end of the semester, full syllabus] -- 50%
- Practical: Lab Exercise +Viva 20%

The major exam will be covering the entire syllabus of the course.

Learning outcomes

By the end of the course, students will:

- The student would command understating in technological development in various components of remote sensing and would also acquire skills to understand the satellite data and its parameters through the lens of electromagnetic radiation principles. [Module 1 and 2; Minor Test 1]
- Imparts the skill to understand the remote sensing technology and satellite data. The technical details of the sensors and various technological dimensions of sensors will be understood. Use of satellite datasets in various environmental applications domain will be detailed [Module 3 and 4; Minor Test 2]
- The student will appreciate cutting-edge development in the domain of remote sensing 1, 2 and 3. [All Modules; Major Test]
- Operational skills necessary to acquire remote sensing data and learn to extract information from them. [Practical]

Pedagogical approach

- The course critically evaluates the concepts of remote sensing and builds the discussion in classroom through lectures, case studies, tutorials, practical exercises.
- The course infuses the interest in remote sensing through hands-on on satellite data as well as through the tutorials

Reading Resources (* = compulsory readings)

- Campbell J.B. (2002) Introduction to Remote Sensing, 3rd ed., The Guilford Press.
- Jensen J.R. (2007) Remote Sensing of the Environment: An Earth Resource Perspective, 2nd ed., Pearson
- Lillesand T., Kiefer R.W., Chipman J. (2015) Remote sensing and image interpretation. John Wiley & Sons
- Richards J.A., Richards J.A. (2022) Remote sensing digital image analysis. Berlin/Heidelberg, Germany, Springer
- Sabins F.F., Ellis J.M. (2020) Remote Sensing Principles, Interpretation, and Applications, 4th Edition

Suggested readings

- Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.
- Joseph G., Jeganathan C. (2018) Fundamentals of Remote Sensing, Universities Press India.
- Kondratyev K.Y., Buznitov A.A. and Pokrovoky O.M. (1996) Global Change and Remote Sensing, John Wiley and Sons.
- Lillesand T., Kiefer R.W., Chipman J. (2015) Remote sensing and image interpretation. John Wiley & Sons

Journals

- 1. Geocarto International
- 2. International Journal of Remote Sensing
- 3. ISPRS Journal of Photogrammetry and Remote Sensing
- 4. Journal of Indian Society of Remote Sensing
- 5. Remote Sensing of Environment
- Additional information (if any)
- Magazines
- 1. Coordinates
- 2. Geospatial today

Student Responsibilities

The students are required to come prepared with readings that would be given in the class. The students are required to participate in the discussion.

Course Designed by:

- Dr Chander Kumar Singh, Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr. Pawan Kr. Joshi, Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
- Dr. R.N Sahoo, Principal Scientist, Agriculture Physics Division, IARI, New Delhi

Enclosure 5

BSc in Environmental Studies (Hons./Hons. with Research)

Semester 1		**Total credits = 20**	
Code	**Course Title**	**Type**	**Credits**
UES 102	Introduction to Environmental Physics	Major	3
UES 104	Introduction to Environmental Biology	Major	3
UES 106	Introduction to Environmental Chemistry	Major	3
AEC 101	Communication Skills and Technical Writing	AEC	2
MDC 103	Data Science Fundamentals	MDC	2
SEC 101	Fundamentals of Computers and Programming	SEC	2
VAC 101	Basic Concepts of Sustainable Development	VAC	2
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	3
Semester 2		**Total credits = 26**	
MDC 101	Environment and Society	Major	2
UES 101	Ecology and Ecosystems	Major	4
UES 103	Earth and Earth Surface Processes	Major	4
UDS 102	Problem-Solving and Python Programming	MDC	3
SEC 102	Introduction to Remote Sensing	SEC	3
AEC 102	Modern Indian Language 1	AEC	3
VAC 102	Ancient Indian Sustainable Practices	VAC	2
VAC 104	Personality Development for Success	VAC	2
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	3
UES XXX	Sustainability Communication	Minor	3
	Vocational course/ Summer internship (8-weeks) to Exit with UG-Certificate	Vocational/ Internship	4
Semester 3		**Total credits = 22**	
	Sustainable Built Environment	Major	3
	Biodiversity Conservation	Major	3
	Soil Conservation and Management	Major	3
	Conventional and Renewable Energy	Minor	3
	Environmental Statistics	MDC	4
	Modern Indian Language 2	AEC	3
	Introduction to Geographic Information System	SEC	3
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	3
Semester 4		**Total credits = 21**	
	Natural Resource Management and Sustainability	Major	4
	Environmental Policy, Law and Governance	Major	4
	Water and Soil Pollution	Major	4
	Environmental Laboratory-I	Major	3

	Introduction to Cartography	Minor	3
	Global Climate Change	Minor	4
	Vocational course/ Summer internship project (8-weeks) to Exit with UG-Diploma	Vocational/ Internship	4
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
Semester 5		**Total credits = 20**	
	Solid and Hazardous Waste Management	Major	4
	Contemporary Environmental Issues	Major	4
	Environmental Economics	Major	4
	Environmental Justice and Ethics	Minor	4
	Geospatial applications for Resource Management	Minor	4
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
Semester 6		**Total credits = 21**	
	Research Methodology	Major	2
	Natural Hazards and Disaster Risk Reduction	Major	4
	Environmental Convention and Treaties	Major	3
	Air and Noise Pollution	Major	4
	Environmental Lab II	Major	2
	Development and Resource Economics	Minor	3
	Global Positioning and Navigation Systems	Minor	3
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
Semester 7		**Total credits = 20**	
	Climate Science and Policy	Major	4
	Integrated Watershed Management	Major	4
	Environmental Health and Risk Assessment	Major	4
	Spatial Data Modelling	Minor	4
	Agriculture and Forest Management	Minor	4
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
Semester 8		**Total credits = 24**	
	Geo-environment	Major	4
	Environmental Management	Major	4
	Climate Change Impacts, Adaptation and Mitigation	Major	4
	Environmental modeling	Major	4
	Digital Image Processing	Minor	4
	Geopolitcs of Energy and Environment	Minor	4
	Research Project/Dissertation	Major	12
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
	Vocational course/ Summer internship project (8-weeks) to Exit 4-Years B.Sc. (Hons./Hons. with Research) in Environmental	Vocational/ Internship	4*

	Studies		

BSc in Data Science (Hons./Hons. with Research)

Semester 1		**Total credits = 23**	
Code	**Course Title**	**Type**	**Credits**
MDC 103	Data Science Fundamentals	Major	2
UDS 101	Statistics for Data Science	Major	4
UDS 103	Mathematics for Data Science	Major	4
UES 102	Introduction to Environmental Physics	MDC	3
AEC 101	Communication Skills and Technical Writing	AEC	2
SEC 101	Fundamentals of Computers and Programming	SEC	2
VAC 101	Basic Concepts of Sustainable Development	VAC	2
NDSXXX	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 2		**Total credits = 25**	
UDS 102	Problem-Solving and Python Programming	Major	3
UDS 104	Fundamentals of Information Technology	Major	3
UDS 106	Database Management System	Major	3
UES 102	Introduction to Environmental Physics	MDC	3
SEC 102	Introduction to Remote Sensing	SEC	3
AEC 102	Modern Indian Language 1	AEC	3
VAC 102	Ancient Indian Sustainable Practices	VAC	2
VAC 104	Personality Development for Success	VAC	2
	Vocational course/ Summer internship (8-weeks) to Exit with UG-Certificate	Vocational/ Internship	4
	Any Major Course from Economics/Management/ Environmental Studies can also be taken as Minor	Minor	3
Semester 3		**Total credits = 22**	
	Data wrangling and Visualization	Major	3
	Cybersecurity for Data Science	Major	3
	Data Mining and Analysis	Major	3
	Environmental Statistics	MDC	4
	Modern Indian Language 2	AEC	3
	Introduction to Geographic Information System	SEC	3
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	3
Semester 4		**Total credits = 20**	
	Time Series Analysis	Major	4
	Open source programming	Major	4
	Network science	Major	4
	Global Climate Change	Minor	4

	Vocational course/ Summer internship project (8-weeks) to Exit with UG-Diploma	Vocational/ Internship	4
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 5		**Total credits = 20**	
	Predictive Modelling and Analytics	Major	4
	Cloud Computing and Big Data	Major	4
	Blockchain security	Major	4
	Geospatial applications for Resource Management	Minor	4
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 6		**Total credits = 22**	
	Machine Learning & NLP	Major	4
	Performance Evaluation of Computing Systems	Major	4
	Digital Marketing Analytics	Major	4
	Research Methodology	Major	2
	Global Positioning and Navigation Systems	Minor	4
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 7		**Total credits = 20**	
	Soft – Computing	Major	4
	Software Engineering and Project Management	Major	4
	Information Retrieval & Semantic Web	Major	4
	Strategic management	Minor	4
	Spatial Data Modelling	Minor	4
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 8		**Total credits = 24**	
	Deep Learning	Major	4
	Intellectual Property rights	Major	4
	Generative AI	Major	4
	Computer Vision	Major	4
	Digital Image Processing	Minor	4
	Research Project/Dissertation	Major	12
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
	Vocational course/ Summer internship project (8-weeks) to Exit 4-Years B.Sc. (Hons./Hons. with Research) in Environmental Studies	Vocational/ Internship	4*

* In case student not credited 4-credit summer internship during 1st / 2nd year / 3rd year has to earn 4-credit summer internship in 8th semester.

BSc (Hons with Research): 12 credits Research Project/Dissertation, 4 credits Major course, 4 credits Minor course, 4 credits vocational course

BSc (Hons.): 16 credits Major course, 4 credits Minor course, 4 credits vocational course

AEC-Ability Enhancement Course, SEC-Skill Enhancement Course, VAC-Value Added Course, MDC-Multidisciplinary

Enclosure 6

Course Title: Data Wrangling and Visualization			
Course Code:	**No. of credits:** 3	**L-T-P:** 20-16-18	**Learning hours:** 45
			L: Lectures**; T:** Tutorials**; P:** Practical
Pre-requisite Course Code and Title (if any): None			
Department: Natural and Applied Sciences			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Major		**Course Offered in:** Semester 3	

Course Description

Data Wrangling is a crucial part of data science, encompassing methods like data pre-processing, exploratory analysis, and feature engineering. This course will provide a comprehensive understanding of cleaning raw data, handling missing values, removing data ambiguities, and transforming data into a usable format. The course aims to demonstrate the different exploratory techniques to help in understanding the underlying patterns and relationships within the data. The learners will explore various data preparation techniques such as data imputation, outlier detection, and normalization, that are employed to prepare data for further analysis. The students will gain insights on exploring the data with different types of visualizations. Finally, the students will perform feature engineering which includes feature extraction, selection, and ranking.

Course Objectives

- Understand the need for data wrangling in data science.
- Perform data pre-processing with exploratory analysis.
- Apply data wrangling techniques and perform data visualization.
- Study impact of feature engineering on data science applications.

Course Content

Module	Topic	L	T	P
1	**Significance of Data Wrangling in Data Science**			
	This module highlights the significance of data wrangling that includes stages like data collection, sufficiency and authentication, and extraction, employing methods such as web crawling and text analysis techniques. The students will learn to ensure credibility of collected data, and ways of enhancing its usability for further analysis and decision-making processes. The following topics will be addressed in this module: Importance of data wrangling, stages of wrangling, data collection, data sufficiency and authentication, data acquisition methods, application programming interfaces, web crawling, web scrapping, query-based data extraction, machine generated logs, public repositories, text analysis.	5	4	3
2	**Data Pre-processing & Data Exploratory Analysis**			
	The focus of this module lays on different techniques for performing data pre-processing, followed by data imputation, and encoding techniques. The	5	4	5

	module will help the students to understand ways of ensuring data quality. Following topics will be covered in this context: Data cleaning process, duplicate data removal, finding structural errors, outlier detection, handling missing values, data imputation for numerical and categorical data, encoding techniques: one hot encoding, label encoding, ordinal and binary encoding, hashing.			
3	**Data Wrangling Techniques and Visualization**			
	The purpose of this module is to illustrate the importance of wrangling methods with the help of several methods of handling class imbalance problem. It will also include visualization techniques for better interpretability. The topics to be covered in this module include: Merging multiple data sources, scaling and normalization: min-max, z-score, unit-vector transformation, handling class imbalance, over sampling, under sampling, data augmentation techniques, cost-sensitive learning, data visualization techniques for data pre-processing: basic plots (scatter, line, boxplots, histograms, etc.), heatmaps, matrix plots, funnel plot, violin plots, word clouds, tree-map, cartograms for geographical data, spatial data analysis	5	4	5
4	**Feature Engineering and Visualization**			
	This module encompasses through feature-based analysis, especially the ranking and selection methods that are considered eminent for building machine learning models. It will also include feature engineering with visualization libraries. This module will include the following contents: Feature extraction, feature scaling and derived features, feature selection and ranking: filter methods (correlation coefficients, mutual information, chi-square test), wrapper methods (Forward Selection, Backward Elimination, Recursive Feature Elimination), embedded methods (lasso and ridge regularization, tree-based methods), principal component analysis, feature importance, Fisher score, variance threshold, dispersion ratio, information gain, visualization libraries for feature analysis: pandas visualization, seaborn, plotly, altair, yellowbrick.	5	4	5
	Total	**20**	**16**	**18**
Practical Sessions	Explore data acquisition techniques using Repositories, GitHub, Kaggle, etc.	-	-	2
	Perform data pre-processing, cleaning, outliers handling			4
	Learn data wrangling techniques with Python programming	-	-	6
	Analysing data with several Python libraries for visualization	-	-	6
	Total Practical Sessions	**-**	**-**	**18**

Evaluation Criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3] -- 20%
- Practical Test: Practical test [including modules 1 and 2] -- 10%

- Project-based learning: Project presentation [at the end of teaching of module 4] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 30%

Learning Outcomes

By the end of the course, students will:

- develop critical understanding of data pre-processing and its significance
  [Module 1 and 2; Minor Test 1]
- acquire knowledge of data wrangling with visualization
  [Module 2 and 3; Minor Test 2; Practical Test]
- gain insights on feature engineering, extraction, selection, and ranking
  [Module 1, 2, 3, and 4; Minor Project; Major Test]

Pedagogical Approach

- The course will provide knowledge and awareness on concepts of data wrangling through classroom discussions, lectures, tutorials, assessments, practical, project-based learning.
- The course will allow learners to develop an understanding of the need for pre-processing and data visualization for data wrangling.
- The course will enable students to explore different techniques of feature engineering.

Reading Resources (* = compulsory readings)

- * Niranjanamurthy, M., Sheoran, K., Dhand, G., & Kaur, P. (2023). *Data Wrangling: Concepts, Applications and Tools*. Wiley.
- * Sarkar, T., & Roychowdhury, S. (2019). *Data Wrangling with Python: Creating actionable data from raw sources*. Packt Publishing.
- Visochek, A. (2017). *Practical Data Wrangling: Expert techniques for transforming your raw data into a valuable source for analytics*. Packt Publishing.
- McGregor, S. E. (2021). *Practical Python Data Wrangling and Data Quality*. O'Reilly Media.

Student Responsibilities

The students are required to come prepared with readings that would be given in the class. The students are required to participate in the discussion.

Course Designed by:

- Dr Adwitiya Sinha, Associate Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr Vir Bahadur Singh, Professor, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi.
- Dr Ela Kumar, Professor, Department of Computer Science and Engineering, Indira Gandhi Delhi Technical University for Women, New Delhi.

Course Title: Cybersecurity for Data Science			
Course Code:	**No. of credits:** 3	**L-T-P:** 24-13-16	**Learning hours:** 45
			L: Lectures**; T:** Tutorials**; P:** Practical
Pre-requisite Course Code and Title (if any): None			
Department: Natural and Applied Sciences			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Major		**Course Offered in:** Semester 3	

Course Description

This course encompasses a comprehensive introduction to the fundamental concepts of cybersecurity and data analytics with a focus on safeguarding digital assets, understanding cyber threats, and utilizing data science techniques for security purposes. Students will explore the basics of cybersecurity, various types of threats and attacks, network security principles, cryptographic techniques for secure communication, and the role of data analytics in ensuring internet security. Additionally, the course will delve into the identification of cybercrimes in mobile and wireless devices using data science approaches and exploring cybersecurity countermeasures for mitigating cyber threats and vulnerabilities.

Course Objectives

- To understand the basic concepts of cybersecurity, threats, and attacks
- To explore cryptographic approach to safeguard communication
- To illustrate significance of data analysis for ensuring security of wireless devices

Course Content

Module	Topic	L	T	P
1	**Introduction to Cybersecurity**			
	This module highlights the significance of cybersecurity and awareness against security breaches. The learners will be able to analyse the landscape of cybercrime and encompass through certain ethical aspects and compliances. The following topics will be addressed in this module: Significance of cybersecurity, data security breaches, cyber attackers, cyberwarfare, methods of infiltration, firewall, malwares, port scanning, behaviour-based security, risk management, legal and ethical issues, cyber laws - Information Technology Act of India, European Union GDPR, US COPPA and CCPA, introduction to CISCO packet tracer, configuration, network design, simulation, exploring files, data integrity checks, packet data analysis.	6	4	5
2	**Cyber Threats, Attacks & Countermeasures**			
	This module illustrates the effectiveness of data analysis to address cyber threats and attacks. The students will obtain insights on various forms cybercrimes and learn robust countermeasures. This module will include the following contents: Cyber threats, internal and external threats, threat complexity, cybersecurity cube, principles of security, CIA triad - confidentiality, integrity, availability, stages of data, data at-rest, in-transit, in-process, cybersecurity countermeasures, policies, standards, ISO cybersecurity model, malware, types, malicious code, deception methods, cyberattacks, denial of service attack, sniffing, spoofing, keyboard logging WEP/WPA attack, cross-site scripting, code injection attack, using packet	6	3	4

	tracer for data encryption, file integrity checks, detecting threats and vulnerabilities, configuring network privacy protocols.			
3	**Network Security and Cryptography**			
	The focus of this module lays on applying data science and analytics that enables proactive detection of anomalies and vulnerabilities over the networks. Through data-driven approaches, the students will be able to enhance their resilience against evolving cyber threats on the web. Following topics will be covered in this context: Cryptography, types, private-key encryption, public-key encryption, symmetric and asymmetric encryption, key management, access control strategies, authentication methods, types of security controls, data masking, steganography, using packet tracer for traffic analysis, mobile related crimes, digital forensic, tools - Autopsy, Network Miner, RAM Capturer	6	3	4
4	**Cybercrime Prevention Methods**			
	The purpose of this module is to illustrate the importance of cybersecurity towards protecting computer networks. It will include measures like intrusion detection/prevention systems, and virtual private networks for ensuring secure configurations and system hardening. The topics to be covered in this module include: Basics of network and security, Data integrity controls, hashing algorithms, salting, HMAC, digital signature, constructing digital certificate, database validation, database integrity, asset management, identification and classification, five nines concept, system resilience, disaster recovery, host hardening, hardening wireless and mobile devices, server hardening, cyber laws, vulnerability scanners, penetration testing, password cracking, exploring Wireshark to compare Telnet/SSH traffic, router/switch resilience using packet tracer, cyber hygiene, components and best practices	6	3	3
	Total	**24**	**13**	**16**
Practical Sessions	Hands-on with CISCO packet tracer, configuration, network design, simulation, exploring files, data integrity checks, packet data analysis	-	-	5
	Exploring packet tracer for data encryption, file integrity checks, detecting threats and vulnerabilities, configuring network privacy protocols.	-	-	4
	Using packet tracer for traffic analysis, Hands-on sessions with open-source forensic tools Autopsy, Network Miner, RAM Capturer	-	-	4
	Hands-on with usage of digital signature, password cracking, exploring Wireshark to compare telnet and SSH traffic, router, and switch resilience	-	-	3
	Total Practical Sessions	**-**	**-**	**16**

Evaluation Criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3] -- 20%
- Assignments [at the end of each module 4] -- 10%
- Practical Test: Lab Exam [at the end of teaching of module 4] -- 20%

- Major Test: Written test [at the end of the semester, full syllabus] -- 30%

Learning Outcomes

By the end of the course, students will:

- develop critical understanding of cybersecurity and network security concerns
  [Module 1 and 2; Minor Test 1]
- acquire knowledge of data analytics techniques for ensuring safety of wireless systems
  [Module 2 and 3; Minor Test 2]
- gain insights of cybercrimes associated with mobile devices and ways of preventing them using data science methods and models
  [Module 1, 2, 3, and 4; Practical Test, Major Test]

Pedagogical Approach

- The course will provide knowledge and awareness on concepts of cybersecurity through classroom discussions, lectures, tutorials, assessments.
- The course will allow learners to develop an understanding of data science approaches to address cyber threats and attacks in network communication.
- The course will enable students to explore different issues of wireless devices security

Reading Resources (* = compulsory readings)

- * Heard, N. A., Adams, N. M., Rubin-delanchy, P., & Turcotte, M. (2018). *Data Science for Cyber-security*. World Scientific Publishing Company.
- * Thuraisingham, B., Kantarcioglu, M., & Khan, L. (2022). *Secure Data Science: Integrating Cyber Security and Data Science*. CRC Press.
- Sikos, L. F., & Choo, K. K. R. (2020). *Data Science in Cybersecurity and Cyberthreat Intelligence*. Springer International Publishing.
- Carrascosa, I.
- P., Kalutarage, H. K., & Huang, Y. (2017). *Data Analytics and Decision Support for Cybersecurity: Trends, Methodologies and Applications*. Springer International Publishing.
- Mongeau, S., & Hajdasinski, A. (2021). *Cybersecurity Data Science: Best Practices in an Emerging Profession*. Springer International Publishing.
- Cisco Course on Introduction to Cybersecurity, 15 hours on-demand video lectures, available at: netacad.com/courses/cybersecurity/introduction-cybersecurity
- Cisco Course on Cybersecurity Essential, 30 hours on-demand video lectures, netacad.com/courses/cybersecurity/cybersecurity-essentials

Student Responsibilities

The students are required to come prepared with readings that would be given in the class. The students are required to participate in the discussion.

Course Designed by:

- Dr Adwitiya Sinha, Associate Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr. D. K. Lobiyal, Professor, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi
- Dr Ankit Chaudhary, Associate Professor, School of Engineering, Jawaharlal Nehru University, New Delhi

Course Title: Data Mining and Analysis			
Course Code:	**No. of credits: 3**	**L-T-P:** 20-10-30(15)	**Learning hours: 45**
			L: Lectures**; T:** Tutorials**; P:** Practicals
Pre-requisite Course Code and Title (if any): None			
Department: Natural and Applied Sciences			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Major		**Course Offered in:** Semester-3	

Course Description

Data Mining involves algorithms and computational approaches that allow computers to find patterns and trends in data, and perform prediction and forecasting. This course will help students to deal with useful knowledge extraction from raw data, which involves data selection, processing, and analysis. This course will delve into mathematical methods and principles that forms the foundation of data mining.

Course Objectives

- Understand the basic concepts and techniques of data mining
- Perform clustering, association, and predictive analysis
- Develop skills of applying data analysis for addressing practical problems

Course Content

Module	Topic	L	T	P
1	**Data Mining and Processing**			
	This module highlights the significance of the fundamentals of data mining and elaborates its associated challenges and applications. The following topics will be addressed in this module: Overview of data mining, issues, challenges, applications, data mining techniques, stages of data mining, data pre-processing, descriptive data, summarization, data integration, transformation, data reduction, types of data - numerical, categorical, ordinal, nominal, interval data, ratio data, text, spatial, time series data, data processing using Python	5	2	6
2	**Data Mining Knowledge Representation**			
	The focus of this module is on different knowledge representation techniques and attribute-oriented analysis. This module will help the students to apply representation techniques to data in a structured format. Following topics will be covered in this context: Knowledge representation methods, Rule-based representation, decision tree, matrices, graph-based representations, textual representations, attribute generalization and relevance, class comparison using descriptive statistics, hypothesis testing, confusion matrix, and cluster analysis, practical session association methods	5	2	8
3	**Association Rule Mining and Analysis**			
	The purpose of this module is to introduce common algorithms for association	5	3	8

	rule mining. It will help to reveal valuable insights from transactional data, for making better decisions. The topics to be covered in this module include: Methods of association rules, A-priori algorithm, partition algorithm, Pincer-Search algorithm, dynamic itemset counting, FP-tree growth, incremental and border algorithms, generalized association rule, association rules, market basket analysis, recommendation systems, hands-on for association methods with case studies			
4	**Clustering Techniques and Prediction Algorithms**			
	This module encompasses through different clustering, prediction, and their types. This module will also provide mathematical framework behind the clustering and prediction algorithms. This will include the following contents: Clustering paradigms, estimation of number of clusters, partitioning algorithms, CURE, k-medoid algorithms, CLARA, hierarchical clustering, BIRCH, density-based clustering, DBSCAN, grid-based clustering, decision tree, tree construction principles, best split, splitting indices and criteria, pruning techniques, nearest neighbour algorithm, significance of classification, types of classification - predictive classification, binary classification, multi-class classification, multi-label classification, imbalanced classification, hands-on for cluster formation and analysis with case studies	5	3	8
	Total	**20**	**10**	**30**
Practical Sessions	Explore analysis of types of data and pre-processing tasks using Python	-	-	6
	Hands-on session on knowledge representation using several algorithms			8
	Practicals on building association methods with case studies and analysis	-	-	8
	Hands-on for cluster formation and analysis with case studies using Python	-	-	8
	Total Practical Sessions	**-**	**-**	**30**

Evaluation Criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3] -- 20%
- Practical Test: Practical test [including modules 1 and 2] -- 10%
- Project-based learning: Project presentation [at end of teaching of module 4] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 30%

Learning Outcomes

By the end of the course, students will:

- develop in-depth understanding of data mining and its significance
  [Module 1 and 2; Minor Test 1]
- acquire knowledge of data analysis techniques
  [Module 2 and 3; Minor Test 2]
- gain insights on clustering, association, and prediction methods
  [Module 1, 2, 3, and 4; Major Test]

Pedagogical Approach

- The course will provide knowledge and awareness on concepts of data mining through classroom discussions, lectures, tutorials, and assessments.
- The course will enable students to explore different techniques of data analysis.

Reading Resources (* = compulsory readings)

- * Pujari, A. K. (2001). *Data Mining Techniques*. Universities Press.
- * Han, J., Kamber, M., & Pei, J. (2011). *Data Mining: Concepts and Techniques*. Elsevier Science.
- Witten, I. H., & Frank, E. (2005). *Data Mining: Practical Machine Learning Tools and Techniques, Second Edition*. Elsevier Science.
- Gorunescu, F. (2011). *Data Mining: Concepts, Models and Techniques*. Springer Berlin Heidelberg.
- Kantardzic, M. (2019). *Data Mining: Concepts, Models, Methods, and Algorithms*. Wiley.

Student Responsibilities

The students are required to come prepared with readings that would be given in the class. The students are required to participate in the discussion.

Course Designed by:

- Dr Adwitiya Sinha, Associate Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr Satish Chand, Professor, School of Computer and Systems Sciences, Jawaharlal Nehru University, New Delhi
- Dr Nanhay Singh, Professor, Department of Computer Science and Engineering, Netaji Subhas University of Technology, New Delhi

Course Title: Biodiversity Conservation			
Course code:	**No. of credits: 3**	**L-T-P: 30-10-10**	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Major		**Course offered in:** Semester 3	

Course Description

This course aims to impart a comprehensive understanding of biodiversity conservation, integrating theoretical knowledge with practical application. It explores the complexities of biodiversity at various levels and examines the multifaceted approaches required for conservation. Through a combination of lectures, hands-on fieldwork, and critical analysis, students will develop a holistic perspective on biodiversity's significance to ecosystem dynamics, and human well-being. Upon completion of the course, the students will acquire interdisciplinary approaches and develop critical thinking to address conservation challenges and provide innovative solutions.

Course objectives

The course aims to build the following basic understanding among students:

- Understanding of biodiversity's scientific principles within an ecological and socio-economic context.
- Practical skills for biodiversity monitoring and conservation, emphasizing innovative and technologies.
- Critical thinking and problem-solving skills through the design and implementation of field-based conservation projects.

Course content

Module	Topic	L	T	P
1	**Introduction to biodiversity**			
	Being an introductory module, this builds a general foundation by highlighting the following basic concepts relevant to biodiversity: Definition of biodiversity, background concepts (taxonomic, spatial levels, endemism), levels of biodiversity (microbial, genetic, species, ecosystem, landscape), drivers of biodiversity, ecosystem functions and biodiversity; indigenous knowledge, and cultural practices in biodiversity conservation	5	0	0
2	**Magnitude and distribution of biodiversity**			
	This module introduces global biodiversity distribution, hotspots, and variations over time, including Indian context. The contents of this module are as follows: Evolution of biodiversity, overview of ecological communities, number of species worldwide, change in global biodiversity over time; global distribution of biodiversity in the major kingdoms of life through different metrics (species, phylogeny, and biomass); biodiversity hotspots, biodiversity in India	4	2	0
3	**Assessment and monitoring of biodiversity**			
	This module introduces students to the methods used for assessing biodiversity and monitoring the changes over time. It also introduces students to some of the global biodiversity assessments. The contents of this module are as follows: Millenium ecosystem assessment, global assessment report on biodiversity and ecosystem services (IPBES), indicators for biodiversity assessment, species richness and evenness, alpha beta and gamma diversity, biodiversity	5	2	0

	indices (Shannon's index, Simpson's index), essential biodiversity variables (EBVs), methodologies for assessment and monitoring of different species groups; role of biodiversity informatics and GIS (Geographic Information System) in biodiversity research.			
4	**Biodiversity loss and its consequences**			
	This module introduces various concepts related to loss of biodiversity - its causes as well as consequences - as covered under following topics: Biodiversity loss: summarising causes and consequences (causes: vulnerability to extinction, habitat fragmentation and destruction, land-use change, climate change, overexploitation, biopiracy, human wildlife conflicts, invasive alien species; consequences: loss of gene pool, loss of ecosystem services, livelihood losses), role of pollution (plastic, chemical, noise, and light pollution) in biodiversity loss	5	0	0
5	**Biodiversity conservation strategies**			
	This module exposes students to the various concepts and strategies deployed to conserve biodiversity. It also enables them to develop an understanding of the advantages and disadvantages of these strategies as well as the problems currently being faced while implementing these. The contents of this module are as follows: Background: Convention on biological diversity (CBD) and Aichi biodiversity targets, population biology of endangered species, conservation genetics, community, and ecosystem-level interactions Ex-situ conservation: facilities, seed and field gene banks, establishment of new populations, captive breeding, reintroduction, discussion of advantages and disadvantages In-situ conservation: assessment of adequate areas, design, and management of protected areas and protected area network, protected areas in India (biosphere reserves, national parks, wildlife sanctuaries, marine protected areas, Ramsar sites) and their issues, protecting sacred groves, connectivity and corridors, sustainable use of biodiversity, citizen science and community-based conservation efforts	6	3	0
6	**Biodiversity and ecosystem restoration**			
	This module introduces principles associated with restoration and rejuvenation of biological diversity and practical applications of these principles in various environmental settings as covered under the following topics: Biodiversity and ecosystem restoration: definitions and principles, extent of degradation, tools and methods, restoration of ecological processes and ecosystem functioning, discussion of case studies	5	3	0
7	**Field Work**			
	Ethical considerations and best practices in field research, field work on different biological communities with simple sampling methods and data analysis; visit to biodiversity parks to better understand eco-restoration; presentation and discussion of results.	0	0	10
	Total	30	10	10

Evaluation criteria

- Minor Test: Written test [at the end of teaching of modules 1, 2 and 3] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment: 20%
- Field report and presentations: 20%

Learning outcomes

Upon completion of the course, the students will be able to:

- analyze and synthesize core concepts: demonstrate a comprehensive understanding of biodiversity conservation's fundamental principles, critically analyze, and synthesize information from diverse modules to learn about various conservation practices [Minor Test, Major Test]
- gain practical implementation skills: design and execute field-based research projects on biodiversity monitoring, employing contemporary methodologies and technologies [Assignment, Field work]
- develop critical thinking and problem-solving skills: develop skills to articulate their findings [Field report and presentations].

Pedagogical approach

- The course will be delivered through lectures, tutorials, and discussion of case studies.
- The course will also include guided assignments, field work and associated exercises.

Reading resources

- Bharucha, E. (2021). *Textbook of environmental studies for undergraduate courses*. Universities Press.
- Díaz, S., & Malhi, Y. (2022). Biodiversity: Concepts, patterns, trends, and perspectives. *Annual Review of Environment and Resources*, 47, 31-63.
- Gadelha, L. M. R., Jr, de Siracusa, P. C., Dalcin, E. C., da Silva, L. A. E., Augusto, D. A., Krempser, E., Affe, H. M., Costa, R. L., Mondelli, M. L., Meirelles, P. M., Thompson, F., Chame, M., Ziviani, A., & de Siqueira, M. F. (2021). A survey of biodiversity informatics: Concepts, practices, and challenges. *Wiley Interdisciplinary Reviews. Data Mining and Knowledge Discovery*, 11(1).
- Gaston, K. J., & Spicer, J. I. (2003). *Biodiversity: An Introduction (2nd ed.)*. Blackwell Science.
- Groom, M. J., Meffe, G. K., & Carroll, C. R. (2012). *Principles of Conservation Biology (3rd ed.)*. Oxford University Press.
- Krishnamurthy, K. V. (2018). *An advanced textbook on Biodiversity: Principles and practice*. Oxford and IBH Publishing.
- Madhusudan, M. D., & Vanak, A. T. (2023). Mapping the distribution and extent of India's semi-arid open natural ecosystems. *Journal of Biogeography*, 50(8), 1377-1387.
- Magurran, A. E. (1988). *Ecological diversity and its measurement.* Princeton University Press, New Jersey.
- Maiti, P. K., & Maiti, P. (2023). *Biodiversity: Perception, peril and preservation*. PHI Learning.
- Primack, R. B. (2014). *Essentials of conservation biology (6th ed.)*. Oxford University Press.
- Sodhi, N. S., & Ehrlich, P. R. (Eds.). (2009). *Conservation Biology for All*. Oxford University Press.
- Wilson, E. O. (1988). *Biodiversity*. National Academies Press.

Student Responsibilities

The students must prepare with readings suggested during the class and ensure timely assignment submission. They are also expected to participate and further strengthen their understanding of concepts through classroom discussions, field work and case studies.

Course Designed by:

- Dr. Amit Singh, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr. Vandana Mishra, Professor, Department of Environmental Studies, University of Delhi, New Delhi
- Dr. Shyam S. Phartyal, Associate Professor, School of Ecology and Environment Studies, Nalanda University, Rajgir
- Dr. Vinod Kumar Garg, Professor, Department of Environmental Science and Technology, Central University of Punjab, Bathinda

Course Title: Soil Conservation and Management			
Course code:	**No. of credits: 3**	**L-T-P: 35-10-0**	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator:	**Course instructor:**		
Contact details:			
Course type: Major	**Course offered in:** Semester 3		

Course Description

The purpose of this course is to provide students with a comprehensive understanding of soil properties and characteristics. By the end of the course, students will be able to identify different types of soil and understand the causes of erosion in various scenarios. They will learn about erosion control measures and gain an introductory understanding of soil pollution and management of degraded soil.

Course objectives

The course aims to build the following basic understanding among students:

- To understand the concept of soil formation, soil profile and its importance as a natural resource.
- To understand the factors responsible for soil erosion, degraded land systems and their impact on the environment.
- To understand the soil erosion models, application of erosion control measures and management

Course content

Module	Topic	L	T	P
1	**Soil Formation, Physical and Chemical Properties**			
	This module introduces concepts related to soil formation, profile, and distribution: Soil texture, structure, soil classifications, colloidal properties of soil, buffering capacity of soil, mobility of nutrient and trace elements during soil genesis; paedogenic evolution and soil nutrient cycle. Fundamental biogeochemical processes and role of soil as carbon source and sink.	6	2	
2	**Land use change and agroecology**			
	This module focuses on agro-ecological zones of India including crop planning and study of soil maps. It covers following topics: Role of land capability and suitability classification and factors affecting soil health. Impact of land use changes due to changing cropping patterns and on the onset of erosion in different topography.	6	2	
3	**Soil Erosion**			
	This module describes the mechanism and various factors that affect the erosion of soil. Following topics are covered under this module: Soil resistance and resilience properties; soil types, vegetation, water, wind, topography, soil moisture loss and nutrient depletion; significance of land degradation due to erosion and sediment losses; reflection on forest ecosystems. Assessment of soil erosion, modelling using Universal Soil Loss Equation (USLE) and its modifications, and discussion using case study approach	8	4	
4	**Soil Conservation Practices**			
	This module focuses on the control and management measures adopted for soil conservation. It covers the following topics: Soil conservation practices adopted for rill and gully erosion and wind erosion, including vegetative and mechanical measures, control of accelerated erosion, traditional and modern practices of soil conservation.	8	2	
5	**Land degradation management**			

	This module discusses causes of land degradation, management, and its remediation: Wasteland reclamation, application of decision support systems including simulation of physical processes using the soil and water assessment too (SWAT). Case study discussion	7		
		35	10	

Evaluation criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment/Field trip: 20%

Learning outcomes

Upon completion of the course, the students will be able to:

- understand different kinds of soil, impact of cropping pattern on land capability and types of erosion. [Modules 1, 2 and 3; Minor Tests 1 and 2]
- understand and assess potential solutions related to soil erosion and soil pollution. [Module 4 and 5; Major Test]

Pedagogical approach

- The course will be delivered through lectures and a case study approach shall be used for analyses of challenges for soil conservation and management.
- The course will focus on classroom discussions and assignments/field trip assessment which help them to make this course more robust and fruitful.

Reading resources

- Brady, N. C., Weil, R. R., & Weil, R. R. (2008). *The nature and properties of soils* (Vol. 13, pp. 662-710). Upper Saddle River, NJ: Prentice Hall.
- Singh, J. S., Singh, S. P., & Gupta, S. R. (2014). *Ecology, environmental science & conservation*. S. Chand Publishing.
- Foth, H. D. (1978). Fundamentals of soil science. *Soil Science*, *125*(4), 272.
- Fundamentals of Soil Science. (2012). *Indian Society of Soil Science.*
- Tan, K. H. (2009). *Environmental Soil Science*. United Kingdom: CRC Press.
- Blanco, H., & Lal, R. (2023). *Soil Conservation and Management*. Springer Nature Switzerland.

Student Responsibilities

The students are required to come prepared with readings that are suggested during the class and ensure timely submission of assignments. They are also expected to participate and further strengthen their understanding of concepts through classroom discussions field trip exposure.

Course Designed by:

- Dr Ranjana Ray Chaudhuri, Head and Associate Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi
- Dr Chandrashekhar Azad Vishwakarma, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr Anshumali, Professor, Indian Institute of Technology (ISM), Dhanbad
- Dr Sudip Mitra, Professor, School of Agro & Rural Technology, Indian Institute of Technology Guwahati (IITG), Guwahati

Course Title: Sustainable Built Environment			
Course code:	**No. of credits: 3**	**L-T-P: 30-15-0**	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Major		**Course offered in:** Semester 3	

Course Description: This course explores the principles and practices of creating sustainable urban environments, focusing on how to design and manage urban spaces. The students will delve into the key components of modern built environments, including urbanism principles, transportation systems, energy use, and the crucial role of blue green infrastructure. Additionally, the course explores nature-based solutions to address the challenges of climate change within urban contexts. Through this interdisciplinary approach, students gain the knowledge and skills needed to contribute to the creation of resilient and sustainable urban environment.

Course objectives

The course seeks to instil in students a fundamental grasp of:

- How buildings and built infrastructure impact associated ecological systems.
- Green building principles and sustainable design practices.
- Concept of urbanism and various components of urban systems.
- Sustainability principles and nature-based solutions (NBS) for solving problems in urban systems.

Course content

Module	Topic	L	T	P
1	**Introduction to Urbanism and Modern Built Environment**			
	This module provides a comprehensive overview of urban environments, focusing on key aspects. Students will explore the diverse characteristics of urban areas, ranging from megacities to small towns, and examine the components comprising the built environment, including infrastructure, architecture, and public spaces. Definition of sustainability, evolution of sustainable design, importance of sustainability in built environment, types of urban areas and their characteristics, components of urban built environment, fundamental principles of urban design, including scale, density, connectivity, and mixed land use, challenges associated with rapid urbanization.	6		
2	**Sustainable Transportation & Urban Mobility**			
	This module offers a holistic exploration of sustainable transportation and logistics. Students will delve into the diverse array of sustainable transportation modes including public transit, cycling, walking, and electric vehicles, analyzing their environmental and social benefits. The topics covered in this module will be: Introduction to sustainable transportation, sustainable transportation modes, smart transportation systems, pedestrian friendly urban design, policy framework for sustainable transportation, green transportation policies and regulation, sustainable freight and logistics, case studies	8	5	
3	**Energy**			
	This module offers a comprehensive exploration of sustainable energy solutions tailored to urban environments. Students will get acquainted to key topics including energy efficiency and sustainable urban energy systems. Energy efficiency in buildings, renewable energy integration, smart grids and energy management, sustainable urban energy systems, case studies involving successful projects showcasing energy-efficient buildings,	6	5	

	renewable energy integration strategies, and sustainable communities			
4	**Green Spaces**			
	This module provides an in-depth exploration of the concept of urban green spaces. Students will explore the importance of green spaces in urban environments for enhancing quality of life, promoting biodiversity, and mitigating environmental impacts. Introduction & typologies of green spaces, concept of urban green spaces, garden city model and principle of intelligent urbanism, indicators for measuring green growth, policy issues for green growth and green spaces, field visits and case studies.	4		
5	**Nature Based Solutions**			
	This module presents a detailed perspective on nature-based solutions (NBS) and their role in addressing challenges of urban development. Students will examine the effectiveness of these NBS in enhancing environmental quality, mitigating climate impacts, and promoting sustainable urban living. Blue green spaces, shade trees, green roofs and vertical greening systems, indicators for assessing the effectiveness of nature-based solutions and related knowledge gaps, green infrastructure for disaster risk reduction, case studies based on advance mainstreaming of nature-based solutions in the development of new residential areas.	6	5	
	Total	30	15	0

Evaluation criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of modules 3 and 4] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment: 20%

Learning outcomes

Upon completion of the course, the students will be able to

- Apply knowledge of sustainable materials, energy efficiency, and green infrastructure in the development of environmentally responsible built environments. [Minor Test 1,
- Minor Test 2, Tutorials/Assignments, Major Test]
- Understand principles and strategies for minimizing environmental impact and promoting resilienc in architectural design and urban planning. [Tutorials/Assignments, Major Test]

Pedagogical approach

- The course will be delivered through class lectures and tutorials.
- The course will focus on classroom discussions, case studies and assignment/field trip which help them to make this course more robust and fruitful.

Reading resources

- Iyer-Raniga, U. (Ed.). (2021). *Sustainability in the Built Environment in the 21st Century: Lesso Learned from India and the Region.* Springer Nature.
- Begum S. and Ahmed Al Shamma'a (2015). *The Sustainable Built Environment: Technica managerial, legal and economic aspects.* Palgrave Macmillan; New edition.
- Loftness, V (2020). *Sustainable built environments: introduction.* Sustainable built environment 1-16. Springer, New York, NY
- Atkinson, C., Yates, A., & Wyatt, M. (2009). *Sustainability in the built environment: A introduction to its definition and measurement.* Watford: IHS BRE Press.
- Langston, C. (2008). *Sustainable practices in the built environment. Routledge.* Taylor & Franc Ltd
- Santamouris, M. (2013). *Energy and climate in the urban built environment.* Routledge. Taylor Francis Ltd
- Rowe, P. G., & Hee, L. (2019). *A City in Blue and Green: the Singapore story.* Springer.

Journals

- Sustainable Cities and Society, Elsevier
- Sustainable Futures, Elsevier

Student Responsibilities

The students must prepare with readings suggested during the class and ensure timely assignment submission. They are also expected to participate and further strengthen their understanding of concepts through classroom discussions.

Course Designed by:

- Dr. Adil Masood, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi
- Dr. Amit Singh, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewed by:

- Dr. Mohammad Saquib, Associate Professor, Faculty of Architecture & Ekistics, Jamia Millia Islamia University, New Delhi
- Dr. Abdul Halim Babbu, Associate Professor, Faculty of Architecture & Ekistics, Jamia Millia Islamia University, New Delhi

Course Title: Conventional and Renewable Energy Resources			
Course Code:	**No. of Credits: 3**	**L-T-P: 33-12-0**	**Learning Hours: 45**
Pre-requisite Course Code and Title (if any): None			
Department: Natural and Applied Sciences			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Minor		**Course Offered In:** Semester 3	

Course Description

This course provides an understanding of conventional and renewable energy sources, including their technologies, applications, environmental impacts, and socio-economic considerations. Through lectures, discussions, and tutorial sessions, students will gain insights into the role of these energy sources in addressing energy challenges and transitioning towards sustainable energy systems.

Course Objectives

- To introduce students to the fundamentals of conventional and renewable energy sources.
- To explore the technological advancements, applications, and limitations of different energy sources.
- To examine the environmental and socio-economic considerations associated with conventional and renewable energy systems.
- To foster critical thinking and problem-solving skills in addressing energy-related challenges.

Course Content

Module	Topic	L	T	P
1	**Introduction to Energy Sources**			
	This module focuses on introductory knowledge about energy sources, their classifications, production/consumption trends, concepts of energy efficiency and security, and environmental-social-economic considerations related to energy, thus setting the context for the next modules.			
	Status of World and Indian Energy scenario, overview of energy sources and their classification; patterns and trends in energy production and consumption; concepts of energy efficiency and energy security; environmental implications of energy use: CO_2 emissions in developed and developing countries; socio-economic considerations.	3	1	
2	**Conventional Energy Sources**			
	This module provides an understanding of conventional energy sources and fossil fuels. Students will explore the technologies, extraction methods, and environmental impacts associated with these energy sources.			
	Introduction to conventional energy sources, history of fossil fuels, classification, fundamental definitions and physio-chemical properties.	3	1	
	Solid Fossil Fuel: Coal – classification, formation, and composition; coal mining techniques: surface mining, underground mining; coal combustion, gasification, liquefaction.	3	1	
	Liquid and Gaseous Fossil Fuels: Petroleum – formation, oil exploration, extraction, and refining processes and products. Natural gas – exploration, extraction; producer gas, water gas, hydrogen gas.	4	2	
	Environmental impacts of fossil fuels.	2		
3	**Nuclear Energy**			
	This module provides a basic introduction to nuclear energy processes, nuclear radiation hazards, and nuclear waste management.			
	Nuclear fission and fusion processes, nuclear reactors, nuclear fuels, nuclear energy safety and waste management: radiation hazards and nuclear waste disposal.	3	1	
4	**Renewable Energy Sources**			

	This module offers an exploration of renewable energy sources, including solar, wind, hydro, biomass, geothermal, and ocean energy. Through theoretical lectures, tutorials and case studies, students will gain an understanding of the technologies and applications associated with renewable energy.			
	Introduction to renewable energy, types of renewable energy sources, importance of renewable energy in the context of sustainable development.	1		
	Solar Energy: Sun as source of energy, solar radiation, and its spectral characteristics, solar photovoltaic (PV) and solar thermal technologies, applications, challenges, benefits, international solar alliance.	3	1	
	Wind Energy: Wind energy resource assessment and potential; wind turbines: technology, types, and operation; wind farms.	2	1	
	Hydropower and Ocean Energy: Hydropower technologies: principles of generation; types (dams, run-of-river), advantages, and challenges; ocean energy technologies: tidal, wave, and ocean thermal energy conversion (OTEC).	3	1	
	Geothermal Energy: Geothermal resource assessment, exploration techniques, geothermal energy extraction methods and applications.	2	1	
	Biomass Energy: Biomass resources: types, characteristics; biomass conversion technologies: combustion, gasification, anaerobic digestion; waste to energy.	2	1	
5	**Challenges and Transitioning towards Sustainable Energy Systems**			
	This module will help students identify the issues related to renewable energy integration, grid management, and the need for transitioning towards sustainable energy systems.			
	Challenges and solutions in renewable energy integration and grid management, smart grid technologies and demand-side management, role of energy storage systems in renewable energy integration, energy-climate change linkages and need for transitioning towards sustainable energy systems.	2	1	
		33	12	

Evaluation Criteria

- Tutorials/assignment: 20%
- Minor Test 1 (Module 1 and 2): 20%
- Minor Test 2 (Module 3 and 4): 20%
- Major Test (Entire Syllabus): 40%

Learning Outcomes

Upon completion of the course, the students will be able to:

- develop an introductory understanding of energy sources, patterns in energy production and consumption, and environmental-social-economic considerations associated with energy resources [Module 1, Minor Test 1, Major Test]
- gain knowledge of the fundamentals of conventional energy sources, including technologies and extraction methods used in producing conventional energy [Module 2, Minor Test 1, Major Test]
- develop an understanding of nuclear energy technologies [Module 3, Minor Test 2, Major Test]
- develop an understanding of various renewable energy technologies and their applications [Module 4, Minor Test 2, Major Test]
- understand the challenges and solutions related to renewable energy integration, grid management, and the need for transitioning towards sustainable energy systems [Module 5, Major Test]

Pedagogical Approach

- The course will be delivered through classroom lectures, class exercises, and tutorials that will be further connected with real-life examples and case studies.
- The course will focus on classroom discussions and assignments that will help to make this study more participatory, robust, and productive.

Reading Resources

1. Hinrichs RA, Kleinbach MH, Wade R (2023). *Energy: Its Use and the Environment*. Sixth Edition, Cengage Learning.

2. Kumar, R. (2013). *Fossil Fuels: Sources, Environmental Concerns and Waste Management Practices.* Nova Science Publishers.
3. Murray, R., & Holbert, K.E. (2019). *Nuclear Energy: An Introduction to the Concepts, Systems, and Applications of Nuclear Processes.* Butterworth-Heinemann.
4. Boyle, G. (2012). *Renewable Energy: Power for a Sustainable Future.* Oxford University Press.
5. Nelson, V.C., & Starcher, K.L. (2016). *Introduction to Renewable Energy.* CRC Press.
6. Kishore, V.V.N. (2008). *Renewable Energy Engineering and Technology–A Knowledge Compendium.* TERI Press, New Delhi.
7. Stephen, A. (2021). *Fundamentals and applications of renewable energy.* States Academic Press, New York.
8. Rajput, R.K. (2014). *Non-conventional energy sources and utilisation.* Sultan Chand, New Delhi.
9. Maisie, W. (2017). *Renewable energy: power for a sustainable future.* Larsen & Keller, New York.
10. Twidell, J., & Weir, T. (2015). *Renewable energy resources.* Routledge.

Student Responsibilities

The students must come prepared with readings suggested during the classes and ensure timely submissions of tutorials and assignments. They are also expected to attend classes regularly, participate, and contribute to classroom discussions to strengthen their understanding further. Their other responsibilities include feedback and discipline.

Course Designed by:

- Dr Anand Madhukar, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Dr Atul Sharma, Professor, Rajiv Gandhi Institute of Petroleum Technology, Jais, Amethi.
- Dr. Ram Narayan Singh, Professor, School of Energy & Environmental Studies, Devi Ahilya Vishwavidayala, Indore.

Course title: Environmental Statistics			
Course code:	**No. of credits:** 4	**L-T-P:** 46-14-0	**Learning hours: 60**
Pre-requisite course code and title (if any): No pre-requisite required			
Department: Natural and Applied Sciences			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Multidisciplinary course		**Course offered in:** Semester 3	

Course description

As the world gets more crowded and technology continues to develop, environmental problems multiply. There are many aspects of these problems–economic, political, psychological, medical, scientific and technological. Addressing such problems often involves quantitative aspects; in particular, the acquisition and analysis of environmental data. Treating these quantitative problems effectively involves the use of statistics. When one is confronted with a new problem that involves the collection and analysis of data, two crucial questions exist: "How will using statistics help this problem?" and "Which techniques should be used?"

The course has been designed and intended to help budding environmental scientists/managers to answer these questions in order better to understand and design systems for environmental protection.

Course objectives

- Introduce basic concepts useful for environmental data analysis
- Become aware of a wide range of applications of statistics in environmental management & decision making
- Develop technical skills to use statistical tools and software in environmental data analysis

Course content

Module	Topic	L	T	P
1	**Introduction**			
	Relevance of statistics in environmental management; the nature environmental data; concept of random variable and its relevance with respect to the environmental data; Review of concepts of inferential statistics – parameter estimation and hypothesis testing	5		
2	**Environmental data sampling**			
	Need and purpose of sampling; methods for selecting sampling locations and times for different environmental matrices – monitoring of water bodies for hydrological and water quality data; air quality monitoring; soil sampling – statistical considerations.	4		
3	**Statistical distribution modelling applications in environment**			
	Discrete distributions–binomial, Poisson, geometric, negative binomial and hypergeometric; Continuous distributions – normal, lognormal, exponential, Weibull, Gamma and Beta; Probability plotting methods for different distributions Model identification using goodness-of-fit tests - Chi-square, Kolmogorov-Smirnov and Anderson-Darling test Parameter estimation methods – method of moments, method of maximum likelihood, method of least squares and probability plot correlation coefficient plot. Case studies	10	4	
4	**Analysis of variance (ANOVA)**			
	Variability and errors in environmental pollution data; Completely randomized design; randomized block design; Multiple comparisons; ANOVA – one way, two way; Design of experiment	8	3	
5	**Extreme values statistics**			
	Introduction to extreme values; Frequency analysis of extreme			

	events: Order statistics – definitions and distributions, probability distribution of extremes, exceedance probability, applications. Case studies: environmental pollution, water resources	4	2	
6	**Environmental data analysis**			
	Outlier detection; different tests for outlier detection; Regression analysis: simple and multiple regression models; curve fitting criteria and parameter estimation; statistical significance of model parameters; model diagnostics. Case studies: rainfall-runoff model, volume-discharge model; Climate change; water quality parameters Analysis of trend in the environmental data Trend and seasonality; detecting and estimating trends – applications to environmental data	15	5	
	Total	**46**	**14**	

Evaluation criteria

- Minor Test 1: 20% [Module 1 & 2, after 5-6 weeks of teaching]
- Minor Test 2: 20% [Module 3 & 4, after 12-13 weeks of teaching]
- Major Test: 40% [Module 1 to 6, end of semester]
- Assignment: 20% [5 tutorial assignments spread over entire semester]

Learning outcomes

After completing this course, the students will be able to:

- implement statistics for environmental monitoring and sampling
- analyse, model and quantify uncertainty and variability in environmental data
- extract information and draw scientific inference from large amount of data collected to solve environmental problems
- analyse trend and seasonality in environmental data
- apply statistical tools and software to analyse environmental data

Assessment mechanism for learning outcomes: The three tests and tutorial assignments spread over the entire semester

Pedagogical approach

Classroom lectures, tutorial assignment along with relevant case studies.

Materials

Textbooks

The following textbooks independently cover all the 6 modules:

- Ayyub, B.M. and McCuen, R.H. (2011) *Probability, Statistics and Reliability for Engineers and Scientists,* CRC Press, Boca Raton, FL.
- Gilbert R.O. (1987) *Statistical Methods for Environmental Pollution Monitoring*, New York, Van Nostrand Reinhold.
- Helsel D.R. and Hirsch R.M. (1997) *Statistical Methods in Water Resources*, Elsevier Science Ltd., UK.
- Kottegoda N.T. and Rosso R. (2008) *Applied Statistics for Civil and Environmental Engineers*, McGraw-Hill, International Edition.

Suggested readings

Suggested readings may be referred to for getting more insights and additional relevant examples for the more interested student.

- Berthouex P.M. and Brown L.C. (1994) *Statistics for Environmental Engineers*, Lewis Publishers, CRC Press, Boca Raton, FL.
- Cothern C.R. and Ross N.P. (1994) *Environmental Statistics, Assessment and Forecasting*, Lewis Publishers, Boca Raton, FL.
- Hoshmand A.R. (1997) *Statistical Methods for Environmental and Agricultural Sciences*, CRC Press, Boca Raton, FL.
- Gibbons R.D. (1994) *Statistical Methods for Groundwater Monitoring*, John Wiley & Sons,

New York.
- Ginevan M.E., Splistone D.E. (2004) *Statistical Tools for Environmental Quality Measurement.* John Wiley & Sons Hoboken, NJ.
- Gregoire T.M. and Valentine H.T. (2008) *Sampling Strategies for Natural Resources and the Environment,* Chapman & Hall/CRC, Boca Raton.
- Keith L.H. (1991) *Environmental Sampling and Analysis: A Practical Guide,* Lewis Publishers, Boca Raton, FL.
- Keith L.H. (ed) (1996) *Principles of Environmental Sampling,* Second Edition, American Chemical Society, Washington, D.C., Distributed by Oxford University Press, New York.
- Manly B.F.J. (2001) *Statistics for Environmental Science and Management*. Chapman & Hall/CRC, Boca Raton, FL.
- McBride G.B. (2005) *Using Statistical Methods for Water Quality Management: Issues, Problems and Solutions,* John Wiley & Sons, Hoboken, NJ, USA.
- Ott W.R. (1995) *Environmental Statistics and Data Analysis*, Lewis Publishers, Boca Raton, FL.
- Shaefer S.J. and Theodore L. (2007) *Probability and Statistics Applications for Environmental Science,* CRC Press, Boca Raton, FL.
- USEPA (2002). *Guidance on Choosing a Sampling Design for Environmental Data Collection,* United States Environmental Protection Agency, Office of the Environmental Information, Washington DC, 20460, EPA/240/R-02/005
- Walford N. (2011) *Practical Statistics for Geographers and Earth Scientists*, John Wiley & Sons, New Jersey, USA.
- Zhang C. (2007) *Fundamentals of Environmental Sampling and Data Analysis*, John Wiley & Sons, NJ, USA.

Journals

- Biometrika
- Environmental and Ecological Statistics
- Environmetrics
- Journal of Statistical Computing and Simulation
- Journal of the American Statistical Association
- Technometrics
- The American Statistician

Additional information (if any)

Student responsibilities

The students are expected to submit assignments in time and come prepared with readings when provided.

Course Designed by:

- Dr Prateek Sharma, Professor and Vice Chancellor, Delhi Technological University

Course Reviewers:

The course is reviewed by following reviewers:

- Dr Krishan Kumar, Professor, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
- Dr Anil Haritash, Associate Professor, Department of Environmental Engineering, Delhi Technological University, Delhi

Course Title: Introduction to Geographic Information Systems			
Course code:	**No. of credits:** 3	**L-T-P: 36-03-12**	**Learning hours: 45**
			L: Lecture**; T:** Tutorial**; P:** Practical
Pre-requisite course code and title (if any): None			
Department: Natural and Applied Sciences			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Skill Enhancement Course		**Course offered in:** Semester 3	

Course Description

This course provides an overview of Geographic Information System (GIS) technology and its applications in various fields. Students will learn the fundamental concepts of GIS, including spatial data collection, data management, analysis, visualization, and interpretation. Students will also gain hands-on experience with GIS software to generate data and manipulate geographic data, perform spatial analysis, and create maps.

Course objectives

- Provide students with an understanding of the fundamental concepts of Geographic Information System (GIS) and its applications in various sectors.
- Familiarize students with the basic concepts of spatial data types, nature of data and formats commonly used in GIS.
- Introduce students to data collection methods and different GIS software to manipulate, analyze, and visualize spatial data.
- Develop skills in creating maps, performing spatial analysis, and interpreting GIS results.
- Apply GIS principles to real-world projects and case studies to solve spatial problems and make informed decisions.

Course content

Module	Topic	L	T	P
1	**Overview of GIS technology**			
	The module is designed to provide an overview of Geographic Information Systems (GIS). This module will cover a brief history of GIS technology, basic concepts of GIS, spatial data types and basics of map projections. Concept of space, location, and scale; history and development of GIS technology; components of GIS; types of spatial data: raster and vector data; coordinate systems, false easting, and false northing; geographic north pole and magnetic north; projections and transformations	6		
2	**Data Acquisition and Management**			
	The module introduces students to the processes and techniques involved in collecting and storing data in various formats. The module also covers various data management techniques. Sources of data: Primary data (remote sensing, GPS, surveys); secondary data; Methods of data capture: printer/plotter, scanner, and digitizer; nature of data - spatial and non-spatial data; raster and vector data models and their structure; database management system - relational database and object-oriented database management system	6	3	
3	**Errors in GIS**			
	This module will explore the types of errors that can arise in GIS, as well as the methods and techniques used to minimize and manage them. Data quality and accuracy; Sources of errors in database - errors through processing, errors associated with overlay issues of features, principles of topology and topological errors	6		

4	**Raster and Vector Data Analysis**			
	The module covers basic geoprocessing tools such as overlaying multiple layers, buffering, and creating spatial queries and raster analysis techniques using map algebra. Raster data analysis – global, local, neighbourhood and extended neighbourhood; Vector data analysis – near, buffer around a feature, identity, intersection, union, clip, and erase; spatial and non-spatial attribute analysis	6		
5	**Digital Cartography**			
	The module provides an overview of the different elements of a map and importance of symbology and layout and how to utilize them effectively to convey information. Principles of map design; elements of a map; symbolization and visualization techniques; labelling and annotation; types of maps; cartographic design principles; typography and colour schemes; introduction to web mapping technologies; interactive and dynamic mapping	6		
6	**Case Studies**			
	This module will explore real-world case studies that demonstrate the diverse applications of GIS. Through examining these case studies, students will gain a deeper understanding of the practical uses and benefits of GIS in different sectors. Case studies of GIS application – healthcare, transportation, water resources, urban planning, agriculture, natural resource management, disaster management	6		
	Total	36	3	12
	Practical Modules			
1.	User interaction with GIS software			2
2.	Georeferencing a toposheet, defining projection and assigning new projection system in spatial dataset			2
3.	Creating and editing spatial data			2
4.	Geodatabase creation – Feature dataset and feature class			2
5.	Topological error correction			2
6.	Map preparation – Symbolization, Labelling and Layout design			2
	Total Practical Sessions			12

Evaluation criteria

- Minor Test 1: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Minor Test 2: Written test [at the end of teaching of module 3 and 4] -- 20%
- Practical Test: [at the end of the semester, full syllabus] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%

Learning outcomes

By the end of the course, students will be able to:

- explain the components of GIS, demonstrate the knowledge of coordinate systems and projections used to accurately represent and analyse spatial data. [Module 1]
- evaluate different approaches to spatial data creation, evaluate the strengths and weaknesses of various spatial data models and its role in ensuring data quality. [Module 2]
- identify the various sources of error in spatial databases and apply topological corrections to improve accuracy and quality. [Module 3]
- apply raster and vector data analysis and construct spatial queries to extract specific information from spatial datasets. [Module 4]
- apply visualization techniques to create maps that effectively communicate patterns and relationships within spatial data. [Module 5]

- gain a comprehensive understanding of spatial dataset and their applications in various sectors [Module 6]

Pedagogical approach

- The course engages in GIS concepts and facilitates student discussion through classroom lectures, case studies, and tutorials.
- The course allows students to actively engage with the GIS tools and techniques through hands-on exercises and real-world applications.

Reading Resources (* = compulsory readings)

- *Chang, K. T. (2019). *Introduction to geographic information systems, 9th Edition.* Mc Graw Hill Higher Education.
- Longley, P. (2005). *Geographic information systems and science.* John Wiley & Sons.
- Bhatta, B. (2008). *Remote sensing and GIS (Vol. 2).* New Delhi: Oxford University Press.
- Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). *Principles of geographical information systems.* Oxford University Press, USA.
- DeMers, Michael N. (2008). *Fundamentals of Geographic Information Systems, 4th. ed.* John Wiley and Sons, Toronto.
- Bolstad, P. (2016). *GIS fundamentals: A First Text on Geographic Information Systems, 5th ed.* Eider Press, White Bear Lake, Minnesota.
- Lo, C.P., and Albert K.W. Yeung, (2007). *Concepts and Techniques of Geographic Information Systems, 2nd ed.* Pearson Education Canada, Inc., Toronto.
- Longley, Paul A., Michael F. Goodchild, David J. Maguire, and David W. Rhind. (2015). *Geographic Information Systems and Science, 4th ed.* John Wiley and Sons, Toronto.
- Verbyla, D. L. (2002). *Practical GIS analysis.* CRC press.

Student Responsibilities

The students must come prepared with the readings given in the class. The students are required to participate in the discussion.

Course Designed by:

- Dr Ayushi Vijhani, Assistant Professor, Department of Natural and Applied Sciences, TERISchool of Advanced Studies, New Delhi

Course Reviewers:

The course is reviewed by following reviewers:

- Prof. Vinay SP Sinha, Centre of the Study Regional Development, School of Social Sciences,Jawaharlal Nehru University, New Delhi
- Dr. Ram Avtar, Associate Professor, Graduate School of Environmental Science Hokkaido University, Japan

Enclosure 7

M.Tech (Renewable Energy Engineering and Management) – M.Tech (REEM)

Existing Structure – 1st semester 7 core courses + 3 audit			**Proposed Structure – 1st semester9 core courses + 1 audit**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ENR 101	Energy lab - I (Power system lab and heat transfer lab)	2	ENR 101	Energy lab - I (Power system lab and heat transfer lab)	2
ENR 119	Fundamentals of thermal and electrical engineering	0 (Audit)	ENR 119	Fundamentals of thermal and electrical engineering	0 (Audit)
ENR 135	Power system engineering	3	ENR 135	Power system engineering	3
ENR 146	Renewable energy resource characteristics	3	ENR 146	Renewable energy resource characteristics	3
ENR 148	Energy and environmental implications	2	ENR 148	Energy and environmental implications	2
ENR 154	Renewable energy policies and regulations	3	ENR 154	Renewable energy policies and regulations	3
ENR 185	Introduction to management techniques - I	1	ENR 185	Introduction to management techniques - I	1
ENR 192	Heat transfer	3	ENR 192	Heat transfer	3
NRE 106	Communication skills andtechnical writing	0 (Audit)	NRE 106	Communication skills andtechnical writing	2
NRE 165	Introduction to Sustainable Development	0 (Audit)	NRE 165	Introduction to Sustainable Development	1
	Total credits	17		Total Credits	20

Existing Structure – 2nd semester8 core courses	**Proposed Structure – 2nd semester 8 core courses**

Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ENR 103	Field visits / exposure to RE plants	1	ENR 103	Field visits / exposure to RE plants	1
ENR 111	Energy conservation and management	2	ENR 111	Energy conservation and management	2
ENR 156	Renewable energy project management	3	ENR 156	Renewable energy project management	3
ENR 157	Energy lab - II	3	ENR 157	Energy lab – II	3
ENR 162	Solar technologies	3	ENR 151	Solar technologies	4
ENR 164	Wind, biomass and other renewable technologies	3	ENR 164	Wind, biomass and other renewable technologies	3

ENR 166	Electric vehicle, energy storage system and Hydrogen technologies	3	ENR 166	Electric vehicle, energy storage system and Hydrogen technologies	3
ENR 167	Energy and Carbon Markets	1	ENR 167	Energy and Carbon Markets	1
	Total credits	19		Total Credits	20

Existing Structure – 3rd semester 2 Core + 2 Elective + Minor Project			**Proposed Structure – 3rd semester 2 Core + 2 Elective + Minor Project**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ENR 165	Energy economics	3	ENR 165	Energy economics	3
ENR 107	Energy simulation laboratory	3	ENR 107	Energy simulation laboratory	3
ENR 118	Dissertation - I/ MinorProject	6	ENR XXX	Dissertation - I/ MinorProject	8
BSI 125	Accounting and finance forsustainability	3 (Elective)	BSI 125	Accounting and finance forsustainability	3 (Elective)
ENR 113	Wind power generation	3 (Elective)	ENR 113	Wind power generation	3 (Elective)
ENR 115	Building energy and green building	3 (Elective)	ENR 115	Building energy and green building	3 (Elective)
ENR 116	Energy audit and management	3 (Elective)	ENR 116	Energy audit and management	3 (Elective)
ENR 143	Grid integration ofrenewable energy	3 (Elective)	ENR 143	Grid integration ofrenewable energy	3 (Elective)
ENR 145	Solar photovoltaic power generation	3 (Elective)	ENR 145	Solar photovoltaic power generation	3 (Elective)
ENR 163	Biofuels and Decentralized Energy Systems	3 (Elective)	ENR 163	Biofuels and Decentralized Energy Systems	3 (Elective)
ENR 168	Applications of machinelearning in alternate energy	3 (Elective)	ENR 168	Applications of machine learning in alternate energy	3 (Elective)
	Total credits	18		Total Credits	20

Existing Structure – 4th semester Major Project			**Proposed Structure – 4th semester Major Project**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ENR 110	Dissertation-II / MajorProject	16	ENR XXX	Dissertation-II / MajorProject	20
	Total credits	16		Total Credits	20

M.Sc. (Energy Studies and Management) – M.Sc (ESM)

Existing Structure – 1st semester 7 core courses + 1 audit			**Proposed Structure – 1st semester 8 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ESM XXX	Introduction to Energy Resources, Systems and Technologies	3	ESM XXX	Introduction to Energy Resources, Systems and Technologies	3
ESM XXX	Energy System Infrastructure & Operations	3	ESM XXX	Energy System Infrastructure & Operations	3
ESM XXX	Climate Change and Energy Transition	3	ESM XXX	Energy Policy, Planning and Programmes	3
ESM XXX	Energy Conservation, Audit and Management	3	ESM XXX	Energy Conservation, Audit and Management	3
ESM XXX	Energy Science Lab	3	ESM XXX	Energy Science Lab	3
ESM XXX	Basic Computer Programming	0 (Audit)	NRG 106	Fundamentals of computers and programming	2
NRE 106	Introduction to Sustainable Development	1	NRE 106	Introduction to Sustainable Development	1
NRE 165	Communication Skills &Technical Writing	2	NRE 165	Communication Skills &Technical Writing	2
	Total credits	18		Total Credits	20

Existing Structure – 2nd semester6 core courses			**Proposed Structure – 2nd semester 7 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ESM XXX	Firm and Dispatchable Energy – Resources, Technologies, Applications	3	ESM XXX	Coal, Gas, Hydro and Biomass – Resources, Technologies & Applications	3
ESM XXX	Variable Energy and Decentralized Systems– Resources, Technologies, Applications	3	ESM XXX	Solar, Wind (utility scale & decentralized systems) — Resources, Technologies &Applications	3
ESM XXX	Building Energy Management and Green Building	3	ESM XXX	Building Energy Management and Green Building	3
ESM XXX	Energy Project Management	3	ESM XXX	Energy Project Management	3
ESM XXX	Energy Markets and Trading	3	ESM XXX	Energy Markets and Trading	3

ESM XXX	Energy Systems Lab	3	ESM XXX	Energy Systems Lab	3
			MPD 149	Fundamentals of Environmental, Social, and Governance (ESG) Principles	2
	Total credits	18		Total Credits	20

Existing Structure – 3rd semester 2 core + 2 elective + Minor Project			**Proposed Structure – 3rd semester 2 core + 2 elective + Minor Project**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ESM XXX	Minor Internship (Summer)	6	ESM XXX	Minor Internship (Summer)	8
ESM XXX	Advancements in Energy Processes, Systems, Technologies and Applications	3	ESM XXX	Electric Vehicle, Green Hydrogen and Energy Storage - Technologies & Applications	3
ESM XXX	Energy Finance & Economics	3	ESM XXX	Energy Finance & Economics	3
ESM XXX	Computing Tools and AIApplications in Energy Sector	3 (Elective)	ESM XXX	Computing Tools and AIApplications in Energy Sector	3 (Elective)
ESM XXX	ESG and Sustainability reporting	3 (Elective)			
ESM XXX	Energy Policy, Planning and Programmes	3 (Elective)	ESM XXX	Climate Change and Energy Transition	3 (Elective)
ESM XXX	Elective(s) from other programmes at TERI SAS	3 (Elective)	ESM XXX	Elective(s) from other programmes at TERI SAS	3 (Elective)
	Total credits	18		Total Credits	20

Existing Structure – 4th semester	**Proposed Structure – 4th semester**

Major Project			**Major Project**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ESM XXX	Major Project/ Internship	20	ESM XXX	Major Project/ Internship	20
	Total credits	20		Total Credits	20

P G Diploma in Renewable Energy management – PGDREM

Existing Structure – 1st semester 6 core courses	**Proposed Structure – 1st semester 7 core courses**

Course No.	Course Title	Number of Credits	Course No.	Course Title	Number of Credits
NRE 106	Communication skills andtechnical writing	2	NRE 106	Communication skills andtechnical writing	2
ENR 148	Energy and environmental implications	2	ENR 148	Energy and environmental implications	2
ENR 185	Introduction to management techniques - I	1	ENR 185	Introduction to management techniques - I	1
ENR 154	Renewable energy policies and regulations	3	ENR 154	Renewable energy policies and regulations	3
ENR 146	Renewable energy resource characteristics	3	ENR 146	Renewable energy resource characteristics	3
ENR 105	Independent study	4	ENR 105	Independent study	4
			NRE 165	Introduction to Sustainable Development	1
	Total credits	15		Total Credits	16

Existing Structure – 2nd semester7 core courses			**Proposed Structure – 2nd semester 7 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
ENR 166	Electric vehicle, energy storage system and Hydro technologies	3	ENR 166	Electric vehicle, energy storage system and Hydro technologies	3
ENR 167	Energy and Carbon Markets	1	ENR 167	Energy and Carbon Markets	1
ENR 111	Energy conservation and management	2	ENR 111	Energy conservation and management	2
ENR 156	Renewable energy project management	3	ENR 156	Renewable energy project management	3
ENR 162	Solar technologies	3	ENR 151	Solar technologies	4
ENR 164	Wind, biomass and other renewable technologies	3	ENR 164	Wind, biomass and other renewable technologies	3
ENR 108	Summer internship	6	ENR 108	Summer internship	8
	Total credits	21		Total Credits	24

M.Tech (Urban Development Management) – M.Tech (UDM)

Existing Structure – 1st semester 8 core courses + 1 audit			**Proposed Structure – 1st semester 9 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**

MEU 143	Urban governance	3	MEU 143	Urban governance	3
MEU 163	Sustainable Provision and Management of Urban Services	3	MEU 163	Sustainable Provision and Management of Urban Services	3
MEU 167	Urban Development Policies and Programmes	3	MEU 167	Urban Development Policies and Programmes	3
NRE 106	Communication skills andtechnical writing	2	NRE 106	Communication skills andtechnical writing	2
MEU 161	Theories of Urbanisation	3	MEU XXX	Theories of Urbanisation and their application forurban development	3
MEU 179	Geoinformatics for UrbanDevelopment	3	MEU 179	Geoinformatics for urban development management	3
MEU 175	Introduction to GIS	1	ENR 185	Introduction to management techniques - I	1
MEU 173	Stochastic Modelling	4	ESM XXX	Energy Conservation, Audit and Management	3
MEU 123	Urban Finance	3	NRE 165	Introduction to Sustainable Development	1
	Total credits	25		Total Credits	22

Existing Structure – 2nd semester7 core courses			**Proposed Structure – 2nd semester 8 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
MEU 121	Urban Ecology and Environment	3	MEU 121	Urban Ecology and Environment	3
MEU 152	City and Regional Planning and Management	3	MEU 152	City and Regional Planning and Management	3
NRG 103	Project management	3	NRG 103	Project management	3

MEU 154	Regeneration and City Competitiveness	2	MEU XXX	Smart Sustainable Cities	2
MEU 177	Qualitative Research Methodology for Urban Studies	2	MEU XXX	Qualitative and quantitative Research Methodology for Urban Studies	3
MEU 184	Real Estate Development	3	MEU XXX	Land, Housing and Real Estate Development	3
MEU 172	Geoinformatics for UrbanDevelopment	3	MEU 123	Urban Finance	3
			ENR 167	Energy and Carbon Markets	1
	Total credits	19		Total Credits	21

Existing Structure – 3rd semester 12 credits from Major Project Part 1 + 2 credits from 1 Core Course and 4 credits from 2 Electives Courses			Proposed Structure – 3rd semester 2 Core + 2 Elective + Major Project 1		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
MEU 102	Major Project Part 1	12	MEU XXX	Major Project 1 (The CityLab)	12
MEU 162	Urban Disaster Management and Climate Resilient Cities	2 (Elective)	MEU 162	Urban Disaster Management and Climate Resilient Cities	2
MEU 144	Sustainable Urban Transport	2 (Elective)	MEU 144	Sustainable Urban Transport	2 (Elective)
MEU 178	Urban Water Supply and Wastewater	2 (Elective)	MEU 178	Urban Water Supply and Wastewater	2 (Elective)
MEU 183	Urban systems modelling	2	MEU XXX	International CollaborativeStudio	3
MEU 112	Energy efficient buildings	2 (Elective)	ENR 115	Building energy and green building	3 (Elective)
MEU 168	Urban housing policy and practice	2 (Elective)	MEU XXX	AI and Cities	2 (Elective)
			MEU XXX	Environmental, Social, and Governance (ESG) Principles and cities	2 (Elective)
			XXXXX	Water & Sanitation Audit	2 (Elective)
	Total credits	18		Total Credits	21

Existing Structure – 4th semester Major Project Part 2	Proposed Structure – 4th semester Major Project 2

Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
MEU 104	Major Project Part 2	16	MEU XXX	Dissertation/Major Project 2	20
	Total credits	16		Total Credits	20

P G Diploma in Urban Development Management – PGDUDM

Existing Structure – 1st semester 8 core courses + 1 audit			Proposed Structure – 1st semester 8 core courses		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
MEU 143	Urban governance	3	MEU 143	Urban governance	3

MEU 163	Sustainable Provision and Management of Urban Services	3	MEU 163	Sustainable Provision and Management of Urban Services	3
MEU 161	Theories of Urbanisation	3	MEU 167	Urban Development Policies and Programmes	3
NRE 106	Communication skills andtechnical writing	2	NRE 106	Communication skills andtechnical writing	2
MEU 177	Qualitative Research Methodology for Urban Studies	3	MEU XXX	Theories of Urbanisation and their application forurban development	3
MEU 179	Geoinformatics for UrbanDevelopment	3	MEU 179	Geoinformatics for urban development management	3
MEU 123	Urban Finance	3	ENR 185	Introduction to management techniques - I	1
			NRE 165	Introduction to Sustainable Development	1
	Total credits	19		Total Credits	19

Existing Structure – 2nd semester7 core courses			**Proposed Structure – 2nd semester 8 core courses**		
Course No.	**Course Title**	**Number of Credits**	**Course No.**	**Course Title**	**Number of Credits**
MEU 121	Urban Ecology and Environment	3	MEU 121	Urban Ecology and Environment	3
MEU 152	City and Regional Planning and Management	3	MEU 152	City and Regional Planning and Management	3
NRG 103	Project management		NRG 103	Project management	3
MEU 154	Regeneration and City Competitiveness	2	MEU XXX	Smart Sustainable Cities	2

MEU 167	Urban Development Policies and Programmes	3	MEU XXX	Qualitative and quantitative Research Methodology for Urban Studies	3
MEU 184	Real Estate Development	3	MEU XXX	Housing and Real Estate Development	3
		3	MEU 123	Urban Finance	3
			ENR 167	Energy and Carbon Markets	1
	Total credits	17		Total Credits	21

Enclosure 8

Course title: Introduction to Energy Resources, Systems and Technologies			
Course code: ESMXXX	**No. of credits: 3**	L-T-P:39-6-0	**Learning hours:**45
Pre-requisite course code and title (if any): NA			
Department: Sustainable Engineering			
Course coordinator:		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course description:

This introductory course has been designed to get the students acquainted with different energy resources (non-renewable and renewable), reserves and their potentials, accounting of the energy, global and Indian energy demand and supply, impact of energy consumption on the environment, climate change assessment and global impact of climate change. Also, introduces students with different energy conversion technologies and their functioning.

Course objectives:

1. To get students understand and familiarity with different types of energies and their measurements, availability and potential.
2. To inculcate skills using different methods for energy accounting.
3. To introduce students with conversion technologies and systems that are used for converting non-renewable and renewable energy resources to useful heat and power.

Module	Topic	L	T	P
1.	**Basics of Energy** System; property and variables; dimensions and units of measurement; temperature and heat; pressure, volume and sates; process; energy and power; forms of energy; grades of energy; transformation of energy; global energy system; energy units and scales; global energy flows; energy end uses; transitions in energy end use and energy supply systems; energy and economic growth; principles of energy resources; energy densities; quantities of energy	4		
2	**Accounting of energy** Energy accounting methods; importance of energy accounting; limitations of primary energy accounting; comparison of global primary energy supply using different accounting methods; main energy statistics and data sources; typical calorific values of solid, liquid and gaseous fuels	2	2	
3	**Energy and environment** Energy Flow Diagram; Global and Indian energy demand and supply; Emission Factor; Atmosphere and energy systems; major energy related sources of atmospheric pollution; greenhouse gas emissions, radiative forcing, climate sensitivity, global and regional impact of climate change, risks from climate change, environmental and social implications	4	2	
4.	**Fossil fuel reserves, resources and estimates** Concepts of McKelvey box; peak debate; Hubbert plot Oil: classification of conventional and unconventional oil, estimations of conventional oil and unconventional Natural gas: Conventional and unconventional natural gas classification, resources and reserves Coal: Coal classification, reserves and resources	4		
5.	**Introduction to energy conversion systems and technologies** Fire, furnaces and boilers; types of boilers; steam engines; principles of steam engines; carnot's law and carnot engine; temperature scales and absolute zero; laws of thermodynamics; steam turbines and condensers; types of steam	7	2	

	turbines; steam jets; marine engines; turbine systems; process flow in a MW thermal power station turbine system Petrol/spark ignition engine: four stroke and two stroke engines; diesel/compression ignition engine; gas turbine: principles of turbojet; propulsion and thrust; thrust and kinetic energy; Stirling engine: principle and operation; power to weight ratio of different engines			
6.	**Nuclear energy reserves, resources and technologies** Conventional and unconventional uranium resources and reserves; global annual uranium production and reactor requirements; thorium resources; Radioactivity; energy from neutron decay; measuring radioactivity; Nuclear fission, energy from fission, components of nuclear power plant; thermal fission reactor; safety aspects in nuclear reactor; types of thermal fission reactor; fast neutron reactors; energy from fusion reactor,	6		
7.	**Introduction to Renewable energy resources and technologies** Overview of hydropower; estimation of hydropower potential; technical and economic potential of hydropower; environmental and social implications Biomass energy: Overview and types of biomass; theoretical and technical potentials of bioenergy; biogas digesters; biomass briquetting; biofuels. Wind energy: theoretical, technical and practical potentials of wind energy; environmental and social implications; onshore and offshore wind turbines; Geothermal energy: Resources and reserves, uses of geothermal energy. Solar energy: theoretical and technical potential of solar energy; economic potential of large scale solar plants; Solar cookers; solar water heating systems; solar concentrators for power generation; solar photovoltaic; Ocean energy-tidal and waves, potential, utilisation technologies	11		
8.	Overall energy systems and technologies and their overall effect on the environment, society, and economics.	1		
	Total	39	6	

Evaluation criteria

Assignment1: 10% (after Module 1-4)
Assignment 2: 10% (after Modules 5-7)
Minor test 1: 15% (after Module 3)
Minor test 2: 15% (after Module 5)
Major test: 50% (after all module)

Learning outcomes:

This course inculcates the skills that shall make the students to:

1. be able to measure and compare the energy contents in different units used for different fossil fuel resources internationally.
2. be able to differentiate different forms of energy and their applications.
3. be able to differentiate and assess the theoretical, technical and economic potentials of the energy resources.
4. understand the impact of energy uses on the climate change and role of IPCC in assessment of climate change and mitigation strategies.
5. be able to understand energy demand and supply flow diagram.
6. learn about different energy conversion technologies and emission factors.
7. understand the functioning energy conversion technologies and systems

Pedagogical approach

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

Materials

Recommended readings

Text Books

1. Global Energy Assessment Writing Team. Global Energy Assessment: Toward a Sustainable Future. Cambridge University Press; 2012

2. Everett, Robert; Boyle, Godfrey; Peake, Stephen and Ramage, Janet eds. (2012). Energy Systems and Sustainability: Power for a Sustainable Future (2nd ed.). Oxford: Oxford University Press.

Reference Books

1. Tushar K. Ghosh and Mark A. Prelas eds. Energy Resources and Systems Volume 1: Fundamentals and Non-Renewable Resources, Springer Dordrecht
2. Energy: Production, conversion, storage, conservation and coupling by Yasar Demirel Springer ISSN 1865-3529
3. TERI Energy & Environment Data Diary and Yearbook (TEDDY) 2020-21. TERI Press
4. United States Department of Energy, International Energy Outlook, Energy Information Administration, DC. https://www.eia.gov/outlooks/ieo/narrative/index.php
5. IEA (2023), *World Energy Outlook 2023*, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2023, Licence: CC BY 4.0 (report); CC BY NC SA 4.0 (Annex A) https://www.iea.org/search?q=World%20Energy%20Outlook
6. bp Energy Outlook. **https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html**
7. Our World in Data**. https://ourworldindata.org/renewable-energy**

Journals

- Resource and Energy Economics
- Journal of Energy Resources Technology
- Liquid and Gaseous Energy Resources
- Progress in Energy and Combustion Science\
- Renewable and Sustainable Energy Reviews
- Nature Energy
- Energy

Additional information (if any): NA

Student responsibilities:
Attendance, feedback, discipline: as per university rules

Course Reviewers

1. Dr. O. P. Rao
   Scientist, CSIR (Retired)
2. Prof. Santanu Bandyopadhyay
   Indian Institute of Technology, Bombay

Enclosure 9

Course title: Energy System Infrastructure and Operations			
Course code: ESM XXX	**No. of credits:** 3	**L-T-P:** 37-08-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: MSc (Energy Studies & Management)			
Course coordinator: Prof. Naqui Anwer		**Course instructor:** Prof. Naqui Anwer	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:

The structure of power systems and their operations are vital for system reliability, control, security and power quality. Further many countries, including India, are witnessing restructured electricity markets. In this deregulation process, it is important to focus on managerial as well as technical aspects of energy system infrastructure and their operations. This course is designed to educate students regarding various components of energy system infrastructure and how the power market is assisting in the reliable operation of the grid.

Course objectives:

- To familiarize students with basic principles of power system elements
- To understand the energy market and services offered by these energy markets.
- To understand operational planning activities like economic load dispatch, unit commitment and power flow
- To impart knowledge about transmission and distribution systems
- To understand ancillary services management and their categorization

Course content

Module	Topic	L	T	P
1.	**Fundamentals of Electric Circuits and Power System** • Circuit concept • Circuit laws • Active & reactive power and electrical energy • 3-phase circuits • Elements/Structure of power systems	7	0	0
2.	**Power Markets** • Overview of the Indian Power sector • Market structure • Role of ISO (Independent System Operator) • Electricity market: Power trading in energy exchanges • Ancillary services: For maintaining generation and load balance, For bulk transmission system security, For emergency preparedness	6	0	0
3.	**Power Plant Engineering** • Basics of power generation (Schematics/layout of coal-based thermal, Gas turbine power plant and Hydroelectric power plant) • Load and load duration curves • Power station management (Regulatory performance standards)	5	0	0

4.	**Transformers and Synchronous generators** • Transformers: construction, working, equivalent circuit, losses, efficiency, voltage regulation • Synchronous generators: construction, principle of operation, equivalent circuits, phasor diagram, operation of synchronous generator on infinite busbar/grid, excitation	6	2	0
5.	**Transmission and Distribution** • HVAC & EHV AC transmission. Classification of transmission lines – short, medium and long transmission line, transmission line parameters, modelling of lines and transmission line performance: Voltage regulation and efficiency • Distribution systems configurations, Loadability of lines • Basic concepts of HVDC	6	3	0
6.	**Power Flows** • Power flow problem and Power flow solution • Control of Power Flow • Unit commitment and Economic Load Dispatch • Grid standards and Load dispatch centres (ISO-Independent System Operator, TSO-Transmission System Operator, NLDC- National Load Dispatch Centre, SLDC- State Load Dispatch Centre etc)	7	3	0
	Total	37	08	00

Evaluation criteria

Minor Test 1: Assignment (after completion of modules 1, 2 and 3)- 10%
Minor Test 2: Written test (after completion of modules 1, 2 and 3)- 25%
Minor Test 3: Written test/ Case Study Presentation (after completion of modules 4, 5 and 6)- 25%
Major Test: Written test/ Presentation (after completion of all modules) - 40%

Learning outcomes

- Appreciate the role of various components of the power system
- Analyze the energy market and their role
- Understand the significance of solutions to load flow problems, economic load dispatch centre and unit commitment
- Understand grid standards

Pedagogical approach

A combination of class-room interactions, tutorials, group discussions assignments, expert talks / site visits

Materials:

Text Books:

- Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder **Operation of Restructured Power Systems** (Kluwer Academic Publishers, 2001).
- John Graigner and William Stevenson, Jr.: **Power System Analysis** (McGraw Hill, 2017).

Reference Books:

- Daniel Kirschen and Goran Strbac: **Fundamentals of Power Systems Economics** (Wiley India, 2016)
- Stephen J. Chapman: **Electric Machinery and Power System Fundamentals** (McGraw Hill, 2001)
- Mohammad Shahidehpour, Hatim Yamin and Zuyi Li: **Market Operations in Electric Power System: Forecasting, Scheduling, and Risk Management** (Wiley-IEEE Press, 2002)
- Jin Zhang: **Power System Economic and Market Operations** (CRC Press, 2018)

Websites:

Central Electricity Regulatory Commission, CERC (http://www.cercindia.gov.in/)
IEX India (https://www.iexindia.com/)

Additional information (if any): N.A.

Student responsibilities
Attendance, discipline, feedback as per TERI SAS rules

Course reviewers:

Dr. Sanjay Agrawal, Professor, Pro-VC, Vivekananda Chhatishgarh Technical University, Bhilai
Dr. M. Rizwan, Professor, Department of Electrical Engineering, Delhi Technological University, New Delhi

Enclosure 10

Course title: Energy Policy, Planning and Programmes			
Course code: ESM XXX	**No. of credits:** 3	**L-T-P:** 45-00-00	**Learning hours:** 45
Pre-requisite course code and title (if any): N.A.			
Department: Sustainable Engineering			
Course coordinator: Dr. Sapan Thapar	**Course instructor(s):** Dr. Sapan Thapar		
Contact details: sapan.thapar@terisas.ac.in			
Course type: Programme Core	**Course offered in:** Semester 1		

Course description

The course is meant to impart knowledge on the energy sector, encompassing policies, regulations and legislative frameworks pertaining to India. Students would be sensitized about the institutional structure – governing entities/ agencies, public sector undertakings, research institutions, private companies, across the business value chain.

Prominent legislations, rules, policies and programs related to coal, oil & gas, hydro, nuclear, electricity and renewable sectors shall be discussed. These would include OALP, Coal Mining Policy, Electricity Act and RE-RPO Scheme. Special focus would be on policies pertaining to renewable energy sector, covering utility-scale and decentralized plants (both electric and non-electric formats). Students would be made aware about the new initiatives on EVs, Biofuels, Green Hydrogen. Discussions would include global practices.

Course objectives

- Impart knowledge on energy related policies, regulations, institutional framework and key stakeholders
- Provide understanding on key programmes pertaining to coal, oil & gas and electricity sectors
- Analyze efficacy of policy instruments on renewable energy sector
- Provide insights on emerging policies/ programs regarding EVs, GH2, CBM, Smart Grids, Biofuels

Course contents

Module	Topic	L	T	P
1	**Overview** Global Energy Sector Introduction to Indian energy sector Resources & Technologies (Coal, Oil, Gas, Hydro, Nuclear, Renewables) Resource Availability, Imports & Exports Energy Demand & Supply, Consumer Segments Energy Security, Energy Access Climate Change and Energy Transition	4	0	0
2	**Institutional Structure – Roles & Responsibilities (India)** Ministries – PNG, Coal, Power, NRE, State Government Bodies Regulators/ Agencies – Niti Aayog, CEA, CERC, APTEL, PNGRB, PPAC, BEE, Grid Controller, DGH PSUs - NTPC, NHPC, SJVN, Coal India, NLC, ONGC, IOCL, BPCL, NPC, PGCIL, NPCIL, SECI, Petronet LNG Energy Trading Platforms – IEX, PSIL, IGX International Agencies – IEA, IRENA, ISA, IBA Funding Agencies – PFC, REC, IREDA, IIFCL Research Agencies – CMPDI, NISE, NIWE Private Players	8	4	0

a	**Policies, Regulations, Programmes – Coal** Business Flow - Coal Mining, Excavation, Transportation; Coal Imports Legislations - Coal Mines (Nationalization); Captive Coal Mining Mineral Concession Rules MMDR Act; Coal Cess Coal Distribution & Marketing Policies	4		
b	**Policies, Regulations, Programmes – Oil & Gas** Business Flow - Exploration & Production, Refining, Transportation, Marketing Open Acreage Licensing Policy (OALP) Hydrocarbon Exploration and Licensing Policy (HELP) Discovered Small Field Policy Business Models - Production/ Revenue Sharing Contracts Refineries & Pipelines Guidelines - Domestic gas supply / City Gas Distribution Open General Licensing category and infrastructure Guidelines for Natural Gas Pricing & Pipeline Tariff Structure Role of LNG and Coal Bed Methane PMUY, Give-it-up Campaign Strategic Petroleum Reserves Pricing Policies Role of Regulator – PNGRB	8		
c	**Policies, Regulations, Programmes – Power Sector** Business Flow - Generation, Transmission, Distribution, Retail & Trading Legislations - Electricity Act-2003; Electricity Rules - 2005 National Electricity Plan; National Tariff Policy Role of CEA & CERC Policies on Thermal Power, Hydro Power, Nuclear Power Policies & Regulations on Transmission System Energy Efficiency Initiatives Key Schemes: Saubhagya, RDSS, UDAY, NSGM, IPDS, UJALA, R&M Key Court Judgements	8		
d	**Policies, Regulations, Programmes – Renewable Energy** National Action Plan on Climate Change National Solar Mission Programmes on Wind (On-shore, Repowering & Off-shore) Programmes on Biomass, Cogeneration, Small Hydro Policies– FiT, VGF, Bidding, REC-RPO Regulations on RE Tariff, Banking, Wheeling, AD, GBI Grid Code, Scheduling and Forecasting, Green Energy Corridors Green Energy Open Access, Captive / Group Captive & Corporate PPAs International Good Practices - Feed-in-Tariff (Germany), PV supply-chain Manufacturing (China), ITC/ PTC (United States)	8		

3	**Other Initiatives** International Solar Alliance Green Hydrogen Mission Global Biofuels Alliance Carbon/ Green Financing EV Policies & Schemes Schemes on decentralized energy systems Solar Rooftop - Policy framework, Programs Biofuels – Policies/ Schemes, Blending PM-KUSUM Scheme for Agriculture	5		
		45	**0**	**0**

Evaluation criteria:

- Minor exam 1: 35% (Sectoral Analysis – Coal, Oil and Gas Sector)
- Minor exam 2: 35% (Sectoral Analysis – Electricity Sector)
- Major exam: 30% (Sectoral Analysis – Renewable Energy Sector)

Learning outcomes:

- Enhanced understanding of energy policies, regulations and programs
- Role and responsibility of different entities

Pedagogical approach:

A combination of class-room interactions, tutorials and case studies/ group discussions

Materials:
Recommended readings/Reading Materials/Reference Documents:

Energy Statistics, MOSPI, GoI
Integrated Energy Policy
Reports by CEA, Niti Aayog, IEA & IRENA
Coal Mining Policy
Open Acreage Licensing Policy (Oil and gas)
Electricity Act, National Electricity Policy & Plan
Policies on Hydro & Thermal Power
Policies on Solar, Wind, Biomass
Policies on CBM, Green Hydrogen, Biofuel & EVs

Portals, Books, Journals and Magazines:
Portals - Ministries of Power, Oil & Gas, Coal, Renewable Energy, Niti Aayog, CERC, CEA, PNGRB, IEX Journals - Energy Policy, Renewable Energy

Books
Global Energy Shifts by Bruce Podobnik
Renewable Energy: Policies, Project Management and Economics by Sapan Thapar

Additional information (if any): NA

Student responsibilities:

Attendance, feedback, discipline: as per university rules.

Course Reviewers:

- Dr Marian Adela, Research Institute for Sustainability, Helmholtz Centre Potsdam, Germany
- Dr Maitreyee Mukherjee, Institute for Environment and Sustainability, National University of Singapore
- Prof. Atul Kumar, School of International Studies, JNU
- Mr DR Konda, Manager, ONGC
- Mr Avijeet Lala, Partner, Niti Niyaman (Law firm)

Enclosure 11

Course title: Energy Conservation, Audit and Management			
Course code: XYZ	**No. of credits:** 3	**L-T-P:** 42-03-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: MSc (Energy Studies & Management)			
Course coordinator:		**Course instructor:** Dr Sapan Thapar	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:

Energy Conservation has been identified as a key instrument to enhance energy security and reduce energy intensity as well as greenhouse emissions. Energy Audit helps to map the flow of energy across a process, identifying potential saving opportunities. Policy makers and technology providers have been working towards the cause of energy management and encourage its prudential use. This course is designed to educate students on the different dimensions of energy, its conservation, management and audit.

Course objectives:

- To impart knowledge in the domain of energy conservation
- To understand energy conservation measures across different consumer segments
- To inculcate knowledge and skills about assessing energy efficiency of an entity
- To understand Energy Audit procedure along with relevant technologies/tools
- To develop Energy Audit Report writing skills

Course content

Module	Topic	L	T	P
1.	**Introduction to Energy Conservation** • Overview - Global & Indian Energy Scenario • Importance of Energy Conservation • Institutional Structure and Key Initiatives	4	0	0
2.	**Policy & Regulations for Energy Conservation** • Bureau of Energy Efficiency (BEE) • Indian Programmes – PAT, S&L, Ujala, MuDSM, AgDSM, ECBC • Impact of Energy Efficiency Measures	8	0	0
3.	**Energy Audit Basics** • Definition and Objectives • Types of Audit • Energy Sources (Electrical and Non-Electrical) • Baseline Assessment and Energy Audit Report • Tools and Techniques, Audit Equipment • Roles and Responsibilities of Energy Auditor and Energy Manager	8	0	0
4.	**Energy Conservation Opportunities – Electrical and Thermal** • Building & Lighting Systems • Motors, Pumps, Transformers • Power Transmission & Distribution Systems • Boilers, Furnaces & Waste Heat Recovery Systems Cogeneration Systems HVAC, Cooling Towers & DG	8	0	0

	Systems			
5.	**Energy Analytics** • Basics of Energy Analytics • Overview on Applications and Tools • Building Energy Management Systems • Case Studies	2	0	0
6.	**Energy Efficiency Finance and Business Models** • Financing Instruments • Key Financial Ratios • Role of Energy Service Company (ESCO) & ESCO Business Models • Climate Finance • Case Studies	6	1	0
7.	**Industrial Use Cases** • Concept of Specific Energy Consumption • Use Cases - Industries/ Power Distribution Utilities/ Railways/ Buildings	6	2	0
	Total	42	03	00

Evaluation criteria

Minor Test 1: Assignment (after completion of modules 1, 2 and 3)- 20%
Minor Test 2: Written test (after completion of modules 1, 2, 3 and 4)- 25%
Minor Test 3: Written test/ Case Study Presentation (after completion of modules 5 and 6)- 25%
Major Test: Written test/ Presentation (after completion of all modules) - 30%

Learning outcomes

- Comprehend importance of energy conservation and associated policies
- Analyze energy systems from a supply and demand perspective
- Identify energy conservation opportunities in different consumer segments
- Understand procedure of energy audit (tools, techniques, finance)

Pedagogical approach

A combination of class-room interactions, tutorials, group discussions assignments, expert talks / site visits

Materials:

Text Books:

LC Witte, PS Schmidt and DR Brown: **Industrial Energy Management and Utilization** (Hemisphere Publishing Corporation, Washington, 1998).

Reference Books:

JL Threlkeld: **Thermal Environmental Engineering**, Second Edition (Prentice Hall,1970)
YP Abbi and Shashank Jain: **Handbook on Energy Audit and Environment Management**, (TERI Press, 2006)
WC Turner: **Energy Management Handbook**, Seventh Edition, (Fairmont Press Inc., 2007) George
Polimeros: **Energy Cogeneration Handbook**, (Industrial Press, Inc., New York, 1981)

Websites:

National Productivity Council (http://www.npcindia.gov.in/) Bureau of Energy Efficiency (https://www.beeindia.gov.in/) Petroleum Conservation Research Association (http://www.pcra.org/) EA/EM Guide E--Books (http://www.em-ea.org/)
Additional information (if any): N.A.
Student responsibilities Attendance, discipline, feedback as per TERI SAS rules

Course reviewers:

Dr Amarjeet Singh, Adjunct Professor, IIIT Delhi and CTO, Zenatix
Mr Shubhashis Dey, Director, Shakti Foundation
Dr O. Prasada Rao, Scientist 'F' (Retd), CSIR

Enclosure 12

Course title: Energy Science Lab			
Course code: XYZ	**No. of credits:** 3	**L-T-P:** 15-00-60	**Learning hours:** 75
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering, MSc (Energy Studies & Management)			
Course coordinator: Prof. Naqui Anwer		**Course instructor:** Prof. Naqui Anwer	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:
Laboratory experiments help in better understanding of the subjects discussed in the classes. The experiments based on basic principles related to energy stimulate students for further investigation and their application.

Course objectives:

- To provide hands-on experience on experimental setups related to basic electrical circuits
- To provide practical learning about the basic operation of electrical circuits and equipment
- To provide hands-on experience on experimental setups related to basic thermal science
- To provide practical learning about the basic operation of equipment used in determination of heat transfer coefficients, thermal mass transer and related experiments

Course content

Module	Topic	L	T	P
1.	**Familiarization with common equipment** Selection of wire and its gauge and electrical parameter measuring devices (Ammeter, Voltmeter, wattmeter, Rheostat, loading devices) while drawing single-phase and three-phase circuits (star/delta)	1		4
2.	**Identification of various components** Identification of various active (diode, transistor) and passive (R,L,C) electronic components To note how the LEDs, resistors, and connecting wires use the columns for electrical connectivity within the breadboard.	1		4
3.	**Resistance Measurement** Measure the value of a given resistor and to confirm with colour code	1		4
4.	**Verification of Laws** • Verification of Ohm's Law • Verification of KCL • Verification of KVL	1		4
5.	**Combinations of components in circuits** Series and parallel circuits for single phase load and measurement of current drawn	1		4
6.	**Power Measurement** Use of voltmeter, ammeter, and wattmeter to determine active, reactive and apparent power consumed in given RLC series circuit.	1		4

7.	**Power Measurement for domestic load** Construction of single phase circuit /electrical network to run domestic load and measurement of power drawn	1		4
8.	**Multiway Switch/ Sensor based switching** Construction of multiway switching circuit to lightup staircase	1		4
9.	**Thermal Conductance** To find the overall thermal conductance and plot the temperature distribution in case of a composite wall.	1		4
10.	**Thermal Convection** To find out the temperature distribution along the length of a Pin Fin under free convection.	1		4
11.	**Stefan Boltzmann constant** To find out the Stefan Boltzmann constant.	1		4
12.	**Temperature Measurement** To perform error analysis test on different temperature measuring sensors and their calibration w.r.t standard reference.	1		4
13.	**Water Boiling Test** To perform water boiling test (WBT) method- Cold Start, Hot Start and Simmer Start.	1		4
14.	**Calorific Value** To determine calorific value of a given sample of biomass solid fuel.	1		4
15.	**Determination of Moisture & Volatile Matter** To determine the moisture, volatile matter, ash and fixed carbon contents in a given coal lignite and biomass solid fuel.	1		4
	Total	15	0	60

Evaluation criteria

Test 1: Performance during experiments - 30%
Test 2: Viva-voce (at the end of the semester) - 30%
Test 3: Practical Exam (at the end of the semester) - 20%
Test 4: Practical Records (spread over the entire semester) - 20%

Learning outcomes

After completing this course, students would be able to:

- Identify various electrical components and appreciate various equipment used in 1-φ and 3-φ circuits
- understand series and parallel circuits
- measure power in domestic load
- use voltmeter, ammeter and wattmeter in different circuits
- verify Ohm's law, KVL, KCL
- understand practical concept of transfer of heat through conduction and connection
- Measure temperature of materials and understand the change in characteristics
- Determine calorific value of different types of fuel materials
- Determine moisture content, volatile matter, ash content and carbon content in different types of fuel materials

Pedagogical approach

Students complete a procedure given in the laboratory manual to determine the behaviour of the equipment/prototypes/experimental setups and produce the expected characteristics
Materials: • Kulshreshtha, D.C. Basic Electrical Engineering. Tata McGraw Hill, New Delhi.2012 • Herman, Stephen L.. The Complete Laboratory Manual for Electricity. United States: Thomson/Delmar Learning, 2004. • YA Cengel and AJ Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", Tata McGraw Hill, 4th edition, 2011 • Robert Alan Granger, "Experiments in Heat Transfer and Thermodynamics", Cambridge University Press, 1994
Additional information (if any): N.A.
Student responsibilities Attendance, discipline, feedback as per TERI SAS rules

Course reviewers:

Dr. Sanjay Agrawal, Professor, Pro-VC, Vivekananda Chhatishgarh Technical University, Bhilai

Dr. M. Rizwan, Professor, Department of Electrical Engineering, Delhi Technological University, New Delhi

Enclosure 13

Course title: Theories of urbanisation and their application for urban development			
Course code: MEU XXX	**No. of credits:** 3	**L-T-P:** 37-08-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:

Urbanisation is the most pervasive spatial and social transformation post-industrialisation. With over half the world's population residing in settlements which are classified as urban and the numbers expected to grow, it is important to focus attention on the processes of urbanisation, the nature of urban settlements and the outcomes of urbanisation. The course is designed to provide an understanding of the historical, economic, social, and spatial phenomena that represent the foundation of urban development and change. It covers various theories which explain the urbanisation process, formation of cities, city systems, city structures and relationships among the various entities within them. The course is structured under four modules. Module 1 sets an Overview of Urbanisation Process. Module 2 covers the Concepts of Urban Economics. Module 3 focuses on the Spatial Organisation of Cities. Module 4 is devoted Urban Sociological Theories.

Course objectives:

- To develop an understanding about the concepts and processes associated with urbanisation
- To create comprehension about the functional (land uses) and social (socio-cultural groups and areas) organisation of space in the city, and hierarchical arrangements of urban settlements

Course content

Module	Topic	L	T	P
1.	**Module 1: Concept of Urban Settlements and Urbanisation Process** a) Typology of urban settlements – statutory, non-statutory, metropolitan city, mega city, urban agglomerations b) Process and causes of urbanisation – the role of migration, industrialisation, globalisation c) City core, peri-urban areas and rural-urban interactions d) Sub urbanisation e) Consequences of urbanisation – development, livelihoods, informal settlements	10	0	0
2.	**Module 2: Concepts of Urban Economics - How do Cities Grow?** a) Agglomeration economies and scale economies b) Land use patterns, land rent c)Bid rent theory	6	0	0
3.	**Module 3: Spatial Organisation of Cities – How do Cities Differ in Size?** a) Primate City b) Rank Size Distribution c) Central Place Theory d) Internal structure of cities: Concentric Zone Theory,	12	0	0

	Sector Theory, Multiple Nuclei Theory e) Edge City Theory f) The Right to the City g) Modernism & Post modernism h) Post-Colonial Urbanism i) New Urbanism j) Sustainable Urbanism k) Transit-Oriented Development (TOD) l) Urban Renewal			
4.	**Module 4: Urban Sociological Theories** a) Demographic transition theory b) Indian city model – neighbourhoods (mohallas), markets (bazaar), residential typologies	6	0	0
5.	**Module 5: Application of these theories in a real life project** a) Selection of a theory and assessment of how these are applied in development of city structure b)Case studies	3	8	0
	Total	37	08	00

Evaluation criteria

The evaluation is based on two distinct components, viz. assignments on any one selected theory and its application in case study and an mid and end-Semester written examination covering the topics covered.

Test 1: 30% - Minor Test
Test 2: 30% - Oral presentation
Test 3: 40% - Written Examination (Evaluation linked to all Modules)

Tests 2 is an individual assignment wherein student select a theory of their interest and apply it any case study.

Learning outcomes

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

1. Develop insights on urbanisation from inter-disciplinary perspectives and demonstrate understanding of the diverse types of urban settlements, processes of urbanisation and its outcomes
2. Assess the transformation of urban spaces due to social and economic activities within urban settlements with the help of field work, secondary research
3. Gain competence in contextualising urbanisation in India for enhanced understanding of learnings from other courses of the programme

Pedagogical approach

The course will be delivered through classroom lectures, enabled by group activities and discussion on various case studies

Materials:

Books

1. Beall, Jo and Fox, Sean (2009): Cities and Development, Routledge Perspectives on Development, Routledge, London
2. Birch, Eugenie L. and Wachter, Susan M. (2011): Global Urbanization: The City in the Twenty-First Century, University of Pennsylvania Press
3. Carter, Harold (2010): The Study of Urban Geography, Rawat Publications, Jaipur, 4 th

Edition.
4. Chatterji, Tathagata (2017): Globalisation and Peri-Urban Transformation: A Comparative Analysis of the Governance Characteristics of the Three Indian Cities, Copal Publishing Group, Ghaziabad.
5. Dikshit, Jutta K. Ed. (2011): The Urban Fringe of Indian Cities, Rawat Publications, Jaipur.
6. Hoover, Edgar M. and Giarratani, Frank (1999): An Introduction to Regional Economics, Regional research Institute, West Virginia University, Available at: http://www.rri.wvu.edu/webbook/giarratani/main.htm
7. Lin, Jan and Mele, Christopher Eds. (2013): The Urban Sociology Reader, Second Edition, Routledge, Oxon, USA, pp. 83-90, 91-99
8. Morris, R.N. (2007): Urban Sociology, George Allen and Unwin Ltd., London
9. O'Sullivan, Arthur (2012): Urban Economics, Eighth Edition, McGraw Hill
10. Paul, Knox and McCarthy, Linda M. (2012): Urbanization: An Introduction to Urban Geography, Third Edition, Prentice Hall
11. Ramachandran, R. (1989): Urbanization and Urban Systems in India, Oxford University Press, New Delhi
12. Rockefeller Foundation (2008): Century of the City, The Rockefeller Foundation, New York, Available at: https://www.rockefellerfoundation.org/report/century-of-thecity/ 13. United Nations Department of Economic and Social Affairs (2011): Population Distribution, Urbanization, Internal Migration and Development: An International Perspective, UNDESA, Available at: http://wedocs.unep.org/bitstream/handle/20.500.11822/18920/Population_Distribution_Urbanization.pdf?sequence=1&isAllowed=y

Research Papers

1. Agarwal, Siddharth (2016): Urban Migration and Social Exclusion: Study from Indore Slums and Informal Settlements, IIED Working Paper, IIED, London.
2. Aijaz, Rumi (December 2017): "Measuring Urbanisation in India", ORF Issue Brief, Issue No. 218
3. Aijaz, Rumi (March 2019): "India's Peri-Urban Regions: The Need for Policy and the Challenges of Governance", ORF Issue Brief, Issue No. 285
4. Alexander, John W. (July 1954): "The Basic-Non Basic Concept of Urban Economic Functions", Economic Geography, Vol. 30, No. 3 pp. 246-261
5. Chandrasekhar, S. and Sharma, Ajay (May 2014): "Urbanization and Spatial Patterns of Internal Migration in India", Indira Gandhi Institute of Development Research, Mumbai, WP-2014-016, Available at: http://www.igidr.ac.in/pdf/publication/WP-2014- 016.pdf
6. Davis, Kingsley (March 1955): "The Origin and Growth of Urbanization in the World", American Journal of Sociology, Vol. 60, No. 5, World Urbanism, pp. 429- 437
7. Denis, Eric, Mukhopadhyay, Partha, Zérah, Marie-Hélène (2012): "Subaltern Urbanisation in India", Economic & Political Weekly, Vol. XLVII, No. 30, pp. 52-62
8. Ellison, Glenn, Glaeser, Edward L. & Kerr, William R. (June 2010): "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns", American Economic Review, Vol. 100, pp. 1195-1213
9. Glaeser, Edward L. (2007): "The Economics Approach to Cities", National Bureau of Economic Research, Working Paper 13696, Cambridge, Massachusetts, Available at: https://www.nber.org/papers/w13696.pdf
10. Glaeser, Edward L. (2010): "Introduction" In Edward L. Glaeser Ed. Agglomeration Economics, University of Chicago Press, Chicago, pp. 1-14, Available at: https://www.nber.org/chapters/c7977.pdf
11. Harris, Chauncy D. and Ullman, Edward L. (November 1945): "The Nature of Cities", The Annals of the American Academy of Political and Social Science, Vol. 242, Building

the Future City, pp. 7-17
12. Jefferson, Mark (April 1939): "The Law of the Primate City", Geographical Review, Vol. 29, No. 2, pp. 226-232
13. Kirk, Dudley (1996): "Demographic Transition Theory", Population Studies, Vol.50, pp. 361-387
14. Kundu, Amitabh (2011): "Trends and Processes of Urbanisation in India", Urbanization and Emerging Population Issues – 6, Human Settlements Group, IIED Population and Development Branch, UNFPA
15. Kundu, Amitabh (2007): "Migration and Urbanisation in India in the Context of Poverty Alleviation", Paper presented at International Conference and Workshop on Policy Perspectives on Growth, Economic Structures and Poverty Reduction, Beijing, China, 7- 9 June. Available at: https://www.networkideas.org/ideasact/jun07/Beijing_Conference_07/Amitabh_Kundu.pdf
16. Lee, Everett S. (1966): "A Theory of Migration", Demography, Vol. 3, No. 1. pp. 47-57 17. Noble, Allen G. (Winter 1998): "Using Descriptive Models to Understand South Asian Cities", Education About Asia, Vol. 3, No. 3, pp. 24-29
18. Ravenstein, E.G. (June 1885): "The Laws of Migration", Journal of the Statistical Society of London, Vol. 48, No. 2, pp. 167-235
19. Redfield, Robert & Singer, Milton B. (October 1954): "The Cultural Role of Cities", Economic Development and Cultural Change, Vol. 3, No. 1, pp. 53-73
20. Robinson, J. (2002): "Global and World Cities: A View from Off the Map", International Journal of Urban and Regional Research, Vol. 26, No. 3, pp. 531-554
21. Samanta, Gopa (May 2014): "The Politics of Classification and the Complexity of Governance in Census Towns", Economic and Political Weekly, Vol. XlIX, No. 22, pp. 55-62
22. Smailes, Arthur E. (1969): "The Indian City: A Descriptive Model", Geographische Zeitschrift, 57. Jahrg., H. 3, pp. 177-190, Available at: http://www.jstor.org/stable/27816984
23. Tacoli, Cecilia, McGranahan, Gordon & Sattherthwaite, David (March 2015): Urbanisation, Rural-Urban Migration and Urban Poverty, IIED Working Paper, IIED, London, pp. 1-33
24. Wirth, Louis (1938): "Urbanism as a Way of Life", American Journal of Sociology, Vol. 44, No. 1, pp. 1-24

Please note: For data related to population of India, refer to the Census of India data sets available at http://censusindia.gov.in/

Additional information (if any): N.A.

Student responsibilities
The students are expected to maintain the required attendance and actively participate in class discussions.

Course reviewers:

1. Dr Vinod Tewari, Formerly Director National Institute of Urban Affairs, New Delhi and Professor/Dean Indian Institute of Management Bangalore.
2. Dr Sudesh Nangia, Retired Professor, CSRD and National Coordinator, UGC - Faculty Recharge Programme, JNU, New Delhi.

Enclosure 14

Course title: Urban Development Policies and Programmes			
Course code: MEU XXX	**No. of credits:** 3	**L-T-P:** 39-06-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:

This course is designed to understand and examine various urban development policies and programmes that have been implemented in the country to: (i) promote a balanced urban development, (ii) create conducive environment for the development of required infrastructure and services, and (iii) assist in efficient management of urban areas. It will present a historical perspective of the policies and programmes as evolved since Independence. The course will provide a critical analysis of recent policies and programmes which are impacting urban development across the country. The course is structured under four modules. Module 1 provides an overview of urban development policies and programmes, implementing institutions, role of each level of organisations. Modules 2 and 3 covers an understanding of the urban development policies and programmes in the traditional and present context. Module 4 higlights the policies and programmes in the global context. Module 5 is devoted to the critical review of on-going policies and programmes. It also looks into the change of a particular overtime and assess its impacts.

Course objectives:

- To generate awareness and knowledge about the rationale and contents of various urban policies and related programmes which have been implemented since Independence
- To develop critical understanding about effectiveness of the implementation of urban development programmes which are designed to achieve the goals of these policies, for taking the urbanisation agenda forward
- To develop an understanding of the urban policies and programmes of other countries that are adopted to tackle the challenges of urbanisation.
- To assess the changes in policies overtime to deal with the pressing urban challenges and highlight its impact.

Course content

Module	Topic	L	T	P
1.	**Overview of Urban Development Policies and Programmes** • Urban development policies and programmes in the Five-Year Plans • Recommendations of the National Commission on Urbanisation (NCU) and need for reforms • Overall institutional framework and sectors for the implementation of the policies and programme • Role of central, state, city and ULB level in implementation of policies and programmes • Progressing towards sustainable cities and communities (Sustainable Development Goal 11)	10	0	0
2.	**Urban Development Policies: In Traditional Context**	8	0	0

	• Urban Community Development Programme, 1958. • Constitution (Seventy-Fourth) Amendment Act, 1992. • Swarna Jayanti Shahari Rozgar Yojana (SJSRY), 1997 • National Policy on Urban Street Vendors, 2004 • Jawaharlal Nehru National Urban Renewal Mission (JNNURM), 2005 • Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT), 2005 • Integrated Housing and Slum Development Programme (IHSDP), 2005 • National Urban Transport Policy,2006 • National Urban Housing and Habitat Policy,2007 • National Urban Sanitation Policy,2008			
3.	**Urban Development Policies, Missions and Programmes: In Present Context** • NITI Aayog • Rajiv Awas Yojna, 2013 • Pradhan Mantri Awas Yojna, 2015 • AMRUT • Smart City Mission • HRIDAY • Deen Dayal Antyodaya Yojana – National Urban Livelihood Mission (DAY-NULM) • National Rural Livelihoods Mission • National Water Policy • National Electricity Policy • National Health Policy • National Education Policy • National Tourism Policy • National Environmental Policy	14	0	0
4.	**International Policies and programmes** • National Urban Policy facilitated by the UN Habitat • OECD (Organisation for Economic Co-operation and Development)Policies • Cities and Local Government Devolution Act (City Deals) in the UK • National Urban Policy in Australia	7	0	0
5.	**Critical Assessment of existing policies and case studies**	0	6	0
	Total	39	06	00

Evaluation criteria

The evaluation is based on two distinct components, viz. assignments on any one selected policy or programme from Modules 2, 3 and 4 and an mid and end-Semester written examination covering the topics covered.

Test 1: 30% - Minor Test
Test 2: 30% - Oral presentation
Test 3: 40% - Written Examination (Evaluation linked to all Modules)

Tests 2 is a group assignment wherein students select a policy/programme of their interest. The assignment is based on review of a selected urban policy or programme and its implementation at a city/State level. The review shall comprise an analysis of policy/programme framework – content and need of the policy/programme; process – formulation and implementation; evaluation. The assignment will use data collected from secondary sources, literature. Students are encouraged to collect primary data through fieldwork to enhance their understanding of programme implementation.
Class participation is evaluated based on discussions held on course readings and/or any other additional readings relevant to the course as well as participation in tutorials for progress of work.

(Evaluation linked to Modules 2, 3 and 4)

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

1. Have a good understanding of the processes, goals and contents of various urban development policies and programmes in India

2. Analyse various provisions of urban development policies and programmes, their implementation, and the institutional mechanisms for their implementation

3. Develop a perspective to enable them to suggest ways to improve the policies and their implementation to achieve sustainable urban development

Pedagogical approach

The course will be delivered through classroom lectures, enabled by group activities and discussion on various case studies

Materials:

1. All urban development policy and programme documents available from the website of the Ministry of Housing and Urban Affairs (formerly Ministry of Urban Development and Ministry of Housing and Urban Poverty Alleviation), Government of India (http://mhupa.gov.in) and individual sites of the urban development Missions
2. Progress of work under different urban development programmes available at: http://mohua.gov.in/cms/progress-reports.php; https://data.gov.in/
3. Five Year Plans documents and mid-term review as available from the website of Planning Commission, Government of India (http://planningcommission.gov.in/index_oldpc.php) and on SDGs from the website of NITI Aayog (https://www.niti.gov.in/niti/)

Research Papers:

1. Aijaz, Rumi (January 2020): "The Smart Cities Mission in Delhi, 2015-2019: An Evaluation", ORF Special Report No. 98, Observer Research Foundation
2. Batra, Lalit (April 2009): A Review of Urbanisation and Urban Policy in Post-

Independent India, Working Paper Series, CSLG/WP/12, Centre for the Study of Law and Governance, Jawaharlal Nehru University, New Delhi
3. Bedi, Jayana and Prashant Narang (2020): Progress Report 2020: Implementing the Street Vendors Act, Centre for Civil Society
4. Bhagat, R.B. (September 2014): "Urban policies and programmes in India: Retrospect and prospect", YOJANA, pp. 4-8
5. CEPT University and ICOMOS India (2017): HRIDAY Reflections: A Monograph on Heritage City Development Augmentation Yojana, Ministry of Housing and Urban Affairs, Government of India
6. D'Souza, Renita (2019): "Housing poverty in urban India: The failures of past and current strategies and the need for a new blueprint", ORF Occasional Paper No. 187, Observer Research Foundation
7. Gauba, Rajiv (2017): "Improving urban infrastructure", Indian Journal of Public Administration, Vol. 63 (2), pp. 165–175
8. INTACH (2015): PEARL Compendium of Good Practices: Urban Heritage in Indian Cities, Available at: https://www.niua.org/pearl/sites/default/files/books/GP-IN4_HERITAGE.pdf
9. Mahadevia, Darshini (July 30, 2011): "Branded and renewed? Policies, politics and processes of urban development in the reform era", Economic and Political Weekly, Vol XLVI, No 31, pp. 56-64
10. Naik, Mukta (2015): "Informal rental housing typologies and experiences of low-income migrant renters in Gurgaon, India", Environment and Urbanization Asia, Vol 6 (2), pp. 154-175
11. Shaw, Annapurna (January 27, 1996): "Urban policy in post-Independent India: An appraisal", Economic and Political Weekly, pp. 224-228
12. Singh, Satpal (November 2020): "Solid waste management in urban India: Imperatives for improvement", ORF Occasional Paper No. 283, Observer Research Foundation
13. Vaidya, Chetan (July 2009): Urban Issues, Reforms and Way Forward in India, Working Paper No.4/2009-DEA, Department of Economic Affairs, Ministry of Finance, Government of India

Additional information (if any): N.A.

Student responsibilities

The students are expected to maintain the required attendance and actively participate in class discussions.

Course reviewers:

Dr K K Pandey, IIPA, New Delhi
Prof. Om Prakash Mathur, Senior Fellow, ISS, New Delhi

Enclosure 15

Course title: Geoinformatics for urban development management			
Course code: MEU XXX	**No. of credits:** 3	**L-T-P:** 29-05-22	**Learning hours:** 56
Pre-requisite course code and title (if any):			
Department: Sustainable Engineering			
Course coordinator:		**Course instructor:**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description:

In today's time, spatial data analysis helps support decision making in urban domain. It is prudent that the students of MTech Urban Development Management learn the techniques of spatial data analysis that includes data collection, management, interpretation and analysis. The course is designed to introduce the concepts and develop understanding of Geographic Information System (GIS) and remote sensing imageries application in urban domain to the students joining the program and holding graduation from varied disciplines. The course structure will help them build knowledge base and develop skills that they can use in various courses and in practice.

Course objectives:

1. To provide understanding of remote sensing / GIS techniques.
2. To develop acumen of remote sensing/ GIS tool application for urban development and management.
3. To enable handling of raster data including image classification and hyperspectral analysis.
4. To develop technical skills in GIS application and software for spatial analysis.

Course content

Module	Topic	L	T	P
1.	**Introduction to Remote sensing:** Electromagnetic spectrum and earth observation, Types of sensors and applications, Sensor resolutions, Image correction, Spatial referencing, Image interpretation, Elements of visual interpretation	6	0	4
2.	**Applications of Remote sensing for Urban Management** Supervised and unsupervised classification for mapping land use land cover, Thermal remote sensing for land surface temperature mapping, Hyperspectral remote sensing for vegetation index and built-up index mapping, Spatial statistics – neighbourhood and zonal statistics, Case examples**,** Understanding of Analytical Hierarchy Process for conducting Land Suitability Analysis	9	2	6
3.	**Introduction to GIS:** Evolution of cartography, Geographic Information System – definition, history, current trends and future, concepts and components of GIS, Big data in GIS, and other geospatial technologies. Introduction to the interface of Arc GIS	2	0	0
4.	**GIS and its components:** Spatial data: Definition, VS Nonspatial data, types (raster and vector), characteristics, sources (including Bhuvan Geo-portal), creation, topology, and standards, Introduction to spatial data analysis. National level initiatives for creating spatial data infrastructure in India.	2	1	0
5.	**Introduction to Mapping Components of GIS:**	6	2	4

	Spatial and non-spatial database management systems, Spatial data types, Vector representations, Topology and spatial relationships, Sequential query language (Spatial), Map Coordinate Systems (Data Reprojection GCS to UTM)			
6.	**Applications of GIS for Urban Management:** Digitizing urban features, Data Collection (Mobile survey, Geotagging photos, geocoding, Data quality/data gaps checks and repairs, Data interpolation, Spatial data analysis (overlay functions, proximity analysis, multicriteria analysis), Data visualization (symbology, map layout and for alternate platforms), Case examples	4	0	8
	Total	29	5	22
Details of the lab				
1	Acquiring remote sensing imagery and spatial referencing of imageries			2
2	Image correction technique			2
3	Supervised and unsupervised image classification and validation through site visits			2
4	Land surface temperature mapping			2
5	Normalized Difference Vegetation Index, Normalized Difference Built-up Index mapping and spatial statistics			2
6	Spatial database management and attribute management			2
7	Map projection and datum			2
8	Vector data acquisition using open-source platforms, digitization and editing			2
9	Spatial and non-spatial SQL, Join and Relate with vector data			2
10	Spatial data analysis			2
11	Map visualization, data classification and map composition			2

Evaluation criteria

Lab assignments / tutorial
Minor test 1: 15%, Assessment based on module 1 & 2
Minor test 2: 15%, Assessment based on module 3 & 4
Lab Assignments/Tutorials: 20%, submission of regular assignments in correspondence to practical lab components, showcase learning of tools and methods based on lab component module 5-6
Project: 20%, a project on integrated application of the tools and methods taught throughout the semester.
Major test: 30%, overall syllabus and course

Learning outcomes

Students will be able to
1. Use remote sensing imageries in various applications of urban development and management.
2.Know the basic concepts in GIS and work with basic tools in GIS software
3. Gather and manage spatial data.
4. Conduct analysis using spatial data on GIS platforms.
5. Generate maps ready for visual interpretation and inclusion in reports and presentations.

Pedagogical approach

The course is designed in a way that remains independent of a particular software. The knowledge gathered can be applied on any platform. For practical exercises in the class ERDAS IMAGINE and ArcGIS will be used.

Materials:

1. Jensen J., Remote Sensing of the Environment: An Earth Resource Perspective, Pearsons, 2009.
2. Lillesand T., Kiefer R. W. and Chipman J., Remote Sensing and Image Interpretation, Wiley & Sons, 2009.
3. Lo, C.P. and Yeung, A.K.W., Concepts and Techniques of Geographic Information Systems, PHI Leaning Private Limited 2011.
4. Longley P. A., Barnsley M. J., Donnay Jean-Paul, Remote Sensing and Urban Analysis, Taylor & Francis, 2001.
5. Yang, X., Urban Remote Sensing Monitoring, Synthesis and Modeling in the urban Environment, Wiley Blackwell, 2011.

Journals for reference:

Computers, Environment and Urban Systems
International Journal of Geographic Information Systems
Urban Planning and Development

Additional information (if any): N.A.

Student responsibilities

Timely submission of weekly lab assignments, Initiative for conducting project, regularity in class, thorough reading of provided material, practice, etc.

Course reviewers:

1. Dr. A. K. Gosain, Professor, Department of Civil Engineering, Indian Institute ofTechnology Delhi
2. Ms. Eleza Boban, Senior GIS Specialist, Stantec, Qatar

Enclosure 16

Year	Courses	Current Credits	New as per NHEQF- (20 credits minimum, across all semesters)
First Year			
1st Semester	8 Core Courses	26	20 (6 core courses)
2nd Semester	7 Core Courses + Field Trip	24	20 (6 courses)
Second Year			
3rd Semester	2 Core Courses + 2 Electives and 1 Minor Project	17	22 (5 Core Courses + 2 Electives and 1 Minor Project of 8 credits)
4th Semester	Major Project	16	20 (to be approved across programmes)

SEMESTER 1

Course No.	Course Title	Type	Existing Number of Credits	Revision as per NHEQF
NRE 115	Environmental statistics	Core	4	4
WSW 131	Hydraulics	Core	3	3
WSW 143	Water resources - Institutions and governance	Core	3	3
WSW 145	Water Quality monitoring methods and analysis	Core	3	3
WSW 163	Gender, rights and equity perspective for sustainable water management	Core	3	Shifted to 3rd semester
WSW 167	Applied hydrology and meteorology	Core	3	3
WSW 169	Introduction to Geoinformatics	Core	4	4
WSW 181	Water planning and management	Core	3	Shifted to 3rd semester

SEMESTER 2

Course No.	Course Title	Type	Existing Number of Credits	Revision as per NHEQF
WSW 101	Field trip on Water Management Practices	Core	1	Removed, Non-credit field trip shall continue
WSW 124	Water audit and demand management	Core	3	3
WSW 136	Irrigation water and drainage management	Core	4	4
WSW 147	Economic and financial evaluation of water infrastructure	Core	4	4
WSW 154	Aquatic eco-system management	Core	3	May be removed
WSW 164	Integrated watershed and river basin management	Core	3	3
WSW 179	Qualitative research methods and technical writing	Core	3	3
WSW 184	Water supply and sanitation	Core	3	3

SEMESTER 3

Course No.	Course Title	Type	Existing Number of Credits	Revision as per NHEQF
WSW 163	Gender, rights and equity perspective for sustainable water management	Core	0	3
NRE 163	Groundwater hydrology and management	Elective*	3	3
WSW 107	Minor Project in Water Science and Governance	Core	6	8
WSW 132	Industrial pollution control	Elective*	3	3
WSW	Water law	Core	3	May be

153				removed
WSW 177	Social, economic and health dimensions of water, sanitation and hygiene	Elective	3	May be removed
WSW 181	Water planning and management	Core	0	3
WSW 182	Water security and conflict management	Core	2	2

- Students can choose electives from other programs in lieu of the proposedones.

SEMESTER 4

Course No.	**Course Title**	**Type**	**Existing Number of Credits**	Revision as per NHEQF
WSW 108	Major Project in Water Science and Governance	Core	16	20

Enclosure 17

Revised Programme Outline: MSc (Economics)

S No	**Existing programme outline**			**Proposed programme outline**		
	Semester 1			Semester 1		
	Course code	Course title	Type	Course code	Course title	Type
1	MPE 127	Macroeconomics-I	Core	MPE 127	Macroeconomics-I	Core
2	MPE 134	Microeconomics-I	Core	MPE 134	Microeconomics-I	Core
3	MPE 186	Econometrics-I	Core	MPE 186	Econometrics-I	Core
4	MPE 113	Mathematical methods for economics	Core	Yet to be decided	**Real Analysis and Optimization**	**Core**
5	NA	NA	NA	**MPE 184**	**Development Economics**	**Core**
Total credits			16	**Total credits**		**20**

S No	**Existing programme outline**			**Proposed programme outline**		
	Semester 2			Semester 2		
	Course code	Course title	Type	Course code	Course title	Type
1	MPE 129	Macroeconomics-II	Core	MPE 129	Macroeconomics-II	Core
2	MPE 137	Microeconomics-II	Core	MPE 134	Microeconomics-II	Core
3	MPE 187	Econometrics-II	Core	MPE 187	Econometrics-II	Core
4	MPE 152	Environmental Economics	Core	MPE 152	Environmental Economics	Core
5	NA	NA	NA	**Yet to be decided**	**Linear Algebra and Dynamic Optimization**	**Core**
Total credits			16	**Total credits**		**20**

S No	**Existing programme outline**			**Proposed programme outline**		
	Semester 3			Semester 3		
	Course code	Course title	Type	Course code	Course title	Type

1	MPE 176	Methods of Research in Economics	Core	MPE 176	Methods of Research in Economics	Core
2	MPE 184	Development Economics	Core	MPE 153	Natural Resource Economics	Core
3	MPE 153	Natural Resource Economics	Core	**Students may opt for *at least three* electives**		
Students may opt for *at least two* electives				MPE 154	Economics of Health and Environment	Elective
4	MPE 154	Economics of Health and Environment	Elective	MPE 122	Indian Agricultural Development: Contemporary Issues	Elective
5	MPE 122	Indian Agricultural Development: Contemporary Issues	Elective	MPE 156	Theory of Contracts	Elective
6	MPE 156	Theory of Contracts	Elective	MPE 188	Labour Economics	Elective
7	MPE 188	Labour Economics	Elective	MPE 193	Trade, Development and Environment	Elective
8	MPE 193	Trade, Development and Environment	Elective	MPE 157	Auctions and Mechanism Design	Elective
9	MPE 157	Auctions and Mechanism Design	Elective			
Total credits			20	Total credits*		20

S. No	**Existing programme outline**			**Proposed programme outline**		
	Semester 4			Semester 4		
	Course code	Course title	Type	Course code	Course title	Type
1	MPE 108	Master's thesis	Core	MPE 108	Master's thesis	Core
Total credits			20	Total credits		20

Enclosure 18

Revised Course Outline of 'Real Analysis and Optimisation'

Coursetitle:Real Analysis and Optimisation			
Coursecode: TBD	No. ofcredits:4	L-T-P:48-12-0	Learninghours:60
Pre-requisitecoursecodeandtitle:			
Department:DepartmentofPolicy and ManagementStudies			
Coursecoordinator:	Courseinstructor:		
Contactdetails:			
Coursetype:Core	Courseofferedin:1st semester		
Coursedescription: This is an introductory course on the fundamentals of mathematics that is heavily used in certain disciplines of economics – microeconomics, macroeconomics, etc. The course is broadly divided into two parts: one is real analysis and the other is optimisation. The course covers sequences, limits, continuity, differentiability, convex analysis, unconstrained optimisation, optimisation with equality and inequality constraints.			
Courseobjective: 1. To develop the core concepts of mathematics that are used in economics. 2. To develop mathematical sophistication and proof writing. 3. To build analytical and technical skills by rigorous analysis. 4. To apply these techniques and skills in economic applications.			

Coursecontents

S.No	Topics	L	T	P
1	**Preliminaries.** Logic: Statements, conjuction and disjunction, implications, necessity and sufficiency, contrapositive and converse, quantifiers, theorems and proofs. Sets and functions: domain, range, types of functions, direct and inverse images, inverse and composite functions. Cardinality: finite sets, denumerable sets, countability.	4		
2	**Real Analysis I.** Supremum and infimum: upper bound, lower bound, bounded sets, completeness property, Archimedean property. Sequences and limits: metric spaces, sequences on the real line, convergence, limit point, cluster point, divergence, bounded sequences, limit supremum, limit infimum, algebraic limit theorem, squeeze theorem, monotone sequences, monotone convergence theorem, subsequence, Bolzano-Weierstrass theorem, Cauchy criteria, completeness, functional limits.	9	3	
3	**Real Analysis II.** Topology: open ball, neighborhood, interior points, closure points, accumulation points, interior of a set, closure of a set, open sets, closed sets, characterisations, open cover, compact sets, Heine-Borel theorem. Continuity and differentiability: continuity and its characterizations, Bolzano's intermediate value theorem, differentiability on the real line, characterisations,	9	3	

	Caratheodory's theorem, Rolle's theorem, mean value theorem, differentiability in higher dimensions, partial derivatives, characterizations.			
4	**Real Analysis III.** Convex sets, subgraph and epigraph of a function, concavity and convexity, characterizations, contour sets, quasiconcavity and quasiconvexity.	6	1	
5	**Optimisation.** Optimisation problems, existence of solutions, Weierstrass theorem. Motivating examples: utility maximisation, cost minimisation, profit maximisation, exchange economy.	4		
6	**Unconstrained optimisation.** Unconstrained optimisation problems, unconstrained maximum, local maximum, unconstrained local maximum, strict local maximum, first-order condition, second-order condition.	4	1	
7	**Optimisation with equality constraints.** Optimisation problems with equality constraints, theorem of Lagrange, constraint qualification under equality constraints, cookbook procedure and its limitations, sufficient conditions for cookbook procedure. Applications: utility maximisation with Cobb-Douglas utility function, cost minimization.	6	2	
8	**Optimisation with inequality constraints.** Optimisation problems with equality constraints, theorem of Kuhn and Tucker, constraint qualification under inequality constraints, cookbook procedure and its limitations, sufficient conditions for cookbook procedure. Applications: utility maximisation with perfect substitutes utility function, cost minimization.	6	2	
	Total	48	12	

Pedagogical approach:

Classroom teaching and problem-solving sessions.

Evaluationcriteria:

Minor1:WrittenExamination- 30% [Syllabus: 1-2, Learning outcomes: 1-3]
Minor 2: Written Examination - 30% [Syllabus: 3-4, Learning outcomes: 1-3]
Major:WrittenExamination -40% [Syllabus: 5-8, Learning outcomes: 1-4]

Learningoutcomes:

1. To understand the core concepts of mathematics.
2. To develop mathematical sophistication.
3. To write proofs rigorously.
4. To apply concepts and results in economic applications.

Core readings:

1. S. Abbott. "Understanding Analysis" (2016) (SA)
2. R. Sundaram. "A First Course in Optimization Theory" (1996) (RS)

Additional readings:

1. R. Bartle, D. Sherbert. “Introduction to Real Analysis” (2010) (RB)
2. C. Simon, L. Blume. “Mathematics for Economists” (2018)

Module-wise chapters:

1. Module 1: SA, Chapter 1 [Learning outcomes: 1]
2. Module 2: SA, Chapters 1 and 2; RS: Chapter 1 [Learning outcomes: 1-3]
3. Module 3: SA, Chapters 3-5; RS: Chapter 1 [Learning outcomes: 1-3]
4. Module 4: RS, Chapters 7-8 [Learning outcomes 1-3]
5. Module 5: RS, Chapters 2 and 3 [Learning outcomes: 1-3]
6. Module 6: RS, Chapter 4 [Learning outcomes: 1-3]
7. Module 7: RS, Chapters 4 and 5 [Learning outcomes: 1-4]
8. Module 8: RS, Chapter 6 [Learning outcomes: 1-4]

Coursepreparedby:Sanyyam Khurana

Studentresponsibilities: Attendance,feedback,discipline:asperuniversityrules.

Coursereviewers:

1. Abhijit Banerji. Professor, Department of Humanities and Social Sciences, Indian Institute of Technology Delhi
2. Sudhir Shah. Professor, Department of Economics, Delhi School of Economics

Revised Course Outline of 'Linear Algebra and Optimisation'

Coursetitle:Linear Algebra and Dynamic Optimisation			
Coursecode: TBD	No. ofcredits:4	L-T-P:51-9-0	Learninghours:60
Pre-requisitecoursecodeandtitle:			
Department:DepartmentofPolicy and ManagementStudies			
Coursecoordinator:	Courseinstructor:		
Contactdetails:			
Coursetype:Core	Courseofferedin:2nd semester		
Coursedescription: This course develops fundamentals of certain areas of mathematics that are relevant to growth economics, game theory, resource economics, and econometrics. The course covers vector spaces, linear transformations, inner product spaces, spectral theory, difference and differential equations, dynamic optimisation in discrete and continuous time.			
Courseobjective: 5. To develop the core concepts of mathematics that are used in economics. 6. To develop mathematical sophistication and proof writing. 7. To build analytical and technical skills by rigorous analysis. 8. To apply these techniques and skills in economic applications.			

Coursecontents

S.No	Topics	L	T	P
1	**Linear Algebra I.** Vector spaces: Real vector space, subspace, span, linear independence and dependence, characterizations, sum, direct sum. Bases and dimension: basis, standard basis, finite dimensional vector space, existence of a basis and its characterization, dimension and its properties.	6	1	
2	**Linear Algebra II.** Linear transformation: linear transformation and its types, transformation matrix, change of basis. Null space and range: null space, range, nullity, rank, fundamental theorem of linear algebra. Inner product spaces: inner product space, normed space, orthogonality, Pythagorean theorem, Cauchy-Schwarz inequality, Parallelogram equality, polarisation identity, othronormal bases, Gram-Schmidt. Spectral theory: eigenvalue, eigenvector, spectrum, diagonalization.	8	1	
3	**Discrete dynamics.** Linear systems in one dimension: difference equations, characterisation, steady state equilibria, existence results, stability of steady states, local stability, global stability. Linear systems in multi dimensions: characterisation, steady states, existence of equilibria, stability analysis.	4		

4	**Differential equations.** First-order ordinary differential equations, solutions, homogeneous equations, stability, saddle points, Picard's existence theorem.	7	1	
5	**Preliminaries for dynamic optimisation** Preliminaries: metric spaces, correspondences, upper hemicontinuity, lower hemicontinuity, contraction mapping theorem, Blackwell's sufficient conditions, theorem of the maximum.	8		
6	**Dynamic optimisation in discrete time.** Finite horizon: Dynamic programming, value function, existence result, Bellman equation. Infinite horizon: Dynamic programming (sequence problem), value function (recursive formulation), Bellman equation (principle of optimality), Euler equation, transversality condition, existence result, concavity of value function. Application: consumption-saving problem, optimal growth model, cake eating problem, tree cutting problem.	10	3	
7	**Optimal control theory.** Dynamic optimisation in continuous time, Hamiltonian function, maximum principle, Mangasarian's sufficient conditions, Arrow's sufficient conditions, transversality conditions. Application: optimal growth model in continuous time.	8	3	
	Total	51	9	

Pedagogical approach:

Classroom teaching and problem-solving sessions.

Evaluationcriteria:

Minor1:WrittenExamination- 30% [Syllabus: 1-2, Learning outcomes: 1-3]
Minor 2: Written Examination - 30% [Syllabus: 3-4, Learning outcomes: 1-4]
Major:WrittenExamination -40% [Syllabus: 5-7, Learning outcomes: 1-4]

Learningoutcomes:

5. To understand the core concepts of mathematics.
6. To develop mathematical sophistication.
7. To write proofs rigorously.
8. To apply concepts and results in economic applications.

Core readings:

3. S. Axler. "Linear Algebra Done Right" (1997) (SA)
4. O. Galor. "Discrete Dynamical Systems" (2003) (OG)
5. G. Simmons, S. Krantz. "Differential Equations: Theory, Technique, and Practice" (2007) (SK)
6. D. Acemoglu. "Introduction to Modern Economic Growth" (DA)
7. R. Sundaram. "A First Course in Optimization Theory" (1996) (RS)

Additional readings:

3. A. Chiang. "Elements of Dynamic Optimization"
4. G. Strang. "Linear Algebra and its Applications", 3rd edition (1998)
5. N. Stokey, R. Lucas. "Recursive Methods in Economic Dynamics" (1988)

Module-wise chapters:

9. Module 1: SA, Chapters 1-3 [Learning outcomes: 1-3]
10. Module 2: SA, Chapters 3 and 10 [Learning outcomes: 1-3]
11. Module 3: OG, Chapters 1-2 [Learning outcomes: 1-3]
12. Module 4: SK, Chapters 3, 10-11 [Learning outcomes: 1-4]
13. Module 5: DA, Chapter 6 [Learning outcomes: 1-3]
14. Module 6: DA, Chapter 6; RS, Chapters 11-12 [Learning outcomes: 1-4]
15. Module 7: DA, Chapter 7 [Learning outcomes: 1-4]

Coursepreparedby:Sanyyam Khurana

Studentresponsibilities: Attendance,feedback,discipline:asperuniversityrules.

Coursereviewers:

1. Abhijit Banerji. Professor, Department of Humanities and Social Sciences, Indian Institute of Technology Delhi
2. Sudhir Shah. Professor, Department of Economics, Delhi School of Economics

Enclosure 19

Revised Course Outline of 'Intermediate Microeconomics I'

Coursetitle:Intermediate Microeconomics I			
Coursecode: TBD	No. ofcredits:4	L-T-P:46-14-0	Learninghours:60
Pre-requisitecoursecodeandtitle: UEO 103: Introductory Mathematical Methods for Economics, UEO 102: Basic Mathematics for Economics, UDS 103: Mathematics for Data Science			
Department:DepartmentofPolicy and ManagementStudies			
Coursecoordinator:	Courseinstructor:		
Contactdetails:			
Coursetype:Core	Courseofferedin:3rd Semester		
Coursedescription: This is a second course on microeconomics which uses calculus that was taught in mathematical economics courses. Broadly, the course is divided into four parts. The first part teaches preferences of a consumer, utility representations, and demands. The second part focuses on production, profit maximisation, and cost minimisation. The third part focuses on different forms of markets – perfect competition and monopoly. The fourth part focuses on general equilibrium and welfare economics.			
Courseobjective: 1. To learn fundamentals of microeconomics using calculus. 2. To apply the core concepts in economic applications.			

Coursecontents

S.No	Topics	L	T	P
1	**Consumer choice I** Preference relations, budget sets, utility representations, cardinal and ordinal utilities, indifference curves, marginal utility, and marginal rate of substitution. Examples of utility functions: Cobb-Douglas, perfect substitutes, perfect complements, CES, and quasi-linear.	8	3	
2	**Consumer choice II** Optimality, Marshallian demands, normal and inferior goods, income offer curves and Engel curve, price offer curve and demand curve, law of demand, substitutes and complements. Substitution and income effects, Slutsky equation, Hicksian demand, revealed preferences, weak axiom of revealed preference, intertemporal choice. Uncertainty, expected utility, risk averse, risk neutral, risk loving preferences.	8	3	
3	**Production and Costs** Technology, marginal product, technical rate of substitution, short and long run, returns to scale, and elasticity of substitution. Examples of technology functions: Cobb-Douglas, perfect substitutes, perfect complements, CES, and quasi-linear. Cost minimization, cost functions, expansion path, fixed and sunk costs, average costs, variable costs, cost-output elasticity, marginal costs and duality with technology.	6	2	

4	**Markets I: Perfect competition** Firm: Perfect competition, demand function of a firm, short-run supply function of a firm, shutdown decision, profit maximization, input demand, producer surplus. Market: market demand, short-run market supply, short-run supply elasticity, short-run equilibrium, long-run supply, long-run supply elasticity and long-run equilibrium.	6	2	
5	**Markets II: Monopoly** Monopolist's problem, linear demands and profits, marginal revenue and elasticity, rectangular hyperbola demands and profits, non-existence of supply functions, deadweight loss. Price discrimination: first-degree price discrimination, second-degree price discrimination, and third-degree price discrimination.	6	2	
6	**General equilibrium** Exchange, endowments, Edgeworth box, Pareto efficiency, relative prices, competitive equilibrium, first theorem of welfare economics, second theorem of welfare economics, applications.	8	2	
7	**Welfare economics** Social welfare function, individual preferences, axioms of Pareto, independence of irrelevant alternative and dictatorship, Arrow's impossibility theorem.	4		
	Total	46	14	

Pedagogical approach:

Classroom teaching and problem-solving sessions.

Evaluationcriteria:

Minor1:WrittenExamination- 30% [Syllabus: 1-4, Learning outcomes: 1-6]
Minor 2: Written Examination - 30% [Syllabus: 5-6, Learning outcomes: 1-6]
Major:WrittenExamination -40% [Syllabus: Complete course, Learning outcomes: 1-6]

Learningoutcomes:

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

1. Understand the core concepts of microeconomics. [Modules 1-6]
2. Analyze an economic problem graphically. [Modules 1-6]
3. Solve an economic problem mathematically using calculus. [Modules 1-6]
4. Build intuitions of the core results. [Modules 1-6]
5. Figure out the cases where cookbook methods are not applicable. [Modules 1-6]
6. Apply the concepts and results in economic applications. [Modules 1-6]

Core reading:

8. H. Varian, "Intermediate Microeconomics: A Modern Approach", 8th edition (2010) (HV)
9. W. Nicholson, C. Snyder. "Microeconomic Theory: Basic Principles and Extensions", 10th edition (NS)

Additional readings:

10. T. Bergstorm, H. Varian. “Workouts in Intermediate Microeconomics” (2014)

Module-wise chapters from the core reading: H. Varian, “Intermediate Microeconomics”, 8th edition (2010) (HV)

1. Module 1: HV, Chapters 2, 3 and 4
2. Module 2: HV, Chapters 5, 6, 7, 8, 10, and 12
3. Module 3: NS, Chapters 9 and 10
4. Module 4: NS, Chapters 11 and 12
5. Module 5: NS, Chapter 14
6. Module 6: HV, Chapter 31
7. Module 7: HV, Chapter 33

Coursepreparedby:Sanyyam Khurana

Studentresponsibilities: Attendance,feedback,discipline:asperuniversityrules.

Coursereviewers:

1. Souvik Dutta. Assistant Professor, Indraprastha Institute of Information Technology Delhi
2. Ankush Garg. Assistant Professor, Jindal School of Government and Public Policy O.P. Jindal Global University

Revised Course Outline of 'Intermediate Microeconomics II'

Coursetitle:Intermediate Microeconomics II			
Coursecode: TBD	No. ofcredits:4	L-T-P:45-15-0	Learninghours:60
Pre-requisitecoursecodeandtitle:UEO 103: Introductory Mathematical Methods for Economics, UEO 102: Basic Mathematics for Economics, UDS 103: Mathematics for Data Science, Intermediate Microeconomics I			
Department:DepartmentofPolicy and ManagementStudies			
Coursecoordinator:	Courseinstructor:		
Contactdetails:			
Coursetype:Core	Courseofferedin:4th Semester		
Coursedescription: This is a second course on intermediate microeconomics that focuses on basic game theory under complete information, oligopoly, externalities, public goods, and information.			
Courseobjective: 3. To learn fundamentals of microeconomics using calculus. 4. To apply the core concepts in economic applications.			

Coursecontents

S.No	Topics	L	T	P
1	**Game theory I** Simultaneous move games: Introduction to game theory, simultaneous move games under complete information, payoff matrix, strategy, Nash equilibrium, best responses, dominated strategies, iterated elimination of dominated strategies. Mixed strategies: mixed strategies, indifference principle, Nash equilibrium in mixed strategies, iterated elimination of dominated strategies. Applications: Prisoner's dilemma, stag-hunt game, matching pennies, rock-paper-scissor, war of attrition.	12	4	
2	**Game theory II** Dynamic games under complete information: game trees, action and strategy, subgames, subgame-perfect Nash equilibrium, backward induction, equilibrium paths. Applications: ultimatum game, entrant-incumbent game, burning a bridge, rotten kid game.	12	4	
3	**Oligopoly** Duopoly, Cournot model, Bertrand model, and Stackelberg model.	6	2	
4	**Externalities and public goods** Externalities: consumption externality, production externality, Coase theorem, tragedy of the commons. Public goods: non-rival, non-excludability, Pareto inefficiency, Pareto improvement, free riding problem.	9	3	

5	**Asymmetric information** Asymmetric information, market for lemons, adverse selection, moral hazard, signaling, incentives.	6	2	
	Total	45	15	

Pedagogical approach:

Classroom teaching and problem-solving sessions.

Evaluationcriteria:

Minor1:WrittenExamination- 30% [Syllabus: 1-2, Learning outcomes: 1-6]
Minor 2: Written Examination - 30% [Syllabus: 3-4, Learning outcomes: 1-6]
Major:WrittenExamination -40% [Syllabus: Complete course, Learning outcomes: 1-6]

Learningoutcomes:

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

7. Understand the core concepts of microeconomics. [Modules 1-5]
8. Analyze an economic problem graphically. [Modules 1-5]
9. Solve an economic problem mathematically using calculus. [Modules 1-5]
10. Build intuitions of the core results. [Modules 1-5]
11. Figure out the cases where cookbook methods are not applicable. [Modules 1-5]
12. Apply the concepts and results in economic applications. [Modules 1-5]

Core reading:

11. H. Varian, "Intermediate Microeconomics", 8th edition (2010) (HV)
12. W. Nicholson, C. Snyder. "Microeconomic Theory: Basic Principles and Extensions", 10th edition (NS)
13. M. Osborne. "Introduction to Game Theory" (2004) (MO)

Additional readings:

14. T. Bergstorm, H. Varian. "Workouts in Intermediate Microeconomics" (2014)

Module-wise chapters:

8. Module 1: MO, Chapters 2 and 4
9. Module 2: MO, Chapter 5
10. Module 3: NS, Chapter 15
11. Module 4: HV, Chapters 34 and 36
12. Module 5: HV, Chapter 37

Additional information:

Coursepreparedby:Sanyyam Khurana

Studentresponsibilities: Attendance,feedback,discipline:asperuniversityrules.

Coursereviewers:

1. Souvik Dutta. Assistant Professor, Indraprastha Institute of Information Technology Delhi
2. Ankush Garg. Assistant Professor, Jindal School of Government and Public Policy O.P. Jindal Global University

Revised Course Outline of 'Intermediate Macroeconomics'

Course title: Intermediate Macroeconomics 1			
Course code: TBD	No. of credits: 4	L-T-P: 44-16-0	Learning hours: 60
Pre-requisite course code and title: UEO 103: Introductory Mathematical Methods for Economics, UEO 102: Basic Mathematics for Economics, UDS 103 : Mathematics for Data Science			
Department: Department of Policy and Management Studies			
Course coordinator:	Course instructor:		
Contact details:			
Course type: Core	Course offered in: 3rd Semester		
Course description: After covering the some topics in macroeconomics in the Principles of Economics course. This is the first course on macroeconomics which takes further various topics in macroeconomics starting from National Income Accounting. This is followed up with a discussion on Money and credit creation, followed by the Keynesian IS LM and AS AD in a closed economy. This will be further followed by discussions on open economy IS LM in the short run.			
Course objective: 1. To get started with the fundamental concepts in macroeconomics 2. To understand functioning of macroeconomic policy in the context of various schools of thought. 3. To understand macro policy in the context of Indian Economy as well as those across the world.			
Course contents			

S. No	Topics	L		P
1	**National Income Accounting** Introduction to Macroeconomics, Measurement of gross domestic product, income, expenditure and product method, the circular flow; real versus nominal GDP; price indices; national income accounting for an open economy; balance of payments: current and capital accounts	8	3	
2	**Money** Functions of money; quantity theory of money; determination of money supply and demand; credit creation; tools of monetary policy, High powered money.	8	3	
3	**IS LM Model in a Closed Economy** Classical and Keynesian systems; simple Keynesian model of income determination; IS-LM model; fiscal multiplier, fiscal and monetary policy, liquidity trap.	10	3	

4	**AS AD Model in a Closed Economy** Labour Markets, AS AD model in Classical and Keynesian system.	8	2	
5	**IS LM Model in an Open Economy** Short-run open economy models; Mundell-Fleming model; exchange rate determination; purchasing power parity; asset market approach.	10	5	
	Total	44	16	

Pedagogical approach:

Classroom teaching, class participation and problem-solving sessions.

Evaluation criteria:

Minor 1: Written Examination - 25% [Syllabus: 1-3, Learning outcomes: 1-4]
Minor 2: Project- 25% [Learning outcomes: 1-4]
Class Participation : 10% [Learning outcomes: 1-4]
Major:Written Examination - 40% [Syllabus: Complete course, Learning outcomes: 1-4]

Additional Notes: The project will be such that students can relate contemporary and historical macroeconomic issues of the Indian and World Economy and apply macroeconomic theory studied during this course in that context. This may be followed by presentation of the project if required.

Class participation will be encourage in-class discussion and debates on macroeconomic issues.

Learning outcomes:

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

1. Understand the core concepts of macroeconomic theory. [Modules 1-4]
2. Understand some schools of Macroeconomic thought. [Modules 2-4]
3. Understand the application of fundamental concepts to macroeconomic policy [Modules 2-4]
4. Intuitively understand the theory in the context of current or past macro policies. [Modules 2-4]

Core readings:

1. Blanchard, O and Johanson. D (2013). *Macroeconomics*, 6*th ed*. Pearson Education. [OB]
2. Abel, A., Bernanke, B. and Croushore (2020). *Macroeconomics*, 10*th ed*. Pearson Education [ABC]
3. Dornbusch, R., Fischer, S., Startz, R. (2018). *Macroeconomics*, *12th ed*. McGraw-Hill. [DFS]

Additional readings:

4. Mankiw, N. (2016). Macroeconomics, 9th ed. Worth Publishers. [NM]
5. https://m.rbi.org.in/Scripts/PublicationsView.aspx?id=9455
6. https://www.rbi.org.in/SCRIPTS/AnnualPublications.aspx?head=Handbook of Statistics on Indian Economy

Module-wise chapters from the core readings:

1. Module 1: ABC, Chapters 1 and 2
2. Module 2: OB, Chapter 4
3. Module 3: OB, Chapters 3,4 and 5 and DFS, Chapter 10
4. Module 4: OB , Chapters 6 and 7
5. Module 5: OB, Chapters 18,19, 20 and 21

Coursepreparedby: Priyanka Arora

Student responsibilities: Attendance, feedback, discipline: as per university rules.

Coursereviewers:

1. Dr. Swati Saini, Assistant Professor, Department of Economics, Delhi School of Economics, University of Delhi

2. Dr. Naveen J Thomas, Associate Professor, Jindal School of Government and Public Policy, O.P. Jindal Global University.

Revised Course Outline of 'Introduction to Development Economics'

Coursetitle:Introduction to Development Economics			
Coursecode:TBD	No. ofcredits:4	L-T-P:60-0-0	Learning hours:60
Pre-requisitecoursecodeandtitle:N/A			
Department:DepartmentofPolicyandManagementStudies			
Coursecoordinator:	Courseinstructor:		
Contactdetails:			
Coursetype:Core	Courseofferedin:3rd Semester		

Course description: This introductory course in development economics aims to build students' capabilities of understanding the challenges and opportunities of a developing country. This course will cover traditional concepts of development economics such as poverty and inequality, along with contemporary issues such as impact of health and education in economic development.

Courseobjective:

1. To familiarize students with conventional and contemporary themes, issues and challenges of development economics.
2. To help students develop analytical abilities to comprehend various developmental challenges and critically analyze them.
3. To help students apply economic tools and techniques in order to analyze the key topics of development economics.

Coursecontents

S.No	Topics	L	T	P
1	**Introduction and Overview** • What do we mean by economic development? • Discussion on global disparity in standard of living across and within nations. • Why Study Development Economics? • Traditional measures of economic development – income per capita, gross national income, gross domestic product • The Millennium Development Goals, the Sustainable development goals and the world transitions.	10		
2	**Basic Indicators of Development** • Purchasing power parity • Indicators of Health and Education • The traditional and new Human Development Index	10		
3	**Poverty and Inequality** ▪ Amartya Sen's "Capability" Approach ▪ Measuring Inequality ▪ Personal or Size Distributions of Income ▪ Measure of income inequality- Kuznets ratio, Lorenz curves, Gini coefficients, The Ahluwalia-Chenery Welfare Index (ACWI) ▪ Atkisons measure and the Entropy class of measures • Measuring Absolute Poverty ▪ Headcount Index ▪ Total Poverty Gap ▪ Human Poverty Index ▪ The Foster-Greer-Thorbecke Index ▪ The Alkire-Foster methodology and the multi-dimensional poverty index. • Policy option on income inequality and poverty	12		

4	**Population Growth and Economic Development** • Basic concepts ▪ Crude birth rate, death rate, age distributions, total fertility rate, life expectancy at birth, under five mortality, youth dependency burden • The Demographic Transition • From population growth to economic development	10		
5	**Human Capital: Education and Health in Economic Development** • The Central Roles of Education and Health • Literacy • Human Capital • Education and Health as Joint Investments for Development • Improving Health and Education: Why Increasing Income Is Not Sufficient	8		
6	**Rural and Urban** • Formal and Informal urban sectors, Agriculture • The Lewis Model • Rural-urban migration o The basic model o The Harris-Todaro Equilibrium	10		
	Total	60	0	0

Pedagogicalapproach:
Classroom lectures and use of economic tools and techniques for key concepts.

Evaluationcriteria:

Minor 1:Written Examination- 30%[Syllabus: Modules 1-2]
Minor 2:Written Examination - 30% [Syllabus: Modules 3-4]
Major:WrittenExamination- 40% [Entire Syllabus]

Learningoutcomes:

Attheendof thecourse,thestudentswillbeableto:

1. Understand the basics of development economics. [Minor 1, Minor 2, Major]
2. To comprehend and appreciate traditional concepts of development economics such as poverty and inequality along with contemporary issues such as impact of health and education in economic development [Minor 1, Minor 2, Major]
3. To apply economic tools and techniques in order to analyze various developmental challenges. [Minor 1, Minor 2, Major]

Corereading:

1. Debraj Ray (1998). *Development Economics,* Princeton University Press. (DE)
2. Todaro, M. P., & Smith, S. C. (2015). *Economic development* 12th edition. (TS)

Additional Reading:

1. Atkinson, AB (1970) On the measurement of inequality. *Journal of Economic Theory*, 2 (3), pp. 244–263 (AB)
2. Alkire, Sabina, et al. (2015) *Multidimensional poverty measurement and analysis*. Oxford University Press (AS)

Module-wise chapters from the core readings:

1. Module1:DE, Chapter 1
   TS, Chapter 1
2. Module2:DE,Chapter2
3. Module3:DE, Chapter 6,7
   TS, Chapter 5
   AS, Chapter 5
   AB
4. Module4:DE,Chapter 9
5. Module5:TS, Chapter 8
6. Module 6: DE, Chapter 10

Additionalinformation:

Coursepreparedby:Subhasree Sarkar

Studentresponsibilities:Attendance,feedback,discipline:asperuniversityrules.

Coursereviewers:

1) Sukanta Bhattacharya (Associate Professor, Department of Economics, University of Calcutta)
2) Shabana Mitra (Associate Professor, Department of Economics, Shiv Nadar University)

Enclosure 20

Marketing Management-II

Course title: Marketing Management-II			
Course code:	**No. of credits: 4**	**L-T-P distribution: 45-15-00**	**Learning hours:** 60
Pre-requisite course code and title (if any): UBA 102, Marketing Management –I			
Department: Department of Policy and Management studies			
Course coordinator (s):		**Course instructor (s):**	
Contact details:			
Course type	Core	**Course offered in:** Semester 3	

Course description

This course aims to expose the students to the modern theory and practices of marketing management and consumer behaviour and equip them with the requisite skills to understand the marketing and customer oriented decision-making framework in which everyday executives work.At the end of the course, a participant will be able to understand and manage the core marketing management function.

Course objectives

This course is an advanced course on marketing and develops the analytical skills, conceptual abilities, and substantive knowledge in marketing concepts like the marketing mix in a variety of real-life marketing situations. The objectives are:

- To conduct strategic analysis of marketing mix.
- To understand how to map opportunities and communicate marketing decisions.
- To demonstrate the theory of Consumer behavior.
- To evaluate the value creation of the firm.

Course content

Module	Topic	L	T	P
1	Marketing Research The role of Marketing research: The Nature of Marketing Research. Marketing Concept. Managerial Value of Marketing Research. The Marketing research process: Decision Making, Types of Marketing Research, and Stages in the Process. The human side of Marketing research: Mission of the Research Department. Organizational Structure of Marketing Research Sources of Conflicts between Marketing Management and Marketing Research. Research Suppliers and Contractors. Ethical Issues in Marketing Research	9	4	0
2	Consumer Behavior The Cognitive Consumer: Perception, Learning and Memory, Sensory systems, exposure, attention, interpretation, biases, Learning theories and process, memory. Decision-Making: Individuals and Situations. The stages in consumer decision-making, situational effects on behavior, buying and disposing, Post-purchase satisfaction and behavior. The Social Consumer: Subcultures; Cultural Influences on Consumer Behavior. Subcultures and consumer identities by age, regions. What is culture, characteristics of culture, culture and consumption, Myths and rituals.	9	3	0

3	Product & brand Management Building a strong brand: Brand Positioning, Brand Value chain, Brand resonance pyramid. New Products Development, Levels of Product and Brand Extensions. Integrated Marketing Communications Mountain Dew Case Study.(Harvard Case study) Strategic Brand Management Process. Fundamentals of Digital Marketing: Digital Branding, Digital distribution, Social media marketing, Search engine marketing, Search engine optimization. Viral Marketing, Buzz marketing.	9	3	0
4	Pricing Strategies Price and Pricing Strategies: Definition of Price, Types of prices, Setting of Prices. Pricing strategies, New product pricing strategies. Pricing Decisions: Factors affecting pricing decisions. Types of Markets. Demand & Demand Curve	6	2	0
5	Distribution Strategies Nature and Importance of Marketing Channels. Operation and Organization of a Channel. Case study: Zara: Fast fashion.(Harvard Case Study) Channel Structure and management Decisions. Marketing Logistics and Supply Chain Management: Wholesale and Retail distribution Strategy.	7	3	0
6.	Communication Strategies: Integrated Marketing Communications. Mountain Dew Case Study.(Emerald case study) Fundamentals of Digital Marketing: Digital Branding, Digital distribution, Social media marketing, Search engine marketing, Search engine optimization. Viral Marketing, Buzz marketing. Green Marketing Strategies.	5	0	0
	Total	**45**	**15**	**0**

Evaluation criteria

- **Test 1: Class participation** 10% (Based on attentiveness and active participation during the entirecourse)
- **Test2:Newspresentations**10%(Topickandcriticallypresentlatestnewsaboutmarketingactivitiesdoneby anycompany)
- **Test3:**20%(Writtenexamaftercompletionof16sessions– totesttheunderstandingofconceptsofmarketing, strategic planning and consumer behavior)
- **Test4:GroupProject**20%(TodeveloptheMarketingPlanforaproduct/serviceandapplyalltheknowledge ofmarketinggainedthroughoutthecourse.Reporttobesubmittedattheendof28sessionsandpresentationin the last 2sessions)
- **Test 5: Written Test** 40% (Written examination covering the entirecourse)

Group Project: Marketing News Presentation and Creating a Marketing Plan

Each group should be prepared to make a presentation of news related to marketing gathered over one week prior to its turn to present in the class.

Each group needs to select one product category from the suggested list. No overlap of product category within each section is permitted. Your group may take the perspective of an organization that is either a leader in the category or a follower or a new entrant.

Prepare a detailed report on the project. The report should be submitted in soft copy on my email.

Each group should be prepared to make a presentation project in the class. Time limit is 15 minutes per group.

Case Study discussion: A case may be studied keeping in mind the following:

1. aproblemdefinitionstatement,whichidentifiesthekeyissuesfacingmanagement(not

morethanafewlines);
2. theobjectives
3. alternative plan ofaction
4. ananalysissectionwhichsynthesizesandintegratestheanswerstothekeyquestionsforthecase,butdoesnot repeat the facts themselves, and presents logical arguments in defense of both the problem definition and the recommended solution;
5. a set of detailed recommendations and suggestions for their implementation, including how to overcomeany potential issues of implementation identified by theanalysis.

Learning outcomes:

After attending this course, students will be able to:

- Developanunderstandingoftheroleofmarketing mix inthesuccessofanorganization (News presentation, Mid Termexam)
- Develop an ability to identify and assess strategic choices in marketing (MidTerm exam, End Termexam)
- Be able to propose innovative solutions to customer needs and continuous improvement of offerings (News presentation, Group Project)
- Be able to develop the Marketing Plan for any organization (Group Project, End Termexam)

Pedagogical approach

- InteractiveLectures
- Case discussions andpresentations
- Newscrunching

Materials

1. **TextBook**:
   - Principal of Marketing, by Philip Kotler, Kevin Keller, Pearson, New Delhi. Latest edition.
2. **ReferenceBook:**
   - Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithleshwar Jha, "Marketing Management, A South Asian Perspective", 14th Ed (2013) by Pearson Education, NewDelhi.
   - Aaker, D and Joachimsthaler, E (2000) Brand leadership, The Free Press
   - Assael, H. (1992) Consumer Behaviour and Marketing Action, 4th Edition, USA: PWS-Kent
   - Hoyer, W.D. and MacInnis, D.J. (2001) Consumer Behaviour, 2nd Edition, USA: Houghton Mifflin Company
   - Baker, M. (2000) Marketing Management and Strategy, 3rd edition, Macmillan Business.
   - Blythe, J. (2001) Essentials of Marketing, 2nd edition, Prentice Hall
   - Booms, B.H. and Bitner, M.J. (1981), Marketing strategies and organisation structures for service firms, in Marketing of Services, J. Donnelly and W.R. George (eds), American Marketing Association.

Additional information (if any)

Student responsibilities: Attendance, timeline adherence for assignments, come prepared with readings / cases according to the session plan and as and when provided

Prepared by: Dr.Shruti Sharma.

Course Reviewers:

1. **Prof. Ruchi Jain, Professor and Director of Amity School of Business, Noida.**
2. **Dr.Shampy Kamboj, Assistant Professor, NIT Hamirpur**

Introduction to Operations Management

Course Title: Introduction to Operations Management			
Course code:	**No. of credits:** 4	**L-T-P:** 45-15-00	**Learning hours:** 60
Pre-requisite course code and title (if any):			
Department: Department of Policy and Management Studies			
Course coordinator:		**Course instructor:**	
Contact details:		**Course offered in:**	
Course type: Core			

Course description:

This course provides an overview of the principles and practices of operations management within the context of business organizations. Students will explore various topics such as process design, quality management, supply chain management, and operations strategy. The course emphasizes the role of operations management in enhancing efficiency, productivity, sustainability and competitiveness in businesses.

Course objectives:

- To understand the fundamental concepts and principles of operations management.
- To assess operations management processes to handle real-world issues and challenges.
- To explore the role of operations management verticals in achieving organizational goals and competitive advantage.
- To analyse different strategies for managing operations effectively.
- To understand the sustainable operations management practices

Course Content

Module	Topic	L	T	P
1.	Introduction to Operations Management: Operations Management Overview,Scope in Manufacturing, Services, and Supply Chain Management, Key Functions, Historical Development, Recent Trends, Role in Organizations, Integration with Other Functional Areas, Impact on Competitiveness, Efficiency, and Customer Satisfaction, Sustainable Operations Management	5	1	0
2.	Operations Processes: Production and manufacturing operation, Process Selection and Classification, Manufacturing vs. Service Operations, Modern Manufacturing Characteristics, Process Types and Flow Analysis, Improvement Techniques and Metrics, Product Development Life Cycle, Forecasting in Operations	6	2	0
3.	Core Operations Management Verticals: • Location and layout operations: Location theories & decision factors, Layout scope & types, Layout planning, Layout tools and techniques. • Materials Management and Scheduling: Materials management functions & operations, Materials planning, BOM, MRP I & II, Master production scheduling, Scheduling strategies. • Quality Management: Purpose & importance of Quality, TQM, Quality policy, ISO standards, Quality Tools and Techniques, Quality improvement methods (PDCA, Six Sigma, Kaizen, 5S and others)	25	10	0

	• Supply Chain Management: Introduction and significance of Supply Chain Management, Strategies for supplier selection & Relationship Management, Flows in the Supply Chain, Role of Supply Chain Analytics • Inventory and Logistics Management: Introduction, significance and roles, Inventory Turnover and Holding Costs, Inventory management techniques (EOQ, EPQ ABC), Warehouse Management Systems, Logistics and Transportation Management, Types of logistical deliveries, Reverse logistics, VMI			
4.	Operations Strategy Formulation and Implementation: Operations Strategy Formulation: Strategies for formulating operations strategies aligned with organizational goals and objectives. Practical approaches to implementing operations strategies effectively, discussion on challenges and best practices in operations strategy implementation.	5	1	0
5.	Sustainable Operations Management: Sustainability in operations management, Importance, Triple bottom line approach (economic, social, environmental), Overview and application of LCA methodology, Green Product Design and Development, Waste Management and Recycling, Role in circular economy.	4	1	0
	Total (in hours)	**45**	**15**	**0**

Evaluation criteria:

1. Minor 1 Exam (Activity/ Case Analysis/Assignment/Presentation) – 30%
2. Minor 2 Exam (Case Analysis/Assignment/Presentation/Written) – 30%
3. Major Exam – 40%

Minor 1 Exam **(Based on Module 1 and 2)**

Structure: The Minor 1 Exam, based on Modules 1 and 2, will evaluate students through activity-based presentations or assignments. It focuses on assessing their understanding and application of operations management concepts, including scope, functions, historical context, and recent trends. Students will also be evaluated on their analysis of operations processes and their ability to integrate sustainable practices through the modes of Activity and/or Assignment

Minor 2 Exam **(Based on Module 3)**

Structure: It will evaluate students through written paper or case studies on core operations management topics. It will include assessment on location and layout operations, materials management, scheduling, quality management, supply chain management, and inventory and logistics management. The exam will assess students' practical understanding of these concepts.

Major Exam **(End-Term Exam; at the end of all modules)**

This will be a written test exam based on all the modules covered in the class.

- **Learning outcomes:**
  - Analyse fundamental concepts and theories in operations management.
  - Evaluate operations management processes to address real-world issues and challenges effectively.
  - Demonstrate how operations management verticals contribute to achieving organizational goals and competitive advantage.
  - Analyse various strategies for managing operations effectively to improve organizational performance.
  - Explain sustainable operations management practices and their significance for organizational sustainability and performance.

Materials

Suggested Readings:

For *Module 1 to 4:*

- Chary, S. *Theory and Problems in Production and Operations Management*. McGraw Hill.

For Module 5:

- Heizer, J., Render, B., Munson, C., Sachan, A. (12th Ed.). *Operations Management:*

Sustainability and Supply Chain Management. Pearson.

Additional Readings:

- Krajewski, L. J., Malhotra, M. K., Ritzman, L. P. *Operations Management: Processes and Supply Chains*. Pearson.
- Bozarth, C. B., Handfield, R. B. *Introduction to Operations and Supply Chain Management*.
- Reid, R. D., Sanders, N. R. *Operations Management: An Integrated Approach*. Wiley.

Pedagogical approach:

- Classroom activity-based learning
- Problem solving using Ms Excel
- Case study method,
- Flip-classroom based learning (For few concepts)

Additional information:

Student responsibilities:

Students will be involved in continuous assessments using

- quizzes,
- assignments,
- viva,
- classroom activities,
- group presentation, and
- written exam

Course Prepared by: Dr. Anand Jaiswal

Course Reviewer(s):

1. Dr. Cherian Samuel, Associate Professor, Industrial Management, IIT (BHU)
2. Dr. Vinaytosh Mishra, Director, Thumbay Institute for AI in Healthcare, Gulf Medical University, UAE

Enclosure 21

S No	**Existing programme outline**			**Proposed programme outline**		
	Semester 1			Semester 1		
	Course code	Course title	Type	Course code	Course title	Type
1	MPL 101	Seminar/Clinic on Contemporary Issues in Infrastructure and Environment	Core	MPL 101	Seminar/Clinic on Contemporary Issues in Infrastructure and Environment	Core
2	MPL 141	Economic Foundations of Environmental and Infrastructure Law	Core	MPL 141	Economic Foundations of Environmental and Infrastructure Law	Core
3	MPL 155	Environmental Law and Policy	Core	MPL 155	Environmental Law and Policy	Core
4	MPL 157	Infrastructure Law and Policy	Core	MPL 157	Infrastructure Law and Policy	Core
Total credits			16	**Total credits**		**20**

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Course 1 MPL 101- Seminar/Clinic on Contemporary Issues in Infrastructure and Environment

CourseTitle: Seminar/cliniconcontemporaryissuesininfrastructureand environment			
Coursecode:	**No.ofcredits:1 Credit**	**L-T-P: 3**-12-0	**Learninghours:**15
Pre-requisitecoursecode andtitle(ifany): None			
Department: CentreforPostGraduateLegalStudies			
Coursecoordinator:	**Courseinstructor:**		
Contactdetails:			
Coursetype: Core	**Courseofferedin:** Semester1		

Coursedescription:

This course aims at sharpening the skillsof students and enable them to handle the challenges related to litigation,teaching, research, policymaking and also that of judicial officers. It also aims at keeping the students abreast with the contemporary legal developments, particularly in their areas ofspecialisation*viz*.environmentandnaturalresourceslawsandinfrastructureandbusinesslaws.Thecourse facilitates thestudentstotranslatelegal theoryintopracticeunder theclosesupervisionofthecourseinstructor.

Courseobjectives:

1. To recall key challenges and debates in infrastructure development and environmental protection and understand the interconnection between the two.
2. To understand legal implications of sustainability issues
3. To analyze the role of government policies, regulations, and international agreements in infrastructure development and environmental justice.
4. To apply policy advocacy and negotiation techniques and develop stakeholder engagement and consensus-building strategies.

Course Contents

S.No.	Topic	L	T	P
1	Achievement of SDG Goals	**1**	**2**	
2	Creating resilience through digitalization/AI	**0**	**2**	
3	Climate Change	**0**	**4**	
4	Cities and Communities	**1**	**2**	
5	Enhancing Governance in Diverse Sectors	**1**	**2**	
	Total	**3**	**12**	

CourseActivities

1. Identifycontemporaryissuesin infrastructure/environment,findunansweredquestionsoflaw,presentthem inwrittenformat,andoffertheirargumentsoneachofthosequestionsthrough seminars/mootcourts/mock trials/discussions and debates or any other similar method.
2. ParticipateintheclinicalactivitiesofTERISASandoffertheirservicestothe needy.

Evaluationcriteria: Thecourseinstructorshallmonitoreachstudentthroughoutthesemesterandshallevaluatethem on the following aspects at the end of the semester.

Minor 1 Quiz:	25% (Module 1)
Class Participation/ Discussion:	25% (Module 2,3,4 & 5)
Term Paper:	30% (Module 2,3,4 & 5)
Final Presentation:	20% (Module 2,3,4 & 5)

Learningoutcomes:

- Analysis of key challenges and debates in infrastructure development and environmental protection. (Minor 1/Quiz)
- Expertise in identifying the gaps between law and society, and also between facts and law. (Class Participation/Discussion)
- The ability to find answers to those variances through appropriate research and logical thinking (Class Participation/Discussion)
- Capacity to deliberate among peers on various individual, social and public interests that should be balanced while finalizing a legal answer, and (Class Participation/Discussion)
- The ability of effective written and verbal representation of these issues before the appropriate forums. (Term Paper/Final Presentation)

Pedagogicalapproach:
Class Lectures, Seminar,Discussions,Debates,Role-play,Client-Counselling,Moot-Court.

Additionalinformation(ifany):

StudentResponsibilities: Studentsareexpected to:

1. FollowtheNewstoidentifycontemporaryissues.
2. Conductfieldvisitswherever possible togatherinformationonthoseissues
3. Participateintheactivitieswithdedicationand zeal.

Recommended Readings:

1. Leelakrishnan, P. (2020). *Environmental Law in India.* Wolters Kluwer India Pvt. Ltd.
2. Singh, Amita (Ed.). (2017). *Environmental Challenges in India: Laws, Policies, and Governance.* Springer.
3. Malik, Sumeet. (2021). *Infrastructure Laws in India.* Eastern Book Company.
4. Singh, M. P. (2018). *Environmental Law: Policies, Issues, and Challenges in India.* Oxford University Press.
5. Mahajan, Vishal. (2019). *Infrastructure Development and Finance in India*. LexisNexis.
6. Hayes, B. (2005). "Infrastructure: A Guide to the Industrial Landscape." New York, NY: W. W. Norton & Company.
7. Salzman, J., & Thompson Jr., B. H. (2019). "Environmental Law and Policy," Fifth Edition. St. Paul, MN: West Academic.
8. Wiersema, A. (2013). "The Law and Policy of Environmental Federalism: A Comparative Analysis." Routledge.
9. Grigg, N. (2017). "Infrastructure Finance: The Business of Infrastructure for a Sustainable Future." Wiley.
10. Farber, D. A., & Peeters, M. (2016). "Climate Change Law and Policy." Edward Elgar Publishing.
11. Sarte, S. B., & Sarte, B. S. (2010). "Sustainable Infrastructure: Principles into Practice." John Wiley & Sons.
12. Heffron, R. J., &Redgwell, C. (Eds.). (2017). "The Oxford Handbook of Energy Law." Oxford University Press.
13. Cullet, P., Koonan, S., & Datta, A. (Eds.). (2017). "Water Law and Policy Governance Without Frontiers." Springer.
14. Frischmann, B. M. (2012). "Infrastructure: The Social Value of Shared Resources." Oxford University Press.
15. Harvey, H., Orvis, R., & Rissman, J. (2018). "Designing Climate Solutions: A Policy Guide for Low-Carbon Energy." Island Press.

Course reviewers:

1. Dr Neelu Mehra, Associate Professor, USLLS, GGSIPU, Delhi. (Comments Awaited; Likely to be received by Monday).
2. Dr Bhawna, Assistant Professor (Law), Faculty of Law, Lucknow University (UP)
3. Dr Shivani Singh, Assistant Professor (Law), Fairfield Institute of Management and Technology, Kapashera, Delhi

Note: Course Revised by Dr Kavita, Assistant Professor (Law), TERI SAS New Delhi

Course 2 MPL 141- Economic Foundations of Environmental and Infrastructure Law

Coursetitle: EconomicFoundationsofEnvironmental andInfrastructure Law			
Course code:	**No.of credits:**2	**L-T-P:**30-0-0	**Learninghours:** 30
Pre-requisitecoursecode andtitle (ifany): None			
Department: Centre forPostGraduateLegalStudies			
Coursecoordinator:	**Courseinstructor:**		
Contactdetails:			
Coursetype: Core	**Courseofferedin:**Semester1		

Coursedescription:

As the title suggests, this course will offer economic foundations for a select set of policies and lawsrelated to infrastructure and natural resources. In particular, it will explore theoretical basis, conceptualfoundations and principles from the discipline of economics to examine policies and laws, aided by therelevant case studies. Importance of this course arises from the very fact that policy and legal regimefunctions with the objective of meeting a number of economic objectives, including augmenting rate ofeconomic 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/wasteorefficientlyallocateor assignthecorrectpricesfornaturalresources—theseinstancesof'marketfailure' makes a strong case of intervention by the State, through appropriate policies and laws, towardsachieving a socially beneficial and sustainable outcome, while considering both costs and benefits. Recentinstances of the State entering into partnerships with the private players imputes additional challenges tothe framingof laws,forsuchinstrumentstoaddressthematterofprofitability,risk-takingability,anduncertaintiesfacedbythe privateplayers,alongwithaimingat the socialobjective.

Course objectives:

1. To provide a clear understanding on the economic theories, concepts and principles relevant for lawsrelatedto infrastructureand naturalresources.
2. To apply the concept of perfect competition and cases of imperfect competition to environmental and infrastructure sectors, to analyze market-based instruments and the role of regulatory agencies in enforcing laws.
3. To explain causes of market failures, apply welfare theories and economic principles behind public policy and regulation of natural monopolies and analyze the relative efficiency of command-and-control and market-based instruments.
4. To connectthetheory,conceptand principleswiththeappropriatecase studies.

Course contents

S. No.	Topic	L	T	P
1	**Basic EconomicConcepts** Concept of Positive and Normative Economics Supply and demand analysis in the context of environmental and infrastructure law frameworks Economic Theories by Adam Smith and Schumpeter Developmental economics	2	0	0
2	**MarketStructures** Perfectcompetitionasan'ideal'for achievingeconomicefficiency Casesofimperfectcompetition:monopolisticcompetition,monopoly,oligopoly	2	0	0

3	**Causes of MarketFailures** Concept of Asymmetric Information - Case study of Lemons market; Property Rights and Pigouvian Fee Casesofmarketfailure ProvisionofPublicGoodbytheStateandprivateprovisionAbse ntmarketsand roleofproperty rights ExternalitiesandCoase Theorem Role of WelfareState- Welfare Theories; EconomicsofRegulation; Economic principles behind public policy;RegulationofNaturalMonopoly Market basedenvironmental policies (e.g., cap and trade, pollution taxes); Carboncredits Command and Control type: tax, subsidies Market Based types Relative efficiency of Command-and-Control and Market Based instruments	8	0	0
4	**Liability,lossanddamages** Compensation Principle EfficiencyofLiabilityRules	2	0	0
5	**International Perspectives** Comparative Analysis of environmental and infrastructure law across different jurisdictions International Investment Law: NAFTA, SAFTA, ASEAN etc. International agreements and treaties related to environmental protection and infrastructure development-Kyoto Protocol, Paris Agreement	6	0	0
6	**Case Studies:** OilandNaturalGasPricinginIndiaSpe ctrumAllocation Electricitypricingmodels Coal pricing and bidding modelsNationalHighway Toll pricing ComputationofEnvironmentaldamagesandEcologicalValues	10	0	0
	Total	30	0	0

Evaluationcriteria:

1. Minor 1 25% (Topics 1 and 2)
2. Assignments/Presentations25% (Topic 6)
3. Final test 50% (Topics 3,4 and 5)

Learningoutcomes:

1. Analysis of economic concepts and theories as they apply to environmental and infrastructure policies. (Minor 1)
2. Evaluation of market structures and regulatory frameworks influencing environmental and infrastructure sectors. (Minor 1 and Major Test)
3. Application of cost-benefit analysis and economic efficiency principles to decision-making processes. (Assignments/Presentations)
4. Assessment of the role of market-based instruments and regulatory agencies in enforcing environmental and infrastructure laws. (Major Test)
5. Analysis of international perspectives and global economic trends impacting environmental and infrastructure policies through case studies. (Major Test)

Pedagogicalapproach:

The course willbe deliveredthrougha mixof classroomlecturesanddiscussionsaroundcase studies.

Reading Materials:

CoretextforModule1-6

1. Cento Veljanovski, 2007, 'Chapter 2: The Economic Approach' in Economic Principles of law,CambridgeUniversity Press, pp. 19-57
2. Roger Perman, Yue Ma, Michael Common, and David Maddison. (2011). "Natural Resource and Environmental Economics." Pearson Education Limited.
3. Nicholas Barr. (1992). "Economic Theory and the Welfare State." Oxford University Press.
4. N. Gregory Mankiw. (2018). "Principles of Economics." Cengage Learning.

Module1

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

Module2and3

6. C T S Ragan and Richard G Lipsey, 1999, 'Chapter 16: Market Failure and GovernmentIntervention and 'Chapter 17: The Economics of Environmental Protection' in Economics,Pearson Canada, pp. 415-445and 449-469
7. Richard Ipotito, 2003, 'Chapter 7: Externalities-the Coase Theorem and Rules of Law,' inEconomicsforLawyers, GeorgeMason SchoolofLaw,mimeo, 168-183
8. J Stiglitz, 'Chapter 1: The Public Sector in a Mixed Economy', in Economics of the PublicSector, pp. 3-25
9. JStiglitz,'Chapter4:MarketFailure'inEconomicsofthe Public Sector,pp.76-90
10. JStiglitz,'Chapter6:PublicGoodsandPubliclyprovidedPrivate Goods',inEconomicsofthePublicSector, pp. 127-152
11. Cento Veljanovski , 2006, 'Chapter 7: Regulation' in The Economics of Law, Second edition,TheInstituteofEconomicAffairs, pp. 142-172
12. Kenneth E Train, 1991, 'Introduction: The Economic Rationale and Task of Regulation' inOptimalRegulation:TheEconomicTheoryof NaturalMonopoly,MITPress,pp.1-17.

Module6:CaseStudies

Oiland NaturalGasPricingin India

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

Paranjoy Guha Thakurata, Subir Ghosh and Jyotirmoy Chaudhuri, 2016, Gas Wars - Crony CapitalismandtheAmbanis,AuthorsupfrontPublishing ServicesPrivateLimited

SpectrumAllocation

12. Upendra Baxi,2012,'GoodLaw,PoorEconomics',IndianExpress,February24
13. RohitPrasad, 2010,'Valueof 2GSpectrumin 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,September13, pp. 33-38

Additionalreference:

Claudio Feijóo, José Luis Gómez-Barroso and Asunción Mochón, 2009, 'Chapter III: Reforms inSpectrumManagementPolicy',inInLee,eds.,Handbookofresearchontelecommunicationsplanningandmanagementforbusiness,Information ScienceReference,pp. 33-47

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

Electricitypricingmodels

17. Paranjoy Guha Thakurta, 2016, 'Power Tariff Scam Gets Bigger at Rs.50,000 Crore', EPW, LI(21), pp. 12-15
    Power(Coal/Nuclear)pricingandbiddingmodels
18. Sumantra Bhattacharya, Rachit Tiwari, 2014, 'Non-Coking Coal Pricing in India', EPW, XLIX(3), pp. 20-22
19. EA SSarma, 2013,'Myopiaon 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. KannanKasturi,2013,'PricingElectricityinDelhi',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. MichaelG.Faure andKarine Fiore,2009,AnEconomicAnalysisOf TheNuclearLiabilitySubsidy, Pace Environmental Law Review, 26 (2). Available at:http://digitalcommons.pace.edu/pelr/vol26/iss2/5

NationalHighwayTollpricing

26. RamSingh,2010,'A High-handedApproachto NationalHighways',EPW, XLV(8),pp.19-21

EnvironmentalDamagesandEcologicalvalues

27. L Venkatachalam, 2005, 'Damage Assessment and Compensation to Farmers: Lessons fromVerdictofLoss of Ecology Authority in TamilNadu', EPW, April9,pp. 1555-60

K. Chopra and P. Dasgupta, 2008, 'Assessing the Economic and Ecosystem ServicesContributionofForests: IssuesinModelling,andanIllustration',InternationalForestryReview,10(2), pp. 376-386

Module 5:

28. "Edited by Robert N. Stavins. (2000). "Economics of the Environment: Selected Readings." Norton.
29. Frischmann, B. M. (2012). "Infrastructure: The Social Value of Shared Resources." Oxford University Press.
30. Grigg, N. (2017). "Infrastructure Finance: The Business of Infrastructure for a Sustainable Future." Wiley.
31. Hartwick, J. M., & Olewiler, N. D. (1998). "The Economics of Natural Resource Use." Addison Wesley Longman.
32. Gómez-Ibáñez, J. A. (2003). "Regulating Infrastructure: Monopoly, Contracts, and Discretion." Harvard University Press.
33. Backhaus, J. G., & Wagner, R. E. (1998). "The Law and Economics of Public Policy: A Plea to Economics for more Interdisciplinary Research." Kluwer Academic Publishers.
34. Hayes, B. (2005). "Infrastructure: A Guide to the Industrial Landscape." W. W. Norton & Company.
35. **Generaladditionalreading:**RelevantjudgmentsoftheSupremeCourt

Indian Authored Books

36. Sunder, S. Shyam. (2016). Law and Economics in India: Understanding and Practice. Oxford University Press.
37. Adhikari, Malay. (2019). *Economics of Development and Environmental Law.* LexisNexis.
38. Gouri, Geeta. (2014). *Competition Law and Economics in India.* Wolters Kluwer.
39. Bhala, Raj. (2013). Law, Economics and Development. Foundation Press.
40. Saran, Shyam (Ed.). (2018). *Law, Economics and Environment in India.* Springer.

Additional information (if any):75% Attendance is compulsory to appear for Major Test.

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. Prof Rakesh Kumar, Professor, USLLS, GGSIPU, Delhi. (Comments Awaited; Likely to be received by Monday).
2. Dr Anant Vijay Maria, Advocate-on-Record, Supreme court of India
3. Ms. Preety Sharma, Assistant Professor (Economics), University School of Humanities and Social Sciences, Guru Gobind Singh Indraprastha University

Note: Course Revised by Dr Kavita, Assistant Professor (Law), TERI SAS New Delhi

Course 3 MPL 155- Environmental Law and Policy

Course Title: Environmental Law and Policy			
Course code:	**No. of credits: 3**	**L-T-P:** 30-15-0	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Centre for Post Graduate Legal Studies			
Course coordinator:	**Course instructor:**		
Contact details:			
Course type: Core	**Course offered in** Semester 1		

Course Description:

Law and policy play 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 has been divided into three broad areas. The first part has covered the basic concepts and principles of Environmental Law. This included the judicial precedents, which formed an essential part of environmental jurisprudence. The second part has been divided into specific introductory modules on forests and wildlife 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 has discussed the role of the judiciary including the National Green Tribunal in protecting the environment and the proposal of a special environmental court.

Course Objectives:

1.To create a new idea for bringing a new legal regime for the protection of the environment.
2.To evaluate the existing law and policy relating to environmental protection in India.
3.To analyze the role of the different national and international institutions which are dealing with environment-related issues in India.
4.To practically apply the existing legislation and policies.
5.To understand the development of environmental law both nationally and internationally.
6.To remember the laws, judgments, and so on relating to environmental protection.

Course contents

S.No	Topic	L	T	P
1	**Introduction** Environment: Definition and importance. -Environment vs. development debates. -Trigger eventsbusiness and environmental law. -A brief introduction to SDGs. - Post Stockholm: aglimpseof international environmental law and development of environmental law in India. - Environmental Institutions: national and international. -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.	10	3	0

2	**Forest, Wildlife, and Biodiversity-relatedLaws** -Evolution and jurisprudence of forest and wildlife and biodiversitylaws: colonial forest policies; forest policies after independence. -Existingstatutory framework on forests, wildlife, and biodiversity: protection and conservation; key points of governance of forest, wildlife, and biodiversity. -Eco-Sensitive Zones (ESZs). -Strategies for conservation and protection: Mangroves; Tiger; Elephant; Rhino; and Snow leopard.	6	3	0
3	**Air and Water Pollution and Control** -Laws relating to the prevention of pollution and control of water and air. -National Water Policy. -Health impacts and air pollution: legal measures taken to date. -Pollution Control Boards.	4	3	0
4	**Environment Protection Laws and Large Projects** -Environment Protection Act 1986: safeguarding nature for a sustainable future; regulating large projects; Environmental Impact Assessment. -Protection of the marine environment: legal mechanism-coastal zone regulations, wetland conservation.	4	3	0
5	**Judicial remedies and the role of the 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. -Proposal for a special environmental court.	6	3	0
	Total	30	15	0

Evaluation criteria:

1. Class participation: 5 marks
2. Attendance: 5 marks
3. Minor 1: Written Examination-20 marks [Module 1]
4. Term paper written submission: 10marks [Module 1-5]
5. Presentation of term paper 10 Marks [Module 1-5]
6. Major Test: Written Examination: 50 marks [Module 2-4]

Learning outcomes:

On completion of this course, the students would:

1.Be able to create new ideas for further development of law and policy relating to environmental protection [Term Paper and Presentation].

2.Be able to evaluate the existing legal regime and provide suggestions for the development of environmental law [Minor 1 and Major Test]

3.Be able to analyze the role of different national and international institutions that are shaping environmental law and policy [Minor 1 and Major Test].

4.Be able to apply the provisions of the law, especially for environmental litigation [Minor 1 and Major Test].

5.Be able to understand and compare the development and importance of environmental law and policy [Minor 1 and Major Test].

6.Be able to remember the key provisions of the law and policy that are important for the protection of the environment in India [Minor 1 and Major Test].

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 classroom. A lot of emphasis is given to self-study.

Materials:

Text Books

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

Suggested Readings

1. Kohli, K. and Menon, M. (eds.) (2016). Business interests and the environmental crisis. New Delhi: Sage India.
2. Dutta, R. (2015). Commentary on the National Green Tribunal Act, 2010. New Delhi: Wadhwa Book Company.
3. Bharat H Desai (2014). International Environmental Governance: Towards UNEPO? Boston, USA: Brill/ Nijhoff.
4. Sahu, G. (2014). Why the underdogs came out ahead. Economic and Political Weekly, 49 (4), 52-57.
5. Sahu, G. (2014). Environmental jurisprudence and the Supreme Court: Litigation, interpretation, implementation. New Delhi: Orient Blackswan.
6. Lele, S. and Menon, A. (eds.) (2014). Democratizing forest governance in India. New Delhi: Oxford University Press
7. Bharat H Desai (2010). Multilateral Environmental Agreements: Legal Status of the Secretariats (New York, NY: Cambridge University Press.
8. Birnie P. (2009). International law and the environment, 3rd ed. Oxford: Oxford University Press.
9. Bharat H Desai (2003). Institutionalizing International Environmental Law, New York: Transnational Publishers.
10. 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.
11. Guha, R. (2000). Environmentalism: A global history. New Delhi: Oxford University Press.
12. Gadgil, M. and Guha, R. (1995). Ecology and equity. New Delhi: Oxford University Press.
13. Singh, C. (1986). Common property and common poverty. New Delhi: Oxford University Press.

Additional information (if any):

-MoEFCC (2023), Status of Mangrove Plantations; https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1947426

-MoEFCC (2022), Conservation and protection of mangroves; https://moef.gov.in/wp-content/uploads/2022/03/Conservation-and-protection-of-mangroves.pdf

-Law Commission of India one Hundred Eighty-Sixth Report on Proposal to Constitute Environment Courts September, 2003;https://cdnbbsr.s3waas.gov.in/s3ca0daec69b5adc880fb464895726dbdf/uploads/2022/08/2022081021-1.pdf

-MoEFCC, "Eco-Sensitive Zones"; https://moef.gov.in/moef/division/forest-divisions-2/eco-sensitive-zone-esz/introduction-2/index.html

-MoEFCC, "92 Eco-Sensitive Zones, 2 Ecologically Sensitive Areas notified in 13 States of Indian Himalayan Region"; 23 March 2023; https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1909904

List of the leading cases:

-GodavarmanThirumulpadv. Union of India and Others (2023).
-Orissa Mining Corporation Ltd v. Ministry of Environment & Forest &Ors (2013).
--Narmada BachaoAndolan v. Union of India (2000).
-Rural Litigation and Entitlement Kendra, Dehradun v. State of Uttar Pradesh (1985).
-M.C. Mehta v. Union of India (1997) (Taj Trapezium case).
-M.C. Mehta v. Kamal Nath &Ors. (1996).
-Indian Council for Enviro- Legal Action v. Union of India, (1996).
--Subhash Kumar v. State of Bihar (1991).
--M.C. Mehta & Another v. Union of India (Shriram Foods & Fertilizer Industries Case) (1987).
-Olga Tellis v. Bombay Municipal Corporation (1986).

Student Responsibilities:

Students are expected to come prepared with readings and actively participate in the discussions.

Course reviewers:

1. Prof. (Dr.) Shiju M. V, Acting Dean, School of Law, Sai University, Tamil Nadu, Chennai.
2. Dr. Smita Srivastava, Assistant Professor, Faculty of Law, University of Allahabad.
3. Dr. Rohin Koul, Assistant Professor, IIULER (Goa)

***Course review process assigned to Dr.Moumita Mandal (Assistant Professor, TERI SAS, New Delhi)**

Course 4 MPL 157- Infrastructure Law and Policy

Course title: Infrastructure Law and Policy			
Course code: MPL 157	**No. of credits: 3**	**L-T-P:** 30-15-00	**Learning hours: 45**
Pre-requisite course code and title (if any): None			
Department: Centre for Post Graduate Legal Studies			
Course coordinator:	**Course instructor:**		
Contact details:			
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 an attempt is made to undertake a comparative assessment of the regulatory laws and policies of different infrastructure sectors.

Course objectives:
1. To provide an overview of the constitutional and the general legal context in which the infrastructure sector operates.
2. To examine the importance of independent regulation in infrastructure
3. A general analysis of the laws, policies, and reforms carried out in select infrastructure sectors
4. To discuss and analyze various legal and policy frameworks within the infrastructure sector and foster the ability to propose policy reforms.

Course contents

S.No	Topic	L	T	P
1	**Constitutional aspects** Constitutional Infrastructure Law in India: Allocation of jurisdiction over different infrastructure sectors between the Centre and State - law-making powers; Allocation of natural resources: Judicial review; Administrative law ; Case Studies for Comparative Analysis: South Korea, Germany, and Singapore Basic Infrastructure (Public Health; Public Education) vs. Developmental Infrastructure	4	2	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 ; Comparative Analysis of Regulatory Frameworks across Different Sectors; Public Participation and Transparency in the Regulatory Process	4	2	0
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, Environmental Considerations in Land Acquisition: Requirement of consent in the case of certain acquisitions, compensation, rehabilitation and resettlement. ; Human Rights and Indigenous Rights Considerations in Land Acquisition	4	2	0
4	**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 ; Renewable Energy Policies and Regulations in India	4	1	0
	Telecommunications The national telecom policies-the legal framework- regulatory agencies functioning, power and functions of TRAI and TDSAT	3	1	0
	Oil, Petroleum and Natural Gas Reforms, policies and legal framework -New Exploration Licensing Policy (NELP)- production sharing contracts- the Petroleum Regulatory and	3	2	0

	Natural Gas Board Act – the emerging regulatory reforms ;			
	Water Water policy General Legal framework and reforms-Water rights- state jurisdiction- new regulatory reforms in water sector.	2	2	0
	Transport Law, policy and reforms relating to Airports-Railways-Road –Port; TAMP; an overview of coastal shipping and Inland Water Transport policy ;Urban Transport Planning and Policy	3	2	0
	Real estate The Real Estate (Regulation and Development) Act, 2016 ; Land Use Planning and Zoning Laws; interrelationship between planning and zoning laws and environmental legislations	2	1	0
	Infrastructure as a contributor and mitigator toward climate change: Cross Sectorial Analysis; Case Studies	1		
	Total	30	15	0

Evaluation criteria:

1. Minor Test: Written Examination- 20% [Syllabus: Module 1]
2. Written Assignment: Research Paper or Case Comment – 20 % [Entire Syllabus]
3. Presentation on the Assignment -20 % [Entire Syllabus]
4. Major Test: Written Examination-40 % [Syllabus: Module 2-4]

Learning outcomes:

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

1. *Understand and Remember* key principles of infrastructure law and policy. [Minor Test, Major Test]

2. *Apply* this knowledge to real-world scenarios in infrastructure development, effectively using legal reasoning to interpret policy implications and regulatory decisions. [Minor Test, Major Test, Case Comment, Presentation]

3. *Analyze* and critique laws, policies, and reforms within various infrastructure sectors, and identify potential areas for improvement. [Research Paper, Presentation]

4. *Evaluate* the role of infrastructure in broader socio-economic contexts, considering the implications of legal frameworks on human rights, environmental sustainability, and economic development. [Minor Test, Major Test, Research Paper or Case Comment, Presentation]

5. *Create* well-founded arguments and proposals for policy or legal reform to address contemporary challenges in infrastructure development. [Research Paper,

Presentation]

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:

Module 1: Constitutional Aspects

- **Baldwin, R., & McCrudden, C. (1987).***Regulation and Public Law*. London: Weidenfeld & Nicolson.
- **National Transport Development Policy Committee Report (Rakesh Mohan Committee).**
- **Shapiro, S., &Tomain, J. (2003).***Regulatory Law and Policy: Cases and Materials*. New Delhi: LexisNexis.

Module 2: Independent Regulation

- **Sarkar, S. K., & Srivastava, L. (Eds.). (2002).***Reforms in the Infrastructure Sectors: Next Steps*. New Delhi: TERI Press.
- **Sundar, S., & Sarkar, S. K. (2000).***Framework for Infrastructure Regulation*. New Delhi: TERI Press.
- **Joshi, P. (2003).***Law Relating to Infrastructure Projects* (2nd ed.). New Delhi: Butterworths.

Module 3: Land Acquisition

- **Cullet, P., &Koonan, S. (2012).***Water Law in India: An Introduction to Legal Instruments*.
- **Iyer, R. R. (2009).***Water and the Laws in India*. Sage.

Module 4: Sectoral Policies, Reforms, and Laws

- **Chatterjee, S. K. (2013).***Commentary On The Electricity Laws of India*. Delhi Law House.
- **Raghavan, V. (2007).***Communications Law in India: Legal Aspects of Telecom, Broadcasting, and Cable Services*. LexisNexis.
- **Naseem, M. (2010).***Energy Law in India*. Kluwer Law International.
- **Fatima, T. (2012).***Transport Law in India*. Kluwer Law International.
- **Palmer, E. (2021).** Regulating infrastructure: Human rights and the sustainable development goals in Myanmar. *Human Rights Law Review, 21*(3), 588-619.
- **Fagundes, A., de Cássia Lisboa Ribeiro, R., de Brito, E. R. B., Recine, E., & Rocha, C. (2022).** Public infrastructure for food and nutrition security in Brazil: Fulfilling the constitutional commitment to the human right to adequate food. *Food Security, 14*(4), 897-905.
- **Hulten, C. R., & Schwab, R. M. (1997).** A fiscal federalism approach to infrastructure policy. *Regional Science and Urban Economics, 27*(2), 139-159.
- **Greiving, S., et al. (2016).** Developments and drawbacks in critical infrastructure and regional planning: A case study on region of Cologne, Germany. *Journal of Extreme Events, 3*(04), 1650014.
- **Malone, N. (2005).** The evolution of private financing of government infrastructure in Australia—2005 and beyond. *Australian Economic Review, 38*(4), 420-430.
- **Shortridge, J., & Camp, J. S. (2019).** Addressing climate change as an emerging risk to infrastructure systems. *Risk Analysis, 39*(5), 959-967.
- **Palin, E. J., et al. (2021).** Implications of climate change for railway infrastructure. *Wiley Interdisciplinary Reviews: Climate Change, 12*(5), e728.

Student responsibilities: Students are expected to come prepared with readings and actively participate in the discussions.

Course Reviewers:

1. Prof. (Dr.) Rashmi Salpekar, Dean and Professor, Vivekananda School of Law and Legal Studies, Vivekananda Institute of Professional Studies-Technical Campus- Delhi
2. Prof. (Dr.) P.P. Mitra, Professor, Woxsen University, Hyderabad
3. Ms. Gurmeet Bindra, Managing Partner, GBA Law offices

Course Revised by :Dr. Manini Syali, Assistant Professor, Centre for Postgraduate Legal Studies, TERI-SAS

Enclosure 23

MA SDP Programme Outline

First year			
	Course	**Credit**	**Duration**
First Semester	**7 core courses**	**20**	**15 weeks**
Second Semester	**7 core courses**	**20**	**15 weeks**
Second Year			
Third Semester	**Minor project**	**8**	**6-8 weeks**
	3 core courses	**10**	**15 weeks**
	3 (or more) electives	**9 (Minimum but can be exceeded if student opts for more than 3 electives**	
Fourth Semester	**Major Project**	**20**	**20 weeks**
Total Credit		**87**	

MA SDP Programme Outline

Course Code	Course Title	Type	No. of Credit	L-T-P
Semester -1				
MPD 137	Current Advances in Environmental Science	Core	3	42-0-6
MPD 143	Principles of Economics	Core	4	47-13-00
MPD 139	Themes and Perspective on Development	Core	2	27-3-0
MPD 107	Global Classroom: Integrated Approaches to Sustainable Development	Core	2	30-0-0
MPD 154	Law, Society and Sustainable Development	Core	3	34-11-0
MPD 114	Qualitative Research Methods for Development practice	Core	3	33-0-24
MPD 115	Quantitative Approaches & Methods for Development Practice	Core	3	34-6-10
Semester -2				
MPD 147	Development Economics	Core	3	37-8-0
MPD 130	Population Health & Sustainable Development: Analytical Perspective	Core	3	38-4-6
MPD 145	Integrated Impact Assessment	Core	3	39-0-12
MPD 106	Group Practicum – Community Needs assessment	Core	4	12-12-72
MPD 149	Fundamentals of Environmental, Social, and Governance (ESG) Principles	Core	2	26-4-0
MPD 148	Gender in Development Practice	Core	2	26-4-0
MPD 150	Management of Development Organizations	Core	3	34-11-00
PPM 210	Climate, Energy and Carbon Market	Elective	2	26-04-0
Semester -3				
MPD 109	Minor Project	Core	8	0-0-240

MPD 161	Public Policy processes and Institution	Core	3	35-10-0
MPD 129	Project Design and Management for Sustainable Development	Core	4	46-14-0
MPD 144	Contemporary Public Health Issues and Emerging Approaches	Core	3	38-04-06
MPD 113	Application of quantitative data analysis in development practice	Elective	3	20-12-22
NRE 168	Food security and agriculture	Elective	3	26-16-6
NRE 149	Governance and management of natural resources	Elective	3	35-10-0
NRE 133	Environmental management system	Elective	4	42-18-0
NRC 162	Climate change and disaster risk reduction	Elective	3	33-12-0
MPE 122	Indian agricultural development: Contemporary Issues	Elective	4	60-0-0
MPE 154	Economics of health and environment	Elective	4	43-15-4
MPL 153	Law and justice in globalizing world	Elective	3	42-0-0
PPM 179	Design thinking	Elective	2	12-18-0
PPM 198	Entrepreneurship	Elective	2	15-14-2
Semester-4				
MPD 104	Major project	Core	20	0-0-480

Enclosure 24

Themes and Perspectives of Development

Course title: Themes and Perspectives of Development			
Course code:	**No. of credits:** 2	**L-T-P: 30**-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any):			
Department: Department of Policy and Management Studies			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Core	**Course offered in** 1st Semester		
Course description: This is a foundation course for any development practitioner. The course provides a base for other subjects in MA-SDP Programme in TERI SAS. Hence, basic social science lexicons of Development will be introduced to the students. Examples from diverse global and regional contexts will be used to facilitate discussions in the classroom.			
Course objectives: This course introduces the conceptual foundations of Development and demonstrates the complexities of 'development' and 'development theories'. The course enables the students – • to develop a critical understanding on both historical and contemporary perspectives of development - both mainstream and alternative • to understand theoretical and empirical notions of development. • to engage the students in various discourses of development practice through debate and discussion			
Course content			

Module	Topic	L	T	P
1	**Understanding Development:** This module introduces the notion of 'development' conceptualized by various development thinkers and practitioners. The following topics will be covered in this module: • Basic concepts of Change and development • Development as dominant discourse of western modernity • Understanding third world and the concept of global north and south • Growth versus Development debate • Agencies of development (state and non-state actors)	6	0	0
2	**Models of Development:** Through this module, the students will be able to understand two dominant models of development – capitalist and socialist model. In the socialist model both the utopian and the scientific socialism will be discussed along with various types of socialist models like social democratic model (Keynesianism and Nordic Model); Centrally planned or Command Economy; Socialist Market economy. Hence, two major topics will be covered – • Capitalism • Socialism	8	0	0
3	**Perspectives of Development (mainstream)** Development theories are about understanding how the processes of change in societies take place. In this regard, the module will be dedicated to the debate and discussion on the emergence of the Post-war growth-centric development theories like modernization, underdevelopment and neoliberalism which shapes contemporary perspectives of Development. • Modernization (Traditional vs. Modern; Stages of Growth) • Theories of Underdevelopment, Dependency, and world system	10	0	0

	• Neoliberalism			
4	**Perspectives of Development (Alternative)** The alternative approaches and their methodologies have emerged as development paradigm indicating a theoretical break from the mainstream development approaches. The following topics will be covered. • Human development • Social development • Sustainable development • Gender and development • Participatory Development	6	0	0
		30	0	0

Evaluation criteria

- **Class participation [10%]:** based on active participation (like debate, discussion and presentation) and attentiveness. [Learning outcomes-1-2]
- **Minor-1: Assignment submission and Presentation** [40%]: the students will submit an assignment by taking any developmental challenges as a case for the assignment. [Learning outcomes 1-3]
- **Major test: written exam** [50%] [Learning outcomes 1-3]

Learning outcomes:

Upon successful completion of the course students should be able to –

1. understand the basic concepts of development and its necessity as a process in social change.
2. critically reflect on the diverse discourses of development.
3. undertake research and formulate arguments on various contemporary development challenges to and exclusion and be able to present a substantiated opinion.

Pedagogical approach: The course will be taught through discussion-centric lectures augmented through relevant academic readings. In addition, contemporary issues will be conceptualized as a practical component to deconstruct the complexities of Development. Various documentary movies on history of Development and emergence of development theories will be shown for debate and discussion on contemporary development challenges

Essential Readings

- Amartya Sen (n.d.) Concept of Development. Harvard University
- Agarwal, B. (2018). Gender equality, food security and the sustainable development goals. Current Opinion in Environmental Sustainability. https://doi.org/10.1016/j.cosust.2018.07.002
- Beteille, Andre (1996), "Sociology and Common Sense", *Economic and Political Weekly*, Vol. 31, No. 35/37, (pp. 2361-2365).
- Baden, H. R. (2000). Gender and Development: Concepts and Definitions. UK: BRIDGE.
- Boellstorff, D. L. (1995). Women in Development: The need for a Grassroots Gender Planning Approach. Nebraska Anthropologist, pp. 45-55.
- Burgess, G. (2008). Planning and the Gender Equality Duty- Why does gender matter? People, Place and Policy Online, 112-121.
- Chambers R. Idea of Development: Reflecting forward, IDS working paper. Institute of Development Studies: England
- Chaudhary A. (2013). Modernization: Impact, Theory, Advantages and Disadvantages. International Journal for Research in Education. Vol. 2 (2).
- Christine Saulnier, S. B. (1999). Gender Planning: Developing an Operational Framework for En-Gendering Healthy Public Policy. Canada: MCEWH.
- Engelhard, Karl (1983) Theories of Development and Underdevelopment and Chances of their Practical Application. Journal of Geography. Vol. 10 (12) pp. 383-89
- Escobar, Arturo (1995), *Encountering development: the making and unmaking of the Third World*, Princeton, N.J.: Princeton University Press. Harvard

- FRANK, AG, (1966) The Development of Underdevelopment, Monthly Review Monthly review. Vol.41(2), p.37-51
- Patnaik U. and Patnaik P. (2021) Capital and Imperialism: Theory History and Present. Monthly Review Press: New York
- Perry, John A & Erna K Perry (2016), *Contemporary Society: An Introduction to Social Science*, Routledge, New York.
- Pieterse, J. N. (1998). My Paradigm or Yours? Alternative Development, Post-Development, Reflexive Development. Development and Change. Vol. 29. pp. 343-73.
- Pieterse, Jan Nederveen, (2010) Development Theory (2nd edition). Sage.
- Przeworski Adam and Papaterra Fernando - Modernization: Theories and Facts (1997 *World Politics* 49.2 (1997) 155-183
- Reyes, G. E. (2001). Four main theories of Development: Modernization, Dependency, World system and Globalization. Nómadas. Revista Crítica de Ciencias Sociales y Jurídicas. Vol.4 (2)
- Rapley, J.2007. Understanding development: theory and Practice in the Third World. Boulder: lynee Reinner Publishers.
- Roberts, J.T. and Hite A. (eds) (2000) From modernization to globalization Perspective on Development and Social Change. Blackwell Publishing: US
- Schuurman, F.J. (2000) Paradigms Lost, Paradigms Regained? Development Studies in 21st century. *Third World Quarterly*, Vol 21, No 1, pp 7- 20.
- Summer, Andy and Tribe, Michael (2008). International Developmental Studies: Theories and Methods in Research and Practice. Sage Publication
- Taylor, V. (1999). Gender Mainstreaming in Development Planning. United Kingdom: Commonwealth Secretariat
- Webster, Andrew. (1984). Introduction to Sociology of Development McMillan Publishers: UK
- Venugopal, R. (2015). Neoliberalism as Concept. *Economy and Society.* Vol.44 (2)
- Willis, Katie (2005). Theories and Practices of Development. Routledge: UK

Recommended journals [for reference]

- Economic and Political Weekly / Journal of Human Development and Capabilities
- Indian Journal of Human Development
- World Development / Journal of Development Studies
- Oxford Development Studies/ Third World Quarterly

Student responsibilities

1. As the University has the policy of minimum 75% of physical presence, the students are expected to plan their academic activities considering the learning goals and evaluation criterion of the Course.
2. Lastly, any sort of academic dishonesty including cheating, copying, inappropriate collaboration and plagiarism will NOT be acceptable.

Course reviewers:

1. Prof. Abhijit Guha, Former Professor of Anthropology, Vidyasagar University, and Senior ICSSR Fellow, Government of India
2. Dr Manasi Mishra, Head of Research Division, Center for Social Research, New Delhi
3. Dr Snigdha Bishnoi, Asst. Professor, School of Liberal Studies, Ambedkar University, Delhi

This Course outline was prepared by Dr Swarup Dutta and approved by the….. Academic Council Meeting on …… at TERI School of Advanced Studies, New Delhi.

Enclosure 25

Law, Society, and Sustainable Development

Course title: Law, Society and Sustainable Development			
Course code:	**No. of credits:** 3	**L-T-P distribution:** 34-11-0	**Learning hours:** 45
Pre-requisite course code and title (if any): NA			
Department: Department of Policy and Management Studies			
Course coordinator (s):		**Course instructor (s):**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course Description: This course provides a comprehensive understanding of the origins and development of the concept of law and sustainable development, along with the multifaceted role of law in society. India has numerous laws and policies aimed at protecting the rights of vulnerable communities and promoting sustainable development across various dimensions, including social, economic, and environmental aspects.The Indian judiciary, particularly the Supreme Court of India, has played a pivotal role in interpreting the Constitutional provisions and has delineated the obligations of the state and citizens to protect the environment and attain the goal of social justice and economic equity. The course will cover legislative frameworks, policies, and judicial interventions that have collectively shaped India's approach to sustainable development.

Course objectives:

- To make the students realize the significance of law as an instrument for social changes in that how it has set the course in the contemporary Indian society.
- To enable students to critically examine how law and legal institutions can be effectively used to combat social oppression and inequalities, promoting justice and equity in Indian society.
- To expose students to various legal principles and familiarize them with the concept of judicial activism and the tool of public interest litigation that has often been used to implement the concept of sustainable development.
- To inculcate an understanding among students of the various legal frameworks at international, national, and local levels that govern sustainable development initiatives. This includes exploring laws and policies aimed at achieving social, economic, and environmental sustainability.
- To provide students with a comprehensive perspective on how the judiciary, legislature, and policy-making institutions collaborate to advance sustainable development goals, ensuring a balanced approach that addresses all facets of sustainability.

Course Contents:

Module	Topic	L	T	P
1	**Introduction to Law, Society and Development:** This module shall cover the conceptual and legal framework of the intersection of law, society, and development. • Discussion on relevant constitutional provisions • Discussion on justice and rule of law • Law as an instrument of social change • Understanding the intersection between law, society, and development • Examination of legal frameworks that address gender-based discrimination. • Exploration of the role of law in promoting human rights.	4	0	0

2	**Key legal concepts:** This module discusses various relevant legal concepts related to **Sustainable development:** • Historical evolution: Brundtland Commission Report. • Key principles of sustainability (e.g., environmental protection, social equity, economic viability) • Sustainable Development Goals (SDGs) and their significance • Role of law and legal institutions for SDG governance in India	6	0	0
3	**International Law and Sustainable Development:** This module deals with the evolution and development of sustainable development frameworks, encompassing environmental, social, and economic aspects. • Important Doctrines: Precautionary Principle, Polluter Pays Principle and Public Trust Doctrine • Biodiversity Convention and Climate Change Law and Policy: Interlinkages with Sustainable Development • Global Economic Policies for Sustainable Development: Analysis of international economic policies and agreements that promote sustainable development, including trade, investment, and development aid policies. • Social Sustainability and International Law: Discussion on international legal frameworks that address social sustainability issues such as poverty alleviation, education, health, and gender equality.	8	0	0
4	**Sustainable Development at the National Level:** This module highlights the laws related to sustainable development at the national level, covering environmental, social, and economic dimensions – • Public Interest Litigation (PIL) • Right to Wholesome Environment: Evolution and Application • Environmental Legislations in India • Legal Framework for Social Inclusion: Laws addressing social equity and justice (Right to Education Act, MGNREGA). • Legal Framework for Economic Development: CSR; Sustainable Business Practices; Labor Rights • Economic and Social Rights of Forest Dwelling Communities	8	6	0
5	**Contemporary Challenges in relation to Emerging Legal Issues in India (Case Studies):** This module will cover the discussion regarding contemporary challenges with respect to emerging legal issues in relation to sustainability with the help of various case studies. • Legal aspects of land use planning: The RFCTLARR Act 2013 (case study: Industrial corridors in Maharashtra) • Water related conflicts at national level (Case Study India): Inter-State Water Disputes Act, 1956; Role of judiciary; Mullaperiya dispute; Cauvery Water Disputes	8	5	0

	• Landmark Judicial Decisions: N.D. Jayal vs Union of India; *Narmada Bachao Andolan vs. Union of India; TN Godavarman vs Union of India*			
Total		**34**	11	**0**

Evaluation procedure:

	Weightage (%)
• Class Participation:	10
• Minor 1: Case Law Discussion	20
• Minor 2: Assignment and Presentation	30
• Major Test: Written test	40

Learning outcomes:

1. Awareness about the basic tenets of Indian Constitutional law specifically focusing on Fundamental Rights, Fundamental Duties and Directive Principles of State Policy
2. Familiarity with the Institutional Structure of Indian Governance for Sustainable Development and the Role of the Indian Judiciary
3. Familiarity with Gender justice, Human rights issues and conceptual understanding of Sustainable Development.
4. Apply critical thinking skills to assess ethical dilemmas and conflicts in sustainable development decision-making, proposing viable solutions and strategies for mitigation.
5. A true understanding of the student over the subject will help them to work in a diverse field of law. They may be able to have a better understanding of the law and society and may understand the impact of law on society and vice versa.

Pedagogical approach:

The course will be taught through interactive sessions based on previously circulated readings. Many legal principles in India have organically developed through judgments of the courts and these judgments will be discussed in class. It is understood that most students do not have a background in law and therefore the readings for class will be decided and the student assessment shall be undertaken keeping that in mind. The teaching learning methodology shall comprise lectures, case studies, group discussions, presentation by the participants, guest lectures, seminars and research.

Suggested Readings:

1. Agnes Flavia - Law and Gender Inequality: The Politics of Women's Rights in India, Oxford, New Delhi (1999)
2. Anna Grear & Louis J. Kotzé (eds.) - Research Handbook on Human Rights and the Environment, Edward Elgar (2015)
3. Bakshi, M.P.- Constitution of India, Vol 1, 19th edition, Lexis Nexis (2023)
4. Basu, D. D. - An Introduction to the Constitution of India, 26th edition, New Delhi, Prentice Hall (2023)
5. Baxi, Upendra - The Crisis of Indian Legal System, Vikas Publication (1982)
6. Eloise Scotford - Environmental Principles and the Evolution of Environmental Law, Hart Publishers (2017)
7. Marc Galanter (ed.) - Law and Society in Modern India, Oxford, New Delhi (1997)
8. P. Leelakrishnan - Environmental Law in India, 3rd Edition, Lexis Nexis, New Delhi (2008)
9. Philippe Cullet & Sujith Koonan (eds.) - Research Handbook on Law, Environment and the Global South, Edward Elgar (2019)
10. S.P. Sathe - Judicial Activism in India: Transgressing Borders and Enforcing Limits, New Delhi: Oxford University Press (2002)
11. Savitri Gunasekhare - Children, Law and Justice, Sage Publications (1997)
12. Sunil Deshta and Kiran Deshta - Law and Menace of Child Labour, Anmol Publications, New Delhi (2007)

13. Shyam Diwan & Armin Rosencranz - Environmental Law and Policy in India, 2nd Edition, Oxford University Press (2001)
14. Segger, M.-C. C., & Khalfan, A. - Sustainable Development Law: Principles, Practices, and Prospects, Oxford: Oxford University Press (2004)
15. Boyle, A.E. and Freestone, D. (eds.) - *International Law and Sustainable Development: Past Achievements and Future Challenges, Oxford University Press, USA (2001)
16. Orebech, Peter - The Role of Customary Law in Sustainable Development, Cambridge University Press (2005)
17. Porras, Ileana M. - The City and International Law: In Pursuit of Sustainable Development, Fordham Urb. LJ 36 (2009): 537
18. Segger, Marie Claire Cordonier, and Freedom-Kai Phillips - Indigenous Traditional Knowledge for Sustainable Development: The Biodiversity Convention and Plant Treaty Regimes, Journal of Forest Research 20.5 (2015): 430-437
19. Bizikova, Livia, John Robinson, and Stewart Cohen - Linking Climate Change and Sustainable Development at the Local Level, Climate Policy 7.4 (2007): 271-277
20. Harish, B. - Role of the Supreme Court in Developing & Applying the Principles of Sustainable Development, Issue 5 Indian JL & Legal Rsch. 4 (2022): 1
21. Puvimanasinhe, Shyami Fernando - Towards a Jurisprudence of Sustainable Development in South Africa: Litigation in the Public Interest, Sustainable Dev. L. & Pol'y 10 (2009): 41
22. Jameel, Anas, and Waseem Ahmed - Sustainable Development Goals and India's Commitment to Gender Justice, Society & Sustainability 3.2 (2021): 68-86
23. MacNaughton, Gillian, and Diane F. Frey - Decent Work, Human Rights and the Sustainable Development Goals, Geo. J. Int'l L. 47 (2015): 607

Student responsibilities:

Attendance: At least 75% attendance will be necessary to be able to appear for the final exam. The students are required to come prepared with readings that are suggested during the class and ensure timely submission of assignments. They are also expected to participate and further strengthen their understanding of concepts through classroom discussions.

Course Reviewers

- Dr Aditi Singh, Associate Professor, Galgotias University, Greater Noida\
- Dr Anant Vijay Maria, ADV on Record Supreme Court of India

This Course outline was prepared by Dr Kavita and Dr Manini Syali and approved by the….. Academic Council Meeting on …… at TERI School of Advanced Studies, New Delhi.

Enclosure 26

Principles of Economics

Course title: Principles of Economics			
Course code: MPD 143	**No. of credits:** 4	**L-T-P: 47-13-00**	**Learning hours:** 60
Pre-requisite course code and title (if any): NA			
Department: Department of Policy and Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course description

This introductory course primarily covers the core and fundamental aspects of microeconomics, macroeconomics, and public finance. The goal of this course is to make students understand the key economic concepts, theories, and principles and how they relate to the world they live in. The emphasis is laid on building students critical thinking and analytical abilities in microeconomics, macroeconomics and public finance. The central focus of this course is how and why markets (one important mechanism for allocating scarce resources) operate, and why markets and pricing principles are fundamental in trade-offs and choice questions. Besides, how the key economic decisions are made by households and firms are discussed and exemplified. Production, costs and market structures are analyzed at firm level. Key macro-economic issues such as output, income, and employment are discussed and their impact on inflation and other macroeconomic indicators are examined. Key concepts of public finance such as taxation and public expenditure and their applications in Indian context will also be elaborated. In each module, Indian context is highlighted so that students can connect theories to practice and to policies. Explanations of economic concepts are supplemented by application-based cases studies and live examples.

Course objectives-

- To familiarize students with the key economic principles and theories and relate it to the world they live in.
- To develop students critical thinking and analytical abilities around concepts of economics
- To provide understanding of how output and income are determined at an aggregated level and impact the (un)employment and inflation
- To expose students how taxation and other policies can influence economic incentives of individuals, firms and other entities
- To create grounds for students to hone skill sets of analyzing, interpreting economic variables through diagrams, and graphs

Course content

Module	Topic	L	T	P
I	**Introduction to economics** A brief history of ideas in economics Basic concepts of Economics Understanding the philosophy of economics Nature of economics: Is economics a science or an art? Scope, method and techniques of economics, Definitional pluralities and distinctions such as micro-versus macro, theories versus models, positive economics and normative economics The economic problem of scarcity, choice, and opportunity cost	4	0	0
II	**Demand, Supply, Elasticities, and Market Efficiency** Demand, supply, and market equilibrium. Derivation of Demand and supply curve Demand and supply applications	6	2	0

	Consumer surplus and producer's surplus Market efficiency and their applications Elasticity: its various forms and estimation methods, point, arc Elasticity and total revenue Elasticity applications in the filed of energy and environment			
III	**Utility, Preferences and Choice** Budget constraints, determination of optimal choices using indifference curve analysis and its applications Extensions of Indifference curve analysis and revealed preference analysis Changes in income and prices, income and substitution effects Behavioural economics as an alternative framework for economic analysis Application of behavioural economic in energy efficiency context	4	2	
IV	**Production and Cost** Production Theory Production function and different forms Short-run and long-run production function, Isoquants, MRTS Total, average and marginal products Economies of scale and scope Theory of cost Short-run and long run costs, cost minimization Total, average and marginal costs Applications of production and costs theory	6	2	0
V	**Market structure and regulation** Market equilibrium and price determination under different market structures Perfect and Imperfect market structure, welfare costs of monopoly Market failure, externalities, role of government, efficiency, and regulation Regulation of public monopolies Application in case of infrastructure industries such as energy and water	6	2	0
VI	**National Income Accounting** Measuring national income, output and employment – different approaches Determination of aggregate output, price level and interest rate – classical, Keynesian and modern theories and approaches GDP estimation in India Critiques of traditional measures of NIA	6	2	0
VII	**Macro-economic policies** Policy effects: monetary and fiscal policy Indian monetary and fiscal policies: evidence from its evolving dynamics Open economy macro-economics: balance of payment, exchange rate, international trade, Indian case study	6	2	0
VIII	**Public Finance** Theories of Public Finance, Theories of taxation, , tax incidence and tax burden, public expenditure, subsidies, public expenditure and external debt structure in India, public sector reform agenda in India, Fiscal federalism in India Public finance case studies in India	8	2	
	Total	**46**	**14**	**0**

Evaluation criteria:

Minor Test 1: 20%
Minor Test 2: Assignment (individual): 20 %
Classroom exercises: 10 %
Major Exam: 50%

Learning outcomes

By the end of the course, students would be able to;

- Understand the core micro , macroeconomic and public finance concepts, theories, models, principles, tools, and techniques (All tests)
- Develop the skills to interpret , analyze the economic concepts and variables through diagrams, tables and graphs (Minor test 1, Class-room exercises, and Major test)
- Relate the key economic principles to real life situations, especially in the context of development challenges which would help students to make informed decisions (Minor test 2)

Pedagogical approach

The course will be delivered through a mix of classroom lectures, quizzes, discussions, classroom exercises and assignments and case studies discussion and presentation.

Course Reading Materials

Suggested core readings:

1. Principles of Economics, Karl Case, Ray Fair, and Sharon Oster, 12th Edition, Pearson Education Inc., 2017.
2. Principles of Economics, Mankiw, N. Gregory, 4th edition. South-Western College Publications, 2006.
3. Principles of Economics, Stiglitz, J.E. and C.E. Walsh, 3rd Edition. New York: W.W. Norton & Company, 2002.
4. Macro Economics, R. Dornbusch, S. Fischer, and R. Startz, 10th Edition, Tata-McGRAW-HILL, 2012.
5. Macroeconomics, Olivier Blanchard, 5th edition, Pearson Education Inc., 2009.
6. Public Finance in Theory and Practice, R. Musgrave and P. Musgrave, McGraw Hill Education, 5th Edition, 2017

Advanced Reading Material

1. Intermediate Micro-economics: A Modern Approach, H.L Varian, 8th Edition, W.W. Norton & Company, 2010.
2. Fundamentals of Microeconomics, C. Snyder and W. Nicholson, 11th Edition, Cengage Learning (India), 2012.
3. Macro-Economics: Theory and Policy, W.H. Branson, Third Edition, East-West Press, 2005.
4. Macroeconomics, Richard T. Froyen, 2nd Edition, Pearson Education Asia, 2005

Additional readings

1. An Inquiry into the Nature and Causes of the Wealth of Nations, Adam Smith
2. Economics: A Very Short Introduction, Partha Dasgupta, First Edition, Oxford University Press, 2007
3. The Company of Strangers, Paul Seabright, Princeton University Press, 2010
4. Free to Choose, Milton Friedman and Rose Director Friedman, First Edition, Mariner Books, 1990
5. The Armchair Economist: Economics and Everyday Life, Steven E. Landsburg, The Free Press, New York, 2012

Additional information

Students should be sincere and regular in classes

Student responsibilities

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

Course reviewers:

Prof. Saon Ray, Professor, ICRIER

Dr Seema Sangita, Associate Professor, Centre for Economic Studies and Planning, JNU
Dr Chandra Sekhar Bahinipati, Associate Professor, IIT Tirupati
Dr Santosh Das, Assistant Professor, ISID

The course outline is prepared by Dr Gopal K. Sarangi.

Enclosure 27

Climate Change and Development

Course title: Climate Change and Development			
Course code:	**No. of credits:** 3	**L-T-P:** 28-17-0	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Policy and Management Studies			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Elective	**Course offered in:** 3rd Semester		

Course description: This course provides an in-depth exploration of climate change, focusing on key aspects such as data analysis, vulnerability assessments, adaptation strategies, maladaptation, and mitigation measures. Students will gain a comprehensive understanding of the science, socio-economic impacts, and responses associated with climate change in the context of development. The course is structured to foster critical thinking, research skills, and practical applications for addressing climate change challenges

Course objectives:

- ✓ To acquire an understanding of the science behind climate change and develop proficiency in climate data analysis.
- ✓ To evaluate the vulnerability of regions, ecosystems, and socio-economic systems to climate change.
- ✓ To investigate adaptation strategies aimed at enhancing resilience and promoting sustainable development.
- ✓ To critically assess instances of maladaptation and unintended consequences.
- ✓ To explore measures for mitigation, such as renewable energy and carbon capture.
- ✓ To analyze real-world case studies and propose climate solutions for development.

Course content

Module	Topic	L	T	P
1	**Introduction to Climate Change in the Context of Development** This foundational module starts by exploring the earth's climate system, providing a comprehensive overview of atmospheric components. By delving into historical perspectives, students gain insight into how climate change has evolved alongside global development agendas and international agreements. The module also addresses key drivers like greenhouse gas emissions, deforestation, and industrial activities, laying the groundwork for understanding the complex forces shaping our climate and developmental landscapes. a) Overview of the Earth's climate system b) Key drivers of climate change and their developmental implications c) Historical perspectives on climate change in global development agendas and other international agreements	4	0	0
2	**Climate Change, Vulnerability, and Development** This module deepens the understanding of vulnerability within	4	2	0

	the context of development, employing both conceptual and practical approaches. It introduces frameworks for vulnerability assessment, enabling students to identify vulnerable regions, populations, and ecosystems. Additionally, it covers tools and methodologies for assessing socio-economic vulnerability, with case studies providing insight into real-world adaptation challenges. a) Concepts and frameworks for vulnerability assessment within the developmental context. b) Identifying vulnerable regions, populations, and ecosystems, with a focus on understanding the intersectionality of socio-economic factors and environmental risks c) Tools and methodologies for assessing socio-economic vulnerability and its implications for development. d) Case studies: Exploring the livelihood vulnerability of mountainous and coastal communities in India, elucidating the intertwined nature of vulnerability and development in the face of climate change.			
3	**Climate Change, Adaptation, and Resilience** This module explores adaptation strategies to enhance resilience and mitigate the impacts of climate change. It covers various types of adaptation, with a focus on nature-based solutions that promote biodiversity and ecosystem services. Emphasis is placed on integrating adaptation strategies into policy and planning processes to mainstream resilience-building measures across sectors and governance levels. a) Types of adaptation: incremental, systemic, and transformational, with a focus on resilience-building b) Nature-based solutions for climate adaptation and their role in fostering resilience c) Mainstreaming adaptation into policy and planning frameworks to enhance overall resilience d) Case studies: Examining adaptation strategies implemented by coastal and mountainous communities in the agriculture and water sectors of India, highlighting resilience-building practices amidst climate challenges.	4	2	0
4	**Climate Change, Maladaptation, and Development** In this module, dedicated to the critical evaluation of adaptation efforts within the context of development, special attention is given to maladaptation. It defines maladaptation and provides examples, scrutinizing the factors contributing to unintended negative consequences. a) Definition and examples of maladaptation, contextualized within the developmental landscape b) Factors contributing to maladaptation, with a focus on the intersection with development challenges c) Assessing the unintended consequences of adaptation measures d) Case studies: Maladaptive outcomes in the agricultural sector and water management of developing and	6	2	0

	developed countries			
5	**Integrating Development Perspectives into Mitigation Measures** In this module, students are introduced to climate change mitigation within the broader context of development, offering a comprehensive overview of strategies aimed at reducing or preventing the emission of greenhouse gases. This module not only explores the technical aspects of mitigation but also underscores the socio-economic dimensions inherent in sustainable development. a) Overview of climate change mitigation with a focus on sustainable development b) Renewable energy technologies c) Sustainable land use and forestry practices d) Carbon capture and storage e) Case studies: Factors determining household use of clean energy and sustainable land use practices in developing countries	6	2	0
6	**Climate Data Analysis in the Context of Development** This module starts by introducing various sources of climate data, emphasizing their significance in climate research. The module then delves into data preprocessing techniques essential for cleaning and organizing datasets. Statistical analysis methods are covered, and students will engage in hands-on exercises, gaining proficiency in working with real-world climate data. a) Introduction to climate data sources and databases b) Data preprocessing techniques c) Statistical analysis of climate data d) Hands-on exercises using climate datasets	4	9	0
		28	17	0

Evaluation criteria:

- ✓ Minor-1: Assignment: Presentation (20%) and Report submission (30%)
- ✓ Major Test: written test (50%)

Learning outcomes:

- ✓ By the end of the Major Test, students will be able to demonstrate a comprehensive understanding of key concepts, theories, and analytical techniques related to climate change and its impact on development.
- ✓ Upon completion of the Assignment Submission, students will showcase their ability to critically analyze and synthesize climate data within the context of development projects. Their assignments will reflect a deep understanding of the interconnectedness between climate change, development, and the utilization of climate data for evidence-based decision-making.

Pedagogical approach:

This course adopts an integrated pedagogical approach, combining theoretical knowledge with practical applications to facilitate deep learning and skill acquisition. It emphasizes active learning methodologies such as hands-on exercises, case studies, and collaborative projects to engage students in real-world problem-solving. Assessment methods are designed to assess both conceptual understanding and practical proficiency, encouraging students to apply their knowledge to analyze and propose solutions to complex climate change challenges.

Essential Reading:

Module 1: Introduction to Climate Change

- Harris, J.M., Roach, B. and Environmental, J.M.H., 2007. The economics of global climate change.
- Pachauri, R.K., Allen, M.R., Barros, V.R., Broome, J., Cramer, W., Christ, R., Church, J.A., Clarke, L., Dahe, Q., Dasgupta, P. and Dubash, N.K., 2014. Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change (p. 151). Ipcc.
- Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P., Trisos, C., Romero, J., Aldunce, P., Barrett, K. and Blanco, G., 2023. Climate change 2023: synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change.

Module 2: Climate Change and Vulnerability Assessment

- Thomas, K., Hardy, R.D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J.T., Rockman, M., Warner, B.P. and Winthrop, R., 2019. Explaining differential vulnerability to climate change: A social science review. Wiley Interdisciplinary Reviews: Climate Change, 10(2), p.e565.
- Pandey, R., Jha, S.K., Alatalo, J.M., Archie, K.M. and Gupta, A.K., 2017. Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities. Ecological indicators, 79, pp.338-346.
- Sahana, M., Rehman, S., Paul, A.K. and Sajjad, H., 2021. Assessing socio-economic vulnerability to climate change-induced disasters: evidence from Sundarban Biosphere Reserve, India. Geology, Ecology, and Landscapes, 5(1), pp.40-52.

Module 3: Climate Change and Adaptation Strategies

- Mendelsohn, R., Dinar, A. and Williams, L., 2006. The distributional impact of climate change on rich and poor countries. Environment and development economics, 11(2), pp.159-178.
- Mendelsohn, R. and Dinar, A., 1999. Climate change, agriculture, and developing countries: does adaptation matter?. The World Bank Research Observer, 14(2), pp.277-293.
- Vermeulen, S.J., Dinesh, D., Howden, S.M., Cramer, L. and Thornton, P.K., 2018. Transformation in practice: a review of empirical cases of transformational adaptation in agriculture under climate change. Frontiers in Sustainable Food Systems, 2, p.65.
- Panda, A., 2018. Transformational adaptation of agricultural systems to climate change. Wiley Interdisciplinary Reviews: Climate Change, 9(4), p.e520.
- Datta, P., Behera, B. and Rahut, D.B., 2023. Climate change and water-related threats in the Indian Sundarbans: food security and management implications. International Journal of Water Resources Development, pp.1-22.
- Shukla, R., Agarwal, A., Gornott, C., Sachdeva, K. and Joshi, P.K., 2019. Farmer typology to understand differentiated climate change adaptation in Himalaya. Scientific reports, 9(1), p.20375.
- Datta, P., Behera, B. and Rahut, D.B., 2022. Climate Change and Indian Agriculture: A Systematic Review of Farmers' Perception, Adaptation, and Transformation. Environmental Challenges, 8.
- Aryal, J.P. and Marenya, P., 2021. Understanding climate-risk coping strategies among farm households: Evidence from five countries in Eastern and Southern Africa. Science of the Total Environment, 769, p.145236.
- Aryal, J.P., Sapkota, T.B., Rahut, D.B., Krupnik, T.J., Shahrin, S., Jat, M.L. and Stirling, C.M., 2020. Major climate risks and adaptation strategies of smallholder farmers in coastal Bangladesh. Environmental Management, 66(1), pp.105-120.
- 10. Aryal, J.P., Sapkota, T.B., Khurana, R., Khatri-Chhetri, A., Rahut, D.B. and Jat, M.L., 2020.

Climate change and agriculture in South Asia: Adaptation options in smallholder production systems. Environment, Development and Sustainability, 22(6), pp.5045-5075.

Module 4: Climate Change and Maladaptation

- Barnett, J. and O'neill, S., 2010. maladaptation. Global environmental change, 20(2), pp.211-213.
- Juhola, S., Glaas, E., Linnér, B.O. and Neset, T.S., 2016. Redefining maladaptation. Environmental Science & Policy, 55, pp.135-140.
- Datta, P. and Behera, B., 2023. Assessing farmers' maladaptation to climate change in a sub-Himalayan region of India. Environment, Development and Sustainability, pp.1-18.

Module 5: Climate Change and Mitigation Measures

- Harris, J.M., Roach, B. and Environmental, J.M.H., 2007. The economics of global climate change.
- Rahut, D., Behera, B. and Ali, A., 2017. Factors determining household use of clean and renewable energy sources for lighting in Sub-Saharan Africa. Renewable and Sustainable Energy Reviews, 72, pp.661-672.
- Dhakal, A., Cockfield, G. and Maraseni, T.N., 2015. Deriving an index of adoption rate and assessing factors affecting adoption of an agroforestry-based farming system in Dhanusha District, Nepal. Agroforestry systems, 89, pp.645-661.
- Azhgaliyeva, D. and Rahut, D.B., 2022. Climate Change Mitigation: Policies and Lessons for Asia.
- Aryal, J.P., Rahut, D.B., Sapkota, T.B., Khurana, R. and Khatri-Chhetri, A., 2020. Climate change mitigation options among farmers in South Asia. Environment, Development and Sustainability, 22(4), pp.3267-3289.

Module 6: Climate Data Analysis

- Gilbert, R. O. (1987). Statistical methods for environmental pollution monitoring. New York: Wiley.
- Datta, P. and Das, S., 2022. Assessing the consistency of trends in Indian summer monsoon rainfall. Hydrological Sciences Journal, 67(9), pp.1384-1396.
- Datta, P. and Das, S., 2019. Analysis of long-term seasonal and annual temperature trends in North Bengal, India. Spatial Information Research, 27(4), pp.475-496.
- Ali, A., 2017. Coping with climate change and its impact on productivity, income, and poverty: evidence from the Himalayan region of Pakistan. International journal of disaster risk reduction, 24, pp.515-525.

Student responsibilities:

Maintaining a minimum attendance of 75% is mandatory. Additionally, students are expected to submit assignments and projects promptly and actively engage in class discussions.

Course Reviewers:

The course is reviewed by the following experts.

1. Prof. Bhagirath Behera, Professor of Economics, Department of Humanities and Social Sciences, Indian Institute of Technology Kharagpur, India.

2. Dr. Dil Bahadur Rahut, Vice-Chair of Research and Senior Research Fellow, Asian Development Bank Institute (ADBI), Japan.

This Course outline was prepared by Dr Pritha Datta and approved by the….. Academic Council Meeting on …… at TERI School of Advanced Studies, New Delhi.

Enclosure 28

Energy Economics, Policy and Finance

Course title: Energy Economics, Policy and Finance			
Course code: MPD XXX	**No. of credits:** 4	**L-T-P: 48-12-00**	**Learning hours:** 60
Pre-requisite course code and title (if any): NA			
Department: Department of Policy and Management Studies			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Elective	**Course offered in:** Semester 3		

Course description

This course is designed to provide an understanding of the application of economic and financial concepts, theories, frameworks, tools and quantitative methods in analyzing the energy sector and energy policies. In this course students will be equipped with the skill sets to apply economic thinking, economic tools and frameworks and use empirical data for economic analysis in energy and finance. It is also designed to trigger students' mind to think about complex developmental issues through the energy lens.

Course objectives-

- To offer a broad overview and critical understanding of the economics of energy and energy finance
- To equip students with the knowledge and skill set of various energy, financial and investment models and frameworks.
- To provide students hands-on experience in using various tools to estimate, assess the energy.

Course content

Module	Topic	L	T	P
I	**Basic concepts of energy economics and finance** Energy as a system, History of energy use, Nexus between energy and economic growth, Global energy and climate policy, Energy as a resource: classification, units/measurement, accounting frameworks, stock and flow, Distinction between primary energy and secondary energy, Concept of energy balance, Energy services and energy demand, Energy versus power, Energy conversions, Concepts of energy efficiency and energy intensity	6	2	0
II	**Economics of energy demand** Theoretical background of energy demand, Load factor and load curves, Derived energy demand, Energy demand at aggregated level and sectoral demand of energy, Energy demand models and tools. Energy demand management, Demand Side Management (DSM) tools, techniques and approaches, Load management, Dynamics of load under renewable energy penetration, Energy efficiency and energy demand, Time of day, seasonal, and block pricing approaches to energy demand management, Energy demand scenario in India, DSM approaches in India, Case studies from India, Business models around energy demand such as agri-photovoltaic and changing energy demand, Energy demand from emerging sectors such as Electric Vehicles and Green Hydrogen, Energy demand in the context of energy storage systems	6	2	0
III	**Economics of energy supply** Economic theories and principles of depletable resources including critical minerals, Economics of fossil fuel supply such as oil, gas and other	6	2	0

	sources, Economics of power generation – both renewable and non-renewable, Economics of supply of energy from new sources such as off-shore wind energy, floating solar Economics of shale gas exploration, Economics of coal bed methane, Grid-scale and decentralized renewable energy (DRE) supply systems, Business models around DRE, Power procurement theories, models and approaches , Examples and case studies from India			
IV	**Energy market and pricing** Structure of various energy markets, changing dynamics of energy markets, different pricing principles, average and marginal cost pricing, peak load pricing, Ramsey pricing, Seasonal and sectoral pricing, Regulated versus market pricing models, Pricing under competition: theories and practice , Price discovery of renewables through auctions, Price discovery through trading, Competitive bidding for renewable energy, Pricing under energy taxes and subsidies, Categories of tariffs, Energy pricing under carbon constrained energy systems, Examples and case studies of energy market and price discovery in India	8	2	0
V	**Energy for sustainable development** Energy access issues, Tiered approach to energy access, Energy poverty, vulnerability, deprivation, Multi-dimensional energy poverty (MEPI), Energy and productive use of energy, Distributed renewable energy (DRE) systems /Off-grid energy systems and productive use of energy, Energy for the agriculture sector, Energy for the industry sector, Energy and inequality issues, Energy security and security indicators, Geopolitical issues around supply of and demand for energy, Energy and International trading, Issues around energy transition and transformation, Just energy transition issues, Sectoral integration and energy transition, Energy transition and WEF nexus, Energy in the urban sector, Energy reform considerations, Political economy dimensions of energy systems and structures, Energy and the low carbon pathways, environmental impacts of different energy sources, Socio-economic impacts of emerging energy technologies and systems such as green hydrogen, large-scale RE, battery storage systems, electric vehicles, Critical minerals and developmental issues	8	2	0
VI	**Energy finance and investment** Investment needs and requirements, Theories of energy finance, Source of energy financing, Energy project financing, Discounted cash flow analysis, Estimating Net Present Value (NPV), Estimating cost of capital, Financing of renewable energy, Renewable policy instruments and institutions for renewable energy Energy and climate finance, Energy transition financing, Financial risk management for energy projects, Spot versus futures markets in energy, Clean tech venture capital financing, Crowd funding for clean tech projects, Carbon market as an instrument of climate financing	8	2	0
VII	**Energy laws, policies, regulation and governance in India** Constitutional position of energy, energy and federal structure, institutional and governance structure of energy in India, Umbrella policies around energy and climate change such as NAPCC cross-cutting policies around energy and other sectors, energy sub-sector policies such as laws, and policies for coal, oil and gas and renewable energy, nuclear. Policies around emerging energy technologies and market such as green hydrogen, electric vehicles, battery storage policies etc.	6	0	
	Total	**48**	**12**	**0**

Evaluation criteria:

- Minor 1: Seminal paper presentation and discussion (individual presentations by students): 25 %
- Minor 2: Case study analysis (individual submissions by students): 25 %
- Major Test (written): 50 %

Learning outcomes

By the end of the course, students would be able to;

- Understand and appreciate the concepts, theories, principles and practices of energy economics, policy and finance (Minor Test 1 and Major Test 3)
- Develop abilities to understand and assess various energy investment models and business models and apply them in real life situations. (All the evaluation criteria)
- Develop analytical abilities to connect various energy economics and finance concepts, approaches and frameworks and critically analyze them (All the evaluation criteria)
- Build skill sets in analyzing energy projects and their operational elements (All the evaluation criteria)

Pedagogical approach

The course will be delivered through a mix of classroom lectures, discussions, classroom exercises and assignments and case studies discussion and presentation.

Course Reading Materials

Suggested core readings:

1. Subhes C. Bhattacharyya, Energy Economics: Concepts, Issues, Markets and Governance, Springer, London, 2011.
2. F.E. Banks, Energy Economics: A Modern Introduction, Springer Verlag, New York, 2012
3. Peter M. Schwarz, Energy Economics, Routledge Publication, 2022
4. J.M. Griffin, and H.B. Steele, Energy Economics and Policy, Academic Press,1985
5. Hunt, Lester C., and Joanne Evans, eds. International handbook on the economics of energy. Edward Elgar Publishing, 2011. (EEP)
6. Betty J. Simkins and Russel E. Simkins, Energy Finance and Economics: Analysis and Valuation, Risk Management, and the Future of Energy, John Wiley & Sons, Hoboken, NJ 2013.
7. P. Deo and S.K Chatterjee, Renewable energy in India, Sage Publications, 2021
8. A. Kumar and S.K. Chatterjee, Electricity Sector in India: Policy and Regulation, Oxford University Press, 2012
9. Kandpal T.C. & Garg, H.P., Financial Evaluation of Renewable Energy Technologies, Macmillan India, 2003
10. D. Yergin, The Prize: The Epic Quest for Oil, Money and Power, Simon and Schuster, 1991

Additional readings

6. Carol A. Dahl, International Energy Markets: Understanding Pricing, Policies, and Profits, Tulsa: Pennwell, 2004.

Journals/Magazines to be referred.

Energy Policy
Energy for Sustainable Development
Renewable and Sustainable Energy Reviews
Energy Economics
The Energy Journal
Energy Research and Social Science
The Economist

Other readings

Reports by IEA, IRENA, UNFCCC, World Bank, ADB
Energy Statistics and Reports by various Indian Ministries and Departments such as MNRE, MoEFCC, MoP, MoPNG, MoC, DST
Reports published by State Energy Departments,
Reports published by CEA, NITI Aayog, FoRs
Regulations and Discussion Papers published by CERC and SERCs
Other emerging policies around energy and climate change

Additional information Students should be sincere and regular in classes
Student responsibilities Attendance: At-least 75% attendance will be necessary to be able to appear for the final exam

Course reviewers:

Prof. Saudamini Das, Professor, Institute of Economic Growth, Delhi

Dr Shyamasree Dasgupta, Associate Professor, IIT, Mandi

Dr Dil Rahut, Vice Chair of Research, ADBI, Japan

The course outline is prepared by Gopal K. Sarangi.

Enclosure 29

Realignment of the Programme Outline of the Master's in Public Policy and Sustainable Development (PPSD)

I. Background

The TERI School of Advanced Studies (TERI SAS) has been one of the first universities to introduce a Master's programme in Public Policy in India. It is the only Institute which offers a comprehensive programme on "Public Policy and Sustainable Development" in the country. The programme started in 2006 with the support of the Department of Personnel and Training, Government of India, primarily intended to orient mid-career civil servants. However, soon, the programme also started admitting candidates with certain years of working experience in national or international non-government organizations (including profit and not-for-profit sectors). The mix of the Govt.-sponsored and self-sponsored participants presents immense opportunities for cross-learning for them.

With the periodic renewal of the Memorandum of Understanding (MoU) between the President of India, through the Minister of Personnel, Public Grievances and Pensions, Department of Personnel and Training (DoPT, Training Division), and the TERI SAS, the DoPT annually circulates a Government Notification to the Secretaries of all the Ministries/Departments in Government of India, Chief Secretaries to all State Governments, Administrators of Union Territories, all the Cadre Controlling Authorities, and Directors General/Directors of Central & State Training Institutes. All these Divisions are requested to give the Circular/Notification wide publicity among officers of their cadre. The completed applications of the interested officers/applicants, after obtaining necessary clearances including Vigilance Clearance from Cadre Controlling Authority/State Government (wherever necessary) are then sent to the DoPT office, with a copy to TERI SAS.

II. Basic Structure of the Programme

The existing structure of the Programme is a two-year Master's Programme in "Public Policy and Sustainable Development (PPSD)", with a one-year exit option (i.e., One-Year Post-Graduate Diploma). The DoPT in its annual circular/notification primarily highlights the One-Year Post-Graduate Diploma (PGD) Programme in Public Policy and Sustainable Development. The participants have the option to continue with the Programme for the second year, wherein they are required to complete a dissertation while on the job during the second year. Due to this structure, the Programme follows a rigorous and engaging one-year on-campus involvement of the participants, while the following year the participants get a supervised off-campus engagement.

The PGD/MA-PPSD Programme is founded on a consolidated and well-organised curriculum focusing on multiple dimensions of public policy making. It revolves around the concepts of formulation, analysis, evaluation, and practical implications while incorporating them into the developmental needs of society. The programme broadly covers public policy processes, geopolitics, governance issues, legal issues in public administration, normative ethics, methods of public policy assessment and evaluation, major public policy issues (such as education, public health, infrastructure development, water security and management, energy security and transition, agriculture and rural development, sustainable urbanization, etc.), public management reforms, management principles

(such as leadership, organisation management and human resources management), environment, and sustainable development, etc.

III. Programme-specific Outcome

The Programme assists the participants in experiential learning and helps them:

- identify problems and the scope for policy research and intervention
- build up strong analytical capabilities that help to evaluate when policy interventions are needed and also their necessary impacts
- gain an understanding of the normative basis of choice of policy objectives and trade-off
- analyse policy constraints, design of public institutions, and choice of policy instruments
- in pragmatic assessment of unintended consequences of various policies
- facilitate the formulation of processes of stakeholder consultations and debates

IV. Need for Realignment of the Programme

- TERI SAS, as an institution of excellence, is known for its commitment towards quality education and under its internal quality assessment activities, it encourages all its academic programmes to undergo a periodic restructuring to offer timely and updated content and curriculum to its students.
- The existing PGD/MA-PPSD Programme was primarily designed to consider the needs of mid-career civil servants or senior professionals, having prior experience in governance systems – ministry, departments, or non-governmental international or national/regional organizations. However, with the increasing participation of fresh graduates (coming from various disciplinary backgrounds) and civil service aspirants motivated to learn and contribute to the process of public policymaking, there is a need to revisit the content and alignment of the courses.
- The DoPT has been an important stakeholder in the implementation of PGD/MA-PPSD Programme since its inception. In addition, such programmes, providing training and orientation to government officials (across different levels of cadres), also come under the functional supervision of the Capacity Building Commission (CBC)[1]. The CBC has recommended a few suggestions to all training Institutions involved in the capacity building of civil servants to incorporate into their programmes.

[1] The Capacity Building Commission was constituted through the Gazette of India on 1 April 2021. As the custodian of the civil services capacity-building ecosystem, the commission is mandated to perform the following:

- Facilitate preparation of **Annual Capacity Building Plans** of departments, ministries and agencies
- **Functional supervision** over all training Institutions involved in capacity building of civil servants
- Prepare and present **CBC's Annual Report** to the Prime Minister's HR Council
- **Make Policy recommendations** to DoPT on personnel/ HR and Capacity Building
- **Audit of Human Resources** in Government and outcomes of the Capacity Building efforts
- **Approve Knowledge Partners** and Content Validation mechanism for training of civil servants

- The Programme needs to be aligned with the guidelines of the National Higher Education Qualifications Framework (NHEQF) under National Education Policy (NEP) 2020, which proposes
    - to facilitate a 1-year Master's programme for students who have completed a 4-year Bachelor's degree (Honours/Research) programme with research.
    - to standardize the credits earned by the students per semester, i.e., 20 credits (one credit equivalent to 15 hours of instruction)
    - one-year (two semesters equivalent to at least 40 credits) Post-Graduate Diploma in the case of those who exit after successful completion of the first year (two semesters) of the 2-year Master's programme.
    - the credit apportionment for internship, and "community engagement and service" is one credit per week.
- The earlier officers or alumni of this Programme, who couldn't continue with the second year of the programme to complete the Master's degree due to their professional/work commitment, and had to exit after having the PG Diploma, request for readmission in the second year to complete their Master's degree. This can be considered under the purview of the NEP 2020 and as per the rules and regulations of the TERI SAS.

V. Process of Realignment of the Programme

The Programme undergoes a systematic approach to carry out the overall realignment of the Programme. The realignment process includes:

- the screening of individual feedback of the participants passing out from the Programme in the last three academic sessions
- the consideration of suggestions accumulated from the Capacity Building Commission and Department of Personnel & Training, Government of India, during the last two meetings
- the discussion points and decisions taken during a series of meetings of the Master Programme Executive Committee (MPEC) of the MA-PPSD Programme, which includes the faculty members involved in the Programme.

Feedback received from the Alumni:

- At least one class/session of each faculty needs to focus on the importance of the particular subject, how it will help in policymaking (with example) and clarity in expectation.
- Less contemporary courses focusing on current policy/industry scenarios. Low focus on International Policy/development environment
- Lack of a course to teach tools and theory for research, data presentation and data analysis.
- Courses offered in 2nd semester should be included in 1st semester; Research methods course are taught in 2nd semester instead of first semester. Certain courses such as PPS191 (Assessing public policy: methods and Measurements) and PPS 198 (Public management: Issues and challenges with special reference to India) courses should be taught in first semester.
- Guidelines are common for both DOPT and private candidates. Now, private candidates are not connected to DOPT rules, and they have different expectations too. So, either have private

candidates or DOPT sponsored ones. In case you do want to continue with both the categories, have separate guidelines.

- Certain courses are divided into 2/3 subtopics, and each has individual project submissions. It doesn't provide time to learn, most of the time is spent in preparing assignments.
- Some topics are extremely intense academically and carry a sizeable weightage in terms of credit, presentations and projects. While practical and pragmatic topics such as 'India & The World' was not given the due credit and weightage. In fact, it should be the other way around. When students graduate from PPSD they need to know what is happening geopolitically across the world in different areas. Hence, a relook on the credit weightage and addition/deletion of some courses, and importantly insertion of relevant topics that are aligned to topics such as 'India & The World'.
- Programme structure needs changes to meet different requirements of the course participants, need for breaking course structure in three parts- 1st phase (two months)- introductory and homogenize with the policy framing required subjects, phase II- basic ingredients for policy framing, analysis, and appraisal work, and phase III shall be for specialization needs of the participants.
- Students should be taught basic of each subject in 1 or 2 sessions, as most of the students come straightway from professional life and may not have been in touch with academia for long time.
- Divide the year into 2 parts: First 6 months- Academics- can be a mix of intense subjects covering all aspects of policy and sustainable development; Second 6 months- Field visit, industry visit. Can be more practical oriented. It is suggested not to make tall promises such as 'International Component', instead start small- make it local. Delhi NCR is the hub of governance and at the same time has different multinational companies operating in recycling, co-generation power, alternate energy, organic farming, etc. More visits can be planned to these places with project submissions. A visit or a discussion can be done at government institutions as well.
- Include topics that are more relevant to the industry, such as Environmental Impact Assessment, etc.
- Instead of public policy - I & II, full policy paper submission can be done at the end, for example during the field visits that students do.
- NGO attachment should be for a longer period and should be coordinated by TERI and not left to the students.
- Program should be crisp with less papers and focused.
- In all the topics- developing the skill to look at different policies pertaining to social issues such as health, education, unemployment, etc, and then designing policy interventions by way of classroom discussions is more important rather than simply reviewing a policy and giving individual suggestions.

Suggestions of the CBC:

1. The highest priority are modules on Behavioural Training (refer to KCM[2] model)

[2] The Kaleidoscope Career Model (KCM) was developed to explain how individuals enact their careers within today's complex, dynamic workplace. The KCM is particularly relevant for studying career development activities, such as networking behavior, a key career management strategy.

a) Personal Leadership
b) Leading Teams
c) Leading Organizations
d) Stakeholder Management
e) Stress Management

2. Functional competencies including:
   a) Big Data Analytics
   b) Writing – particularly report writing
   c) Communications to various stakeholders
   d) Impactful presentations
   e) Digital fluency
   f) Financial Management
   g) Emerging technologies
3. There is a strong need to create programs in more domain and technically oriented fields, e.g.
   a) Data Management
   b) Artificial Intelligence
   c) Social Sector
   d) Infrastructure Sector
   e) Finance Sector
4. Rather than having general post-degree courses, the programs can be designed around the various specializations or sectors as shown above.
5. In addition, comments made last year included the need to do a detailed impact assessment of the officers who have taken the courses.
6. Most of the training being done now for officers is in hybrid mode and we should look for courses that are offered in hybrid mode – 30% digital and 70% physical.

Discussion Points and the Decision taken by the MPEC:

1. In the meeting held on 12th April 2024, the MPEC considered that the existing PGD/MA-PPSD Programme Structure must be sustained to avoid any sort of discrepancies in the requirements to be fulfilled by the DoPT-sponsored candidates and the self-sponsored candidates.
2. However, fresh graduates should not be allowed for a Post-Graduate Diploma, i.e., exiting the Programme after only completing the first year of the Programme. Awarding a PG Diploma should only be applicable for Senior & Mid-Career Officers and Professionals, who fulfil the requirement of completing the credits mentioned for the PGD.
3. Considering the increasing number of applications of fresh graduates, MPEC also discussed the prospects of the Programme which was originally designed to cater for the needs of Mid-Career Administrative Officers sent by the Department of Personnel & Training (DoPT). To ensure the sanctity and relevance of the Programme as per the MoU with the Govt. of India, MPEC believes that in the case of a good number of candidates (at least 15) from the DoPT and an adequate number of admissions of fresh graduates (e.g., more than 20) in the Programme, we need to run this Programme in sections (separately for fresh graduates and the DoPT candidates).

4. The issue of the past students who could not continue the second year of the Programme due to some circumstances at their work front, and now willing to continue the second year of Project work in order to complete the requirement for the Degree, was put before the MPEC for consideration. Considering the second year of the Programme in which the candidates are required to complete their research work and submit the Dissertation is a stand-alone activity, MPEC was of the opinion that the alumni, who were awarded the PGD and are now willing to fulfil the requirements of the second year of the Programme, can be allowed to complete the required credits for the award of the Master's Degree as per the old structure of the Programme.
5. In the meeting held on 16th April 2024, the MPEC discussed the realignment and required modifications in the existing courses and the need for the introduction of new courses as per the requirements of fresh graduates admitted to the Programme.
6. The feedback received from the Alumni and the Capacity Building Commission (CBC), Govt. of India were given due consideration while implementing required modifications in the realignment of the courses being offered in the first two semesters. In addition, the MPEC also ensured that the Programme fulfils the credit requirements suggested for the Post-Graduate Diploma (PGD) and the Master's Programme in the National Higher Education Quality Framework (NHEQF).
7. MPEC decided to reach out to a few foreign universities, such as the Lee Kuan Yew School of Public Policy, the University of Leeds, etc. to collaborate in developing Policy Ratiocination Panel Discussions, Webinars, Workshops, etc. under the course "International Collaborative Studio on Public Policy", and for deliberations in other courses.
8. MPEC also considered the need for an in-house faculty member with specialization in the field of Public Policy, who can deal with related courses across the Programmes.

VI. Revised Programme Outline

Based on the suggestions received from all the stakeholders of the PGD/MA-PPSD Programme, the following revised Programme Outline (see page 8-9) is proposed for getting the approval of the Board of Studies (BoS), Department of Policy and Management Studies. The old/existing Programme Outline can be accessed here: https://www.terisas.ac.in/ma-public-policy-and-sustainable-development.php

MA in Public Policy & Sustainable Development	
Semester	**Credits**
Semester-I	20
Semester-II	21
Semester-III	20
Semester-IV	20
Total Credits	**81**

PG Diploma* in Public Policy & Sustainable Development	
Semester	**Credits**
Semester-I	20
Semester-II	21
Summer Internship (8 weeks)	8

International/Domestic Field Exposure	NC
Bridge Course: Stress Management	NC
Total Credits	**49**

* Only for Senior & Mid-Career Officers and Professionals
NC: Non-Credit Activity

l. No.	**Revised Programme Outline**	
	Semester I	**Credit**
1	Public Policy: A Concise Exposure	3
2	Social Policies & Sustainable Development	3
3	Public Administration and Systems Management	3
4	Research Methods for Public Policy	3
5	Globalisation and Changing Geopolitics: Implications for Economic & Foreign Policies	2
6	Sustainable Consumption and Production: Policies & Practices	2
7	Economics for Public Policy	2
8	International Collaborative Studio on Public Policy	1
9	Policy Lab - I: Sectoral Policy Scoping	1
	Total Credits (Semester I)	**20**
	Semester II	
10	Sustainable Urbanization	2
11	Water and Sustainable Development: Policy Perspectives	2
12	Energy and Sustainable Development: Issues, Challenges & Policy	2
13	Digital Economy: Dividends, Disputes & Dimensions	2
14	Infrastructure Development and Sustainability: Issues & Policy Perspectives	2
15	Sustainable Industrial Development: Policies & Practices	2
16	Climate Change and Cities: Policies & Practices	2
17	Public Policy Assessment: Methods & Measurements	2
18	Policy Lab - II: Developing a Policy Paper	3
19	Electives [Select courses from the following list to earn 2 credits]	2
	MPL 165: Competition Law and Policy	2
	MPL 134: Climate Change and Law	2
	MPL 144: Contracts Law and Management	2
	MPL 166: Urban Infrastructure Laws and Management	2
	MPL 158: Forest Law and Policy	2
	PPS 195: Communities and Conservation	2
	Total Credits (Semester II)	**21**
	Semester III	
20	Major Project - I	20
	Semester IV	
21	Major Project - II	20
	Total Credits (MA - PPSD)	**81**

Enclosure 30

Public Policy: A Concise Exposure

Course title: Public Policy: A Concise Exposure			
Course code: PPS XXX	**No. of credits:** 3	**L-T-P:** 43-02-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** 1st Semester	

Course description

Public policy affects almost every aspect of one's daily life, but it cannot be understood without reference to policy-making processes, which refer to a series of decisions made by public actors. Learning more about public policy and the making of it covers the whole process of public decision-making. It also includes the feedback policymakers receive on their decisions. This course is designed to provide the students a brief, yet comprehensive, overview of the Public Policy processes including formulation, implementation, monitoring and evaluation, and key actors/institutions. The course comprises four modules: the first module sets the context for policymaking, which begins with discussing fundamental concepts related to public policy discipline; the second module focuses on approaches/models and determinants of policy formulation; the third includes the approaches/models and instruments of policy implementation, and a brief overview of the policy monitoring and evaluation issues; and the fourth module provides a background of public policy formulation and implementation in India along with a few case studies.

Learning objectives:

- To introduce students to key concepts, elements, approaches/models, processes, scope, and dimensions specific to the public policy discipline.
- To discuss the role of key institutions and actors in public policy processes.
- To provide students with an overview of the public policy formulation and implementation in the Indian context.

Course content

Module	Topic	L	T	P
1.	**Policy Perspectives, Institutions & Actors** • Linkages between Polity, Politics, and Policy • Governance: A synoptic perspective on Policymaking • Public Policy: Significance, Elements, Scope, Typologies, Dimensions, Styles, and Advocacy • Policy Institutions: National (e.g., Constitutions & Constitutional Courts, Division of Powers, Electoral Institutions & Party Systems); and Intergovernmental Organizations (e.g., The United Nations System, The World Trade Organization) • Key Policy Actors: Public Actors (Executive, Legislature, Judiciary, Bureaucracy); Political Parties; Private Actors (Interest Groups, Experts) • The Policy Cycle	12	0	0
2.	**Policy Formulation** • Approaches/Models of Policy Formulation: Rational Model; Incremental Model; Group Theory Model; Elite Theory Model; Institutional Model; Game Theory Model, Systems Model. • Determinants of Policy Formulation: Expertise, Information, and Ideas; International Organizations; Interest Groups; Political Preferences; Pursuit of Private Interests (Bureau-shaping)	8	0	0

3.	**Policy Implementation, Monitoring & Evaluation** • Policy Implementation Approaches/Models: Top-Down Model; Bottom-Up Model; Policy-Action Relationship Model; Inter-Organizational Interaction Approach; A Synthesis of Bottom-Up and Top-Down Approaches • Policy Implementation Instruments: Organizational, Authoritative, Financial, and Information-based Implementation Tools • Barriers and Conditions for Successful Policy Implementation • Policy Monitoring: Approaches, Techniques, and Challenges • Policy Evaluation: Criteria, Types, Approaches, and Methods	15	0	0
4.	**Public Policy in India** • Public Policy in India: Historical Perspective and Contemporary Issues • Civil Society Organization's interface with Government in India and their role in policy formulation • Policy implementation in India • Key Indian Policy case studies: for example, The Environment (Protection) Act, 1986; The Right of Children to Free and Compulsory Education Act, 2009; The Muslim Women (Protection of Rights on Marriage) Act, 2019; The Medical Termination of Pregnancy (MTP) Act, 1971 and MTP (Amendment) Act, 2021.	8	2	0
	Total	**43**	**2**	**0**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (20%)
- **Minor Test-2:** Guided Reading and Presentation of Policy Case Studies (30%)
- **Major Test:** Written Test/Term Paper Submission and Presentation (50%)

Learning outcomes

Upon completion of this course, candidates would be:

1. able to understand the fundamental concepts, elements, approaches, considerations, scope, and dimensions of public policy and its processes (All evaluations)
2. able to critically reflect on the role and functions of key actors and public policy institutions (All evaluations)

Pedagogical approach

Classroom lectures; Student Seminars; Invited talks from Policy Experts in particular domains including Practitioners and Senior/Superannuated Govt. Officers; Case studies. The learning expectation is to enhance critical and informed understanding.

Suggested Readings

Module 1:

- Birkland, T. A. (2015). *An Introduction to the Policy Process: Theories, Concepts, and Models of Public Policy Making, Third Edition*. London & New York: Routledge (Taylor & Francis Group).
- Howlett, M., & Tosun, J. (Eds.) (2017). *Policy Styles and Policy-Making: Exploring the Linkages*. London & New York: Routledge (Taylor & Francis Group).
- Kingdon, J. W. (2014). *Agendas, Alternatives, and Public Policies, Second Edition*. England: Pearson Education Limited.
- Knill, C., & Tosun, J. (2020). *Public Policy: A New Introduction, Second Edition*. London: Red Globe Press (Macmillan Education Ltd.).
- O'Connell, S. (ND). Policy Development and Policy Advocacy. A Manual prepared by the National Democratic Institute, Arab Center for Development. Available at: https://www.ndi.org/sites/default/files/Policy%20Development%20and%20Advocacy%20Workbook_EN.pdf.
- Rinfret, S. R., Scheberle, D., & Pautz, M. C. (2019). *Public Policy: A Concise Introduction*. California: CQ Press.
- Zahariadis, N. (Ed.) (2016). *Handbook of Public Policy Agenda Setting*. Cheltenham, UK: Edward Elgar Publishing Ltd.

Module 2:

- Cairney, P. (ed.) (2012). *Understanding Public Policy: Theories and Issues*. UK: Palgrave Macmillan.
- Christopher, W.M., & Sabatier, P.A. (Eds.) (2018). *Theories of the Policy Process, Fourth Edition*. New York: Routledge.
- Dye, T.R. (2017). *Understanding Public Policy, Fifteenth Edition*. Boston, USA: Pearson Education, Inc.
- Gerston, L. N. (2015). *Public Policy Making: Process and Principles, Third Edition*. London & New York:

Routledge (Taylor & Francis Group).
- Howlett, M., & Mukherjee, I. (2017). *Handbook of Policy Formulation*. Cheltenham, UK: Edward Elgar Publishing Ltd.
- Howlett, M., Ramesh, M., & Perl, A. (2020). *Studying Public Policy: Principles and Processes, Fourth Edition*. Ontario: Oxford University Press.
- Potůček, M. et al. (2017). *Public Policy: A Comprehensive Introduction*. Prague, Czech Republic: Karolinum Press.

Module 3:

- Bochel, C., & Hugh Bochel, H. (2018). *Making and Implementing Public Policy: Key Concepts and Issues*. London: Palgrave.
- Gardner, A. L., & Brindis, C. D. (2017). *Advocacy and Policy Change Evaluation: Theory and Practice*. California: Stanford University Press.
- Howlett, M. (2019). *Designing Public Policies: Principles and Instruments, Second edition*. London & New York: Routledge (Taylor & Francis Group).
- Linquiti, P. D. (2022). *Rebooting Policy Analysis*: *Strengthening the Foundation, Expanding the Scope.* California: CQ Press.
- Shah, A. (Ed.) (2020). Policy, *Program and Project Evaluation: A Toolkit for Economic Analysis in a Changing World*. Cham, Switzerland: company Springer Nature Switzerland AG.

Module 4:

- Bhattacharya, R. (Ed.) (2015). *Regional Development and Public Policy Challenges in India*. New Delhi: Springer.
- Chakrabarti, R., & Sanyal, K. (2017). *Public Policy in India*. New Delhi: Oxford University Press.
- Chopra, K. (2017). *Development and Environmental Policy in India: The Last Few Decades*. Singapore: Springer Nature Singapore Pte Ltd.
- Mitra, S.K. (2017). *Politics in India: Structure, Process and Policy, Second Edition*. New York: Routledge.

Student responsibilities

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

Course reviewers

1. Prof. Vishal Narain, Professor, Public Policy and Governance, Management Development Institute, Gurugram.
2. Prof. Arvind K. Mishra, Professor, Zakir Husain Centre for Educational Studies, School of Social Sciences, Jawaharlal Nehru University, New Delhi, India

Enclosure 31

Social Policies & Sustainable Development

Course title: Social Policies & Sustainable Development			
Course code: PPS XXX	**No. of credits:** 3	**L-T-P:** 41-04-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Core	**Course offered in:** 1st Semester		

Course description

Strong social policy is essential for sustainable growth. Social policies have been expanded across the Global South during the last few decades, and social protection is increasingly highlighted as a fundamental component of the global sustainable development agenda. Having an overview of social policy issues is extremely useful for students of public policy and anyone who wants to understand the true roots of successful sustainable development. This course comprises five modules discussing social policy in the sustainable development context with an emphasis on four select social policy domains and well-being with special reference to India. It begins by introducing the fundamentals of sustainable development and how social policies can be instrumental in achieving its objectives. Further, the course discusses four key social policy domains; first, the food and nutrition security issues and related agrarian policy initiatives and innovations; second, the population health and well-being issues and associated schemes/programmes; third includes the education and skill development policy initiatives; and fourth focuses on work and employment issues and initiatives. The aim is to orient students to the importance of social policies in promoting sustainable development, along with the processes and challenges in developing and implementing such policies, with special reference to India.

Learning objectives:

- To provide students with a basic understanding of sustainable development and social policies, their instruments, and how well-implemented social policies help achieve the objectives of sustainable development.
- To discuss the aspects of food and nutrition security, sustainable food systems, and government initiatives taken to end hunger through food and agricultural policies in the Indian context.
- To orient students to understand and assess the public health issues and challenges, and discuss major government schemes/programmes in India to improve population health and wellbeing.
- To provide an overview of the processes and challenges related to India's education policy and recent scenarios of population skilling initiatives.
- To discuss the livelihood and workforce participation scenarios including employment and unemployment patterns of the Indian population along with contemporary government initiatives to promote and generate employment.

Course content

Module	Topic	L	T	P
1.	**Introduction to Sustainable Development & Social Policy** • Sustainable Development: Concept, Evolution, Framework, and Challenges • Social Policy in a Sustainable Development Context: emphasizing Gender Issues, Regional Disparities, Social Marginalization, Disability, Inclusivity. • Social Policy Instruments: Food Subsidies, Guarantee of Work, Social Assistance, Conditional Cash Transfers, Social (Health) Insurance for the Poor, Social Security, Direct Benefit Transfer	5		
2.	**Food Security and Agrarian Innovations** • Drivers of Food System affecting the Access to Safe and Nutritious Food for All • The ecosystem of India's food security regime: Evolution of National Food Security Act (NFSA) • An Overview of Food-based Safety Net Programmes in India • Sustainable Food Systems: Priorities to End Hunger and Protect the Planet • Innovations in Production Technologies in India: Green Revolution, White Revolution, Blue Revolution, Red Revolution, Golden Revolution • Innovations in Incentive Policies in Indian Agriculture: *Pradhan Mantri Annadata Aay*	10		

	Sanrakshan Abhiyan (PM AASHA), Direct income (investment) support-based schemes, Reforms in marketing policies, arrangements, and infrastructure			
3.	**Health and Wellbeing** • Approaches to understanding Population Health and Disease • Recent trends and patterns of key public health challenges in India (including progress towards SDG 3 targets) • Importance of social determinants of health in India's context and its policy relevance • Major Contemporary Health Schemes and Programmes as case studies (subject to change as per the Government's focus/priority): for example – National Health Mission, Integrated Child Development Services (ICDS) Scheme, *Janani Suraksha Yojana* and its modified/allied schemes or programmes, *Ayushman Bharat* Scheme, POSHAN *Abhiyaan*, etc. • One Health Approach	10	1	
4.	**Education and Skill Development** • History of Education Policymaking in India since Independence • Salient Features of National Education Policy 2020: • Contemporary Education System in India: Issues & Challenges • Inequality in Access to Education in India: social group, gender, economic, locational, and age disadvantage (including progress towards SDG 4 targets) • Education, Skill, and Employability Gaps in India • Skill Development in India: Challenges; Solutions; and Government Schemes including *Pradhan Mantri Kaushal Vikas Yojana (PMKVY)*, Skills Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP), UDAAN, Standard Training Assessment and Reward Scheme (STAR), Polytechnic Schemes, Vocationalisation of Education	10	2	
5.	**Work and Employment** • Workforce across economic sectors in India including progress in female workforce participation. • Contemporary Employment and Unemployment scenario in India • Special cases: child labour, migrant workers (particularly women migrants), precarious employment, forced labour, gig workers. • Employment Guarantee Schemes and other Government Initiatives for Employment Generation	6	1	
	Total	**41**	**4**	

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (20%)
- **Minor Test-2:** Guided Reading and Presentation of Select Social Policy Context (30%)
- **Major Test:** Written Test (50%)

Learning outcomes

Upon completion of this course, candidates would be:

1. able to understand the fundamental concepts, considerations, and challenges related to the development and implementation of social policy in a country and its linkages with sustainable development (All evaluations)
2. able to independently identify, conceptualize, articulate, and systematically document any social policy issues in the form of a brief report (Minor Test-2)

Pedagogical approach

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

Suggested Readings

Module 1:

- Alcock, C., Daly, G., & Griggs, E. (2008). *Introducing Social Policy, Second Edition*. England: Pearson Education Limited.
- Alcock, P., May, M., & Wright, S. (Eds.) (2012). *The Student's Companion to Social Policy, Fourth Edition*. West Sussex, UK: John Wiley & Sons Ltd.
- Blakemore, K., & Griggs, E. (2007). *Social Policy: An Introduction, Third Edition*. Berkshire, England: Open University Press.
- Elliott, J.A. (2013). *An Introduction to Sustainable Development, Fourth Edition*. London & New York: Routledge (Taylor & Francis Group).
- Hall, A., & Midgley, J. (2004). *Social Policy for Development*. London: Sage Publications Ltd.
- Mkandawire, T. (Ed.) (2004). *Social Policy in a Development Context*. UK: Palgrave Macmillan.
- Sachs, J.D. (2015). *The age of sustainable development*. New York: Columbia University Press.
- Spicker, P. (2014). *Social Policy: Theory and Practice, Third Edition*. Bristol, UK: Policy Press.
- Redclift, M., & Springett, D. (2015). *Routledge International Handbook of Sustainable Development*. New York: Routledge.
- Wapling, L., Schjoedt, R., & Sibun, D. (2021). *Social Protection and Disability in India*. Working Paper. London: Development Pathways Ltd. Available at: https://www.developmentpathways.co.uk/wp-content/uploads/2021/02/India-disability-Feb-2021-1.pdf.

Module 2:

- Behnassi, M., Pollmann, O., & Gupta, H. (Eds.) (2019). *Climate Change, Food Security and Natural Resource Management: Regional Case Studies from Three Continents*. Cham, Switzerland: Springer Nature.
- Erokhin, V., & Gao, T. (2020). *Handbook of Research on Globalized Agricultural Trade and New Challenges for Food Security*. Hershey PA, USA: IGI Global.
- Goswami, B., Bezbaruah, M. P., & Mandal, R. (Eds.) (2018). *Indian Agriculture after the Green Revolution: Changes and Challenges*. London & New York: Routledge (Taylor & Francis Group).
- Gulati, A., Roy, R., & Saini, S. (Eds.) (2021). *Revitalizing Indian Agriculture and Boosting Farmer Incomes*. Singapore: Springer Nature Singapore Pte Ltd.
- Gulati, A., Zhou, Y., Huang, J., Tal, A., & Juneja, R. (2021). *From Food Scarcity to Surplus: Innovations in Indian, Chinese and Israeli Agriculture*. Singapore: Springer Nature Singapore Pte Ltd.
- Narayanan, S. (2015). Food Security in India: The Imperative and Its Challenges. *Asia & the Pacific Policy Studies*, 2(1), 197–209.
- Naylor, R.L. (Ed.) (2014). *The Evolving Sphere of Food Security*. New York: Oxford University Press.
- Pingali, P., Aiyar, A., Abraham, M., & Rahman, A. (2019). *Transforming Food Systems for a Rising India*. UK: Palgrave Macmillan.
- Saad, M. B. (2013). *The Global Hunger Crisis: Tackling Food Insecurity in Developing Countries*. London: Pluto Press.
- Sarkar, A., Sensarma, S.R., & vanLoon, G.W. (Eds.) (2019). *Sustainable Solutions for Food Security: Combating Climate Change by Adaptation*. Cham, Switzerland: Springer Nature.
- Upadhyaya, A.S., Kolås,Å., & Beri, R. (Eds.) (2022). *Food Governance in India: Rights, Security and Challenges in the Global Sphere*. London & New York: Routledge (Taylor & Francis Group).
- von Braun, J., Afsana, K., Fresco, L.O., & Hassan, M.H.A. (Eds.) (2023). *Science and Innovations for Food Systems Transformation*. Cham, Switzerland: Springer Nature. https://link.springer.com/book/10.1007/978-3-031-15703-5.
- Webb, J. (Ed.) (2017). *Food Security: Treat Factors, Policies and Challenges*. New York: Nova Science Publishers, Inc.

Module 3:

- Bharat, S., & Sethi, G. (Eds.) (2019). *Health and Wellbeing of India's Young People: Challenges and Prospects*. Singapore: Springer Nature Singapore Pte Ltd.
- Boccia, S., Villari, P., & Ricciardi, W. (2015). *A Systematic Review of Key Issues in Public Health*. Switzerland: Springer International Publishing.
- Brown GW, Yamey G, Wamala S (Eds.) (2014). *The Handbook of Global Health Policy*. West Sussex: John Wiley & Sons, Ltd.
- Clavier, C., & de Leeuw, E. (2013). *Health Promotion and the Policy Process*. New York: Oxford University Press, Inc.
- Mackenzie, J. S., Jeggo, M., Daszak, P., & Richt, J. A. (Eds.) (2013). *One Health: The Human–Animal–Environment Interfaces in Emerging Infectious Diseases. Food Safety and Security, and International and National Plans for Implementation of One Health Activities*. Heidelberg: Springer-Verlag.
- Mohanty, S. K., Mishra, U. S., & Chauhan, R. K. (Eds.) (2019). *The Demographic and Development Divide in India: A District-Level Analyses*. Singapore: Springer Nature Singapore Pte Ltd.

- Phelan, J. C., Link, B. G., & Tehranifar, P. (2010). Social conditions as fundamental causes of health inequalities: theory, evidence, and policy implications. *Journal of health and social behavior*, 51 Suppl, S28–S40.
- Prata, J. C., Ribeiro, A. I., & Rocha-Santos, T. (Eds.) (2022). *One Health: Integrated Approach to 21st Century Challenges to Health.* London: Elsevier Inc.
- Rüegg, S. R., Häsler, B., & Zinsstag, J. (Eds.) (2018). Integrated approaches to health: A handbook for the evaluation of One Health. The Netherlands: Wageningen Academic Publishers.
- Spasoff RA (1999). *Epidemiologic Methods for Health Policy*. New York: Oxford University Press.
- WHO (2010). *A Conceptual Framework for Action on the Social Determinant of Health*. Social Determinants of Health Discussion Paper 2. Debates, Policy & Practice, Case Studies. Geneva: World Health Organization (WHO).

Module 4:

- Ayyar, R.V.V. (2017). *History of Education Policymaking in India, 1947–2016*. New Delhi: Oxford University Press.
- Borooah, V. K. (2017). *The Progress of Education in India: A Quantitative Analysis of Challenges and Opportunities*. Cham, Switzerland: Springer Nature.
- GoI (2021). National Education Policy 2020. Ministry of Human Resource Development, Govt. of India. Available at: https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf.
- Jain, M., Mehendale, A., Mukhopadhyay, R., Sarangapani, P.M., & Winch, C. (Eds.) (2018). *School Education in India: Market, State and Quality*. London & New York: Routledge (Taylor & Francis Group).
- Kaul, V., & Bhattacharjea, S. (Eds.) (2019). *Early Childhood Education and School Readiness in India: Quality and Diversity*. Singapore: Springer Nature Singapore Pte Ltd.
- Kumar, C., Singh, S.P., & Nauriyal, D.K. (2016). *Dynamics of Occupational and Educational Mobility in India*. New Delhi: Authors Press.
- Kumar, K. (Eds.) (2018). *Routledge Handbook of Education in India: Debates, Practices, and Policies*. London & New York: Routledge (Taylor & Francis Group).
- Mishra, M., & Pettala, R. (Eds.) (2023). *Education of Socio-Economic Disadvantaged Groups: From Marginalisation to Inclusion*. London & New York: Routledge (Taylor & Francis Group).
- Nambissan, G.B., & Rao, S. (Eds.) (2013). Sociology of Education in India: Changing Contours and Emerging Concerns. New Delhi: Oxford University Press
- Raina, J. (Ed.) (2020). Elementary Education in India: Policy Shifts, Issues and Challenges. London & New York: Routledge (Taylor & Francis Group).
- Sarangapani, P. M., & Pappu, R. (Eds.) (2021). *Handbook of Education Systems in South Asia*. Singapore: Springer Nature Singapore Pte Ltd.
- Varghese, N.V., & Sabharwal, N.S. (Eds.) (2024). *India Higher Education Report 2022: Women in Higher Education*. London & New York: Routledge (Taylor & Francis Group).

Module 5:

- Balasubramanian, I. (2016). Local skill concentrations and district employment growth: a simultaneous equation approach for India. *Annals of Regional Science*, 56(2), 491-511.
- Bhide, S., Balasubramanyam, V.N., & Krishna, K.L. (Eds.) (2021). *Deciphering India's Services*
- Bisht, N., & Pattanaik, F. (2023). Youth Employment across Industrial Categories in India during the Neoliberal Paradigm. *Youth Voice Journal*, 12, 3-29.
- Borooah, V.K. (2019). *Disparity and Discrimination in Labour Market Outcomes in India: A Quantitative Analysis of Inequalities*. London: Palgrave Macmillan.
- Chand, R., & Singh, J. (2022). Workforce Changes and Employment: Some Findings from PLFS Data Series. NITI Aayog Discussion Paper. https://www.niti.gov.in/sites/default/files/2023-02/Discussion_Paper_on_Workforce_05042022.pdf
- Das, K., & Mahanta A. (2023). Rural non-farm employment diversification in India: the role of gender, education, caste and land ownership. *International Journal of Social Economics*, 50(6), 741-765.
- Jatav, M., & Nair J. (2023). Determinants of Participation in India's Mahatma Gandhi National Rural Employment Guarantee Scheme in Three Southern States. *Journal of Asian and African Studies*, 58(7), 1055-1075.
- Khan, G.A. (2021). A critical analysis of vulnerability in informal sector employment in India: Protective mechanisms and adequacy of protection. *International Social Science Journal*, 71 (241-242), 197-215.
- Klonner, S., & Oldiges, C. (2022). The welfare effects of India's rural employment guarantee. *Journal of Development Economics*, 157, 102848.
- Patwardhan, S., & Tasciotti, L. (2023). The effect of the Mahatma Gandhi National Rural Employment Guarantee Act on the size of outstanding debts in rural India. *Journal of Development Effectiveness*, 15(4), 353-372.
- Posso, A. (Ed.) (2020). *Child Labor in the Developing World: Theory, Practice and Policy*. Singapore: Springer Nature Singapore Pte Ltd.
- Raj, R. S. N., & Singha, K. (Eds.) (2022). *The Routledge Handbook of Post-Reform Indian Economy*. London & New York: Routledge (Taylor & Francis Group).
- Ramaswamy, K.V. (2015). *Labour, Employment and Economic Growth in India*. New Delhi: Cambridge University

Press.
- Roychowdhury, A. (2023). Economic viability and underemployment in India's unorganized manufacturing firms: evidence from nationally representative surveys. *Journal of the Asia Pacific Economy*, 28(2), 786-811.
- Sarkar, S., Sahoo, S., & Klasen, S. (2019). Employment transitions of women in India: A panel analysis. *World Development*, 115, 291-309.
- *Sector Growth*. London & New York: Routledge (Taylor & Francis Group).
- Tiwari, R., & Tiwari, S. (2016). Women employment in unorganised sector in India: An empirical analysis. *Journal of Rural Development*, 35(4), 645-664.
- Upadhya, C., & RoyChowdhury, S. (2024). Crafting new service workers: skill training, migration and employment in Bengaluru, India. *Third World Quarterly*, 45(4), 753-770.

Student responsibilities

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

Course reviewers

1. Prof. Arvind K. Mishra, Professor, Zakir Husain Centre for Educational Studies, School of Social Sciences, Jawaharlal Nehru University, New Delhi, India
2. Prof. M. Mahapatro, Professor & Head, Department of Social Sciences, The National Institute of Health and Family Welfare, New Delhi, India.

Enclosure 32

Public Administration and Systems Management

Course title: Public Administration and Systems Management			
Course code: PPS XXX	**No. of credits:** 3	**L-T-P:** 43-02-00	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** 1st Semester	

Course description

With the changing role of the State and government, Public Administrators are now viewed by many as entrepreneurial managers, who are expected to be more entrepreneurial and result-focused. Public systems management is a developing theme lending a new dimension to the discipline of public administration. This course, divided into three modules, is designed to provide an overview of public administration and its role in successful implementation of public policies/programmes with emerging approaches. The first module begins with a discussion of the elements of governance and public administration, which can be described as two sides of a coin, governance refers primarily to government, and one of the pillars of government is public administration. The second module introduces public systems management with modern elements and techniques, and its integration with new technologies. Further, the third module focuses on micro-level planning and implementation through decentralised administration and local governance.

Learning objectives:

- To provide students with an overview of governance and public administration, along with the systems approach for organisational management.
- To discuss the nature, elements, techniques and considerations of public systems management and its integration with new technologies.
- To orient students to understand the administrative decentralisation, and the role and functioning of local administrative bodies towards planning and implementation of public policies/programmes.

Course content

Module	Topic	L	T	P
1.	**Governance and Public Administration** • Governance: Concept, Contextual Uses, Forms, and Models • Role of Bureaucracy, Political Executive, Legislature, and the Judiciary in Governance • Changing nature of Public Services and State of Administrative Principles in the Twenty-first Century • Work Ethics in Public Administration • Organizational Conflict Resolution and Management • Leadership Skills • Systems Approach for Organizational Management: Closed-Systems Approach (Scientific Management; Administrative Management Movement; Weberian Bureaucracy), and Open-Systems Approach (The Hawthrone Experiment; Hierarchy of Needs; Humanistic Organization; Prismatic-Sala Model; Cooperative System)	14	0	0
2.	**Public Systems Management** • Public Systems Management: Concept, Nature, Scope, and Characteristics • New Technologies & Public Systems Management: Electronic Governance; Digital Governance; Challenges in Application of New Technology • Management Information System in Public Services: Evolution, Framework, Structure and Appraisal • Group Decision-Making Techniques: Brainstorming, Synectics, Delphi, Nominal Group Technique, Heuristic Technique • Accountability and Responsiveness in Public Systems Management • Transparency and Citizen's Right to Information	14	2	0

3.	**Decentralised Administration & Local Governance** • Federal Structure: Central and State Relationship • Understanding Decentralization in Contemporary Settings: Political, Functional, Administrative and Financial Decentralization • Organizational Structure and Administrative Functioning of Rural Local Bodies: Panchayati Raj System; Intra-Tier Distribution of Powers and Functions; Intra-Tier Implementation Hurdles • Organizational Structure and Administrative Functioning of Urban Local Bodies: Municipalities and Metropolitan Planning Committee • Partnership among Local Authorities and Special Purpose Agencies in various sectors, e.g., Education Sector, Health Sector, Telecom Sector, Agriculture Sector • Micro-level Planning formulation and implementation: Considerations and Constraints	15	0	0
	Total	**43**	**2**	**0**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (20%)
- **Minor Test-2:** Seminar Presentation and Field Report Submission based on the Group visit of Rural/Urban Local Bodies (30%)
- **Major Test:** Written Test/Term Paper submission and presentation (50%)

Learning outcomes

Upon completion of this course, candidates would be:

1. able to understand the fundamental concepts, elements and approaches related to governance and public administration or organisational management (All evaluations)
2. able to independently formulate a micro-level plan to implement any intervention/strategies through the local-level administrative bodies in rural/urban areas (Minor Test-2)

Pedagogical approach

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

Suggested Readings

Module 1:

- Basu, R. (2019). *Public Administration in the 21st Century: A Global South Perspective*. London & New York: Routledge.
- Frederickson, H. G., Smith, K. B., Larimer, C. W., & Licari, M. J. (2012). *The Public Administration Theory Primer, 2nd Edition*. Boulder, Colorado: Westview Press.
- Harrison, N. E., & Geyer, R. (2022). *Governing complexity in the 21st century*. London & New York: Routledge.
- Laxmikanth, M. (2011). *Public Administration*. New Delhi: McGraw Hill Education (India) Pvt. Ltd.
- Laxmikanth, M. (2014). *Governance in India*. New Delhi: McGraw Hill Education (India) Pvt. Ltd.
- Rosenbloom, D. H., Kravchuk, R. S., & Clerkin, R. M. (2015). *Public Administration: Understanding Management, Politics, and Law in the Public Sector, 8th Edition*. New York: McGraw Hill Education.
- Singh, H., & Sachdeva, P. (2012). *Public Administration: Theory and Practice*. New Delhi: Pearson Education.
- Singh, H., & Singh, P. (2011). *Indian Administration*. New Delhi: Pearson Education.

Module 2:

- Arora, R. K. (Ed.) (2001). *Management in Government: Concerns and Priorities*. Jaipur: Aalekh Publishers.
- Batley, R., & Larbi, G. (2004). *The Changing Role of Government: The Reforms of Public Services in Developing Countries*. England: Palgrave Macmillan.
- Bhattacharya, M. (2001). *New Horizons of Public Administration*. New Delhi: Jawahar Publishers and Distributors.
- Bresser-Periera, L. C. (2004). *Democracy and Public Management Reform-Building the Republican State*. Oxford: Oxford University Press.
- Ferlie, E., Lynn Jr, L. E., & Pollitt, C. (Eds.) (2007). *The Oxford Handbook of Public Management*. New York: Oxford University Press Inc.
- Osborne, S. P. (Ed.) (2002). Public Management: Critical Perspectives. London & New York: Routledge.
- Sahni, P., & Medury, U. (Eds.) (2003). *Governance for Development: Issues and Strategies*. New Delhi: Prentice-Hall India Learning Pvt. Ltd.
- Vayunandan, E., & Mathew, D. (Eds.) (2003). *Good Governance: Initiatives in India*. New Delhi: Prentice-Hall India Learning Pvt. Ltd.

Module 3:

- Chaubey, P. K. (2004). *Urban Local Bodies in India: Governance with Self Reliance*. New Delhi: Indian Institute of Public Administration.
- Ghosh, B., & Kumar, G. (2003). State Politics and Panchayats in India. New Delhi: Manohar Publications.
- Sachdeva, P. (2011). Local Government in India. New Delhi: Pearson Education (Dorling Kindersley (India) Pvt. Ltd.).
- Mullen, R. D. (Ed.) (2012). Decentralization, Local Governance, and Social Wellbeing in India: Do local governments matter? London & New York: Routledge.

Student responsibilities

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

Course reviewers

1. Prof. Praveen K. Pathak, Professor, Centre for the Study of Regional Development, School of Social Sciences, Jawaharlal Nehru University, New Delhi, India
2. Dr. Smriti Das, Associate Professor, Strategic Management, XLRI, National Capital Region of Delhi, India.

Enclosure 33

Research Methods for Public Policy

Course title: Research Methods for Public Policy			
Course code:	**No. of credits:** 3	**L-T-P:** 39-04-04	**Learning hours:** 45
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** Semester 1	

Course description

This course is designed to orient students to essential research methods helpful for understanding and conceptualizing policy research and tools for administrative decision-making. Policy research often employs the methods of social science disciplines. The course aims to create a firm base on basic quantitative and qualitative research methods and tools, their appropriate application in policy research and to help students build perspectives based on robust evidence. This course comprises five modules: the first module discusses the basic features of research, with special reference to policy research; the second module provides crosscutting methods; the third and fourth modules provide an overview of qualitative and quantitative analytical methods, respectively; and the fifth module focuses on organizing and documenting analytic evidence.

Learning objectives:

- To orient students to basic and unique features of research in public policy.
- To enable students to design and carry out an independent study using quantitative or qualitative or mixed method approach.
- To help students develop the ability to select appropriate methods and tools for quantitative and qualitative data analyses and to draw inferences.
- To support students developing or strengthening their skills in organizing, synthesizing, and documenting analytical evidence in the form of research/technical reports.

Course content

Module	Topic	L	T	P
1.	**Basic Features of Research in Public Policy** • Unique Features of Research in Public Policy • Basis Steps of Policy Analysis and Research for Evidence-based Policymaking • Research Ethics	6	0	0
2.	**Research Design, Data, and Measurement Approaches & Tools** • Study Design for Policy Research: Cross-Sectional Study, Time-Series Study, Longitudinal design, Systematic Review, Meta-Analysis, Experimental Research Study, Case Study • Identifying and Gathering Secondary Data: Public or Private Sources of Data, Bibliographic Databases, Literature Review, Legal Searches, Management Records • Primary Data Collection Approaches/Methods for Policy Information: The Investigative Approach, Survey Method, In-depth Interview, Focus-Group Discussion, Observation • Definition and Measurements of Theoretical Concepts & Constructs; Types of Data; Scales of Measurements; Reliability and Validity • Population, Sampling, and Subjects: concept of population and sample, various approaches to the sampling, central limit theorem, issues in sample size selection, and basic sampling designs • Preparation of Survey Instrument: Considerations for Quality Questionnaire Design	12	0	0
3.	**Qualitative Research Approach and Analysis** • Qualitative Research Approaches: Grounded Theory; Ethnography; Discourse Analysis and Critical Discourse Analysis; Phenomenology. • Analysis and Interpretation of Qualitative Data: Transcribing and listening; Organizing the Data; Coding and Categorizing; Interpreting the Data; Evaluating the Interpretation; Being Reflexive about the Interpretation; Some Specific Analytical Issues. • Use of Software for Qualitative data analysis: e.g., ATLAS.ti, NVivo, etc.	7	2	2

4.	**Quantitative Data Analysis** • Univariate Analysis: Frequencies, Measures of Central tendency, Measures of Dispersion • Combining Indicators and Constructing Indices • Examining the Relationship between and among Variables with Tests of Statistical Significance: Introduction to Hypothesis Testing; Type of Statistical Errors; Level of Significance; Confidence Interval; Statistical vs. Practical Significance; some commonly used Statistical Tests • Correlation and Regression Analysis • Use of Statistical Software for Data Analysis: e.g., SPSS, Stata, R, etc. (along with Microsoft Excel).	12	2	2
5.	**Communicating/Documenting the Analysis** • Organization of the Report • Presentation of quantitative data into meaningful tables • Using Graphics to communicate • Interpretation and Discussion of results • Acknowledging the limitations of the study	2	0	0
	Total	**39**	**4**	**4**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (20%)
- **Minor Test-2:** Presentation & Submission of Excel-based Exercises on Quantitative Data (30%)
- **Major Test:** Presentation and submission of a Research study proposal (50%); the students are required to select any policy research question, and develop a research proposal, which will be submitted and presented as a part of the major/final test. The structure of the research proposal for a policy research study includes:
  - Introduction
  - Research Questions
  - Objectives
  - Methodology: Research hypothesis; Study design; Study setting; Reference and study population; Sample size; Sampling method; Exclusion criteria (if any); Specify the measures/variables; Study tools/instruments; Technique/Process of using the instruments and making the measurements; Pilot study, Data analysis plan
  - Expected Outcomes
  - Study Timeline

  Indicators for evaluation: (a) Identification of research problem; (b) Framing research questions, objectives, and hypothesis (if any); (c) Description of components under methodology section; (d) Conceptualizing expected outcomes and timeline; (d) Content, language, clarity; (e) Reference style and number of references cited

Learning outcomes

1. Upon completion of the course, candidates would be able to systematically identify the policy research questions and conceptualize them to carry out a scientific investigation (All evaluations)
2. Knowledge of quantitative and qualitative research methods and their usage will help participants appropriately apply such methods in their research inquiries that they'll carry out in the following semesters as well as in the future (All evaluations)
3. Participants would get the ability to develop a research proposal based on objective(s) which require(s) investigation using quantitative, qualitative, or mixed method approach (Major Test)

Pedagogical approach

Classroom lectures, excel-based data analysis, and invited talks from guest speakers, especially those working in the development sector who could provide exposure to different sorts of quantitative or qualitative analysis carried out by them on real-world data.

Suggested Readings

Module 1:

- Ewing, R., & Park, K. (Eds.) (2020). *Basic Quantitative Research Methods for Urban Planners*. New York & London: Routledge.
- Gelman, A., & Cortina, J. (Eds.) (2009). *A Quantitative Tour of the Social Sciences*. Cambridge, UK: Cambridge University Press.
- Gravetter, F. J., & Wallnau, L. B. (2014). *Essentials of Statistics for the Behavioral Sciences, 8th Edition*. Belmont:Thomson Wadsworth.
- Howlett, M. (Ed.) (2023). *The Routledge Handbook of Policy Tools*. London & New York: Routledge.
- Patton, C. V., Sawicki, D. S., & Clark, J. J. (2016). *Basic Methods of Policy Analysis and Planning, 3rd Edition*. London & New York: Routledge.
- Weimer, D. L., & Vining, A. R. (2017). *Policy Analysis: Concepts and Practice, 6th Edition*. New York &

London: Routledge.

Module 2:

- Creswell, J. W., & Creswell, J. D. (2018). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition*. California: SAGE Publication, Inc.
- Rassel, G., Leland, S., Mohr, Z., & O'Sullivan, E. (2021). *Research Methods for Public Administrators, 7th Edition*. New York & London: Routledge.
- Rosenbaum, P. R. (2017). *Observation and experiment: an introduction to causal inference*. Massachusetts: Harvard University Press.
- Roy, T. K., Acharya, R., & Roy, A. K. (2016). *Statistical Survey Design and Evaluating Impact*. Delhi: Cambridge University Press.
- van Thiel, S. (2022). *Research Methods in Public Administration and Public Management: An Introduction, 2nd Edition*. London & New York: Routledge.

Module 3:

- Daymon, C., & Holloway, I. (2011). *Qualitative Research Methods in Public Relations and Marketing Communications, 2nd Edition*. London & New York: Routledge.
- Kachuyevski, A., & Samuel, L. M. (Eds.) (2018). Doing Qualitative Research in Politics: Integrating Theory Building and Policy Relevance. Cham, Switzerland: Palgrave Macmillan.
- Merriam, S. B., & Tisdell, E. J. (2016*). Qualitative Research: A Guide to Design and Implementation, 4th Edition*. San Francisco, CA: Jossey-Bass (John Wiley & Sons, Inc.).

Module 4:

- Gupta, S. P. (2021). *Statistical Methods, 46th Edition*. New Delhi: Sultan Chand & Sons Educational Publishers.
- Kirk, R. E. (2008). *Statistics: An Introduction, 5th Edition*. Belmont: Wadsworth Publishing Co., Inc.
- Peck, R., Olsen, C., & Devore, J. L. (2016). *Introduction to Statistics and Data Analysis, 5th Edition*. Boston, MA,USA: Cengage Learning.
- Woodbury, G. (2002). *An Introduction to Statistics, 8th Edition*. Pacific Grove, CA, USA: Duxbury.

Module 5:

- Kothari, C. R. (2004). *Research Methodology: Methods and Techniques, 2nd Revised Edition*. New Delhi: New Age International Publishers.
- Maimon, E., & Yancey, K. B. (2020). *A Writer's Resource: A Handbook for Writing and Research, 6th Edition*. New York: McGraw-Hill Education.
- Mligo, E. S. (2016). *Introduction to Research Methods and Report Writing: A Practical Guide for Students and Researchers in Social Sciences and the Humanities*. Eugene, Oregon: Wipf and Stock Publishers.

Additional information: Up to 5 candidates will be accommodated from other courses/disciplines after discussion with the course coordinator

Student responsibilities

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

Course reviewers

1. Dr. Mathew Gayman, Associate Professor, Department of Sociology, Georgia State University, Atlanta, Georgia, United States of America.
2. Dr. Neeti, Associate Professor, Centre for Climate Change, Azim Premji University, Bengaluru, India.

Enclosure 34

Globalisation and Changing Geopolitics: Implications for Economic & Foreign Policies

Course title: Globalisation and Changing Geopolitics: Implications for Economic & Foreign Policies			
Course code: PPS XXX	**No. of credits:** 2	**L-T-P:** 30-00-00	**Learning hours:** 30
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):	**Course instructor(s):**		
Contact details:			
Course type: Core	**Course offered in:** 1st Semester		

Course description

Studying a country's economic and foreign policies is almost impossible without understanding the features of globalisation and dynamic geopolitics. This course will discuss the issues surrounding globalisation, and geopolitical and security challenges from an Indian perspective, and their implications on the economic and foreign policies. It will provide an understanding of how international agreements and institutions have been shaping up due to political, technological, and economic forces. The role of India as well as the shrinking policy space at the national level will also be discussed. The discussions on how ethics and equity can be mainstreamed into international law and global institutions will form an important part of the course. This course comprises four modules: the first module discusses the fundamentals of globalization, industrialization, international trade systems, and the learnings from global financial crises; the second module focuses on the Indian economy's transition in the globalizing world; the third module provides the basics of geopolitics and international relations issues in the contemporary world; and the fourth module focuses on India's international relations and foreign policy.

Learning objectives:

- To provide students with a basic understanding of the process of globalisation, the related institutional structure, and their implications on the Indian economy and associated policies.
- To orient students to critically understand the global geopolitics including security concerns from an Indian perspective and how India has been shaping the global discourse and institutions.

Course content

Module	Topic	L	T	P
1.	**Globalisation, Industrialization, Trade System and Financial Crisis** • Globalisation: concept; economic, political, and cultural dimensions; Challenges to Globalism • Phases and Theories of Industrial Development/Industrialization • World Trade System: Gains and losses in International Trade; Trade Theories and Public Policy; Political economy of the World Trading System • Learnings from the Global Financial Crisis: Keynesian Models after the Great Depression; The Bretton Woods System; The State of Crisis Theories; Sustainability in the Face of Crisis	6	0	0
2.	**Indian Economy in the Globalizing World** • Features of the Indian State in the Planning Era • India's Economic Transition: Neoliberal Globalization; Global Capitalism; Inclusive Development and Sustainability • India's Position and Approaches to International & Regional Trade Agreements and Organizations: e.g., GATT/WTO; SAARC, BIMSTEC, BBIN, etc. • Indian approach to Bilateral Investment Treaties (BIT) and Foreign Direct Investment (FDI) • Essential Principles of Indian Development Cooperation	6	0	0
3.	**Geopolitics and International Relations** • Understanding Geopolitics: using a framework focusing on place, scale, region, territory, network, and structure and agency • International Relations: Significance, Scope, and Approaches • Roots of Geopolitical Tensions in the 21st Century: USA-Russia-Europe • Major Contemporary Geopolitical Fissures: Syria, Ukraine, South China Sea, DPRK	8	0	0

4.	**India's International Relations & Foreign Policy** • India's Foreign Policy and its Relations with Major Powers (i.e., India's relations with the USA, China, Russia, and EU) • India's Policy to Immediate Neighbourhood: Pakistan, China, Nepal, Bangladesh, Sri Lanka, Bhutan. • Geopolitics in India's Extended Neighbourhood: West Asia; Central Asia; India's Act East Policy: Japan, ASEAN & Australia; Africa; Indian Ocean • India at the UN: UN Reforms & India's Quest for a Permanent UN Security Council Seat • India's Security Policy • India's role in Other Multilateral Bodies: Quad, BRICS, G20, etc.; India as a Green Leader: International Solar Alliance (ISA).	10	0	0
	Total	**30**	**0**	**0**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test-1:** Short-Answer Type Questions/Quizzes/MCQs (30%)
- **Minor Test-2:** Seminar/Debate Sessions on select Geopolitical Issues (20%)
- **Major Test:** Written Test/Term Paper Submission & Presentation (50%)

Learning outcomes

Upon completion of this course, candidates would be:

1. able to understand the fundamental concepts and theoretical background of globalisation, geopolitics and international relations concerning India's role and implications (All evaluations)
2. able to develop critical thinking on the global discourse on international trade and geopolitics including the role and impacts of global institutions and agreements on Indian policies and institutions (All evaluations)

Pedagogical approach

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

Suggested Readings

Module 1:

- Steger, M. B. (2003). *Globalization: A Very Short Introduction*. New York: Oxford University Press Inc.
- Stiglitz, J. E. (2003). *Globalization and its discontents*. New Delhi: Penguin Books India Pvt. Ltd.
- Nanda, N. (2008). *Expanding Frontiers of Global Trade Rules: The political economy dynamics of the international trading system*. London: Routledge.
- Thirlwall, A. P. (2013). *Economic Growth in an Open Developing Economy*. London: Edward Elgar.
- WTO (2015). *Understanding the WTO, 5th Edition*. Geneva: WTO.

Module 2:

- Basu, K., & Maertens, A. (2012). *The New Oxford Companion to Economics in India*. New Delhi: Oxford University Press.
- Chaturvedi, S., & Mulakala, A. (Eds.) (2016). *India's Approach to Development Cooperation*. London: Routledge.
- Nayar, B. R. (2014). *Globalization and India's Economic Integration*. Washington, D.C., US: Georgetown University Press.
- Nayyar, D. (2017). Economic Liberalisation in India: Then and Now. *Economic and Political Weekly*, 52(2), 41-48.

Module 3:

- Bordachev, T. (2022). *Europe, Russia, and the Liberal World Order: International Relations after the Cold War*. Routledge.
- Burchill, S., Linklater, A., Devetak, R., Donnelly, J., Nardin, T., Paterson, M., Reus-Snnit, C., & True, J. (2013). *Theories of International Relations, 5th Edition*. England: Palgrave Macmillan.
- Criekemans, D. (Ed.) (2021). *Geopolitics and International Relations: Grounding World Politics Anew*. Leiden, The Netherlands: Koninklijke Brill NV.
- Dittmer, J., & Sharp, J. (Eds.) (2014). *Geopolitics: An Introductory Reader*. Routledge.
- Dodds, K. (2019). *Geopolitics: A Very Short Introduction, 3rd Edition*. Oxford University Press.
- Dodds, K. (2019). *Geopolitics: A Very Short Introduction*. Oxford University Press
- Dugin, A. (2021). *The Theory of a Multipolar World*. Arktos Media Ltd.
- Dyvik, S. L., Selby, J., & Wilkinson, R. (Eds.) (2017). *What's the Point of International Relations?* Routledge.
- Flint, C. (2022). *Introduction to Geopolitics, 4th Edition*. London & New York: Routledge.
- Kumar, Y. (2020). *Geopolitics in the Era of Globalisation; Mapping an Alternative Global Future*. Routledge.
- Nestorovic, C. (2023). *Geopolitics and Business: Relevance and Resonance*. Springer.

- O'Donnell, F., & Ganguly, S. (Eds.) (2022). *Routledge Handbook of the International Relations of South Asia*. Routledge.
- Voskressenski, A. D. (2017). *Non-Western Theories of International Relations: Conceptualizing World Regional Studies*. Palgrave Macmillan.
- Ward, M. D. (Ed.) (2022). *The New Geopolitics*. Routledge.
- Wilkinson, P. (2007). *International Relations: A Very Short Introduction*. New York: Oxford University Press Inc.

Module 4:

- Beitelmair-Berini, B. (2021). *India's Grand Strategy and Foreign Policy: Strategic Pluralism and Subcultures*. Routledge.
- Bekkevold, J. I., & Kalyanaraman, S. (Eds.) (2021). *India's Great Power Politics: Managing China's Rise*. Routledge India.
- Bhatnagar, A. & Passi, R. (Eds.) (2016). *Neighbourhood First: Navigating Ties under Modi*. New Delhi: Observer Research Foundation and Global Policy Journal.
- Bhatnagar, S. (2020). *India's Pakistan Policy: How Think Tanks Are Shaping Foreign Relations*. Routledge India.
- Chakraborti, T., & Chakraborty, M. (2020). *India's Strategy in the South China Sea*. Routledge.
- Dhaliwal, S. (Ed.) (2021). *Indo-US Relations: Steering through the Changing World Order*. Routledge India.
- Dhaliwal, S. (Ed.) (2023). *India and the Changing World Order*. London & New York: Routledge.
- Gieg, P., Lowinger, T., Pietzko, M., Zürn, A., Bava, U. S., & Müller-Brandeck-Bocquet, G. (Eds.) (2021). *EU-India Relations: The Strategic Partnership in the Light of the European Union Global Strategy*. Cham, Switzerland: Springer Nature Switzerland AG.
- Hall, I. (2019). *Modi and the Reinvention of Indian Foreign Policy*. Bristol University Press.
- Hansel, M., Khan, R., & Levaillant, M. (Eds.) (2017). *Theorizing Indian Foreign Policy*. Routledge.
- Kim, Y-C. (Ed.) (2020*). China-India Relations: Geo-political Competition, Economic Cooperation, Cultural Exchange and Business Ties*. Springer International Publishing.
- Mayilvaganan, M. (Ed.) (2021). *ASEAN and India–ASEAN Relations: Navigating Shifting Geopolitics*. Routledge.
- Ogden, C. (2023). *Global India: The Pursuit of Influence and Status*. Routledge
- Panda, J. P., & Gunasekara-Rockwell, E. (Eds.) (2022). *Quad Plus and Indo-Pacific; The Changing Profile of International Relations*. Routledge.
- Pethiyagoda, K. (2021). *Indian Foreign Policy and Cultural Values*. Cham, Switzerland: Palgrave Macmillan (Springer Nature Switzerland AG).
- Schmidt, J. D., & Chakrabarti, S. (Eds.) (2021). *The Interface of Domestic and International Factors in India's Foreign Policy*. Routledge.

Student responsibilities

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

Course reviewers

1. Prof. S. P. Singh, Professor, Department of Humanities & Social Sciences, Indian Institute of Technology Roorkee (IITR), Roorkee, Uttarakhand, India.
2. Dr. R. R. Shukla, Associate Professor, Centre for Comparative Politics & Political Theory, School of International Studies, Jawaharlal Nehru University, New Delhi, India.

Enclosure 35

Economics for Public Policy

Course title: Economics for Public Policy			
Course code: MPD 143	**No. of credits:** 2	**L-T-P: 26-04-00**	**Learning hours:** 30
Pre-requisite course code and title (if any): NA			
Department: Department of Policy and Management Studies			
Course coordinator(s): ******	**Course instructor(s):** ****		
Contact details:			
Course type: Core	**Course offered in:** Semester 1		

Course description

This introductory course primarily covers the impacts and implications of government policy by emphasizing the core and fundamental concepts, theories, principles, tools and instruments in economics. The emphasis is laid on building students critical thinking and analytical abilities in applying the economic concepts to range of public policy problems in evaluating it and analyzing it. It lays emphasis on developing students' understanding in how and why markets (one important mechanism for allocating scarce resources) operate, and under what conditions markets fail. What are the mechanisms to correct market failure?

Course objectives-

- To develop students critical thinking around a range of public issues by using tools and techniques of economics
- To make students understand how and why markets work, when do they fail and mechanisms to correct such failures
- To build students skill sets for analyzing, interpreting public policy issues by using various economics tools and techniques

Course content

Module	Topic	L	T	P
I	**Fundamentals** Basic concepts and the philosophy behind economics Assumptions of perfectly competition markets and rationale actors Inefficiency and imperfect markets Welfare economics and policy applications	8	0	0
II	**Market failure: Definition, causes and typologies.** Why do markets fail? Causes of market failure, Externalities and public goods, Natural monopolies, Free-rider problem, Common property problems, Information asymmetry Behavioral economics in the context of market failure Case studies in market failure in infrastructure sector	6	2	0
III	**Mechanisms to correct the market failure** Introduction to various intervention tools such as command and control approach (CAC) versus Market based Instruments (MBI's) such as taxes and cap and trade mechanisms Role of regulation in market failure, Theories of economic regulation and its applications in infrastructure sector Theories of public expenditure	6	0	0
IV	**Tools for analyzing public policy** Introduction to cost-benefit analysis Present value analysis, choosing the discount rate Policy analysis involving risks and uncertainty Economic impact analysis tools Project management tools in public policy analysis Case study: Tools for catalyzing fossil fuel transitions	6	2	0
	Total	**26**	**4**	**0**

Evaluation criteria:

Minor Test 1 : Written test 20 %

Minor test 2 : Group assignment in the form of group presentations of important public policy case studies: 30 %

Major Exam: 50%

Learning outcomes

By the end of the course, students would be able to;

- Understand the key concepts, theories, models, tools, and techniques of economics to apply in the public policy context (Major Exam)
- Understand and appraise the role of market, market failure and mechanisms for correcting the market failure (Minor Exam 2 and Major test)
- Develop the skills to interpret, analyze the economic concepts, tools, and techniques for resolving public problem problems (Minor Test 1 and 2)

Pedagogical approach

The course will be delivered through a mix of classroom lectures, quizzes, discussions, classroom exercises and assignments and case studies discussion and presentation.

Course Reading Materials

Suggested core readings:

7. Principles of Economics, Karl Case, Ray Fair, and Sharon Oster, 12th Edition, Pearson Education Inc., 2017.
8. Gruber J. Public Finance and Public Policy, 7th edition, Worth Publishers, 2022.
9. Mishan, E.J., Cost Benefit Analysis, Routledge Publication, 2020.
10. Kolstad C.D. Environmental Economics, Oxford University Press, 2002
11. Nudge: improving decision about health, by R. H Thaler and C.R. Sunstein, Penguin UK, 2009

Additional readings

7. Economics: A Very Short Introduction, Partha Dasgupta, First Ey Edition, Oxford University Press, 2007
8. Free to Choose, Milton Friedman and Rose Director Friedman, First Edition, Mariner Books, 1990
9. The Armchair Economist: Economics and Everyday Life, Steven E. Landsburg, The Free Press, New York, 2012
10. The Political Economy of Public Goods: Some Evidence from India by Abhijit Banerjee and Rohini Somanathan, Journal of Development Economics 82 (2007)

Additional information

Students should be sincere and regular in classes

Student responsibilities

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

Course reviewers:

Prof. Badri Narayan Rath, Professor, IIT Hyderabad

Dr Subir Sen, Associate Professor, IIT Roorkee

Course prepared by : Dr Gopal Sarangi

Enclosure 36

International Collaborative Studio on Public Policy

Course title: International Collaborative Studio on Public Policy			
Course code: PPS XXX	**No. of credits:** 1	**L-T-P:** 15-00-00	**Learning hours:** 15
Pre-requisite course code and title (if any):			
Department: Department of Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course type: Core		**Course offered in:** 1st Semester	

Course description

This course is intended to provide students with an international platform to have exposure to global, contemporary, and state-of-the-art perspectives on critical public policy domains with a focus on sustainability. This platform would help the students to directly interact with experts from academia and industry including popular foreign university centres/schools/departments leading the education in public policy, and independent centres across various domains having important roles in public policy processes. The course will be delivered through five or six structured panel discussions on select thematic areas in a hybrid mode considering the mutually convenient period across time zones of the involved collaborators. This platform would open opportunities for students for further continued formal/informal interactions with external experts to develop or conceptualise ideas or policy research questions to carry out their requirements for developing a policy paper or writing dissertations in the following semesters of the Programme. On a mutual understanding or acceptance between the external expert and the student as per the specific guidelines of the Programme and the Institute, the student can get an opportunity to work under the mentorship of the external experts too.

Learning objectives:

- To provide students with an understanding of key public policy issues and challenges of the global community and critically reflect on the context under discussion.
- To develop the skills among students to summarise the debates on any thematic policy issues.

Course content

Module	Topic	L	T	P
1.	International Discussion Panels shall be structured to focus on the public policy dimension of diverse, yet critical thematic areas linked to sustainability. • Climate Change • Urbanisation • Water resources • Energy • Digital Economy • Infrastructure Development • Industrial Development • Various Social Policies, including Food Security, Education, Health, Work & Employment, etc.	15	0	0
	Total	**15**	**0**	**0**

Evaluation criteria:

Course grades will be based on the concurrent evaluation process:

- **Assignment (90%):** Submission of the Summary Report of each panel discussion in a prescribed format as per the guidelines over the semester.
- **Active participation (10%):** Active participation in the Panel Discussion would be observed through students' presence/attendance and asking relevant questions to the experts.

Learning outcomes

Upon completion of this course, students would be able to:

1. enhance their understanding towards complexities and possible solutions for diverse sustainability dimensions such as climate change, urbanisation, water resources, energy, digital economy, infrastructure development, industrial development, etc. (All evaluations).
2. develop summaries or briefs based on the major discussion points of importance or the outcome of the live expert panel discussions (All evaluations).

Pedagogical approach

Panel Discussion sessions will be conducted in hybrid mode. The international or national experts from academia or industry/research organisations will participate in the thematic deliberations.

Student responsibilities

- At least 75% attendance will be required.
- Active participation in the organised panel discussions/webinars/workshops, etc. through asking relevant questions to the experts.

Course reviewers

1. Prof. Shannon B. Olsson, Global Director, Echo Network, India Office, Bengaluru, Karnataka, India; the Special Scientific Envoy to India with the Danish Academy of Technical Sciences (ATV).
2. Dr. Sunil Pandey, Director, Circular Economy and Waste Management, The Energy and Resources Institute (TERI), New Delhi, India

Enclosure 37

Policy Lab-I: Sectoral Policy Scoping

Course title: Policy Lab-I: Sectoral Policy Scoping			
Course code:	**No. of credits:** 1	**L-T-P**: 10-00-10	**Learning hours:** 15
Pre-requisite course code and title (if any): None			
Department: Department of Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course Type: Core		**Course offered in:** Semester 1	

Course Description

This course is designed to provide students with a practical environment to reflect upon the policy-relevant dimensions covered across the sectors and develop their skills to conduct evidence synthesis and scoping in order to identify key policy research questions. In the second part of this course, the students will take up some of the identified research questions to develop a policy paper considering their feasibility to be carried out. Some of the unattended research questions students may select for their dissertation work. This course is the first part of a two-part course that imparts practical knowledge of the processes of policymaking or developing a policy paper/brief. In this part, the students learn initial process of identifying policy-relevant research questions through the scoping of literature and other evidence, and stakeholder consultation.

Course objectives

- To provide students with a platform to practically engage in evidence synthesis and systematically review the bibliographic databases and other sources of evidence to carry out a scoping exercise in the select policy-relevant domains.
- To equip students with the skill to identify and draft policy-relevant research questions based on the identified research gaps from the scoping exercise of the collated literature/evidence.
- To orient students to the relevance and essential conditions to carry out the stakeholder analysis including the process of identifying key stakeholders and critical research questions based on the discussions.
- To provide students with a platform to enhance their skills to conduct, moderate or lead the brainstorming sessions to extract critical research questions through reaching on consensus.

Course content

Module	Topic	L	T	P
1.	**Scoping of Policy Research Questions:** The students will be guided and instructed to identify policy-relevant research questions by scoping bibliographic databases, govt. reports, grey literature, and newspaper articles as per the context and domain under investigation. Based on the nature of policy domains or research investigation, the students would also conduct a stakeholder analysis to come up with critical issues for investigation. Based on the class size, the scoping activity and presentation of the outcome would be conducted in groups or as individual exercises.	10	0	10
	TOTAL	**10**	**0**	**10**

Evaluation criteria:

Course grades will be based on the following criteria:

- **Minor Test:** Presentation of Scoping Excercise (40%)
- **Major Test:** Submission of Review Paper (60%)

Learning Outcomes:

Upon completion of this course, students would be able to:

- enhance their practical skills to delineate policy dimensions across the domains.
- augment their understanding to develop relevant policy research questions through scoping of literature and other evidence.

Pedagogical approach:

Systematic literature review; content analysis; brainstorming sessions, group, or individual presentation, etc.

Suggested readings:

It is a practical exercise using the knowledge gained from other taught courses and through the review

process.
Relevant literature, reports, textbooks, case studies, journals, databases will be suggested to the students based on the context and requirements.

Student responsibilities:

- At least 75% attendance will be required.
- Active classroom participation; Critical reflections during Brainstorming Sessions; Equal participation of the participants working in a group.

Course reviewers

1. Dr. Sunil Pandey, Director, Circular Economy and Waste Management, The Energy and Resources Institute (TERI), New Delhi, India.
2. Dr. Prashanth N. Srinivas, Director & Health Equity Cluster Lead, Institute of Public Health, Bengaluru, India.

Enclosure 38

Two changes in the overall program structure are made to align the credit requirements as per NHEQF. The course BBP 112 Statistics for the Life Sciences is shifted from Semester 2 to Semester 3. Second, the credits of course BBP 108 Major Project credits are changed from 16 to 20. Accordingly, the total credit requirement for overall program is 82.

Total credits: 82

Semester	Courses	Credits	Duration
1st Semester	7 core courses of 2-7 credits each, and 2 core audit courses	21	15 weeks
2nd Semester	7 core courses of 2-7 credits and 1 course of 2 credits in the area of specialisation**	20	15 weeks
Second Year			
3rd Semester	4 core courses of 2-7 credits and 1 course of 3 credits in the area of specialisation**	21	15 weeks
4th Semester	Major project	20	15 weeks
	Total	**82**	

Semester	Course No.	Course Title	Type	Number of Credits	No. of L-T-P
Semester 1	NRE 113	Applied mathematics	Core	0	33-12-0
Semester 1	BBP 111	Bioanalytical techniques	Core	3	39-6-0
Semester 1	BBP 174	Bioinformatics and computational biology - Part I	Core	2	22-8-0
Semester 1	BBP 105	Biotechnology laboratory - Part 1	Core	7	7-0-196
Semester 1	NRE 106	Communication Skills and Technical Writing	Core	0	16-14-0
Semester 1	BBP 158	Conceptual foundations of molecular biology	Core	2	30-0-0
Semester 1	BBP 123	Plant and Animal Biotechnology	Core	2	45-0-0
Semester 1	BBP 161	Principles of Biochemistry and Biophysics	Core	2	30-0-0
Semester 1	BBP 155	Principles of genetic engineering and recombinant DNA technology	Core	3	30-15-0
Semester 2	BBP 106	Biotechnology Laboratory - Part 2	Core	7	0-0-210
Semester 2	BBP 144	Conservation Genetics and Genomics	Core	2	30-0-0
Semester 2	BBP 146	Genome Structure and Diversity: Concepts and Methodologies	Core	3	23-22-0
Semester 2	BBP 115	Introduction to Nanobiotechnology	Core	2	22-8-0
Semester 2	BBP 145	Microbial Pathogenesis	PE	2	15-15-0
Semester 2	BBP 114	Molecular Cell Biology - From Genes to Communities	Core	2	30-0-0
Semester 2	BBP 131	Molecular Microbiology and Immunology	Core	2	30-0-0
Semester 2	BBP 116	Molecular Plant Physiology and Metabolism	PE	2	30-0-0
Semester 3	BBP 112	Statistics for The Life Sciences	Core	3	30-15-0
Semester 3	BBP 141	Bioethics, IPR and Regulations in Biotechnology	Core	3	39-6-0
Semester 3	BBP 162	Bioprocess Engineering and Environmental Biotechnology	PE	3	30-15-0
Semester 3	BBP 103	Biotechnology Laboratory - Part 3	Core	7	0-0-210
Semester 3	BBP 147	Molecular Genetics for Plant Functional Genomics: Principles and Practice	PE	3	22-23-0

Semester	Course No.	Course Title	Type	Number of Credits	No. of L-T-P
Semester 3	BBP 163	Gene Expression Analysis and Transcriptomics	Core	2	30-0-0
Semester 1	NRE 165	Introduction to Sustainable Development	OE	0	15-0-0
Semester 3	BBP 164	Proteomics and Protein Engineering	Core	3	45-0-0
Semester 4	BBP 108	Major project	Core	20	0-0-672

Enclosure 39

SCHEME FOR APPOINTMENT OF HONORARY DISTINGUISHED PROFESSOR AT THE TERI SCHOOL OF ADVANCED STUDIES (TERI SAS)

1. PREAMBLE

A retired Professor or Eminent Academic of repute of any University/Research/Academic Organization having an authoritative standing in a field of interest to a Department of TERI SAS may, on the recommendation of the Vice-Chancellor, be selected for appointment as Honorary Distinguished Professor. The terms and conditions and procedure of selection shall be as provided in this scheme. As the position is a purely honorary one, the Honorary Distinguished Professor shall not be paid any salary from TERI SAS funds.

2. SELECTION

The conferment of distinguished professorship by the TERI SAS shall be done only on such scholars who have earned national/global recognition with their distinguished work. Active Academics/Researchers of such repute, who are performance oriented (writing books, writing essays, comments etc.) and have potential to contribute to the academic environment of TERI SAS shall be eligible for conferment of said status under the scheme. The procedure of selection of scholars for award of the said status shall be as follows:

a) There shall be no age bar for consideration of Distinguished scholar of the university.

b) The Scheme will be notified as per the requirement for such positions subject to departmental approval and requirements. Applications will be invited and the outcome of the selection process will be communicated to all applicants before the end of the subsequent month as well as prominently displayed on the TERI SAS website. Further in addition to application-based selection, nominations of esteemed academicians and individuals of eminence by former/present Vice Chancellors, former/present Directors of National Institutes, Fellows of the National Academies shall be considered as Honorary Distinguished Professors at TERI SAS.

c) Host departments will scrutinize applications and forward their recommendations to the Vice-Chancellor. If the host department advises against selection, the same will the communicated to the applicant. If the host department recommends selection, the applicant's candidature will be forwarded to the Consultative Committee.

d) **The Consultative Committee:** A Committee consisting of the Vice-Chancellor as Chairman, the Deans and two persons of eminence in the relevant field (to be nominated by the Vice-Chancellor from the panel approved by the Executive Council) as members, shall consider the individual(s) suggested for Honorary Distinguished Professorship and, if found suitable, forward their endorsement of the said individual's candidature to the Executive Council for final approval.

e) The Registrar's office will document the above process during every selection cycle.

The Departments and the Consultative Committees should make their recommendations based on the following criteria:

1. The candidate for Honorary Distinguished Professorship should be a highly acclaimed academician.

2. S/he should have consistent publications in highly reputed journals/publishing houses.
3. S/he should have received patents/copyrights or have inventions to his/her credit or other relevant discipline-specific indicators of eminence.
4. S/he should have supervised Ph.D. students and/or post-doctoral fellows within the preceding 5 years.
5. S/he should have received national and/or international recognition as evidenced by for example, selection to the membership of leading discipline-specific national and/or international academies. (Note: Paid memberships to various professional associations will not count towards this indicator).
6. He/She should be a good teacher and should have contributed to the development of innovative methods of teaching and improvement of course curricula.
7. Any other noted accomplishments and contributions to the field of education and/or research.

3. FUNCTIONS OF THE HONORARY DISTINGUISHED PROFESSOR

The Honorary Distinguished Professor would function as guide, philosopher and mentor for the hosting department.

The Honorary Distinguished Professor of TERI SAS may discharge any or all of the following illustrative (but not comprehensive) functions:

a) Delivering special lectures for the students/faculty members.
b) Conducting specialized short-term refresher courses and to help research students and members of faculty.
c) Guiding to shape the existing course curricula to make it contemporary and contextual as an invited member of the Board of Studies of the host Department.
d) Aiding conceptualization of new research areas and development of research projects in that line.
e) Extending need-based guidance in the relevant field.
f) Extending guidance across Departments to enable multi-disciplinarity and in other matters of the University, where required.
g) Each Honorary Distinguished Professor should submit a yearly report on his/her work and accomplishments during the year duly forwarded by the Head of the department to the Vice-Chancellor. This report shall form part of the Annual Report of the University.
h) Each Honorary Distinguished Professor should deliver a public lecture on his/her work and/or emerging trends in his/her field every year.
i) The Distinguished Professor's affiliation to the hosting Department and TERI SAS should be mentioned prominently on his/her written works, such as books, research articles etc.
j) All standards of professional conduct prescribed in the faculty code of conduct shall be applicable to the Honorary Distinguished Professor.

Notwithstanding anything contained above, the Honorary Distinguished Professor will not be assigned administrative roles (Dean, HoD, Program Coordinators etc.).

4. PRIVILEGES

(a) An Honorary Distinguished Professor will be treated as an 'honoured' member of the

department and appropriate facilities for discharge of his functions shall be extended to him/her by the hosting department. However, extension of laboratory facilities and other research-related facilities to the Distinguished Professor shall be decided at the department level. These provisions should not constitute any kind of additional cost to TERI SAS.

(b) He/she should also be extended Library facilities at par with regular faculty members to enable proper pursuance of his/her academic pursuits.

(c) An Honorary Distinguished Professor who is invited to the Campus from outside shall be entitled for payment of honoraria for lectures delivered in various courses taught at TERI SAS at prevailing rates recommended for guest faculty.

(d) Submitting joint research proposals for extramural funding with a regular faculty of TERI SAS as co-investigator. (However, the administrative and financial responsibilities in such projects would rest with the co-investigator from TERI).

(e) The Honorary Distinguished Professor may elect to supervise doctoral students and/or post-doctoral fellows provided a regular faculty of TERI SAS consents to serve as the co-supervisor.

5. TENURE

(a) The tenure of the Honorary Distinguished Professor shall be **five** years from the date of joining, subject to termination from either side with a three-month's notice.

(b) The tenure of the Honorary Distinguished Professor may be renewed by the Vice-Chancellor for an additional **five** years based on the recommendation of the host department and the Deans. Only **one** extension is permitted.

NOTE: This scheme is not open to current or past employees of TERI and TERI SAS.