TERI School of Advanced Studies (Deemed to be University)

10, INSTITUTIONAL AREA, VASANT KUNJ, NEW DELHI

MINUTES

61ST MEETING OF ACADEMIC COUNCIL

Meeting No. : 61st (Sixty First)

Date : 16 July 2025 (Wednesday)

Venue : Conference Room, TERI School of Advanced Studies

Time : 10.30 AM

TERI School of Advanced Studies (Deemed to be University)
MINUTES FOR THE 61st MEETING OF THE ACADEMIC COUNCIL
16 July 2025 (10.30 AM ONWARDS)

ITEMS AT A GLANCE

<u>**Item No.**</u>   <u>**Particulars**</u>

Item No.61.1:   Welcome and opening remarks by the Vice Chancellor

Confirmation of Minutes

Item No. 61.2:   To confirm the minutes of the Sixtieth (60th) Meeting of the Academic Council held on 24 December 2024.

Action Taken Report

Item No. 61.3:   Action Taken Report on the 60th Academic Council Meeting.

Agenda items for Information

Item No. 61.4:   Matters of information

           61.4.1 Appointment and resignation of Professor of Practice
           61.4.2 Revision in the eligibility criteria for admission to MSc (Environmental Studies and Resource Management) programme
           61.4.3 Visit of students to Linnaeus university
           61.4.4 Erasmus+ International Mobility with University of Graz
           61.4.5 Award of Internal grants
           61.4.6 MoU(s) concluded
           61.4.7 Appointment of Hony. Distinguished Professor
           61.4.8 Case of Student Grievance Redressal
           61.4.9 To consider revision in the eligibility criteria for M.Sc. (Climate Science and Policy)
           61.4.10 To approve the proposal of starting B.Sc./ Integrated M.Sc. (Energy and Computer Applications) in the Department of Sustainable Engineering.

Agenda items for Consideration

Item No. 61.5.   Agenda Items

           61.5.1 To consider and approve course content of semester 1 courses of Four-Year Undergraduate Program (FYUP)/Five-Year Integrated Post-Graduate Program (FYIPP) by the Department of Biotechnology in the Academic Year 2025-26.
           61.5.2 To discuss and approve course outlines of the 3rd semester courses of M.Sc. (Energy Studies and management) offered by Department of Sustainable Engineering.
           61.5.3 To consider and approve programme outline and programme structure of B.Sc. (Energy and Computer Applications) offered by the Department of Sustainable Engineering.
           61.5.4 To consider and approve outlines of two 1-credit elective courses as part of 2nd semester of M.Tech (Renewable Energy Engineering and Management) offered by the Department of Sustainable Engineering.
           61.5.5 To consider and approve a new course on 'Applied Machine Learning' for MSc students of ESRM and CSP, offered by the Department of Natural and Applied Sciences

61.5.6   To consider and approve the course framework for four years UG programme for Environmental Studies (ES), and UG programme for Data Science (DS)

61.5.7   To consider and approve courses for the fifth semester of UG - DS programme and UG - ES programme

61.5.8   To consider and approve the award of degree with Major and Minor disciplines for the undergraduate programmes

61.5.9   To consider and approve revised programme structure of the Economics 5-year integrated programme offered by Dept. of Policy and Management Studies

61.5.10   To consider and approve four courses for BSc Economics Programme offered by Dept. of Policy and Management Studies

61.5.11   To consider and approve change in the evaluation pattern of the MSc (Economics) Course on Development Economics offered by Dept. of Policy and Management Studies

61.5.12   To consider and approve addendum in the evaluation criteria for the Course MPE 176 offered by Dept. of Policy and Management Studies

61.5.13   To consider and approve revised course credit structure of MBA Programme offered by Dept. of Policy and Management Studies

61.5.14   To consider and approve new courses for BBA Programme offered by Dept. of Policy and Management Studies

61.5.15   To consider and approve amendment to Evaluation and Examination policy

61.5.16   To consider and approve amendment to Grade improvement policy

61.4.17   Eligibility of students for admission from Open School and Correspondence Degree

61.5.18   To consider and approve extension of enrolment date in PhD programme

Item No. 61.6:   Any other item with the permission of the Chair

TERI School of Advanced Studies (Deemed to be University)

**MINUTES FOR THE 61st MEETING OF
THE ACADEMIC COUNCIL
16 July 2025 (10.30 AM ONWARDS)**

The Sixty first meeting of the Academic Council was held on 16 July 2025 at 1030 hours. The following were present:-

Members Present

Prof Suman Kumar Dhar	Prof Ramakrishnan Sitaraman
Prof Shreekant Gupta	Dr Ramkishore Singh
Prof Vivek Suneja	Prof Sukanya Das
Prof Sagnik Dey	Dr Chaithanya Madhurantakam
Mr Sudhir Vadehra	Dr Shruti Sharma Rana
Prof Chander Kumar Singh	Prof Shaleen Singhal
Prof Anandita Singh	Prof Shashi Bhushan Tripathi
Dr Shantanu De Roy	Dr Chandan Kumar
Dr Priyanka Arora	Dr Amit Singh
Dr Adwitiya Sinha	Dr Swarup Dutta
Dr Moumita Acharyya	Col B Venkat
Dr Ranjana Ray Chaudhuri (online)	

Prof Naqui Anwer, Dr Sapan Thapar, Prof P.S.N. Rao, Prof Suresh Jain, Dr Gopal Sarangi, and Prof Arun Kansal were absent with prior information.

Item No 61.1: Welcome and opening remarks by the Vice Chancellor.

Professor Suman Kumar Dhar welcomed all the members to the meeting and thanked them for their presence. He also welcomed Dr Chandan Kumar and Dr Moumita Acharyya who have been newly inducted in the Academic Council.

Confirmation of Minutes

Item No. 61.2: **To confirm the minutes of the Sixtieth (60th) Meeting of the Academic Council held on 24 December 2024.**

The minutes of the Sixtieth Meeting of the Academic Council, held on 24 December 2024, were circulated to the members and no comments were received.

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

The Academic Council approved the minutes of Sixtieth (60th) Meeting of Academic Council held on 24 December 2024.

Action Taken Report on the 60th Academic Council Meeting.

Item No.61.3: Action Taken Report on the 60th Academic Council Meeting

Sr.No.	Agenda	Action taken
Item No.1	60.5.1 To consider in-principle approval for launching the proposed Four-Year Undergraduate Program (FYUP) and the Five-Year Integrated Post-Graduate Program (FYIPP) by the Department of	The same has since been implemented, with inclusion in NTA CUET UG portal with batch strength of .

	Biotechnology in the Academic Year 2025-26. Department of Biotechnology proposes to launch Four-Year Undergraduate Program (FYUP) and the Five-Year Integrated Post-Graduate Program (FYIPP) from the Academic year 2025 – 26. Professor Shashi Bhushan Tripathi presented the detailed proposal for the Four-Year Undergraduate Program (FYUP) and the Five-Year Integrated Post-Graduate Program (FYIPP) to the Academic Council members. Professor Tripathi provided background information on the launch of the programs, the proposed courses to be covered over the four years, and the credit requirements for students to attain the degree. The Academic Council members discussed the FYUP and FYIPP in detail. **The Academic Council members approved the proposal for both the Four-Year Undergraduate Program (FYUP) and the Five-Year Integrated Post-Graduate Program (FYIPP), incorporating the suggested changes.**	
Item No.2	**60.5.2 To discuss and approve the proposal of starting B.Tech (Energy Engineering) and its proposed course structure.** Department of Sustainable Engineering proposes to launch B.Tech (Energy Engineering) from the Academic year 2025 – 26. Dr. Naqui Anwer presented the detailed context, unique selling proposition (USP), and proposed program structure for the B.Tech (Energy Engineering) to be offered by the DoSE. The Academic Council members discussed the various courses being proposed and recommended the inclusion of topics on smart energy, as well as subjects related to electrical, mechanical, and chemical engineering, to enhance the program's focus on skills development and improve its job-oriented approach for graduates. Professor Anwer also outlined the infrastructure and manpower requirements necessary to apply for AICTE approval for launching this program. **The Academic Council members approved the proposal for the B.Tech**	**The regulating body, AICTE has not approved the proposal citing Clause 2.6(c) of APH 2024-27, which states "Increase in intake / Additional Course in Diploma / Under Graduate /Post Graduate level in Engineering and Technology shall be permissible, if the Institution is already offering minimum three (3) courses in Core Branches including Multidisciplinary/Region Specific branches".**

	(Energy Engineering), incorporating the suggested changes. **It was proposed that certain management specific courses be part of the program, to bring in an additional option of a minor.** **In addition aspects of new gen technologies such as AI / ML be introduced across all the programs offered at both UG / PG level.**	
Item No.3	**60.5.3 To consider and approve six Course Outlines of the 2nd semester courses of M.Sc. (Energy Studies and Management) offered by the Department of Sustainable Engineering** M. Sc (Energy Studies and management) has commenced from the academic session 2024-25. Following six core courses as given below are under offer in the 2nd semester. (a) Firm and Dispatchable Energy – Resources, Technologies, Applications (b) Variable Energy and Decentralized Systems – Resources, Technologies, Applications (c) Building Energy Management and Green Building (d) Energy Markets and Trading (e) Energy Project Management (f) Energy Systems Lab **For consideration and approval of the Academic Council please.**	**The same has since been implemented.**
Item No.4	**60.5.4 To consider and approve one Course Outline of the 3rd semester course of M.Tech (Renewable Energy Engineering and management) offered by the Department of Sustainable Engineering** . A 3-credit course titled "Waste to Energy" is proposed to be included for the 3rd semester of M.Tech (Renewable Energy Engineering and Management). **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented.**
Item No.5	**60.5.5 To consider and approve starting the one-year PG Diploma in Renewable Energy Management (PGDREM) in online mode and also approve the**	**The online platform has been prepared in-house and the modules to be offered as part of**

	Programme Project Report (PPR) To consider and approve starting one-year PG Diploma in Renewable Energy Management (PGDREM) in online mode offered by the Department of Sustainable Engineering along with Programme Project Report (PPR). **The Academic Council discussed, gave inputs and approved the agenda.**	**PGDREM are under preparation.**
Item No.6	**60.5.6 To consider and approve shifting of courses in the semester of M.Sc. Environmental Studies and Resource Management (ESRM) programme of the Department of Natural and Applied Sciences** To shift the course NRE 144 Environmental Health and Risk Assessment (3 credits) from second semester to third semester and the course NRE 133 Environmental Management Systems (4 credits) from third semester to second semester of MSc Environmental Studies and Resource Management (ESRM) programme as approved by the BoS (both courses are offered as electives, and proposed changes will not impact the current minimum credits required per semester for the programme structure already approved as per the NHEQF). Furthermore, the proposed changes also to be reflected in all programme outlines where these courses are offered as electives. **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented.**
Item No.7	**60.5.7 To consider and approve course framework for four years UG programme for Data Science (DS), and UG programme for Environmental Studies (ES) of the Department of Natural and Applied Sciences** The course framework for four years UG programme for Data Science (DS), and UG programme for Environmental Studies (ES) of the Department of Natural and Applied Sciences is placed for approval. **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented.**

Item No.8	60.5.8 To consider and approve nine Course Outlines and syllabus of the 4th semester undergraduate – Data Science and Environmental Studies programmes offered by the Department of Natural and Applied Sciences
	
	To discuss course outlines and syllabus of fourth semester undergraduate – Data Science programme and Environmental Studies programme reviewed by the BoS and approval of the Academic Council as placed in **Enclosure 8.**
	  (a) Environmental Policy, Law and Governance (ES)
	  (b) Global Climate Change (Minor)
	  (c) Network Science (DS)
	  (d) Open Source Programming (DS)
	  (e) Time Series Analysis in Data Science (DS)
	  (f) Environmental Laboratory – I (ES)
	  (g) Sustainable Natural Resource Management (ES)
	  (h) Water and Soil Pollution (ES)
	  (i) Spatial Data Modelling and Analysis (Minor)
	
	The Academic Council discussed, gave inputs and approved the agenda.
		The same has since been implemented.

Item No.9	60.5.9 To consider and approve the change in offering of the following courses in all the Masters' programmes (DoSE, DoPMS – less MBA (SM)) of the Departments
	
	It is proposed to approve the change in offering of the following courses in all the Masters' programmes (DoSE, DoPMS – less MBA (SM)) of the Departments:-
	
	  (a) Design Thinking
	  (b) Introduction to Sustainable Development
	
	It is proposed that university level courses such as 'Design Thinking' and 'Introduction to Sustainable Development' (currently offered as mandatory courses) be offered as elective courses for the students.
	
	The Academic Council discussed, gave inputs and approved the agenda.
		The proposal is under process of implementation from the coming semester.

Item No.10	60.5.10 To consider and approve extension of time period for thesis submission	**Mr Tushaar Saxena shall be submitting his thesis by 27 July 2025**

	Mr Tushaar Saxena, PhD candidate has submitted a request on 13th December 2024 for an extension of time duration for one semester for his thesis submission. He has provided the progress details justifying the case. The request was circulated between the SRC and DRC members for their information and input. Inputs received from the Officiating Supervisor and Co-supervisors and SRC members are placed in Enclosure. **The Academic Council noted the matter.**	

Item No.11	**60.5.11 To consider and approve new courses for the 4th semester BSc Economics programme of the Department of Policy and Management Studies**.
	
	It is proposed to approve the following new courses for the 4th Semester BSc Economics programme of TERI School of Advanced Studies.
	
	List of courses
	    (a) Intermediate Macroeconomics-II
	    (b) Intermediate Statistical methods for economics, and
	    (c) Economic History of India
	
	The Academic Council discussed, gave inputs and approved
		The same has since been implemented.

Item No.12	**60.5.12 To consider and review the eligibility criteria for admission for MSc-Economics and BSC-Economics Programmes**
	
	It is proposed that for admission in Economics as a Major discipline under the BSc (Economics) programme at the TERI-SAS, following eligibility criteria be considered:-
	Eligibility criteria for BSc (Economics)
	    (a) Senior Secondary School Leaving Certificate or Higher Secondary (12th Grade) Certificate obtained after successful completion of Grade 12 or equivalent from any discipline with Mathematics or Applied Mathematics in Grade 12.
	    (b) Applicants without a background in Mathematics/Applied Mathematics in Grade 12 may be considered eligible on successfully completing a Senior Secondary (equivalent to the 10+2 level) Mathematics course(s) at the National Institute of Open Schooling (NIOS).
		The same has since been implemented

	(c) There is no upper age bar. **Eligibility criteria for MSc (Economics)** (a) The existing criteria for admissions may be continued. **The Academic Council discussed, gave inputs and approved the agenda.**	
Item No.13	**60.5.13 To consider and approve the introduction of 5-year integrated programme in Economics for BSc (Economics) programme from AY 2025-26 onwards** It is proposed to introduce 5-year integrated programme in Economics for BSc (Economics) from AY 2025-26 onwards. **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented**
Item No.14	**60.5.14 To consider and approve the new courses as per AICTE Model Curriculum for the BBA programme of the Department of Policy and Management Studies**. It is proposed to revise / modify BBA program under offer as per AICTE Model Curriculum. Towards this, approval for the following new courses as applicable for the 2nd and 4th Semester is placed:- (a) Business Communication -II (b) Human Behavior (c) Business Economics (d) Emerging Technologies and Business Application (e) Marketing Management (f) Media Literacy & Critical Thinking (g) Human Resource Management (h) Management accounting (i) Management Information System (j) Business Research Methodology (k) Entrepreneurship (l) Legal and ethical issues in business **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented**
Item No.15	**60.5.15 To consider and approve the revised courses for the LLM Programme as per the NHEQF Guidelines.** It is proposed to review and approve the following revised courses for the LLM Programme as per the NHEQF Guidelines. (a) Legal Aspects of Bidding and	**The same has since been implemented**

	Public Private Partnership (Proposed to increase from 2 Credit Course to 3 Credit Course) (b) Mining and Mineral Laws (Proposed to increase from 2 Credit Course at present to 3 Credit Course) (c) Contract Law and Management (Proposed to increase from 2 Credit Course at present to 3 Credit Course) (d) Forest Law and Policy (Proposed to increase from 2 Credit Course at present to 3 Credit Course) (e) Competition Law and Policy (Proposed to increase from 2 Credit Course at present to 3 Credit Course) (f) Urban Infrastructure Law and Management (Proposed to increase from 2 Credit Course to 3 Credit Course) (g) Environmental Aspects of Business Activities (Proposed to increase from 2 Credit at present to 3 Credit Course) (h) Climate Change and Law (Proposed to increase from 2 Credit Course at present to 3 Credit Course) (j) Infrastructure Project Finance Law (Proposed to increase from 2 Credit Course to 3 Credit Course) (k) Energy Law (Proposed to increase from 2 Credit Course at present to 3 Credit Course) **The Academic Council discussed, gave inputs and approved the agenda.**	
Item No.16	**60.5.16 To consider and approve the modification of the courses of MA SDP Programme of the Department of Policy and Management Studies.** It is proposed to approve the modification of the following courses of MA SDP Programme of the Department of Policy and Management Studies:- **S.No. Courses Proposed changes** 1. Gender in Increase in credit Development from 2 to 3 in Practice (SEM-II). MPD 148 2. Themes and Increasing the credit Perspectives of from 2 to 3 in Development (SEM-1) MPD 139 3. Management of Modification has	**The same has since been implemented**

	been Development done by rearranging Organization (SEM-II) two modules along with a minor change in evaluation pattern. **The Academic Council discussed, gave inputs and approved the agenda.**	
Item No.17	**60.5.17 To consider and approve the courses of MA PPSD Programme of the Department of Policy and Management Studies** It is proposed to approve the following courses of MA PPSD Programme. <table><tr><td></td><td>Semester II</td><td>Credits</td></tr><tr><td>1</td><td>Sustainable Urbanization</td><td>2</td></tr><tr><td>2</td><td>Water and Sustainable Development: Policy Perspectives</td><td>2</td></tr><tr><td>3</td><td>Energy and Sustainable Development: Issues, Challenges & Policy</td><td>2</td></tr><tr><td>4</td><td>Digital Economy: Dividends, Disputes & Dimensions</td><td>2</td></tr><tr><td>5</td><td>Infrastructure Development and Sustainability: Issues & Policy Perspectives</td><td>2</td></tr><tr><td>6</td><td>Sustainable Industrial Development: Policies & Practices</td><td>2</td></tr><tr><td>7</td><td>Climate Change and Cities: Policies & Practices</td><td>2</td></tr><tr><td>8</td><td>Public Policy Assessment: Methods & Measurements</td><td>2</td></tr><tr><td>9</td><td>Policy Lab - II: Developing a Policy Paper</td><td>3</td></tr><tr><td></td><td>Semester III</td><td></td></tr><tr><td>10</td><td>Major Project – I</td><td>20</td></tr><tr><td></td><td>Semester IV</td><td></td></tr><tr><td>11</td><td>Major Project – II</td><td>20</td></tr></table> Detailed outlines and revised programme structure of MA PPSD programme are presented. **The Academic Council discussed, gave inputs and approved the agenda.**	**The same has since been implemented**
Item No.18	**60.5.18 To consider and approve revised Ph.D. regulations** The revised Ph.D. regulations of TERI School of Advanced Studies is placed for consideration and approval of the Academic Council	**The same has since been implemented**

	Dr Gopal Sarangi presented and highlighted the proposed changes in the TERI School of Advanced Studies Ph.D. Rules-2024. **The Academic Council members deliberated on the points and approved the enclosed policy.**	
Item No.19	**60.6.1 Eligibility criteria of the programmes offered at TERI School of Advanced Studies** Dr Chander Kumar Singh presented the eligibility qualifications criteria for admission to various programmes being offered by the Institute. **The Academic Council members noted the details presented and approved the agenda item.**	**The same has since been implemented.**
Item No.20	**60.6.2 Extension for Ph.D. Scholars** Dr Chander Kumar Singh informed that Ms Anjulata Singh, Gurbir Kaur Sidhu and Gurdeep Kaur, Ph.D. scholars of DBT are in the final stages of their thesis submission and are being given one last extension of one semester for submission of thesis with all prescribed formalities as per PhD regulations. Mr Jeevan Jethani from DoPMS is also given one semester extension beyond which no further extension would be given. **The Academic Council members approved the extension.**	**Ms. Anjulata Singh, Ms. Gurbir Kaur Sindhu and Ms Gurdeep Kaur have since submitted their thesis.** **Mr Jeevan Jethani shall be submitting his thesis by 24 July 2025.**

The Academic Council members noted the action taken on the various items mentioned above.

Agenda items for Information

Item No. 61.4: Matters of information

61.4.1 Appointment and resignation of Professor of Practice

Dr Swapan Sahoo has been appointed as Professor of Practice in the Department of Natural and Applied Sciences from 10 April 2025. Brief profile of Dr Swapan Sahoo is placed as **Enclosure 1**.

Dr Neeraj Sharma was appointed as Professor of Practice on 29 May 2023 in the Department of Policy and Management Studies. After a two year period Dr Neeraj Sharma has relinquished from his position as Professor of Practice.

TERI School of Advanced Studies acknowledges his contribution during his term as Professor of Practice.

The Academic Council noted the matter.

61.4.2 Revision in the eligibility criteria for admission to MSc Environmental Studies and Resource Management programme

The Department of Natural and Applied Sciences carried following revision in the eligibility criteria for admission to MSc Environmental Studies and Resource Management programme as follows:

<u>Existing eligibility criteria:</u>
A Bachelor's degree to include (Open School and Correspondence Degree) in Science / Engineering / Economics / Mathematics / Statistics / Geology / Geography with a minimum cumulative grade point average of 6.75 on a 10 point scale or equivalent, as determined by TERI School of Advanced Studies, wherever letter grades are awarded, or 60% marks in aggregate, wherever marks are awarded. For candidates with bachelor's degree in Humanities (e.g. Economics/Geography), a relaxation of 5%/0.75 Cumulative Grade Point Average could be allowed.
The admission process will be based on the aggregate marks obtained in the qualifying degree, followed by interaction/counselling.

<u>Revised eligibility criteria:</u>
A Bachelor's degree to include (Open School and Correspondence Degree) in Science / Engineering / Architecture / Planning / Economics / Mathematics / Statistics / Geology / Geography.

The admission process will be based on CUET PG scores in relevant subjects or aggregate marks obtained in the qualifying degree, followed by interaction/counselling.

The Academic Council noted the matter.

61.4.3 Visit of students to Linnaeus university

Following students of M.Tech (REEM) batch 2023-2025 had visited Linnaeus University, Sweden under student exchange programme and completed their major project/dissertation:

Mobility Period: February 2025 to June 2025
1.   Mr Siddhartha Kamal Kishore
2.   Ms Arya Pramod Bele
3.   Mr Prabuddh Vaidya

Following PhD Scholars have visited KTH Royal Institute of Technology, Linnaeus University and Lund University in Sweden under SEED (Doctoral School in Sustainable Energy Engineering) funded by Swedish Research Council:

Mobility period: August 2024 to December 2024
1.   Mr Souryadeep Basak
2.   Mr Divyansh Sharma
3.   Ms Tejasi Shah

The Academic Council noted the matter.

61.4.4 Erasmus+ International Mobility with University of Graz

Vide the agreement with University of Graz for international mobility of students and staff, Mr. Julius Ott from University of Graz visited TERI School of Advanced Studies for a week from 17 to 21 February 2025 and was actively involved in teaching processes in the Department of Policy and Management Studies. As part of student mobility Ms. Jayati Gupta, MSc (Economics) batch 2023-25 visited University of Graz for five months from 12 February 2025 to 11 July 2025.

The Academic Council noted the matter.

61.4.5 Award of Internal grants

Under the internal grant guidelines of TERI School of Advanced Studies following faculty and students were provided with the financial assistance:-

Faculty

Sr.No.	Name	Amount	Topic
1.	Dr Parul Behl	20,000	Participation in 7th International Conference on Information System and Management Science (ISMS-2024) to be held on 22-23 February 2025 at NIT Kurushetra, India.
2.	Dr Gaurika Chugh (PI) and Dr Kavita (Co-PI)	2 lakhs	Mapping the gaps: Socio-legal and economic barriers SVAMITVA's implementation in Dadri Tehsil of Gautam Buddha Nagar, Uttar Pradesh (seed grant)
3.	Dr Souren Paul	2 lakhs	Evaluation of the role of TREXT in activating CGAS-STING signalling in carbon-ion radiation and STING against treated triple negative breast cancer cells (seed grant)
4.	Dr Adwitiya Sinha	2 lakhs	Machine learning strategies for analysing and detecting misinformation propagation on social web (seed grant)

Student

Sr.No.	Name	Amount	Topic
1.	Ms Yashika Gupta, M.Sc Geoinformatics	10,000	Participation in the conference on Indian Cryopshere Meet 2025 at IIT Bombay, Mumbai during 14th-15th February 2025
2.	Ms Tejashi Shah, PhD Scholar	10,000	Participation in the International Conference on Circular Economy and Bio-economy (ICCEP-25), 26-27 March 2025 in Fukuoka, Japan
3.	Ms Khushboo Uppal, PhD Scholar	10,000	2nd Annual Five-Day Workshop on Open-Economy Macroeconomics in Emerging Market Economies (EMEs) at Madras Institute for Development Studies, Chennai from 18-20 June 2025

The Academic Council noted the matter.

61.4.6 MoU(s) concluded

(a) Between Institute of Bioresources and Sustainable Development (IBSD) and TERI School of Advanced Studies concluded on 15 January 2025.

Institute of Bioresources and Sustainable Development (IBSD) is an Autonomous Institute under Department of Biotechnology, Government of India, having its campus at Takyelpat, Imphal, Manipur. TERI School of Advanced Studies signed a MoU with IBSD on 15 January 2025. Areas of cooperation agreed were to undertake joint research and academic programs; organize joint seminars, colloquium and other academic and outreach programs; exchange of information, publications and materials for academic purposes; promotion of research activities in the common area(s) of interest; joint PhD supervision, apply for collaboration projects jointly to national and international funding agencies.

(b) Between University of Windsor, Canada and TERI School of Advanced Studies concluded on 11 February 2025.

The University of Windsor is a public research university in Windsor, Ontario, Canada. TERI School of Advanced Studies signed a MoU with University of Windsor on 11 February 2025. Areas of cooperation agreed were on exchange of scholars (professors, advanced graduate fellows, and/or researchers); promotion of joint research projects in the fields of interest; exchange of research materials and information; and promotion of Articulation programs.

(c) Between Concordia College, Minnesota and TERI School of Advanced Studies concluded on 12 February 2025.

TERI School of Advanced Studies signed a MoU with Concordia College, Minnesota on 11 February 2025. Areas of cooperation agreed were on reciprocal exchange of students, faculty and staff; Joint academic programs; Collaborative research projects; exchange of publications, reports and other academic information; collaborative professional faculty and staff development activities.

(d) Between OTH Regensburg, Germany and TERI School of Advanced Studies concluded on 24 June 2025.

TERI School of Advanced Studies signed a MoU with OTH Regensburg, Germany on 24 June 2025. Areas of cooperation agreed were on reciprocal exchange of students, educational and scientific cooperation and joint activities.

(e) Renewal of DSIR SIRO recognition

Department of Scientific and Industrial Research (DSIR) had accepted our application for renewal of recognition as a Scientific and Industrial Research Organisation (SIRO) for a further period of three years commencing from 01 April 2025 which would enable us to avail custom duty exemption on purchase of equipment, instruments, consumables, etc. for research purposes.

The Academic Council noted the matter.

61.4.7 Appointment of Hony. Distinguished Professor

Prof Rakesh Bhatnagar, National Science Chair, School of Biotechnology, Jawaharlal Nehru University was appointed as Hony. Distinguished Professor in the Department of Biotechnology on 22 October 2024 for the period of five years. (CV attached as **Enclosure 2**).

The Academic Council noted the matter.

61.4.8 Case of Student Grievance Redressal

Mr. Ayananshu Mohapatra, M.Sc. Economics had represented against mental harassment by barring him from submitting Masters' Thesis in the IV Semester to the VC, TERI School of Advanced Studies and also to Ombudsman, TERI School of Advanced Studies on 06 June 2025.

The representation was referred to the Students' Grievance Redressal Committee and the outcome of the same was informed to both Mr. Ayananshu Mohapatra and the ombudsman, The recommendation of the Students' Grievance Redressal Committee is as follows:

*Mr. Ayananshu Mohapatra should try to **complete MPE 176 and MPE 108** during the academic year 2025-2026. As per University regulations, students are permitted to complete their degree within **(N+2) years**, where N is the normal duration of the program.*

Prof. K K Aggarwal in his response sent to Mr. Ayananshu Mohapatra dated June 27, 2025 (as shared with TERI School of Advanced Studies) has mentioned that "***there is no violation by the University administration of the existing rules and regulations".***

Accordingly, Mr. Ayananshu Mohapatra was advised to follow the earlier decision of the University as communicated.

Further, as per University regulations, students are permitted to complete their degree within **(N+2) years**, where *N* is the normal duration of the program.

The Academic Council noted the matter.

61.4.9 To consider revision in the eligibility criteria for M.Sc. (Climate Science and Policy).

For

M.Sc. (Climate Science and Policy)
A Bachelor's degree to include (Open School and Correspondence Degree)in Science / Engineering / B.Arch / Mathematics / Statistics / DataScience / Geology / Geography / Economics / Energy /Commerce / Management / Computer or B.Voc. in relevant stream.

Read

M.Sc. (Climate Science and Policy)
A Bachelor's degree to include (Open School and Correspondence Degree)in Science / Engineering / B.Arch / Mathematics / Statistics / DataScience / Geology / Geography / Economics / Energy /Commerce / Management / Computer in relevant stream.

The agenda was circulated and approved by the members of the Academic Council on 17 June 2025.

61.4.10 To approve the proposal of starting B.Sc./ Integrated M.Sc. (Energy and Computer Applications) in the Department of Sustainable Engineering.

Department of Sustainable Engineering proposes to launch B.Sc./ Integrated M.Sc. (Energy and Computer Applications) from the Academic year 2025 – 26. The eligibility criteria for the program shall be as follows-

Senior Secondary School (10 + 2) Certificate to include (Open School and Correspondence) in science or equivalent, from a recognized Board of Education with at least 50% marks in aggregate (best of 3 subjects + English).

Admission will be based on aggregate marks obtained in the qualifying Senior Secondary School Certificate Examination, followed by interaction/counselling.

The agenda was circulated and approved by the members of the Academic Council on 17 June 2025.

The members of the Academic Council further deliberated and advised to go for MoU/ Agreement with industries to enable opportunities for internships, placements and structuring programmes as per latest academic and industrial norms. Mr Sudhir Vadehra proposed preparing a vision document in continuation to the existing keeping into consideration changes mandated by the NEP 2020 and the dynamics existing as of now.

It was proposed to commence B.Sc./ Integrated M.Sc. (Energy and Computer Applications) with a batch strength of 30 per year.

Agenda Items for Consideration

Item No. 61.5   Agenda items

61.5.1 **To consider and approve course content of semester 1 courses of Four-Year Undergraduate Program (FYUP)/Five-Year Integrated Post-Graduate Program (FYIPP) by the Department of Biotechnology in the Academic Year 2025-26.**

To consider and approve course content of semester 1 course of Four-Year Undergraduate Program (FYUP)/Five-Year Integrated Post-Graduate Program (FYIPP) by the Department of Biotechnology in the Academic Year 2025-26. Details are placed as **Enclosure 3.**

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

61.5.2 **To discuss and approve course outlines of the 3rd semester courses of M.Sc. (Energy Studies and management) offered by Department of Sustainable Engineering.**

The programme structure of 3rd semester courses of M.Sc. (Energy Studies and Management) consists of 2 core courses, 2 elective courses (to be selected from 3 elective courses) and 1 Minor Internship. The details are as shown below:

Existing Structure – 3rd semester 2 core + 2 elective + Minor Project			
Course No.	Course Title	Core/ Elective	Number of Credits
DSE XXX	Minor Internship (Summer)	Core	8

DSE XXX	Advancements in Energy Processes, Systems, Technologies and Applications	Core	3
DSE XXX	Energy Finance & Economics	Core	3
DSE XXX	Computing Tools and AI Applications in Energy Sector	Elective	3 (Elective)
DSE XXX	Climate Change and Energy Transition	Elective	3 (Elective)
DSE XXX	Elective(s) from other programmes at TERI School of Advanced Studies	Elective	3 (Elective)
	Total credits		20

The course outlines of five courses are placed as Enclosures:

Minor Internship (Summer)	-	**Enclosure 4**
Advancements in Energy Processes, Systems, Technologies and Applications	-	**Enclosure 5**
Energy Finance & Economics	-	**Enclosure 6**
Computing Tools and AI Applications in Energy Sector	-	**Enclosure 7**
Climate Change and Energy Transition	-	**Enclosure 8**

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

61.5.3 **To consider and approve programme outline and programme structure of B.Sc. (Energy and Computer Applications) offered by the Department of Sustainable Engineering**

Department of Sustainable Engineering has offered B.Sc. programme in the domain of Energy from the academic session 2025-26 titled B.Sc. (Energy and Computer Applications). The B.Sc. in Energy and Computer Applications shall offer promising career opportunities, as it combines two high-demand fields: energy and computer science. The proposed programme would have good market potential due to two main reasons - 1. Growing Demand for Renewable Energy: With global efforts toward sustainability, careers in solar, wind, and smart grid technologies are expanding and 2. Tech Integration in Energy: AI, IoT, and data analytics are revolutionizing energy management, creating demand for professionals with both energy and computing expertise.

The detailed justification, background, career prospects, USP, programme outline and programme structure as per guidelines of NEP 2020 is placed as **Enclosure 9**.

The Academic Council discussed, gave inputs and approved the agenda. Further, the Academic Council suggested the following:

The current set of courses in the Energy domain exhibit significant overlap and interlinkages. A structured process of review, discussion, and brainstorming is essential to streamline the curriculum. This will help align the programmes with current industry trends and market demands, thereby increasing their appeal to prospective students.

61.5.4 **To consider and approve outlines of two 1-credit elective courses as part of 2nd semester of M.Tech (Renewable Energy Engineering and Management) offered by the Department of Sustainable Engineering.**

The DoSE is mandated to design courses focused on BIPV (Building Integrated Photovoltaic) & Agri-PV (Agri-Photovoltaics) under GiZ sponsored projects taken up by Dr Sapan Thapar as lead. Based on learnings made during the training workshops, extensive literature review (including structure as shared by GiZ) and discussions with stakeholders; the course outlines for both the courses have been prepared. Looking at the prospects of these growing PV technologies, it was proposed to include the two courses as 1-credit elective courses as part of 2nd semester of M.Tech (Renewable Energy Engineering and Management) programme.

The detailed rationale along with the updated course outlines as per standard format is placed as **Enclosure 10**.

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

61.5.5 **To consider and approve a new course on 'Applied Machine Learning' for MSc students of Environmental Studies and Resource Management (ESRM) and Climate Science and Policy (CSP), offered by the Department of Natural and Applied Sciences**

The Department of Natural and Applied Sciences proposes to approve a new course on 'Applied Machine Learning' for MSc students of ESRM and CSP as placed in **Enclosure 11.**

The Academic Council deliberated the matter and were of the opinion that with "Applied Machine Learning" being the latest and a subject of relevance across all disciplines, TERI School of Advanced Studies should consider offering it for all the programmes at the University. The way ahead was proposed to prepare two courses as follows:-

> **(i)** **Foundational course in "Applied Machine Learning" (being a generalised course may be applicable to all interested students).**
> **(ii)** **Specific "Applied Machine Learning" to include specifics to a programme.**

The present proposed course on "Applied Machine Learning" be offered to the MSc students of Environmental Studies and Resource Management (ESRM) and Climate Science and Policy (CSP).

61.5.6 **To consider and approve the course framework for four years UG programme for Environmental Studies (ES), and UG programme for Data Science (DS) offered by the Department of Natural and Applied Sciences.**

The Department of Natural and Applied Sciences would like to approve the course framework for four years UG programme for Environmental Studies (ES), and UG programme for Data Science (DS) as placed in **Enclosure 12**.

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

61.5.7 **To consider and approve courses for the fifth semester of UG - DS**

programme and UG - ES programme offered by the Department of Natural and Applied Sciences

The Department of Natural and Applied Sciences would like to approve the following courses for the fifth semester of UG - DS programme and UG - ES programme as placed in **Enclosure 13.**

    (a) Introduction to Environmental and Resource Economics (ES)
    (b) Solid and Hazardous Waste Management (ES)
    (c) Water and Wastewater Treatment (ES)
    (d) Atmosphere and Ocean (ES)
    (e) Machine Learning and Applications (DS)
    (f) Software Engineering (DS)
    (g) Java Programming and Web Technologies (DS)
    (h) Guidelines for Minor Project work of B.Sc. Environmental Studies and B.Sc. Data Science

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

61.5.8 **To consider and approve the award of degree with Major and Minor disciplines for the undergraduate programmes by the Department of Natural and Applied Sciences**

The BoS members were apprised of the framework, rationale and credit requirements for the award of degree with Major and Minor disciplines for the undergraduate programmes in the Department of Natural and Applied Sciences. BoS approved the proposal and recommended its adoption (reference Curriculum and Credit Framework for Undergraduate Programmes, UGC, December, 2022).

The Academic Council approved the proposal of award of degree with major and minor disciplines for all the undergraduate programmes as per the curriculum and credit framework for undergraduate programmes, UGC December 2022 less BBA.

Further it was proposed that every department shall identify the courses which can be offered as minor to students of other departments along with pre-requisites for the complete duration of the programme.

61.5.9 **To consider and approve revised programme structure of the Economics 5-year integrated programme offered by Dept. of Policy and Management Studies**

To consider and approve revised programme structure of the Economics 5-year integrated programme offered by Dept. of Policy and Management Studies. Certain changes in the Four-Year Undergraduate programme are proposed to integrate it with the Five-Year programme. The details are placed as **Enclosure 14**.

The Academic Council deliberated in-depth the proposed changes offered by the Department of Policy and Management Studies in the undergraduate/integrated BSc/MSc (Economics). After detailed discussions and deliberations, the Academic Council approved the changes with offering of the degree after four years in alignment with the rules and regulations of UGC as follows:-

(i)   **BSc (Honours)**

(ii)   BSc (Honours with Research)

61.5.10 To consider and approve four courses for BSc Economics Programme offered by Dept. of Policy and Management Studies

To consider and approve following four courses for BSc Economics Programme offered by Dept. of Policy and Management Studies:

1. Game Theory
2. Growth Economics
3. Issues in Indian Economy
4. Econometrics 1

The details are placed as **Enclosure 15**.

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

61.5.11 To consider and approve change in the evaluation pattern of the MSc (Economics) Course on Development Economics offered by Dept. of Policy and Management Studies

To consider and approve change in the evaluation pattern of the MSc (Economics) Course on Development Economics offered by Dept. of Policy and Management Studies. Evaluation pattern of 'Development Economics' course is revised to keep the weightage of at least one of the evaluation components more than 30%. The revised course outline is placed as **Enclosure 16**.

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

61.5.12 To consider and approve addendum in the evaluation criteria for the Course MPE 176 offered by Dept. of Policy and Management Studies

To consider and approve addendum in the evaluation criteria for the Course MPE 176 (Methods of Research in Economics offered by Dept. of Policy and Management Studies. -   A line, as follows, has been incorporated in the Evaluation Criteria section of the course MPE 176 (Methods of Research Economics). It was earlier mentioned in the course content of MPE 108.

"A minimum grade of 'C' in absolute grade is required to qualify for the next semester and submit the masters' thesis"

The revised course outline is placed as **Enclosure 17**.

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

61.5.13 To consider and approve revised course credit structure of MBA Programme offered by Dept. of Policy and Management Studies

To consider and approve revised course credit structure of MBA Programme offered by Dept. of Policy and Management Studies. The credit structure of the following courses got revised:
1. Principles and Concepts of Sustainability
2. Business communication
3. Management concepts and Organizational Behavior
4. Business Mathematics & Statistics
5. Accounting for Managerial Decisions

6. Managerial Economics
7. Sustainability Reporting
8. Marketing Management
9. Corporate Governance and Business Ethics

The details are placed as **Enclosure 18**.

<u>Here is the proposed credit structure</u>

Sl. No.	Code	Course	Core	Credits	L-T-P		Credits	L-T-P
					Existing structure		**Proposed structure**	
1	PPM 130	Accounting for Managerial Decisions	Core	4	44-16-00		4	30-10-00
2	PPM 101	Business Communication	Core	3	45-00-00		3	30-00-00
3	MPP 164	Principles and Concepts of Sustainability	Core	3	31-14-00		3	20-10-00
4	PPM 196	Marketing Management	Core	3	35-08-04		4	40-00-00
5	PPM 118	Management Concepts and Organisational Behaviour	Core	3	35-08-04		4	40-00-00
6	PPM 148	Managerial Economics	Core	4	50-10-00		4	32-08-00
7	PPM 119	Business Mathematics and Statistics	Core	4	34-23-06		4	40-00-00
8	PPM 168	Sustainability Reporting	Core	2	20-10-00		3	20-10-00
9	PPM 201	Corporate Governance and Business Ethics	Core	3	36-6-6		4	31-6-6
			TOTAL	29		TOTAL	33	

The comparative structure is placed as **Enclosure 19**.

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

61.5.14 To consider and approve new courses for BBA Programme offered by Dept. of Policy and Management Studies

To consider and approve new courses for BBA Programme offered by Dept. of Policy and Management Studies as given below:

1. Strategic Management
2. ESG: Environmental, Social, and Governance in Business Strategy
3. Corporate Social Responsibility: Strategy, Implementation & Impact
4. Logistics and Supply Chain Management
5. Business Statistics & Logic
6. Indian Knowledge Systems
7. Guidelines for Summer Internship Project

The details are placed as **Enclosure 20**.

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

61.5.15 To consider and approve amendment to Evaluation and Examination policy

The present evaluation and examination policy was approved in the 48 Academic Council meeting held on 16 July 2020. (Agenda No. 8 to 48th Academic Council refers), wherein clarity on appearing for the terminal assessment is silent.

It is proposed to introduce the following:

If a student misses one or more minor test/assignment, then he/she may be allowed to appear for the same in consultation with the programme coordinator within that semester with proper justification. However, major examination is compulsory to attend, provided the student completes at least one minor test before the major exam.

In case of absence in all the minor/internal and also major/terminal of a

particular course the student shall be graded as absent (Ab.), and shall undergo repeat of that particular course in the semester as and when it is offered.

61.5.16 To consider and approve amendment to Grade improvement policy

The present grade improvement policy was approved in the 48 Academic Council meeting held on 16 July 2020 (Agenda No. 9 to 48th Academic Council refers).

For

The eligible students should have the opportunity to take improvement examination for at least one assessment of a significant weightage in every course. In general, this would be the terminal assessment of a course. However, the decision regarding the specific assessment(s) that are eligible for improvement examination lies with the course coordinator. The course coordinator may inform the students about the improvement examination options at the beginning of each semester.

Read

The eligible students should have the opportunity to take improvement examination for only one assessment of the highest weightage in every course (up to a maximum of two courses per semester). However, in case of ambiguity, the decision of the course coordinator shall be final.

The Academic Council discussed and approved the agenda.

61.5.17 Eligibility of students for admission from Open School and Correspondence Degree

Keeping in line with the NEP 2020 and GER, eligibility of students towards admission in programmes for both UG/PG shall also include students from Open School and Correspondence Degree except MTech (Renewable Energy Engineering Management) programme.

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

61.5.18 To consider and approve extension of enrollment date in PhD programme.

Mohammed Suleman, enrolled for PhD programme in January 2025 and paid registration fees for the same. However, since he could not get clearance from his organization he could not enroll for courses in time and has requested that he may be allowed to enroll for course commencing from August 2025 and his admission may be changed from full time to part time.

The Academic Council approved the agenda.

Item No.61.6 Any other item with the permission of the Chair.

61.6.1 To consider offering one year Masters' Program from the Academic year 2025 - 26

Keeping into consideration, NEP 2020 and offering of four-year UG programs, with students passing out with degree as B.Sc. (Hons / Hons with Research), it is proposed to commence offering Masters' as one year program in addition to the existing two years from the Academic year 2025 – 26.

After deliberation Academic Council members approved the agenda.

The members of the Academic Council were apprised of guidelines enumerated through the National Education Policy towards offering of one year Masters' Program considering the undergraduate programmes being now of four years. The Academic Council discussed the matter and to ensure that the academic rigour and continuity is maintained, proposed that the Masters' Program having continuity from the undergraduate programme offer one year Masters programmes in addition to the existing two year Masters' programme.

Two years Masters' programme not having their continuity from the undergraduate programmes to propose exit option after one year as per NEP 2020.

All departments were advised to ensure that in the next Academic Council meeting course curriculum, content, design of one year Masters' programme (and exit option after one year for two years programme as above) duly approved by the Board of Studies be put up for consideration with a view to offer the same from the next academic session.

61.6.2 To consider offering Tech programs with multidisciplinary courses across all departments.

Presently the university offers only one tech program and that too at Masters level through the Department of Sustainable Engineering. With a view to enhance the diversification and have a robust engineering / tech programs, it is proposed to offer the same across all departments wherever applicable.

The members of the Academic Council welcomed the proposal and advised all members present to identify certain existing programmes which can naturally be aligned to tech. programmes or launching of fresh tech. programmes through the department.

61.6.3 To consider inclusion of students in Statutory Bodies.

In the last cycle of NAAC accreditation, the university was graded (2.58/4) in the criteria 5, "Student Support and Progression". To enhance this grading and to ensure larger participation of students in governance structure of the university it is proposed that the Statutory Bodies like the Board of Studies and Academic Council may consider including student representatives particularly for curriculum design, internships amongst others. It has been recommended by IQAC also.

The members supported the inclusion of students participation in statutory bodies like the Board of Studies and Academic Council.

Swapan Sahoo
Principal Geologist
Equinor US

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Personal Statement

I am an exploration geoscientist with diverse geological systems and leadership capabilities. Integration and problem solving are a passion. My motivation is underpinned by a desire to continue to develop my technical and business skills to make the right decisions. In the world where 'net zero' and 'new energy demand' are important issues, I plan to continue to leverage my background in multi-disciplinary integrated geology and expand my experience by working on these questions to further strengthen my skills—both technically and intellectually.

Career History

Company: Equinor US
Dates: October, 2017 - Present

Position: Principal Geologist,
New Business Investments (NBI) in Technology, Digital and Innovation (TDI) (November, 2021—present).
- Subsurface Lead to Lithium and other mineral exploration. Understanding the source to sink—full value chain. Re-evaluating assets and also work closely with partners in the realm of energy transition.

Position: Principal Geologist, ***Secondment at KoBold Metals*** (June, 2020—November, 2021).
- Work closely with Sediment Hosted Copper Deposits in Zambia and other global basins. The focus is to find new deposits of copper (Cu), cobalt (Co) and nickel (Ni), metals used in electric car batteries—by collecting and analysing multiple streams of data. As an exploration geologist my main goal is to gain expertise in using artificial intelligence and machine learning to hunt for oil and gas.
- Workshops— Quarterly meetings to bring synergy in our core business and bridge the gap of knowledge between two energy companies.
- Equinor and KoBold needs—a key role to understand the needs for Kobold business and how Equinor can help as well as which part of KoBold business can help Equinor—business strategy, data engineering, enterprise usage, and many more.

Position: Principal Geologist, ***Petroleum Systems Analyst, Exploration Excellence*** (October, 2017—2022)
- Responsible individually, and working with others, for identifying and recommending progression of resources from access, through basin evaluation, prospect generation, and appraisal to development that adds value to Equinor.
- To address the above, review existing data and use Equinor best practices to assess resource volume uncertainty and estimate risk – w.r.t. hydrocarbon presence & type, reservoir temperature and quality.
- Document work as required by GCQ to support access, seismic, drilling and well data gathering recommendations, including sweet spots and CRS mapping, where appropriate.
- Grow capability by mentoring and network with petro-technical professionals and other disciplines to make consultation or provide support when necessary.

- Provide technical leadership in the Exploration Function for petroleum systems
- Support business decisions through assurance of sound technical descriptions.

Key Achievements:
- Delivered high quality PSA work/projects in US-GoM, Mexico, Angola & India.
- Exploring for Sweet Oil – Developed new methodology using bio-geo-chemistry and data analytics.
- Mentoring: mentored summer intern; – ad hoc technical discussions. Equinor fellow PhD advising.
- Liquinor (EIP and beyond) – Contributing to low-Carbon and renewable energy
- Mercury (Hg) risk and source in our value chain.
- Growing a sense of community within the Exploration Unconventional discipline – global communications, R&T and Asset conversation, connecting people.
- GeochemDB – Bring USA and Mexico legacy unstructured data to Equinor's common database.

Company: BP America INC
Dates: July, 2014 - October, 2017
Position: Geologist, Petroleum Systems Analyst – GoM Paleogene/Miocene Appraisal and Exploration
Job Accountabilities & Key Achievements:
Accountabilities:
- Provide technical products in the Exploration, Appraisal & OBO Function for petroleum systems
- Pre and post well analysis – Provide quality through choice, participate in partner meetings.
- Review existing data and use exploration common practise to assess resource volume uncertainty and estimate risk (trap, seal, hydrocarbon presence & type, reservoir presence, quality and deliverability).
- Regional Basin Modelling – module of Integrated Paleogene Reservoir Deliverability. Established technical understanding of regional sand presence, fluid quality and relationship between permeability and effective stress to position lease access decisions.
- Effectively worked in various dispersed team environments.
- Support business decisions through assurance of sound technical descriptions

Achievements:
- Paleogene k*h/mu - Fluids Quality and Reservoir Quality Model (High-grade Lease Sale)
- Bid Rounds – High-grade prospect inventory and charge access modules to provide quality choice
- Neogene (Mio-Plio) play in Secondary Basins – Basin models to identify and high-grade areas
- Hadrian-Lucius Play in Western GoM – Resource volume uncertainty and estimate risk.
- Great White Field Study – Led to understanding of filling history of a Giant Field and apply that to the Mexico waters and prospectively in W-GoM; AAPG 2017.
- Tigris Appraisal – Led to Guadalupe_3 Well and Overall Tigris business decision.
- Delivery of Petroleum Systems integrated products.

Company: UNLV
Dates: January, 2009 - May, 2014
Position: GeoSymposium Chair Coordinator, Lecturer (GIS)
Job Accountabilities & Key Achievements:
Academic Achievements:
- Late Devonian organofacies mapping and its palaeoceanography (Great Basin, USA).
- Pre-Cambrian black shale geochemistry (Nanhua Basin, South China)
- Mapping Mega-Sequences in the Otavi Platform, Namibia – Sequence Stratigraphy understanding

- Organofacies Mapping in the Cauvery Basin, India – Cenomanian-Turonian interval potential.

Personal Achievements:
- Grow capability by coaching, mentoring, and teaching – Coach and mentor junior students.
- Arc GIS and Remote Sensing Lecturer – Take professional level classes and laboratory for wide group of diverse discipline students.
- GeoSymposium Chair-Coordinator – Leadership role to organize and execute professional conference.

Professional Service
Associate Editor
- Marine and Petroleum Geology

Research Associate
- Bureau of Economic Geology, Jackson School of Geosciences, University of Texas, Austin.

Scientific Journal Reviewer
- Nature Communications
- Nature Geoscience
- Geology
- Geochimica et Cosmochimica Acta
- Precambrian Research
- Geobiology
- GSA Bulletin
- Marine and Petroleum Geology
- Journal of Earth Science
- AAPG Bulletin
- Journal of Petroleum Science and Engineering

Conference Session Chair/Convenor
- Goldschmidt Meeting, 2024 (14bO2: The importance of industry-academic alliances for geochemistry)
- Goldschmidt Meeting, 2024 (7cO2: Coevolution of life, climate, and environment from the Archean to Phanerozoic)
- EAGE, 2024 (DS-18: Critical Minerals and Rare Earth Elements in Focus: Geoscientists at the Helm of the Energy Transition)
- GEOGULF, 2024: Critical metals (and Lithium) exploration value chain.
- Goldschmidt Meeting, 2023 (07f: Critical raw materials for the renewable energy revolution)
- Goldschmidt Meeting, 2022 (S in our value chain, form biogeochemistry to industry safety)
- GEOGULF 2021: Theme Chair: Critical Metals
- AAPG ACE, 2020: Theme Committee: Geochemistry, Basin Modelling and Petroleum Systems
- Goldschmidt Meeting, 2017 (03I: The not so boring billion–emerging insight into life and the earth system in the Mesoproterozoic)

Doctoral Committee Member

- Bhattacharya, S., (PhD; expected, Nov, 2024). Geochemical Phase Associations of Rare Earth Elements and Lithium in Black Shales of the USA: A study in the Appalachian and Haynesville basins.
- Li, S., (MSc; expected, 2023). Li concentration across the brine-rock interaction in the Bakken Formation
- Gomez, K., (PhD; Graduated, 20202). Jurassic Redox evolution of the Viking Seaway, North Sea.
- Paez-Reyes, M., (PhD; Graduated, 2020). A Biogeochemical Tour of the Cenomanian Turonian OAE2 in Colombia: Reconstructing Paleo-Redox Dynamics Surrounding the OAE2.

Professional Affiliations

- American Association of Petroleum Geologist (AAPG)
- American Geophysical Union (AGU)
- Geological Society of America (GSA)
- Geochemical Society (GS, EAGE)
- Houston Geological Society (HGS)
- Geological Society of Nevada, Southern Chapter (President: 2009-10)

University Education

University: University of Nevada, Las Vegas

Dates: January, 2009 - May, 2014

Degree Category: Doctorate

Degree Title: Ediacaran Ocean Redox Evolution

- Stable Isotopes and Trace Metal geochemistry; Ocean Redox and Paleogeographic reconstruction.
- Sequence stratigraphic modelling and stratigraphic correlations (acquisition, analysis and interpretation).
- Extensive field work experience, structural and geological mapping of carbonates and siliciclastic.

University: Tulane University

Dates: August, 2004 - May, 2006

Degree Category: Masters in Tectonics and Sedimentation

University: University of Calcutta

Dates: September, 2001 - August, 2003

Degree Category: Structural Geology; Masters.

- Structural Geology, Tectonics and Micro-structural Analysis of Archean shear zones (India).

Dates: September, 1998 - August, 2001

Degree Category: Structural Geology; Bachelors.

Notable Publications

Peer Reviewed Papers

denotes corresponding author

Sahoo, S. K. *, Gilleaudeau, G. J., Wilson, K., Hart, B., Faison, T., Davis, B., Bowman, A., Larsen, T., Kaufman, A. J., **2023**, Basin-scale reconstruction of euxinia and Late Devonian mass extinctions, *Nature* 615, p. 640–645.

Zheng, W., Zhou, A., **Sahoo, S. K. ***, Nolan, M. R., Ostrander, C. M., Sun, R., Anbar, A. D., Xiao, S., Chen, J., 2023, Recurrent photic zone euxinia limited ocean oxygenation and animal evolution during the Ediacaran, *Nature Communications*, 14, 3920.

Gomez, K. J., **Sahoo, S. K.***, Panteli, E., Moscardelli, L., Anthonissen, E., Larson, T. E., Howie, A., Rush, W. D., **2023**, Partial paleobathymetric restriction from the local North Sea Dome in the Viking Corridor during the Early-Middle Jurassic, **Global Planetary Changes**, v. 230, 104255.

Zheng, W., Gilleaudeau, G. J., Algeo, T. J., Zhao, Y., Song, Y., Zhang, Y., **Sahoo, S. K.,** Anbar, A. D., Carmichael, S. K., Xie, S., Liu, C-Q., Chen, J., **2023**, Mercury isotope evidence for recurrent photic-zone euxinia triggered by enhanced terrestrial nutrient inputs during the Late Devonian mass extinction, *Earth and Planetary Science Letters*, v. 613, 118175.

Vimpere, L., Spangenberg, J. E., Roige, M., Adatte, T., Kaenel, E. D., Fildani, A., Clark, J., **Sahoo, S. K.**, Bowman, A., Sternai, P., Castelltort, S., **2023**. Carbon isotope and biostratigraphic evidence for an expanded Paleocene–Eocene Thermal Maximum sedimentary record in the deep Gulf of Mexico, *Geology*, v. 51 (4), 334-339.

Xu, D., Wang, X., Zhu, J-M., Jiang, G., Shi, X., Wang, X., **Sahoo, S. K., 2022**, Chromium isotope evidence for oxygenation events in the Ediacaran ocean, *Geochimica et Cosmochimica Acta*, v. 323, p. 258-275.

Ferrell et al., **2021**, The Sedimentary Geochemistry and Paleoenvironments Project, *Geobiology*, p. 1-12

Paez-Reyes, M., Carvajal-Ortiz, H., **Sahoo, S. K.,** Varol, O., Miller, B. V., Hughes, G. W., Gaona-Narvaez, T., German, D. P., Curtis, J. H., Lerma, I., Copeland, P., **2021**, Assessing the contribution of the La Luna Sea to the global sink of organic carbon during the Cenomanian-Turonian Oceanic Anoxic Event 2 (OAE2): *Global and Planetary Change*, v. 199, 103424.

Ostrander, C. M., Owens, J. D., Nielsen, S. G., Lyons, T. W., Shu, Y., Chen, X., Sperling, E. A., Jiang, G., Johnston, D.T., **Sahoo, S. K., 2020**, Thallium isotope ratios in shales from South China and northwestern Canada suggest widespread O2 accumulation in marine bottom waters was an uncommon occurrence during the Ediacaran Period: *Chemical Geology*, v. 557, 119856.

Gilleaudeau, G. J., **Sahoo, S. K. ***, Ostrander, C. M., Owens, J. D., Poulton, S. W., Lyons, T. W., Anbar, A. D., **2020**, Molybdenum isotope and trace metal signals in an iron-rich Mesoproterozoic ocean: a snapshot from the Vindhyan Basin, India: *Precambrian Research*, v. 343, 105718.

Ostrander, C. M., **Sahoo, S. K.**, Kendall, B., Jiang, G., Planavsky, N. J., Lyons, T. W., Nielsen, S.G., Owens, J. D., Gordon, G. W., Romaniello, S.J., and Anbar, A. D., 2019, Multiple negative molybdenum isotope excursions in the Doushantuo Formation (South China) fingerprint complex redox-related processes in the Ediacaran Nanhua Basin: *Geochimica et Cosmochimica Acta*, v. 261, p. 191-209.

Gilleaudeau, G.J., **Sahoo, S. K. ***, Kah, L.C., Henderson, M.A., and Kaufman, A.J., 2018, Proterozoic carbonates of the Vindhyan Basin, India: Chemostratigraphy and diagenesis: *Gondwana Research*, v. 57, p. 10-25.

Sahoo, S. K. *, **D**zou, L., Hospedales, A., Afifi, A., Becker, L., Lapinski, T., Dailey, D., Steinhoff, D., Jia, T., Ritter, G., 2016, Plumbing a Giant Filed: Great White Filed–An integrated approach to better understand the Paleogene charge access: *Subsurface, BP INC.*

Becker, L., Afifi, A., Dailey, D., Hospedales, A., **Sahoo, S. K.**, Steuer, M., Moreno-Vega, M., O'Leary, J., Krueger, S., 2016, Finding the next giant field and avoiding the next dry hole through deeper sub-regional understanding of the Perdido Fold Belt: *Subsurface, BP INC.*

Sahoo, S. K., Planavsky, N. J., Jiang, G., Kendall, B., Owens, J. D., Wang, X., Shi, X., Anbar, A. D., and Lyons, T. W., 2016, Oceanic oxygenation events in the anoxic Ediacaran ocean: *Geobiology*, v. 14, p. 457-468.

Sahoo, S. K., Planavsky, N. J., Kendall, B., Wang, X., Shi, X., Scott, C., Anbar, A. D., Lyons, T. W., and Jiang, G., 2012, Ocean oxygenation in the wake of the Marinoan glaciation: *Nature*, v. 489, p. 546-549.

Conference Papers and Presentations*

*Sahoo, S. K., Mehra, A., **2024, Invited speaker,** Testing geochemical proxy development from fundamental sedimentology 101, *Goldschmidt Conference*

*Sahoo, S. K., 2024, Bridging the gap between academia and industry for the next set of challenges in energy transition, *Goldschmidt Conference*

K. J. Gomez., **S. K., 2024,** Bridging Silos: The Power of Collaborative Partnerships in Geoscience Research, *Goldschmidt Conference*

Mehra, A., **Sahoo, S. K., 2024**, A joint academic and industry effort to produce paleoenvironmental insights, *Goldschmidt Conference*

*Sahoo, S. K., 2024, The Role of Black Shales in the Energy Transition, *EAGE Annual*

K. J. Gomez., **S. K., 2024,** Early-Middle Jurassic: an Eventful Period that could Shape the Next Exploration Strategies in the North Sea, *EAGE Annual*

Zumberge, A., Spence, G., **Sahoo, S. K., 2024**, The history and future of critical metals: Knowledge integration and future business direction, *GEOGULF*

Aragon, A., Gilleaudeau, G. J., **Sahoo, S. K.,** Kaufman, A. J., 2023, A New Carbon Isotope Record Through the Lower Mississippian K/O Event or TICE Event from the Williston Basin, North Dakota, USA, *AGU Fall Meeting*

*Sahoo, S. K., 2023, Invited Keynote, Williston Basin: Bridging the gap between academia and industry, for the next set of challenges in energy transition, *AAPG RMS Annual Meeting.*

Henderson, K. M., Williams-Jones, A. E., **Sahoo, S. K., 2023**, A possible role for detrital silicates in generating Li-enriched oilfield brines: a case study from the Bakken Formation, Williston Basin, North Dakota, *AAPG RMS Annual Meeting.*

Mishra, P., **Sahoo, S. K., 2023**, High productivity prior to the Great Oxidation Event: Insights from Archean and Paleoproterozoic Banded Iron Formations of India, *Goldschmidt Conference*

*Sahoo, S. K., Gilleaudeau, G. J., Kaufman, A. J., **2023**, Eustacy, euxinia and extinction during the Devonian-Carboniferous transition, *Goldschmidt Conference*

Ghosh, P., Ghosh, R., **Sahoo, S. K.,** Gilleaudeau, G. J., **2022**, New constraints on Late Mesoproterozoic Sea surface temperatures from Clumped Isotope Thermometry of the Lakheri Limestone, Vindhyan Basin, India, *Goldschmidt Conference*

Randolph, R., Geoffrey, G. J., Mariano, M., **Sahoo, S. K.**, Algeo, T. J., **2022**, Redox Gradients recorded in lower Mississippian black shales of the Appalachian and Williston basins, north America: a test case for uranium isotope behaviour, *GSA North-Central South-eastern section meeting*.

*Sahoo, S. K., 2022, History and Future of Metals in Shales: A Knowledge Integration and Inspiration towards the next Generation of Geologist, *FORCE Conference*, Stavanger.

Henderson, K. M., Williams-Jones, A. E., Li, S., **Sahoo, S. K.**, **2021**, Lithium-enrichment in oilfield brines, *GEOGULF*, Austin, TX, USA.

Gomez, K. J., **Sahoo, S. K.,** Panteli, E., Moscardelli, L., Howie, A., Larson, T. E., Kerans, C., **2021**, Assessing the Impact of Local Versus Global Volcanic Events on Redox Conditions Within the Viking Corridor, North Sea Basin During Early to Middle Jurassic, *AGU Fall Meeting*

*Sahoo, S. K., Gilleaudeau, G. J., Kaufman, A. J., **2021**, Eustasy, euxinia, and extinction: Global reorganization across the Devonian-Carboniferous transition, *GSA Annual Meeting*.

Gomez, K. J., **Sahoo, S. K.,** Panteli, E., Moscardelli, L., Howie, A., Larson, T. E., Kerans, C., **2021**, Early to Middle Jurassic redox evolution across the Norwegian Continental Shelf: a case study in the Viking Corridor, North Sea Basin, *Goldschmidt Conference*

Gomez, K. J., **Sahoo, S. K.,** Panteli, E., Moscardelli, L., Howie, A., Larson, T. E., Kerans, C., **2021**, Evolution of early to middle Jurassic redox conditions within the Viking corridor, North Sea Basin, *GSA Annual Meeting*.

Zhou, A., Nolan, M., **Sahoo, S. K.,** Ostrander, C. M., Anbar, A. D., Jones, D., Xiao, S., Chen, J., Zheng, W., **2021**, Recurrent photic zone euxinia in Ediacaran South China Basin revealed by mercury enrichment and isotope compositions, *Goldschmidt Conference.*

Gilleaudeau, G. J., **Sahoo, S. K.**, Ostrander, C. M., Owens, J. D., Poulton, S. W., Lyons, T. W., Anbar, A. D., **2019**, Molybdenum isotope and trace metal signals in an iron-rich Mesoproterozoic ocean: a snapshot from the Vindhyan Basin, India, *GSA Annual Meeting*

Ostrander, C.M., **Sahoo, S.K.**, Kendall, B., Jiang, G., Planavsky, N.J., Lyons, T.W., Nielsen, S.G., Owens, J.D., Romaniello, S.J., Anbar, A.D., **2019**, Multiple negative molybdenum isotope excursions in the Doushantuo Formation (South China) fingerprint complex redox-related processes in the Ediacaran Nanhua Basin, *GSA Annual Meeting*.

Paez-Reyes, M., Owens, J. D., Carvajal, H., Gaona, T., Lerma, I., Brandon, A., **Sahoo, S. K.**, & Copelandard, P., **2019**, Why was there no mass extinction during the Cenomanian-Turonian Oceanic Anoxic Event 2? *Goldschmidt Conference.*

*Sahoo, S.K., Hlava, K., Hart., B., **2019**, Trace Metal Variability in the Lower Bakken Formation — Implications for Late Devonian Global Ocean Redox, *AAPG Annual Convention & Exhibition.*

Jingqian Kang, J., Heyn, T., Evenick, J., **Sahoo, S.K.**, Pfau, G., Ritter, G., Schupack, B., **2018**, Observations and Interpretation of the Salt Keel Features in U.S. Gulf of Mexico, Keathley Canyon Protraction Area and 2-D Restoration of a Cross-Section, *AAPG Annual Convention & Exhibition.*

Slotnick, B.S., Chetel, L., **Sahoo, S. K.**, Veale, C., Francis, L., Volk, H., Paulson, S., and Doebbert, A., **2018**, Relating Chemical Speciation of Pore Fluids to Initial Seawater Chemistry and to Diagenetic Reaction Pathways: SrRSA Data Compilation, Gulf of Mexico, USA, *AAPG Annual Convention & Exhibition.*

*Sahoo, S. K., Dzou, L., Hospedales, A., Jin, H., Afifi, A., Becker, L., Lapinski, T., Dailey, D., Steinhoff, D., Jia, T., Ritter, G., Pfau, G., **2017**, Unravelling Complex Petroleum Filling History of Great White Field by 4D Integrated Petroleum Systems Approach: *AAPG Annual Convention & Exhibition.*

*Sahoo, S. K., Jin, H., **2017**, How Reducing was the Late Devonian Ocean? The Role of Extensive Expansion of Anoxia in Marine Biogeochemical Cycles of Redox Sensitive Metals, *AGU Fall Meeting, Abstract #PP41B-1308.*

Ostrander, C. M., Nielsen, S., Owens, J. D., Jiang, G., Planavsky, N.J, **Sahoo, S. K.**, Zhang, F., Lyons, T. W., and Anbar, A. D., **2017**, Thallium isotopes track fluctuations in global manganese oxide burial during the Ediacaran Period, *AGU Fall Meeting, Abstracts #PP41B-1305.*

Gilleaudeau, G. J., Kaufman, A. J., Luo, G.; Romaniello, S. J., Zhang, F., Kah, L. C., Azmy, K., Bartley, J. K., **Sahoo, S. K.**, Knoll, A. H., and Anbar, A. D., **2017**, Constraining the redox landscape of the mid-Proterozoic oceans: new insights from the carbonate uranium isotope record, *AGU Fall Meeting, Abstract #PP43E-07.*

*Sahoo, S. K., Gilleaudeau, G., Owens, J., Poulton, S., and Lyons, T., **2017**, Iron-Rich Conditions and Molybdenum Enrichment in a Mesoproterozoic Shelf Setting: A Snapshot from the VindhyanBasin, India, *Goldschmidt Conference.*

Gilleaudeau, G., Frei, R., Kaufman, A., Luo, G., Romaniello, S., Zhang, F., Klaebe, R., **Sahoo, S. K.**, Kah, L., Azmy, K., Bartley, J., Chernyavskiy, P., Knoll, A., & Anbar, A., **2017**, Deciphering the Carbonate Record of Mesoproterozoic Biospheric Oxygenation: Insights from Chromium and Uranium Isotopes, *Goldschmidt Conference.*

Maharjan, D. K., Jiang, G., Peng, Y., **Sahoo, S. K.**, Henry, R. A., **2014**, Coupling Organic Carbon and Nitrogen Isotope with Carbonate Carbon Isotope Excursion Across the Early Mississippian Kinderhookian-Osagean Boundary in Great Basin, Western USA: *AGU Fall Meeting, Abstract #PP41A-1337.*

Gilleaudeau, G. J., **Sahoo, S. K.**, Kah, L. C., Henderson, M. A., Frei, R., Kaufman, A. J., **2014**, Integrated chemostratigraphy of upper Vindhyan sequence carbonates, central India: implications for depositional age and global correlations: GSA Annual Meeting in Vancouver, British Columbia.

*Sahoo, S. K., Jiang, G., Planavsky, N. J., Kendall, B., Owens, J. D., Anbar, A. D., Lyons, T. W., **2013**, Turbulent times for early animals?: *GSA Abstracts with Programs, Vol. 45, No. 7, p. 754.*

Ventralli, A. M., **Sahoo, S. K.**, Jiang, G., **2013**, Coupling of the global carbon cycle and sea-level change during the early Mississippian: *GSA Abstracts with Programs, Vol. 45, No. 7, p. 243.*
Lyons, T., Anbar, A., Chu, X., Gordan, G., Jiang, G., Kendall, B., Planavsky, N., Reinhard, C., **Sahoo, S. K.**, Scott, C., **2012**, New geochemical perspectives on oxygenation of the Late Proterozoic ocean. In The Neoproterozoic Era: Evolution, Glaciation, Oxygenation, page 13. *Geological Society of London.*

*Sahoo, S. K., Planavsky, N. J., Kendall, B., Wang, X., Shi, X., Anbar, A. D., Lyons, T. W., Jiang, G., **2012**, Ocean redox changes in the wake of the Marinoan glaciation, Goldschmidt Conference.

*Sahoo, S. K., Jiang, G., Kendall, B., Planavsky, N. J., Wang, X., Shi, X., Anbar, A. D., and Lyons, T. W., **2011**, An oxygen window for early Ediacaran animal life, Goldschmidt Conference.

*Sahoo, S. K., **2010**, Geospatial integration of hazards, infrastructure and resources in an assessment of potential disasters and effects of climate change in Clark County, Nevada, USGS Mohave Climate Change Meeting, Las Vegas.

*Sahoo, S. K., **2007**, Tectonic Horst: Field evidence from the South Purulia Shear Zone, India, GSA Abstracts with Programs, Vol. 39, No. 6, p. 231.

Symposium Abstracts and Presentations*
- Exploring for Sweet Oil: Revisiting trace metals in organic rich source rocks, 2020, GeoSeminar Equinor.
- Collaboration within Equinor: Exploring new ideas to improve our understanding of unconventional resources, 2019, North America Summit, Equinor.
- Metals, Nutrients, Life and the Evolution of Ediacaran Oxygen Cycle, 2013, GeoSymposium, UNLV.
- Deconstruction of the Proterozoic Vindhyan Basin, 2012, Geobiology Conference, Riverside, California.
- Phosphorite Deposits at the Dawn of Animal Life, 2010, GeoSymposium, UNLV, Las Vegas, Nevada.
- Is The 1.8 Ga Kajrahat Limestone in the Vindhyan Basin of central India recording a glacial event during the Paleoproterozoic super-greenhouse time-period? 2009, GeoSymposium, UNLV.

Invited Presentation
- Black Shales – Oils, Metals, and O_2 over Earth's history, 2020, Jackson School of Geo. UT Austin.
- Metal History through Earth's History, 2013, Geological Society of Nevada
- Extreme Climate Change Linked to Early Animal Evolution, 2012, Delhi University, New Delhi, India.
- Ocean Redox Changes in the Wake of the Marinoan Glaciation, 2012, GPSA Brown Bag Series, UNLV

Field Work Experiences

Over two years (if continuously counted) of field work experience in 8 Basins over 4 countries.

- Great Basin, Nevada and Utah, USA – Mississippian Carbonates and Shales (2009 – 2012, 2013)
- Vindhyan Basin, India – Proterozoic aged Carbonates (2012, 2014, 2022)
- Nanhua Basin, China – Ediacaran aged Carbonates and Black Shales (2009)
- Krol Formation, Himalayas, India – Early Ediacaran Shales (2009)
- Otavi Platform, Namibia – Sequence Stratigraphy of Neoproterozoic aged interglacial carbonates (2007)
- Western Interior Seaway, Western USA – Sequence Stratigraphic Architecture of the Cretaceous (2007)
- Cauvery Basin, India – Coring of Cenomanian-Turonian aged Black Shales (2006)
- Vindhyan Basin, India – Paleo-Proterozoic and Mesoproterozoic Carbonates and Black Shales (2006)
- Basin and Range, Oregon, USA – Fault Asymmetry Mapping using GPS and Satellite Image (2005)
- Pearl River, Mississippi, USA – Flood Plain Sedimentation Rate and Morphology (2005)
- Mississippi Delta, Louisiana, USA – Sediment flow rate using Multi-beam (2005)
- Shingbhum Craton, India – Shear Zone mapping of the Achaean Green Stone Belt (2001 – 2003)
- Aravalli Schist Belt, India – Mapping and analyzing Tectono-Sedimentary Architecture (2001)
- Shingbhum Craton, India –Mapping projects using remote sensing and GIS techniques (2002)

Teaching

- Sedimentology and Stratigraphy (University of Nevada): Guest lectures, labs, and field trips
- Earth's Systems (University of Nevada): Guest lectures, labs, and field trips
- Structural Geology (Tulane University): Labs and Field Trips

Outreach

- High School Judge for Science Projects
- High School Career Fair – Opening the world of Geoscience to young scientists.
- Science Outreach Volunteer – NSF Work Session, Nevada Chapter

Grants and Awards:

Graduate Student Research Grants: >$25,000

- Geological Society of America, 2013 (Outstanding Mention)
- Sigma Xi, Grants-in-Aid of Research, 2013
- Society for Sedimentary Geology, 2013

Student Awards

- Academic Achievement Award, 2013
- GPSA Research Forum, Outstanding Presentation, 2013
- Goldschmidt Conference, Travel Grant, 2012
- Graduate Student Professional Association Research Funding, 2011, 2012, 2013
- UNLV Access Grant
- Edwards & Olswang Fellowship
- Bernada E. French Scholarship in Geology, 2009 – 2012
- International Programs Student Grant, 2011, 2012
- Lawrence L. Sloss Summer Research Award, Northwestern University, 2006 – 2008
- N.N. Chatterjee Memorial Book Grant: Geological, Mining and Metallurgical Society of India, 2002
- National Scholarship, Geological Mining and Metallurgical Society of India, 2001 – 2002

Prof. Rakesh Bhatnagar
FNA, FASc, FNASc, JC Bose National Fellow
National Science Chair
School of Biotechnology, Jawaharlal Nehru University
Former Vice Chancellor, Banaras Hindu University, Varanasi
Former Vice-Chancellor, Kumaun University, Nainital
Former Vice-Chancellor, Amity University Rajasthan, Jaipur
Former Dean, School of Biotechnology, JNU, New Delhi
Former Director, AIRF, JNU, New Delhi
Former Director, Academic Staff College, JNU, New Delhi
Email: Rakeshbhatnagar@jnu.ac.in ; Nationalsciencechair@jnu.ac.in
Prof.Rakeshbhatnagar@gmail.com

Qualification

Ph.D. from National Sugar Institute, Kanpur

Areas of Interest:

Molecular Biology of Infectious Diseases Recombinant Vaccine Development Humanized Therapeutic Antibodies

Specialization:

Biotechnology, Vaccinology, Infectious Diseases

Awards and Fellowships:

SI.	Name of Award / Fellowship etc.	Awarded by	Year of Award
1.	National Science Chair	SERB, Department of Science & Technology, Ministry of Science & Technology, GoI	2022
2.	President's Award for Innovation	President of India	2016
3.	Fellow, Indian National Science Academy, New Delhi,	Indian National Science Academy, New Delhi	2015
4.	J C Bose National Fellow	Department of Science and Technology, Government of India	2015
5.	Fellow, Indian Academy Science, Bangalore	Indian Academy of Science, Bangalore	2010
6.	Ranked 7th among the top ten eminent researchers publishing commendable research papers on anthrax	Open source Global Anthrax Research Literature	2006

7.	Fellow, National Academy of Science, Allahabad	National Academy of Science, Allahabad	2005
8.	ICMR Award for outstanding research work in the field of Immunology	Indian Council of Medical Research	2003
9.	Delivered Press Conference with Prof. Murli Manohar Joshi, Minister of Science and Technology, Government of India to announce development of Vaccine against Anthrax	Ministry of Science and Technology, Government of India	2001
10.	Announced the development of Vaccine against Anthrax in "Meet the Press" program	American Society of Cell Biology, Washington DC	2001
11.	All India Biotech Association Award	All India Biotech Association	2001

Best five peer reviewed publications

1. **Sharma, S., Bahl, V., Srivastava, G., Shamim, R., Bhatnagar, R. and Gaur, D. (2023) Recombinant Full-Length *Bacillus Anthracis* Protective Antigen and Its 63kDa Form Elicits Protective Response in Formulation with Addavax *Frontiers in immunology.* DOI 10.3389/fimmu.2022.1075662**

2. **Joshi, H., Kandari , D. and Bhatnagar, R. (2022).** Biosensors for the detection of *Mycobacterium tuberculosis***: A comprehensive overview.** *Critical Reviews in Microbiology,* **23:1-29**.

3. **Kandari, D. and Bhatnagar, R. (2021). Antibody engineering and its therapeutic applications.** *International Review of Immunology,* **6:1-28.**

4. **Sanduja, P., Gupta, M., Somani, V., Dua, M., Hanski, E., Sharma, A., Bhatnagar, R. and Johri, A. (2020). Cross-serotype protection against group A Streptococcal infections induced by immunization with SPy_2191.** *Nature Communications.* **11 :3545-3556.**

5. **Majumder, S., Das, S., Somani, V., Makam, S.S., Kingston, J.J. and Bhatnagar, R.(2019). A bivalent protein r-PAbxpB comprising PA domain IV and exosporium protein BxpB confers protection against** *B. anthracis* **spores and toxin** *Front. Immunol.* **10:498-509.**

Course title: Origin and diversity of life			
Course code: BBP ---	**No. of credits:** 2	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): Class 12 or equivalent in Science			
Department: Department of Biotechnology			
Course coordinator: Prof. Shashi Bhushan Tripathi	**Course instructor:**		
Contact details:			
Course type: Major	**Course offered in:** Semester 1		
Course description: The course intends to provide the students with a broad understanding of different life forms, similarity and variations among and between different taxa of plants (non-flowering and flowering) and animals (both invertebrates and vertebrates). It introduces students to the concept of classification and the utility of morphological, biochemical, anatomical and functional diversity in classification of major groups of living organisms. Further, it provides the students with the concept of molecular basis of evolution as to how different group of organisms arose, and how the DNA sequence information helps in understanding the interrelatedness of different taxonomic groups.			
Course objectives: 1. To provide a broad understanding of diversity of life from microorganisms and fungi to plants and animals 2. To familiarize the students to key concepts of evolution, speciation and extinction 3. To familiarize the student to applications of DNA sequence data for identification and classification of organisms			

Course contents

Module	Topic	L	T	P
1	• Origin of life • Principles of taxonomy, major criteria used for classification of different life forms • Broad classification of plants, animals and microorganisms • Morphology and characteristics of major phyla • Concepts of species and hierarchical taxa, binomial nomenclature	10		
2	• Diversity in life cycles of different organisms • Alternation of generations • Diversity at subcellular level • Unicellular, colonial and multicellular forms of organisms • Levels of structural organization; Organization of tissues, organs & systems in multicellular organisms	12		
3	• Evolutionary relationships among organisms • Genome diversity at different taxonomic levels • Molecular taxonomy, DNA barcoding	8		

	Total	30	0	0

Evaluation criteria:
1. Minor test: Mid-semester (40%)
2. Major exam: End-Semester (60%)

Learning outcomes:
1. Understand the principles of classification of organisms (Minor test)
2. Understand the biological concept of species (Minor test)
3. Morphological diversity in microbes, plants and animals (Minor test)
4. Understand the diversity at subcellular, tissue, organ and system levels in plants and animals (Major exam)
5. Understand the utility of molecular (DNA and protein) data in studying evolutionary relationships among different taxa (Major exam)

Pedagogical Approach:
1. Online/classroom lectures and discussions
2. Case studies and examples from original research articles
3. Visit to Aravali Biodiversity Park

Skill Set:
1. Next generation sequencing platforms
2. Germplasm characterisation using principles of population genetics
3. 16S RNA sequencing and metagenomics analysis

Employability:
1. Forestry and wildlife research institutions involved in conservation
2. Research organisations engaged in germplasm management

Materials:

Suggested Readings
1. Campbell Biology: Australian and New Zealand edition, Reece J.B. and others, Pearson 12th ed. 2021
2. National Academy of Sciences. 1999. Science and Creationism: A View from the National Academy of Sciences, Second Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/6024.

Additional information (if any):

Student responsibilities:
1. Class attendance.
2. Study of reading materials as specified by course instructor
3. Self-study

Course reviewers:
1. Dr. Santan Barthwal, Scientist-G & Head, Genetics & Tree Improvement Division, Forest Research Institute, Dehradun
2. Dr. Rupesh Deshmukh, Professor & Head, Department of Biotechnology, Central University of Haryana, Mahendergarh, Haryana

Course title: Biological Chemistry			
Course code: XXXX	**No. of credits: 4**	**L-T-P: 60-0-0**	**Learning hours: 60**

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

Department: Department of Biotechnology

Course coordinator: Dr. Chaithanya Madhurantakam	**Course instructor**

Contact details: chaithanya.madhurantakam@terisas.ac.in

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

Course description:
The course aims to provide students with basic concepts and to introduce them to the molecular study of interactions observed among biological macromolecules. The knowledge of biochemistry is a necessity for the students to understand the complex molecular functions of living systems. This course will provide a detailed information on the chemical nature of all biological macromolecules, which further leads onto the study of metabolic pathways and signaling mechanisms. Further, this course will deal with the bioenergetics of major pathways.

Course objectives:
1. To familiarize students with solution chemistry.
2. To acquaint students with basic concepts on structure and function of macromolecules
3. To introduce students to enzyme technology, with a focus on enzyme kinetics and applications.
4. To provide students with fundamentals of bioenergetics and thermodynamics.

Course contents

Module	Topic	L	T	P
Module 1: Chemistry of Life				
1.1. Molecules and Solutions: Chemical structure of atoms and molecules, Types of chemical bonding; Solution chemistry: Acids and Bases, Water, Buffers and pH (Henderson-Hasselbalch equation), molarity, normality, mole fraction, and molality; Micronutrients: Vitamins and minerals; Bile pigments and Porphyrins; Free-radicals and antioxidants.		6	0	0
1.2. Carbohydrates: Sugars; Nomenclature of sugars- monosaccharides, disaccharides and trisaccharides; Role of structural polysaccharides and applications; Chirality- Structural and Stereoisomers, mutarotation, epimer and anomer; Industrial and pharmaceutical applications of carbohydrates (stereoisomers), Fischer and Haworth projections of carbohydrates.		6	0	0
1.3. Lipids: Classification and physiochemical properties of lipids, Chemical structure of fats and oils (triglycerides), phospholipids, waxes and sterols, Complex and derived lipids; Transport and storage of lipids, Cellular, clinical and physiological significance of lipids.		6	0	0
1.4. Nucleic Acids: Nucleobases, nucleotides and oligonucleotides, Topology and conformation of nucleic acids: DNA (A-, B- and Z-forms), RNA (m-, t-, r-, mi-, sn-, lnc-, and sno-RNAs), G-quadruplexes (higher order DNA and RNA); R-loops (DNA:RNA hybrid structures).		6	0	0
1.5. Proteins:		6	0	0

Aminoacids, physico-chemical properties of aminoacids, zwitterions, reactions due to amino and carboxyl groups of aminoacids, TLC, structure and geometry of a peptide bond, protein levels of complexity (primary, secondary, tertiary and quaternary forms with examples), biologically significant proteins and peptides.			
Module 2: Enzymology			
2.1. Enzymes: Classification and nomenclature of enzymes (Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, metallo enzymes, monomeric and oligomeric enzymes).	4	0	0
2.2. Enzyme kinetics: Factors influencing enzyme activity, activation state, and transition state; enzyme specificity, and affinity, Michaelis-Menten equation (K_m, V_{max}, and k_{cat}) and derivation, Enzyme inhibition and mechanism of action.	4	0	0
2.3. Enzymes and applications: Enzyme assays, Zymogens, multi-enzyme complexes, Isozymes and Ribozymes. Enzyme design and engineering, Applications of enzymes in Industry and Research.	4	0	0
Module 3: Energy and Metabolism			
3.1. Molecular Metabolism and Regulation: Metabolic mechanisms of carbohydrates, lipids, aminoacids and nucleic acids (Concept of Glycolysis, Citric Acid Cycle, Gluconeogenesis, Urea Cycle, Pentose Phosphate Pathway, Glyoxalate pathway, Shunt pathways), Ketogenesis, Cholesterol metabolism, Hormones and regulation of fuel metabolism.	6	0	0
3.2. Bioenergetics: Electron Transport Chain, Energy currency (role of ATP), Energy transducers, Oxidative and Photophosphorylation.	4	0	0
Module 4: Cellular functions and Molecular network			
4.1. Macromolecular assemblies: Nucleosome, Replisome, Ribosome, Muscle and the cytoskeleton: Actin-Myosin complex, Microtubules,	4	0	0
4.2. Membrane Architecture and Signaling: Membrane transport, Signal transduction pathways with examples (GPCR, Gated Ion-Channels, and Membrane Attack Complex), Endocrine functions (Glucagon and Insulin).	4	0	0
Total	60	0	0

Evaluation criteria:
1. Test 1: Mid-semester (40%)
2. Test 2: End-Semester (60%)

Learning outcomes:
1. Concepts of structural properties of all biological macromolecules (Test 1)

2. Knowledge of nucleic acid and protein chemistry (Test 1 & 2).

3. Understanding of enzyme mechanisms and applications (Test 2).

4. A grasp of metabolic pathways, signaling mechanisms employed in living systems, and the bioenergetics component of such metabolic pathways (Test 2).

5. Knowledge gained shall help students to pursue their future academic and research (both applied and basic) careers.

Pedagogical Approach: Class room teaching and provision of case study (as per requirement)

Skill Set: Knowledge of biochemistry principles and concepts, and to apply these principles in further studies.
Employability: The course will provide skill sets and knowledge that may be crucial to be employed in Universities, R & D industry, Medical centres/Colleges, Research Institutes and Diagnostic centres apart from specialized units like pharma, breweries, dairy and agri- sectors at an entry (junior) level after graduation.
Materials: **Text Books** **1.** Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7th ed.). W.H. Freeman. **2.** Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of biochemistry* (5th ed.). John Wiley & Sons. **3.** Berg, J. M., Hines, J, Tymoczko, J. L. & Stryer, L. (2023) Biochemistry (10th ed.).W.H. Freeman & Co Ltd. **Suggested Readings:** **1.** West, E. S., & Todd, W. R. (1961). Textbook of Biochemistry (3rd ed.). New York: The MacMillan Company. **2.** Rodwell, Victor W, Bender, David A, Botham, Kathleen M, Kennelly, Peter J, Weil, Anthony P. (2018). Harper's Illustrated Biochemistry (31st). New York: McGraw-Hill Education
Additional information (if any): **a.** The course framework has been designed by Dr. Chaithanya Madhurantakam (Associate Professor, DBT-TERI SAS). **b.** Inputs from Dr. Anandita Singh (Professor, DBT- TERI SAS), and Dr. Pooja Anjali Mazumdar (Scientific Consultant-Independent, New Delhi) were incorporated.
Student responsibilities:
Study of course material as specified by the instructor. Proactive involvement in studying, and analysing the accessible scientific literature in online/offline modes.

Course reviewers:

Dr. Rajakumara Eerappa, Professor, Room: B-204, Academic Block B, Indian Institute of Technology- Hyderabad, Kandi-502284, Sangareddy, Telangana, India	**Dr. Saugata Hazra**, Associate Professor, Indian Insitute of Technology- Roorkee

Course title: Cell and molecular biology			
Course code: Undergraduate	**No. of credits:** 2	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): None			
Department: Biotechnology			
Course coordinator(s): Prof. Ramakrishnan Sitaraman	**Course instructor(s):**		
Contact details:			
Course type: Core	**Course offered in:** Semester 1		

Course description: Understanding life processes at the molecular level has revolutionized our approach to all areas of biology. An understanding of cell and molecular biology is therefore indispensable for the modern biologist, regardless of their eventual specialization. Accordingly, this foundational course provides an overview of the subject tailored for students of varying disciplinary backgrounds at the entry level to the FYUP/FYIPP in biotechnology.

The course commences with a brief introduction to the types of cellular organization within an evolutionary context. This is followed by a detailed review of the structure and expression of DNA and its central position as the genetic material. The concluding module reviews DNA replication at the molecular level in prokaryotes and eukaryotes, followed by a description of mutational processes and their importance for evolution by natural selection.

Course objectives:
1.   To present an integrated overview of cellular organization and processes across the three kingdoms of life.
2.   To embed learning about molecular biology within an evolutionary context.

Course contents

S.No	Topic	L	T	P
Module 1	**Cellular organization and function**	**10**	0	0
1	Theories of evolution of cell types. The three-kingdom classification, symbiogenesis and 'transitional forms,' origins and evolution of viruses.	4	0	0
2	Structural organization of prokaryotic and eukaryotic cells. Intracellular organelles: Functions of the cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, phagosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility. Cell division (mitosis, meiosis).	6	0	0
Module 2	**Genome organization and replication**	**10**	0	0
1	Mendelian genetics, inborn errors of metabolism, DNA structure, concept of one-gene-one-enzyme	3	0	0
2	Organization of genes and genomes in prokaryotes and eukaryotes: Heterochromatin and euchromatin, operon, introns and exons, gene families, unique and repetitive DNA. Nucleosomes and packaging of DNA into higher order structures.	4	0	0
3	DNA replication in prokaryotes and eukaryotes. Leading and lagging strands, differential accumulation of mutations. Molecular basis of mutation and repair.	3	0	0
Module 3	**Gene expression**	**10**		
1	Transcription in prokaryotes and eukaryotes: RNA polymerases, promoters, DNA footprinting, various stages of RNA synthesis, initiation, elongation and termination, rho-	5	0	0

	dependent and -independent termination. The *lac* operon, bidirectional operons, transcriptional regulation.			
2	Translation in prokaryotes and eukaryotes: The genetic code, three types of major RNAs, ribosome function. Three stages of translation – initiation, elongation and termination. Post-transcriptional and post-translational regulation.	5	0	0
	Total	**30**	**0**	**0**

Evaluation criteria:
Test 1 – 40% weightage – mid-semester
Test 2 – 60% weightage – final

Learning outcomes:
1. Knowledge of cell types and organizational patterns across the three kingdoms (Test 1).
2. Understanding of basic Mendelian and molecular genetics (Test 1).
3. Realizing the evolutionary context of life processes (Tests 1 & 2)
4. Ability to understand and apply the basic principles and concepts of molecular biology (Test 2).

Pedagogical Approach:
A combination of online/offline lectures/self-study/group study for various topics.

Skill Set:
1. Problem-solving in basic molecular biology.
2. Ability to formulate questions for further inquiry.

Employability:
1. Life science tutoring at the middle-school level.
2. School assistant teacher / lab assistant.

Materials:

Textbooks
1. Alberts, Bruce, Rebecca Heald, Alexander Johnson, David Morgan, Martin C. Raff, K. Roberts, and Peter Walter. *Molecular biology of the cell*. New York, NY: W. W. Norton & Company, 2022.
2. Watson, James D., Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard M. Losick. *Molecular biology of the gene*. New Delhi: Affiliated East-West Press Private Limited, 2024.

Case studies – None

Suggested readings
1. Watson, James D. *The double helix: The discovery of the structure of DNA*. London: Phoenix, 2010.

Journals – None

Other readings – None

Additional information (if any):
Designed by: Dr. Ramakrishnan Sitaraman

Student responsibilities:
1. Class attendance (online/offline).
2. Study/self-study of course materials as specified by the instructor.

Course reviewers:
1. Dr. Meenakshi Kuhar
Associate Professor
Department of Biochemistry
Sri Venkateswara college
Benito Juarez Road,
Dhaula Kuan, New Delhi - 110021

2. Dr. S. Ramachandran,
Emeritus Professor,
Research Development Cell,
Biotechnology and Allied Life Science Department,
Manav Rachna International Institute of Research and Studies,
Sector 43, Delhi-Surajkund Road, Faridabad, Haryana.
Adjunct Professor, Jamia Hamdard
Adjunct Professor, Indraparastha Institute of Information Technology
Former Chief Scientist and Professor, AcSIR, Faculty of Biological Sciences
CSIR-Institute of Genomics and Integrative Biology

Course title: Biotechnology Laboratory 1				
Course code: BBP ---	**No. of credits:** 2	**L-T-P:** 7.5-0-45	**Learning hours:** 52.5	
Pre-requisite course code and title (if any): Class 12 or equivalent in Science				
Department: Department of Biotechnology				
Course coordinator: Dr. Souren Paul		**Course instructor:**		
Contact details:				
Course type: Major		**Course offered in:** Semester 1		
Course description: The objective of this laboratory course is to introduce students to experiments related to biotechnology. This is a basic laboratory course which intends to introduce the students to basic laboratory activities required for biotechnology research. The experiments will be related to the theory courses taught in the first semester. The list of experiments is representative and not exhaustive.				

Course objectives:
4. To provide a basic level training of preparing solutions used in biotechnology research
5. Use of compound microscopes to study different plant and animal tissue and study of microbes

Course contents

Modu le	Topic	L	T	P
1	• Lab safety	7.5		0
2	• Liquid handling and pipetting • Preparation of solutions and reagents • Understanding the laboratory and equipment • Examination of pond water for diversity • Study of whole mounts of Euglena, Amoeba and Paramecium • Gram staining • Microscopic studies of plant and animal cells and tissues • Study of cell division, mitosis and meiosis	0		45
	Total	7.5	0	45

Evaluation criteria:

1. Attendance: 5%
2. Preparation of lab record(s) throughout the semester: 25%
3. End semester evaluation: 70% (Following components would be included)
    3. Spotting: 15 %
    4. Viva-voce: 15 %
    5. Experiment(s) assigned on the day of the exam: 40%

Learning outcomes:
1. Ability to conduct experiments with adequate safety precautions.
2. Capacity to compare and evaluate various approaches in solving a given experimental problem.

Pedagogical Approach:
    4. Laboratory experiments, demonstration, writing and experiments result analysis.

5. Visit to Aravali Biodiversity Park

Skill Set:

4. Able to work in biotechnology lab and perform experiments
5. Able to analyses experimental data and critical thinking.

Employability:

3. Forestry and wildlife research institutions involved in conservation
4. Academic and industrial research
5. Industries based on biotechnology, pharmacy, and agriculture.

Materials:

Suggested Readings

3. Campbell Biology: Australian and New Zealand edition, Reece J.B. and others, Pearson 12th ed. 2021
4. National Academy of Sciences. 1999. Science and Creationism: A View from the National Academy of Sciences, Second Edition. Washington, DC: The National Academies Press. https://doi.org/10.17226/6024.

Additional information (if any):

Student responsibilities:

4. Class attendance.
5. Conducting experiments as instructed during the class
6. Self-study

Course title: 'Ethics and Values in Life Sciences' (EVLS)				
Course code: <mark>XXXXX</mark>	**No. of credits: 2**	**L-T-P:** 20-10-0		**Learning hours: 30**

Pre-requisite course code and title (if any): No pre-requisite required

Department: Department of Biotechnology

Course coordinator(s):	**Course instructor(s):**

Contact details:

Course type: Value Added Course under Indian Knowledge System	**Course offered in:**

Course description

The world around us goes through constant changes and development in different spheres, be it science, technology, social systems or the morals and values that are constructed in a society for every individual. An individual in any discipline has to confirm to some ethics for a smooth functioning of the particular field. Ethics and values play a crucial role in shaping individuals into responsible and conscientious members of the society. They serve as guiding principles that influences decision making, behaviour and both interpersonal and intrapersonal interactions. In an era marked up by rapid technological advancements and complex societal challenges, understanding ethical considerations is more important than ever. Upholding values such as honesty, integrity, compassion and respect fosters culture of trust and accountability. Whether in academics, workplaces or everyday life, ethical conduct ensures fairness and justice, ultimately contributing to a more harmonious and progressive society. The structured understanding of these ethics and values in a discipline facilitates the elimination of malpractices in realm of academics and in society at large.

Course objectives

The course aims to achieve the following objectives

- Understanding the historical and theoretical framework of ethics and values.
- Understanding ethics in scientific research.
- Detailed analysis of ethics and values in life sciences.
- Analysing ethical dilemmas and case studies in life sciences.

Course content

Module	Topic	L	T	P
1.	**Introduction to Ethics** The module begins by defining ethics in the realm of everyday life and narrowing down its significance in scientific research. Discussion on ethical theories such as deontology, virtue ethics and utilitarianism.	4	2	

	• Utilitarianism: this theory involves focusing on overall happiness and wellbeing for the betterment of the society as a whole. The concept can be understood through philosophical and theoretical understanding of different texts and scriptures. • Deontology: Rooted in philosophy, it emphasises concepts like duty, rules and principles driven by set of norms for a smooth functioning of a discipline. • Virtue Ethics: This theory focuses on moral character of individuals, with emphasising on concepts like integrity, honesty and respect.			
2.	**Understanding Ethics in Scientific Research** The module will focus on important ethics in research to avoid academic malpractices like plagiarism, falsification of data, manipulation, misuse of subjects and misrepresentation of findings. The course will focus on understanding ethics in research emphasising on consent, credibility, reliability, research reproducibility and respect for the subject in detail with a major focus on bioethics that play a crucial role in guiding scientific advancement and prevent misleading conclusions that can harm scientific integrity.	4	2	
3.	**Core Human Values and Their Significance** This course will focus on theories that will correspond with the discussion on core human values. The course will emphasis on defining value, understanding the nature and type of values through different theories such as **Schwartz theory of basic values, Rokeach Value system. Maslow's hierarchy of needs and values etc.** Discussion on foundational and intrinsic values and concepts of Duty, Justice, Equality and Responsibility.	4	2	
4.	**Importance of Ethics and Values in Life Science** The module will focus on: - • Tracing the history of ethical considerations in life sciences • Detailed discussion on scientific integrity majorly focusing on rights of subjects, concerns in healthcare and social justice, ethics in biodiversity etc while understanding fundamental ethical principles in life sciences. • Understanding legal framework and ethical guidelines in life sciences. (emergence of IRBs and RCTs)	4	2	
5.	**Ethical Dilemmas and Case studies** The module will provide a deeper understanding of ethics and values in research majorly focusing on scientific research through various case studies. • Nazi Germany World War 1 Study (1940's) and emergence of German regulations	4	2	

	• The Tuskegee Alabama Syphilis Study and the Belmont Report (1972) • The MK-Ultra Experiments study of USA (1950)				
11	**Total**		**20**	**10**	

Evaluation criteria

- Test 1: 40% (Mid-Term Assessment) (modules 1, 2, 3)
- Test 2: 60% (End-Term Assessment) (modules 4 & 5)

Learning outcomes

After completing this course, the students will be able to

- Apply the theories in scientific and academic research.
- Recognize and avoid unethical malpractices that harm scientific integrity.
- Evaluate core human values to apply in daily life and in science as a discipline.
- Critically analyse the significance of ethics and values through real life case studies.

Additional information: This course was designed by Prof. Neeraj Sharma, Professor of Practice, Department of Policy and Management Studies, TERI SAS.

References

Emanuel, E. J., Wendler, D., & Grady, C. (n.d.). *What Makes Clinical Research Ethical?* www.jama.com

Gefenas, E. (2006). The concept of risk and responsible conduct of research. *Science and Engineering Ethics*, *12*(1), 75–83. https://doi.org/10.1007/s11948-006-0007-x

Gristina, V., Galvano, A., Pirrotta, A., Russo, A. (2023). Ethics in Life Sciences and Research. Congiunti, L., Lo Piccolo, F., Russo, A., Serio, M. (2023) Ethics in Research. UNIPA Springer Series. Springer, Cham. https://doi.org/10.1007/978-3-031-24060-7_3

Maheshkar, Chandan., & Sonwalkar, Jayant. (2023). *Handbook of research on cultural and cross-cultural psychology*. Vernon Press.

Min E. *A Study on the Hierarchy of Value*https://www.bu.edu/wcp/Papers/Valu/ValuMin.htm

Rice, T. W. (n.d.). *Symposium Papers The Historical, Ethical, and Legal Background of Human-Subjects Research The National Research Act of 1974 and the National Commission The Belmont Report The Institutional Review Board Modern Day Institutional Review Boards and Human Subject Protections Summary* (Vol. 53). www.liebertpub.com

Ross, A., & Athanassoulis, N. (2014). The role of research ethics committees in making decisions about risk. HEC Forum : An Interdisciplinary Journal on Hospitals' Ethical and Legal Issues, 26(3), 203–224. https://doi.org/10.1007/s10730-014-9244-6

Salikhova, N. R. (2015). Types of personal values in the continuum of unrealisability–realisability of their meaning. *Review of European Studies*, *7*(5), 217–230. https://doi.org/10.5539/res.v7n5p217

Schwartz, S. H. (2012). An Overview of the Schwartz Theory of Basic Values. *Online Readings in Psychology and Culture*, *2*(1). https://doi.org/10.9707/2307-0919.1116

Sierra, X. (2011). Ethics in Medical Research in Humans: A Historical Perspective Ética e investigación médica en humanos: perspectiva histórica. In *Actas Dermosifiliogr* (Vol. 102, Issue 6).

Additional information (if any). Designed by Prof. Neeraj Sharma, Professor of Practice, Department of Policy and Management Studies, TERI SAS.

Student responsibilities

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

Course Reviewers

1. **Prof Sushil –** Professor Emeritus, Department of Management Studies, Indian Institute of Technology, Delhi,
2. **Prof Sanjay Verma,** Professor, Department of Information Science, Indian Institute of Management, Ahmedabad

Course title: Minor Internship (Summer)			
Course code: ESM xxx	**No. of credits:** 8	**L-T-P:** 0-0-240	**Learning hours:** 240
Pre-requisite course code and title (if any): N.A.			
Department: Sustainable Engineering			
Course Coordinator: Prof. Naqui Anwer	**Course Instructor:**		
Contact details:			
Course type: Core	**Course offered in:** Semester 3 (During summer break before semester 3)		

Course description

The course offers a thorough problem-based learning approach, guided by realistic and challenging industry requirements. The course includes 6-8 weeks of on-job training on current industry-relevant problem through supervised self-learning approach. The students shall apply their classroom learnings for identification of problem, execute analysis based on available literature, data& reports and present the output.

Course objective
- To provide industrial exposure to students to the real time problems related to contemporary areas of power sector, RE industry, green energy projects, energy efficiency, energy audit & management and policy & regulations.
- Enable the students to work on short industry projects and come up with the solutions commensurate with the assigned problem to the students.
- To impart skills in preparing detailed report describing the project and results/findings.
- Identify gap in existing knowledge to help develop a specialization

Course contents

Module	Topic	L	T	P
1	- Problem identification on thematic area in consultation with the host industry/organization - Literature review - Preliminary interaction with industry experts - Define objective and relevant tasks to be performed - Define methods to be followed and tools to be used - Writing synopsis	0	0	120
2	- Consolidating objective and relevant tasks to be performed - Finalizing methods to be followed and tools to be used - Review of internal or external reports, articles, accumulated data, academic literatures on the specific problem - Perform survey-based research, if required - Analysis and interpretation of data/results - Preparing final report	0	0	120
	Total	**0**	**0**	**240**

Evaluation criteria
- Meeting timeline (10%) (Consisting of: joining report (2%), progress reports (2% each), feedback form (2%), and final thesis (2%). [during Module 1, 2]
- Test 1: Internship report (40%) [after Module 2]
- Test 2: Presentation and Viva (30%) [after Module 2]
- Response/feedback from the host organization/supervisor (20%) [after Module 2]
- Plagiarism is unacceptable and the institute has a very strict policy to deal with it. If a student engages in plagiarism, it could attract serious penal actions. All reported cases of plagiarism would be dealt with as per the process mandated by Departmental Academic Integrity Panel (DAIP) and Institutional Academic Integrity Panel (IAIP).
- The students scoring less than or equal to 40% (or ≤ 40%) overall marks in the evaluation would be considered to have failed in this course. Grading of the Summer Internship will be absolute in nature and would be done as per the following criteria:

>90	A+
>80≤90	A
>70≤80	B+
>60≤70	B
>50≤60	C+
>45≤50	C
>40≤45	D
≤40	F

Learning outcomes

- Develop an understanding of real time problems/challenges in contemporary areas of power sector, RE industry, green energy projects, energy efficiency, energy audit & management and policy & regulations [Test 1, 2]
- Realizing Standard Operating Procedure of industry for specific project domain [Test 1, 2]
- Effectively communicate the learning through project report and oral presentation [Test 1, 2]

Pedagogical approach

Self-learning; discussion with supervisors; interaction with experts;

Materials

Literature and reports related to the specific problem.

Additional information (if any)

A detailed guideline along with important dates and format will be notified by the department, in advance, with other relevant details.

If there is any change in evaluation criteria/policy, it will be updated in the guideline every year.

Report submission and schedule of presentation will be coordinated by Project/Programme coordinators.

Student responsibilities

Attendance; Discipline; Research Ethics etc.

Cours Outline prepared by: Prof. Naqui Anwer

External reviewers:
1. Dr. Anish Modi, Assistant Professor, IIT Bombay
2. Mr. Mudit Jain, Head (Research), Tata Cleantech Capital Limited
3. Mr. Alok Kumar Jindal, GM (RE), Tractebel Engineering Pvt. Ltd.

Course title: Advancements in Energy Processes, Systems, Technologies and Applications				
Course code: ESM XXX	No. of credits: 3	L-T-P: 37 - 8 - 0		Learning hours: 45
Pre-requisite course code and title (if any): N/A				
Department: Sustainable Engineering				
Course coordinator: Prof Naqui Anwer		Course Instructor: Prof. Naqui Anwer/ Prof. S C Mullick/ Prof. D K Sharma		
Contact: naqui.anwer@terisas.ac.in				
Course type: Core		Course offered in: Semester 3		

Course description

This course is designed to provide a comprehensive understanding of advancements in energy processes, systems, technologies, and their applications. Electric Vehicles are the talk of the present. Energy storage systems have become more relevant with the penetration of variable renewable energy sources. Hydrogen energy has got policy impetus, and its role is very obvious now. Quantum Computing has the potential to revolutionize renewable energy in various ways in the near future. These four technologies have been included in this course so as to give an in-depth knowledge of these technologies.

Course objective

- ▪ Recognize EV/HEV technical and economic objectives. Identify efficient EV/HEV architectures.
- ▪ Explain the mechanism of battery and motors in terms of functionality, control, and integration.
- ▪ Describe a basic coordinated control between different parts of EV.
- ▪ To study details of various energy storage systems along with applications
- ▪ Enabling to identify the optimal solutions to a particular energy storage application/utility.
- ▪ To provide comprehensive and logical knowledge of hydrogen production, storage, and utilization
- ▪ To familiarize with the concept of Quantum Computing.

Course contents

Module	Topic	L	T	P
1	**Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) Developments:** **EV and HEV: A Policy Perspective** • Historical developments, recent developments, National Electric Mobility Mission Plan (NEMMP) • Policies and regulations for EV adoption • Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) Scheme. **Introduction to EV and HEV:** • State of art EVs and HEVs • EV configurations • EV parameters • HEV configurations • Power flow control. **Electric Propulsion: EV and HEV Motor, Converters, and Inverters:** • Different types of power converter-based DC motor drives • Induction motor drives, • Permanent magnet motor drives • Regenerative Braking systems **Energy Sources: Batteries, Fuel Cells and Advanced Technologies:** • Basics of Batteries (Parameters: Capacity, Discharge rate, State of charge, state of Discharge of Batteries) **EV Charging:** • EV Charging (Charging Standards like CCS, ChaDeMo (Japanese), GB/T (Chinese), Bharat AC-001 and DC-001 and other BIS standards)	13	0	0

| 2 | **Necessity and Types of Energy Storage Systems:**

Energy Storage System: A Policy Perspective
• Necessity of energy storage
• Policy and regulatory developments in energy storage
• Recent standards for energy storage systems - MESA, IEC, IEEE
Energy Storage Methods:
• Mechanical, chemical, electrical, thermal and other energy storage methods
Energy Storage Systems:
• Thermal Energy Storage:
  o Sensible Thermal Energy Storage (Rock and Water/Rock TES, Solar Ponds, Thermally Stratified TES Tanks)
  o Latent thermal Energy Storage (Phase Change Materials)
• Electrical Energy Storage
  o Super Capacitors,
  o Magnetic Energy Storage
  o Superconducting Systems,
  o Mechanical-Pumped Hydro,
  o Flywheels
  o Pressurized Air Energy Storage, | 8 | 3 | 0 |
| 3 | **Hydrogen Energy Systems:**

• **Hydrogen Energy: A Policy Perspective**
  o Policies and Regulations for the Promotion of Hydrogen
  o National Green Hydrogen Mission
• **Hydrogen Energy: An Introduction**
  o Concept of Grey, Blue and Green hydrogen
  o Properties of Hydrogen as Fuel
  o Hydrogen Pathways
  o Infrastructure Requirement for Hydrogen Production,
  o Storage, Dispensing and Utilization,
  o Hydrogen Production Plants
• **Hydrogen production processes:**
  o Thermal-Steam Reformation
  o Thermo-chemical Water Splitting
  o Gasification- Pyrolysis,
  o Nuclear Thermal Catalytic
  o Partial Oxidation Methods
  o Electrochemical- Electrolysis
  o Photo Electrochemical method.
• **Hydrogen storage and safety:**
  o General Storage Methods
  o Metal Hydride Storage
  o Hydrogen Safety Aspects | 8 | 3 | 0 |

				8	2	
4		**Quantum Computing:** • History of Quantum Computing • Quantum Computing versus Classical Computing • Applications of Quantum Computing • Fundamentals of Quantum Mechanics **Building Blocks of Quantum Computing** • Introduction to Quantum Bits (Qubits) • Visualizing Single Qubits • The Bloch Sphere and Basis States • Superposition and Interference • Mach-Zender Interferometer • Entanglement • Logic Gates • Quantum Hardware				
		Total		**37**	**8**	**0**

Evaluation criteria

Minor test 1: 20% (at the end of module 1)
Minor test 2: 20% (at the end of module 2)
Assignment: 10% (at the end of module 1, 2 & 3)
Major test: 50% (at the end of the semester)

Learning outcomes

After completing the course, the students will be able to:
- Learn fundamentals of advanced batteries, super-capacitors and fuel cells for electrification of vehicles.
- Learn hybridization of various energy conversion devices for vehicle electrification.
- Understand battery management systems and state-of-charge estimation.
- Understand the overall operation of Electric vehicles.
- The student will be able to cope up with upcoming technologies in the energy storage systems.
- Minimize environmental hazards associated with the use of hydrogen storage and fuel cell technology
- Familiarize with the concepts of Quantum Computing

Pedagogical approach

A combination of class-room interactions, expert lecture, assignment, tutorial, practical and case study

Reference Books:

1. C. C. Chan, K. T. Chau, "Modern Electric Vehicle Technology" published by Oxford University Press, 2001.
2. Rodrego Garcia-valle and J. A. P Lopes "Electric Vehicle Integration into Modern Power Networks" Springer, 2012.
3. Chris Mi and M. Abul Masrur, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives" John Wiley Ltd. Publication, 2017.
4. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design" CRC Press, 2004.
5. S. P. Sukhatme and J K Nayak, Solar Energy: Principles of thermal collection and storage, Tata McGraw-Hill, 2009.
6. H. P. Garg, S. C. Mullick and A. K. Bhargava, Solar Thermal Energy Storage, Springer, 1985.
7. Michael Hirscher, Hand Book of Hydrogen Storage, Wiley-VCN Verlag GmbH, 2010.
8. A.G.Ter-Gazarian, "Energy Storage for Power Systems", Second Edition, The Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919-219-4), 2011.
9. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016.
10. A. R. Pendse, "Energy Storage Science and Technology", SBS Publishers & Distributors Pvt. Ltd., New Delhi, (ISBN – 13:9789380090122), 2011.
11. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech, 2013.
12. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York, 1984.
13. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub, 2010.

Additional information (if any): NA

Student responsibilities

Adopt peer learning and knowledge sharing within the class, attendance, feedback, discipline: as per university rules

Course Prepared by
Prof. Naqui Anwer & Dr Asif Nazar, TERI SAS

Course Reviewer
Dr Shashank Vyas, Senior Associate Consultant (Energy and Utilities), Infosys
Dr Odne Stokke Burheim, Professor, Department of Energy and Process Engineering. NTNU, Norway

Course title: Energy Economics and Finance			
Course code: DSE XYZ	**No. of credits:** 3	**L-T-P:** 34-09-04	**Learning hours:** 47
Pre-requisite course code and title (if any): NA			
Department: Sustainable Engineering			
Course coordinator: Dr. Sapan Thapar		**Course instructor:** Dr. Sapan Thapar	
Contact details: sapan.thapar@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 3	

Course Description

The course aims to that equip students with analytical skills and industry knowledge needed to thrive in the energy sector. It encompassed in detail aspects related to capital sources, financing instruments and computation of financial ratios. In relation to energy economics, it covers relevant legislations pertaining to power sector, tariff determination procedure and loss accounting methods. The course includes business models and concepts on oil & gas trading.

Course Objectives

▪ Provide the students a thorough understanding of economics and finance pertaining to the energy sector
▪ Introduction to concepts of capital structure, funding sources, instruments and lending terms
▪ Understand and calculate key financial metrics like LCOE, IRR, payback period, NPV
▪ Provides an overview on Electricity Act, including sectoral challenges
▪ Students would grasp the process of tariff determination besides loss accounting methods
▪ Introduction to concepts of oil & gas trading

Course content

Module	Topic	L	T	P
1	**Introduction to Energy Finance** • Energy Demand & Supply (oil, gas, coal, electricity, RE) • Energy Finance -Trends and Statistics • Climate Finance Taxonomy of India • Overview on Green Finance Initiatives (Global and Indian)	3	0	0
2	**Concept of Project Finance for Energy Sector** • Overview on Project Finance • Types of Structures, contracts and business models • PPA, DPR • Project Risk Assessment • Profitability and Sensitivity Analysis	4	1	0
3	**Capital Structure & Contracts** • Debt and Equity • Funding Sources – Multilateral/ Bilateral agencies, Public & Private Banks, NBFCs, Government Agencies, Institutional Investors, PE/ VC Funds, Sovereign Wealth Funds, Insurance and Pension Funds, Public markets, Microfinance • Terms and Conditions of finance • Emerging trends - ESG-linked bonds, transition finance, Climate Funds, carbon pricing mechanisms, Green Bonds & Hedging, Green Loans and Deposits, Take-out/ Re-Finance, Leasing, InVITs, IPOs	5	0	0

4	**PPP Models** • TBCB (Tariff Based Competitive Bidding), AOMT (Acquire, Operate, Maintain, and Transfer), Distribution Franchisee, Risk Guarantee • Model Concession Agreements and Risk Assessment • Use of Public Funds and their Leverage Ratio	2	0	0
5	**Economic Analysis** • Discounted cash flow analysis • Matrices - LCOE, IRR, NPV, DSCR, Payback Period • Case Studies / Class Exercises - RE Project Finance (solar, wind, battery, biomass, coal, hydro projects)	6	4	0
6	**Energy Economics** • Energy- Public Good vs Commodity • Energy Elasticity • Marginal Cost Pricing • Energy Taxation • Demand Forecasting • Energy Derivatives	4	0	0
7	**Electricity Act, 2003** • Power Sector Regulations, Policies, Initiatives • Power Markets • Open Access Regulations (including green energy open access) • Types of Tariffs (fixed, variable) • Demand factor, Diversity factor, Load Factor • Sectoral Reforms – RDSS, UDAY, APDRP, Smart Metering	4	0	0
8	**Tariff Determination Process** • Tariff Determination Process - Generation, Distribution, Retail • Power Procurement Mode (Cost-Plus, Competitive) • ARR & ACoS – Concept, Calculation, State wise statistics • Power Distribution - T&D Loss, AT&C Loss • Class Exercises	4	0	4
9	**Project Development Models** • Captive/ Group Captive • FIT / Open Tender • OA/ Exchange • VPP/ REC/ carbon markets / Other Options **Group Activity**	2	4	0
	TOTAL	34	9	4

Evaluation criteria
- Test 1: 25%
- Test 2: 25%
- Major: 50%

	Learning outcomes By the end of this course, the student will be able to: ▪ Relate economics and finance with the energy sector ▪ Compute cost of generation (LCOE) for different project configurations/ technologies ▪ Determine financial ratios- IRR, payback period, NPV ▪ Compute ARR, ACOS, tariff and associated loss levels (AT&C/ T&D) ▪ Get an overview on working of oil & gas sector

	Pedagogical approach
	- Classroom lectures - Group discussions - Spreadsheet based models
	Materials **Textbooks** - Bhattacharyya, S C. (2011), Concepts, Issues, Markets and Governance, Springer - Thapar Sapan (2024), Renewable Energy: Policies, Project Management and Economics, Springer - Kandpal T.C. & Garg, H.P. (2003), Financial Evaluation of Renewable Energy Technologies, Macmillan India - Stevens, P. (2000). An Introduction to Energy Economics - The Economics of Energy, Vol.1, Edward Elgar, Cheltenham, UK **Reports** - Landscape of Green Finance in India, Climate Policy initiative - Energy Transition Investment Trends, BloombergNEF - Renewable Power Generation Costs, IRENA - Financing renewable energy - Options for Developing Financing - Instruments Using Public Funds, The World Bank - Sovereign green bond framework of India - Climate Taxonomy of India, Ministry of Finance, Government of India - Report on Transition Finance, IFSCA - Towards a Greener Cleaner India, RBI **Journals** - Energy Policy - Energy Economics - Energy - Renewable Energy **Portals** - MoP / MNRE/ MoPNG - Niti Aayog - IREDA/ PFC - CEA/ CERC/ PPAC - IEA/ IRENA

Student Responsibilities

Students should have basic understanding about energy sector, including relevant las and market scenario. Attendance and class participation will be of utmost importance.

Course Prepared by

- Dr Sapan Thapar, TERI SAS

Course Reviewed by

- Prof Atul Kumar, JNU
- Mr Sandeep Goel, Energy Specialist, The World Bank
- Mr Mudit Jain, Head-Research, Tata Capital
- Dr Piyush Pandey, IIT Bombay

Course title: Computing Tools and AI Applications in Energy Sector				
Course code: ESMXXX	**No. of credits: 3**	L-T-P:10-14-42	**Learning hours:**66	
Pre-requisite course code and title (if any): NA				
Department: Sustainable Engineering				
Course coordinator:		**Course instructor(s):**		
Contact details:				
Course type: Elective		**Course offered in:** Semester 3		

Course description:

This course has been designed to make the students versed about energy systems, technologies and building modelling, simulation and optimizations. Further, students will learn about artificial intelligence techniques and they will be able to implement artificial intelligence in the energy sector for predictive maintenance, forecasting of solar radiation, solar power generation, demand management etc.

Course objectives:

1. To get students learn and remember to operate various simulation and analysis software used for design, analysis and modelling renewable energy systems and technologies.
2. To learn, understand the process of building thermal modelling and simulation.
3. To learn, understand and implement artificial intelligence techniques for different applications in energy sector.

Module	Topic	L	T	P
1	RET Screen (i) Design and sizing RET Projects (ii) Greenhouse Gas (GHG) Emission Reduction Analysis (ii) Financial Analysis for various case studies listed below a. Photovoltaic Project Model for on-grid (central-grid and micro-grid PV systems); off-grid (stand-alone (PV-battery) and hybrid (PV-battery-genset) systems; and water pumping applications b. Wind Energy Project Model for central-grid and micro-grid connected projects, ranging in size from large-scale multi-turbine wind farms to small-scale single- turbine wind-diesel hybrid systems. c. Small Hydro Project Model for central-grid and isolated-grid connected projects, ranging in size from multi-turbine small andmini hydro installations to single- turbine micro hydro systems. d. Solar Water Heating Project Model for domestic hot water, industrial process heat and swimming pools, ranging in size from small residential systems to large scale commercial, institutional and industrial systems.	1	1	4
2	PVSyst (i) Design and simulate grid-connected solar PV power plant for two sites with different latitudes under fixed tilt, seasonal tilt and tracking. a. Analyse average monthly performance ratio and energy production b. Analyse impact of thermal losses for silicon and thin-film technologies c. Analyse total losses for two different locations. d. Plant layout design and electrical outlet design & shading loss analysis (ii) Design and simulate Rooftop PV system for off grid application for a household	1	1	5
3	Wind Atlas Analysis and Application Program (WAsP) (i) Simulate and analyse grid-connected a wind turbine for two sites. (ii) Design and simulate grid-connected wind farm for power generation.	1	1	4
4	System Advisor Model (i) Design and simulate solar photovoltaic system for for two sites with different latitudes (ii) Design and simulate different types of concentrator solar thermal power plants	1	2	6
5	HOMER (i) Design and simulate an electrical system for a typical village using more than two renewable energy sources and technologies	1	1	4
6	EnergyPlus/DesignBuilder: (i) Designing windows (size, material glazing, and position, etc) (ii) Impact of different glazing types (iii) Design lighting and air-condition a pre-defined building with windows (iv) Impact of various insulation material	2	2	4

7	Overview of Artificial intelligence techniques, Learning theories of AI for renewable energy applications: *Introducing to statistical programming language:* Programming fundamentals, variables, data types, control statements and blocks; data visualization through graphs and charts; Correlation Analysis; performance metrics – AUC (ROC), MSE, MAPE, R^2, RMSE; *Machine learning techniques* - Simple and Multiple Linear Regression - Logistic Regression - Nearest Neighbor, - Decision Trees, - Random Forests, - Support vector-machines (SVM) Artificial Neural Network (ANN)	3	6	15
Total		10	14	42

Evaluation criteria

Simulation assignments: Performance (preparing the simulation and getting results closer to the expected, spread over the entire semester) - 50%

End semester modelling and simulation Exam - 35%

End semester theory exam-15%

Learning outcomes:

This course inculcates the skills that shall make the students to:
1. be able to understand, use various energy modelling and simulation tools
2. learn and implement artificial intelligence techniques for optimizing energy consumption, power generation forecasting, solar radiation forecasting, predictive maintenance, energy use prediction etc.

Pedagogical approach

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

Materials
Recommended readings
Learning materials/books/data sets
1. *Leng, G., Meloche, N., Monarque, A., Painchaud, G., Thevenard, D., Ross, M., & Hosette, P. (2004).*
2. *Clean Energy Project Analysis: RETScreen Engineering & Cases Textbook-Photovoltaic Project Analysis. CANMET Energy Technology Center.*
3. *Mortensen, N. G. (2007). Getting started with WAsP 9. Risø-I-2571 (EN), Risoe National Laboratory,Technical University of Denmark, Roskilde.*

4. *Blair, N., Dobos, A., Freeman, J., Neises, T., Wagner, M., Ferguson, T and Janzou, S. (2014). System advisor model, sam 2014.1. 14: General description. NREL Rep. No. TP-6A20-61019, Natl. Renew. EnergyLab. Golden, CO, 13.*
5. *Energy, H. O. M. E. R. (2011). Getting Started Guide for HOMER Legacy (Version 2.68). HOMEREnergy: Boulder, Colorado*
6. *Mermoud, A., & Wittmer, B. (2014). PVSYST user's manual. Switzerland.*
7. *U.S. Department of Energy (2017) EnergyPlus Documentation* https://energyplus.net/documentation
8. https://designbuilder.co.uk/
9. *Dimitris Vrakas and Ioannis PL. Vlahavas, Artificial Intelligence for Advanced Problem Solving Techniques, InformatIon scIence reference*
10. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, Third Edition (2009)
11. Nils J Nilsson, Principles of Artificial Intelligence, Illustrated Reprint Edition, Springer Heidelberg, 2014.
12. https://www.nrel.gov/solar/data-tools
13. https://www.nrel.gov/computational-science/data-tools

Additional information (if any): NA

Student responsibilities:

Attendance, feedback, discipline: as per university rules

Course Outline Prepared by –Dr. Ramkishore Singh

Course Reviewers

1. Prof. Atul Sharma, RGIPT, Jais, Amethi (U.P.)
2. Prof. Rajesh Singh, Uttaranchal University, Dehradun

Course title: Climate Change and Energy Transition				
Course code: DSE XYZ	**No. of credits:** 3	**L-T-P:** 34-11-00		**Learning hours:** 45
Pre-requisite course code and title (if any):				
Department: Sustainable Engineering/ MSc (Energy Studies & Management)				
Course coordinator: Dr Sapan Thapar		**Course instructor:** XYZ		
Contact details:				
Course type: Elective		**Course offered in:** Semester 3		

Course Description:

Climate change has been identified as an existential threat to human society. A major reason for rising carbon emissions is attributed to use of fossil fuels for energy generation. Countries across the globe are working to reduce emission by decarbonizing their energy sector.

This course shall provide an overview on the global climate discourse, the science behind it, indicators of Climate Change, global and regional climatic trends. It shall cover UNFCCC Protocols, greenhouse gases, mitigation as well as adaptation strategies under NDCs. The course would introduce concept on energy transition, Decarbonization, Just Transition and carbon markets.

Course Objectives

- Science, Issues and Drivers behind climate change
- Climate Change Protocols, Role of UNFCCC, NDCs
- Greenhouse gases, GWP and Emission Trajectory
- Climate Change - Planning, Mitigation and Adaption Strategies
- Energy Transition, Net-Zero, Decarbonization, Just Transition
- Carbon Markets and Trading Schemes
- Corporate NZE Strategies

Course Content

Module	Topic	L	T	P
1.	**Introduction to Climate Change** • Elements of Climate • Climate Change Indicators • Global and Regional Climatic Trends • Changes in Temperature and Precipitation Regimes • Melting of Ice Caps and Glaciers, Sea-Level Rise • Ocean Acidification • Extreme Climate Events • Climate Change and Its Impacts • Climate Risk Assessment and Scenario Analysis	7	3	
2.	**Science of Climate Change** • Natural Drivers of Climate Change, • Solar Radiations and Spectrum, • Greenhouse Gases (GHGs), Greenhouse Effect, • Anthropogenic Drivers of Climate Change and Human Impact on Climate, • Aerosols, Carbon Cycle • Modelling the Future Climate	8	2	
3.	**Climate Change Adaptation and Mitigation** • Adaptation and Mitigation Strategies • IPCC guidelines for GHG Inventories • International Conventions: UNFCCC, Kyoto Protocol, Paris Agreement • National Programmes: National Action Plan on Climate Change • Policy Responses and Tools, Case Studies	7	3	
4	**Energy Transition** • Energy Scenario - Global & Indian Perspectives	4	0	

	• Energy Transition and Decarbonization - Global and Domestic Initiatives • Relevance of Geopolitics, Technologies, Trade • Concept of Just Transition			
5	**Carbon Markets** • Global Schemes and Initiatives • Indian Carbon Market - Scheme & Regulations • Emission Factors and Carbon Footprint Assessment • Carbon Markets, Trading Mechanisms, Pricing and Finance	4	0	
6	**Business Strategies on Net-Zero** • Corporate Initiatives and Commitments • Tools and techniques (ICP, voluntary/ mandatory compliance, offsets) • Examples and Case Studies	4	3	
	Total	34	11	0

Evaluation criteria
Minor Test 1: 25
Minor Test 2: 25
Major Test : 50

Learning outcomes
After completing this course, students would be able to:
- Understand science behind climate change
- Estimate GHG emissions, suggest mitigation cum adaptation techniques
- Appreciate importance of energy transition in combating climate change
- Understand working of carbon markets
- Develop decarbonization and NZE Strategies

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

Materials:
Text Books:
- UNDP, Carbon Handbook, United Nations Development Programme (2014)
- Gupta M. Restricting Greenhouse Gas Emissions: Economic Implications for India,New Delhi. (2006)
- Gilbert M. Masters and Wendell P. Ela. Introduction to Environmental Engineeringand Science. 3rd edition. PHI learnings, New Delhi (2007)

Suggested Readings:
- IRENA - World Energy Transitions Outlook 2023
- IPCC Assessment Reports
- UNFCCC Annual Reports
- IEA Reports
- GHG Inventory of India (MOEFCC)
- NAPCCC, India
- National Carbon Markets Scheme, India
- World Bank - State and Trends of Carbon Pricing (Report)
- Niti Aayog - Inter-ministerial committee on Just transition from coal (Report)

Journals:
- Climate Dynamics
- Combustion Technologies
- Energy Policy
- Global Environmental Change
- Renewable Energy

• Review of Environmental Economics and Policy • Sustainable and Renewable Energy Reviews	
Additional information (if any): N.A.	
Student responsibilities The students are expected to maintain the required attendance and actively participate in class discussions.	
Course Prepared by • Dr Sapan Thapar, TERI SAS	
Course Reviewed by • Prof. Kamna Sachdeva, Delhi Skill and Entrepreneurship University • Dr Moitre Mukherjee, National University of Singapore • Dr OP Rao, Scientist 'F' (Retd), CSIR	

Department of Sustainable Engineering

B.Sc. / Integrated M.Sc. (Energy and Computer Applications)

Four-year UG Programme (FYUP) in Energy and Computer Applications (B.Sc.) / Five-year Integrated PG Programme (FYIPP) in Energy and Computer Applications (M.Sc.)

There is an increasing demand for professionals who possess both a deep understanding of energy systems and strong skills in the domain of computer applications. Traditional engineering or computer science programs often lack this interdisciplinary focus. The shift towards decentralized energy generation (e.g., rooftop solar) necessitates advanced computing for managing distributed energy resources, ensuring grid stability, and enabling peer-to-peer energy trading. For smart grids that optimize energy distribution to intelligent building management systems, computer applications are essential for designing, implementing, and maintaining these systems. Computer applications, with its ability to manage, analyse, and optimize complex energy systems, is crucial for this transition. An undergraduate program in Energy and Computer Application is forward thinking and highly beneficial due to the increasing intersection of these two critical fields.

Looking at the current changes in the market and increased application of computers in Energy domain, the department of Sustainable Engineering at TERI School of Advanced Studies starts offering **Four-year UG Programme (FYUP) in Energy and Computer Applications (B.Sc.) / Five-year Integrated PG Programme (FYIPP) in Energy and Computer Applications (M.Sc.)** from the session 2025-26. The programme is structured maintaining the ethos of NEP 2020 and curriculum is designed to equip the students with necessary knowledge, skills, training and understanding to solve the real-world problems in the domains of energy and computer applications. An integrated curriculum will allow students to work on real-world problems, such as developing energy management software, designing smart grid simulations, or creating AI models for energy forecasting. This practical experience is highly valued by employers.

The convergence of energy and computer applications are not a transitory trend but a fundamental shift in how we manage and utilize energy. A degree in this interdisciplinary field would equip students with skills that are highly relevant and in demand for decades to come, offering excellent job security and high earning potential. In essence, an undergraduate / integrated post-graduate programme in Energy and Computer Applications would equip students with a unique and powerful skillset, preparing them to be leaders and innovators in the rapidly evolving landscape of sustainable energy and digital transformation.

Career Opportunities:

1. Renewable Energy Companies: Developing software for solar, wind, and other renewable energy systems, optimizing their performance, and managing energy storage.
2. Smart Grid Development: Designing and implementing intelligent systems for energy transmission and distribution.
3. Energy Efficiency and Management: Creating software solutions for energy optimization in buildings, industries, and transportation.
4. Data Science in Energy: Analyzing vast datasets from energy systems to identify trends, predict consumption, and optimize operations.
5. Cybersecurity for Energy Infrastructure: Protecting critical energy infrastructure from cyber threats.
6. Energy Trading and Markets: Developing algorithms for optimized energy trading and forecasting.
7. Electric Vehicles (EVs) and charging Infrastructure: Developing software for EV battery management, charging networks, and grid integration.
8. Research and Development: Contributing to advancements in energy technologies and their computational aspects.

Unique Selling Points (USP)

The Undergraduate Programme in Energy and Computer Application is designed to integrate the principles of energy systems with cutting-edge computer applications. Some of its unique selling points (USP) include:

- **Interdisciplinary Approach:** Combines energy studies with computer science, preparing students for diverse career paths.
- **Industry-Relevant Curriculum:** Focuses on sustainable energy solutions, smart grids, and AI-driven applications in energy management.
- **Cutting-Edge Curriculum:** Covers topics like energy optimization, data analytics, IoT applications, and automation in energy management.
- **Hands-on Learning:** Offers practical exposure through labs, projects, and internships with leading energy and tech firms.
- **Future-Ready Skills:** Equips students with expertise in data analytics, IoT, software development, cybersecurity, computational modelling and automation for energy optimization.
- **Global Opportunities:** Opens doors to careers in renewable energy, smart infrastructure, and software development for energy applications.

Eligibility:

Senior Secondary School (10 + 2) Certificate, to include (Open School and Correspondence), in science or equivalent, from a recognized Board of Education with at least 50% marks in aggregate (best of 3 subjects + English).

Admission will be based on aggregate marks obtained in the qualifying Senior Secondary School Certificate Examination, followed by interaction/counselling.

CUET-UG score/NEET score/JEE mains score accepted

Programme Outline:

Credit distribution Framework for three/four years Honours/Honours with Research Degree Programme with Multiple Entry and Exits Options:

NcrF Credit Level	Semester	Major (Core)	Minor (Electives)	Multi/Inter disciplinary	AEC	SEC/ Internship	VAC/ IKS	RP/PM /OJT	Cumulative Credit per Semester	Qualification
4.5	I	10	4	-	2	2 (SEC)	2	-	20	UG Certificate
	II	10	4	-	2	2 (SEC)	2	-	20	
1st Year Cumulative Credits		20	8	-	4	4	4	-	40	
Exit 1: Award of UG certificate in Major with 40 credits with additional 4 credits Summer Internship in core NSQF course OR continue with Major and Minor										
5.0	III	8	4	3	2	3 (SEC)	-	-	20	UG Diploma
	IV	12	4	-	2	-	2	-	20	
2nd Year Cumulative Credits		40	16	3	8	7	6	-	80	
Exit 2: Award of UG Diploma in Major with 80 credits with additional 4 credits Summer Internship in core NSQF course OR continue with Major and Minor										
5.5	V	10	4	3	-	2 (SEC)	-	-	20	UG Degree
	VI	10	4	3	-	4 (Internship)	-	-	20	
3rd Year Cumulative Credits		60	24	9	8	13	6	-	120	

Exit 3: Award of UG Degree in Major with 120 credits and Internship in same discipline OR continue with Major and Minor										
6.0	VII	**12**	**4**	-	-	-	-	4 (RM)	20	UG Honours Degree
	VIII	**8**	**4**	-	-	-	-	8 (OJT)	20	
4th Year Cumulative Credits		**80**	**32**	**9**	**8**	**13**	**6**	**12**	**160**	
Four Years UG Honours Degree in Major and Minor with 160 credits										
6.0	VII	12	4	-	-	-	-	4 (RP)	20	UG Honours with Research Degree
	VIII	8	4	-	-	-	-	8 (RP)	20	
4th Year Cumulative Credits		80	32	9	8	13	6	12	160	
Four Years UG Honours Degree (with research) in Major and Minor with 160 credits										
6.5	IX	12	4	-	-	-	-	4 (RP)	20	PG* Honours Degree
	X	8	4	-	-	-	-	8 (RP)	20	
5th Year Cumulative Credits		100	40	9	8	13	6	24	200	
Five Years Integrated PG Honours Degree in Major and Minor with 200 credits ***** Subject to change as per UGC/NEP guidelines										

AEC – Ability Enhancement Course, SEC – Skill Enhancement Course, VAC – Value Added Course, IKS – Indian Knowledge System, RP – Research Project, RM – Research Methodology, OJT – On the job training

Programme Structure:

Semester 1

Course No.	Course Title	Type	Number of Credits
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
	Applied physics – I	Major	4
	Applied chemistry for Energy	Major	4
	Applied mathematics – I	Major	4
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4

Semester 2

Course No.	Course Title	Type	Number of Credits
AEC 102	Modern Indian Language 1	AEC	3
UDS 102	Problem-Solving and Python Programming	Multidisciplinary	3
VAC 102	Ancient Indian Sustainable Practices	VAC	2
VAC 104	Personality Development for Success	VAC	2

	Applied physics – II	Major	4
	Applied mathematics – II	Major	4
	Fundamentals of Energy Science	Major	4
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	3

Semester 3

Course No.	Course Title	Type	Number of Credits
AEC 201	Modern Indian Language 2	AEC	3
	Environmental Science & Sustainability	Multidisciplinary	3
SEC 201	Introduction to Geography Information System	SEC	3
	Materials for Energy applications	Major	4
	Object-Oriented Programming	Major	4
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4

Semester 4

Course No.	Course Title	Type	Number of Credits
VAC 106	Constitutional Values and Fundamental Duties	VAC	2
	Data structures and Database Management Systems	AEC	3
	Basic Electrical Circuits & Power Systems	Major	4
	Thermodynamics & Heat Transfer for Energy	Major	4
	Artificial Intelligence & Machine Learning	Major	4
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4
	Vocational course/ Summer internship project (8-weeks) to Exit with UG-Diploma	Vocational/ Internship	4

Semester 5

Course No.	Course Title	Type	Number of Credits
	Energy Policy, Economics, and Regulation	Multidisciplinary	4
	Internet of Things (IoT) for Smart Energy	SEC	2
	Energy resources, systems & technologies – I (Conventional)	Major	4
	Energy Audit & Conservation – I (Thermal)	Major	3
	Energy Audit & Conservation – II (Electrical)	Major	3
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4

Semester 6			
Course No.	Course Title	Type	Number of Credits
	AI/ML for Energy Optimization	Multidisciplinary	3
	Energy resources, systems & technologies – II (Solar)	Major	4
	Energy resources, systems & technologies – III (Wind, Biomass & other)	Major	4
	Energy Lab	Major	3
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4
	Vocational course/ Summer internship project (8-weeks)	Vocational/ Internship	4

Semester 7			
Course No.	Course Title	Type	Number of Credits
	Research methodology	RM	4
	Cloud computing & Cybersecurity	Major	4
	Data structures and Database Management Systems	Major	4
	Electric Vehicle, hydrogen technology & energy storage systems	Major	4
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	Minor	4

Semester 8			
Course No.	Course Title	Type	Number of Credits
	Energy and carbon markets	Major	2
	Smart Grids & Microgrids	Major	3
	Computational Modelling & Simulation Lab	Major	4
	Energy Data Analytics & Forecasting	Major	4
	Research Project/Dissertation	OJT	8
	Any one Minor Course from Data Science/ Economics/ Management/Environmental Studies/Biotechnology	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

Course title: Physics-I				
Course code: ECA XXX		**No. of credits:** 4	**L-T-P:** 40 -10 -20	**Learning hours:** 70
Pre-requisite course code and title (if any): N/A				
Department: Sustainable Engineering				
Course coordinator: Dr. Ramkishore Singh		**Course Instructor:**		
Contact: ramkishore.singh@terisas.ac.in				
Course type: Core		**Course offered in:** Semester 1		

Course description

This interdisciplinary course provides a foundational understanding of classical mechanics, electromagnetism, quantum mechanics, and solid-state physics, with a focus on their applications in energy systems and modern computing technologies. Students will explore the dynamics of mechanical systems, principles of electric and magnetic fields, and the behavior of materials at atomic scales. Emphasis is placed on semiconductor physics, electromagnetic wave propagation, and quantum phenomena that underpin energy conversion processes, electronic devices, and computational hardware applications. It provides both theoretical foundations and practical laboratory experience to develop a deep understanding of physical phenomena and their applications.

Course objective

Through this course students should be able to:

- Understand and apply the principles of classical mechanics
- Analyze electrostatic and magnetostatic phenomena using vector calculus and integral theorems.
- Explore the foundational concepts of electromagnetic theory, including Maxwell's equations and their physical implications.
- Grasp the basic principles of quantum mechanics
- Develop an understanding of solid-state physics, including band theory, semiconductors, and charge carrier dynamics.
- Connect theoretical concepts to practical energy-related applications.

Course contents

Module	Topic	L	T	P
1	**Classical Mechanics:** Review of Newtonian Mechanics In Rectilinear Coordinate System, Rigid Body, Translational and Rotational Motion, Moment of Inertia, Radius of Gyration, Kinematics of Rotational Motion About Fixed Axis (Parallel Axis and Perpendicular Axis Theorem), Simple Harmonic Motion (SHM), Phaser Representation of SHM, Simple Pendulum and Compound Pendulum, Damped Harmonic Oscillator- Heavy, Critical and Light Damping, Energy Decay In Damped Harmonic Oscillator, Quality Factor.	7	1	
2	**Electrostatics** Coordinate Systems: Cartesian, Cylindrical and Spherical, Transformation of Coordinate Systems, Gradient of a Scalar, Divergence and Curl of a Vector; Line Integral, Surface Integral and Volume Integral, Gauss Divergence Theorem and its Applications, Stokes Theorem and its Applications, Charge Distribution along Line, across Surface and Over Volume, Gauss's Law and its Applications, Electric Field Due to Uniformly Charged Infinitely Long Wire, Electric Field Due to : Thin Infinite Plane Sheet, Infinite Parallel Sheets, Uniformly Distributed Charged Spherical Shell and Non-Conducting Charged Solid Sphere, Working and Principle of Potentiometer and Wheatstone Bridge.	8	2	
3	**Magnetostatics** Bio-Savart Law and Its Application, Magnetic Field Due to Current Carrying Conductor, Magnetic Field at the Centre and at the Axis of Circular Coil Carrying Current, Magnetic Flux, Gauss`s Law in Magneto Statics, Ampere`s Circuital	7	2	

	Law and its Applications, Magnetic Induction Due to Long Linear Conductor, Magnetic Field Due to Long Circular Cylinder, Equation of Continuity, Concept of Displacement Current, Modified Ampere Circuital Law, Qualitative discussion of magnetic field in presence of magnetic materials.			
4	**Electromagnetic theory** Scalar and vectors fields, concept of gradient, divergence and curl, dielectric constant, Gauss theorem and Stokes theorem (qualitative), Poisson and Laplace equations, continuity equation, Maxwell electromagnetic equations (differential and integral forms), physical significance of Maxwell equations, Ampere Circuital Law, Maxwell displacement current and correction in Ampere Circuital Law, Impedance, Poynting vector and Energy density in EM waves.	6	2	
5	**Introduction to Quantum Mechanism:** Prerequisite of Quantum Theory, Concept of Black Body Radiation, Wien's Displacement Law, Rayleigh Jeans Hypothesis, Planck`s Hypothesis, Wave Particle Duality; Photoelectric Effect; De-Broglie Hypothesis; Experimental Evidence of Matter Waves (Davisson-Germer Experiment), Compton Effect, Uncertainty Principle and its Applications.	5	1	
6	**Solid State Physics:** Free electron theory (Introduction), diffusion and drift current (qualitative), fermi energy, Weidmann Franz Law, Bose Einstein and Fermi Dirac Statistical Distribution Function, theory of solids -formation of allowed and forbidden energy bands, concept of effective mass - electrons and holes, Hall effect (with derivation), semiconductors and insulators, fermi level for intrinsic and extrinsic semiconductors, direct and indirect band gap semiconductors, Concept of Doping in Semiconductors, P-Type and N-Type Semiconductors, Carrier Concentration, Electrical Conductivity and Mobility of Charge Carriers in Intrinsic and Extrinsic Semiconductors. solar cell basics	7	2	
7	**Introduction to Electromagnetic Theory** • To Calculate the Moment of Inertia (M.I) of M.I. Table Using Solid Metallic Objects such as Cube, Cone, Cylinder, And Sphere. • To Determine the M.I. and Energy Lost Per Revolution of the given Fly Wheel by Measuring Time Interval. • To Determine the Spring Constant (k) of a Given Spring By Static Method. • To Determine the Spring Constant (k) of a Given Spring By Dynamic Method. • Experiments on electromagnetic induction and electromagnetic braking; • LC circuit and LCR circuit; • Resonance phenomena in LCR circuits; • Magnetic field from Helmholtz coil; • Measurement of Lorentz force in a vacuum tube.			20
	Total	40	10	20

Evaluation criteria
Minor test 1: 15% (at the end of module 2)
Minor test 2: 15% (at the end of module 4)
Practical records and performance of practicals: 10%
Practical exam: 10%
Major test: 50% (at the end of the semester)

Learning outcomes
Upon successful completion of the course, students will be able to:
- Understand the principles of energy generation, conversion, and conservation in various physical systems.
- Evaluate energy and momentum flow in electromagnetic fields using the Poynting vector.
- Relate electromagnetic theory to real-world energy technologies and devices.

- Analyze electrical circuits and electromagnetic systems relevant to energy applications.
- Interpret data from energy-related experiments and use it to validate theoretical models.
- Understand the role of semiconductors and electronic devices in energy systems and computing.
- Utilize basic quantum and solid-state physics concepts in the context of modern energy technologies.
- Develop problem-solving skills using computer-based simulations and numerical methods.

Pedagogical approach

A combination of class-room interactions, expert lecture, assignment, tutorial, practical and case study

Textbooks / References:

1. Introduction to Quantum Mechanics by David J. Griffiths
2. Introduction to Solid State Physics: Charles Kittel
3. Introduction to Electrodynamics By David J. Griffith, Fourth Edition, (2015)
4. Concepts of Modern Physics by Arthur Beiser
5. Engineering Physics by A. Nag A. B. Bhattacharya 2021
6. Physics by Halliday and Resnick
7. The Feynman Lectures on Physics by Feynman Richard P.

Additional information (if any): NA

Student responsibilities

Adopt peer learning and knowledge sharing within the class, attendance, feedback, discipline: as per university rules

Course prepared by:

Dr. Ramkishore Singh

Course Reviewer(s):

1. Prof. Zishan Husain Khan
   Department of Applied Sciences & Humanities, Faculty of Engg. & Tech
   Jamia Millia Islamia, New Delhi
2. Prof. Atul Sharma
   Department of Sciences and Humanities
   Rajiv Gandhi Institute of Petroleum Technology,
   Jais, Amethi (U.P.)

Course title: Applied chemistry for Energy				
Course code: ECA XXX		No. of credits: 4	L-T-P: 40 -10 -20	Learning hours: 70
Pre-requisite course code and title (if any): N/A				
Department: Sustainable Engineering				
Course coordinator: Prof Naqui Anwer		Course Instructor:		
Contact: naqui.anwer@terisas.ac.in				
Course type: Core		Course offered in: Semester 1		

Course description

This course is to acquaint the students with the basic phenomenon/concepts of chemistry which the student faces during the course of their study in the industry and field of applied science. The students, with the knowledge of basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry and field related to energy. The student will be able to understand the new developments and breakthroughs efficiently in energy and computational applications. The introduction of the latest (R&D oriented) topics will make the students upgrade with the new technologies.

Course objective
To provide comprehensive knowledge of atomic and molecular structure
To understand principles of spectroscopy and Spectro chemistry in detail.
To provide knowledge of free energy in chemical equilibrium.

Course contents

Module	Topic	L	T	P
1	**Atomic and Molecular Structure** Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	6	0	0
2	**Spectroscopic techniques and applications** Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in energy. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.	6	0	0
3	**Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.	4	0	0
4	**Use of free energy in chemical equilibria** Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energy. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.	6	4	0
5	**Periodic properties** Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	6	4	0

6	**Stereochemistry** Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds.	6	0	0
7	**Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclisation and ring openings. Synthesis of a commonly used drug molecule.	6	2	0

8	**Practicals**
	  1. Determination of surface tension and viscosity.
	  2. Thin layer chromatography.
	  3. Ion exchange column for removal of hardness of water.
	  4. Determination of chloride content of water.
	  5. Colligative properties using freezing point depression.
	  6. Determination of the rate constant of a reaction.
	  7. Potentiometry - determination of redox potentials and emfs.
	  8. Synthesis of a polymer/drug.
	  9. Saponification/acid value of an oil.
	  10. Chemical analysis of a salt.
		0	0	20

	Total	40	10	20

Evaluation criteria

Minor test 1: 20% (at the end of module 1&2)

Minor test 2: 20% (at the end of module 3&4)

Practical records and performance of practicals: 10%

Practical exam: 10%

Major test: 40% (at the end of the semester)

Learning outcomes

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

- To analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- To rationalize bulk properties and processes using thermodynamic considerations.
- To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
- To rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- To list major chemical reactions that are used in the synthesis of molecules.
- To estimate rate constants of reactions from concentration of reactants/products as a function of time.
- To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
- To synthesize a small drug molecule and analyze a salt sample.

Pedagogical approach

A combination of class-room interactions, expert lecture, assignment, tutorial, practical and case study

Textbooks / References:

1. Engineering Chemistry, by Manisha Agrawal
2. University chemistry, by B. H. Mahan
3. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
4. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
5. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
6. Physical Chemistry, by P. W. Atkins
7. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

Additional information (if any): NA

Student responsibilities
Adopt peer learning and knowledge sharing within the class, attendance, feedback, discipline: as per university rules
Course prepared by:
Prof. Naqui Anwer
Course Reviewer(s):
1. Dr Richa Kothari
Professor & Head, Deptt. of Environmental Sciences
Central University of Jammu
2. Dr Raquib Alam
Assistant Professor at University Polytechnic
Faculty of chemistry, Jamia Millia Islamia, New Delhi

Course title: Applied Mathematics – I				
Course code: ECA XXX		No. of credits: 4	L-T-P: 46 -14 -0	Learning hours: 60
Pre-requisite course code and title (if any): N/A				
Department: Sustainable Engineering				
Course coordinator: Prof Naqui Anwer		Course Instructor:		
Contact: naqui.anwer@terisas.ac.in				
Course type: Core		Course offered in: Semester 1		

Course description

The goal of this course is to achieve conceptual understanding and to retain the best traditions of basic calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling computational problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in understanding concepts of science, engineering, economics and computer science, among other disciplines.

Course objective
- To understand the fundamentals of calculus for energy and computer applications.
- To solve numerical problems on single and multivariable calculus.
- To learn calculating liner approximation, error estimates, maxima, minima and saddle points.
- To solve computational problems on single, double and triple integrals.

Course contents

Module	Topic	L	T	P
1	**Basic Calculus** Curvature, evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate length of curves, surface areas and volumes of solids of revolutions.	10	2	0
2	**Single variable Calculus (Differentiation)** Rolle's theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule.	8	2	0
3	**Sequences and series** Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates.	8	2	0
4	**Multivariable Calculus (Differentiation)** Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.	10	4	0
5	**Multivariable Calculus (Integration)** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface Gauss and Stokes.	10	4	0
	Total	46	14	0

Evaluation criteria

Minor test 1: 20% (at the end of module 1&2)
Minor test 2: 20% (at the end of module 3&4) Assignment: 10% (at the end of module 1, 2 &3) Major test: 50% (at the end of the semester)

Learning outcomes

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

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.   - The fallouts of Rolle's Theorem that is fundamental to the application of analysis to computational problems.   - The tool of power series and Fourier series for learning advanced energy & computational Mathematics.   - To deal with functions of several variables that are essential in most systems.   - To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

Pedagogical approach

A combination of class-room interactions, expert lecture, assignment, tutorial, practical and case study

Textbooks / References:

1. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing, 2023.
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing, 2023.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Additional information (if any): NA

Student responsibilities

Adopt peer learning and knowledge sharing within the class, attendance, feedback, discipline: as per university rules

Course prepared by:

Prof. Naqui Anwer

Course Reviewer(s):

1. Dr. Obaidur Rahman

Assistant Professor, Deptt. of Electrical Engineering,

Zakir Hussain College of Engineering & Technology, Aligarh Muslim University, Aligarh

2. Prof. Sujatha Varma

Professor of Mathematics, School of Sciences (SOS)

IGNOU, New Delhi

Overall Rationale

- Both courses Agri-PV and BIPV are planned to be offered as electives in REEM (part of GIZ sponsored projects)
- Course Outlines developed based on learnings made during recently concluded workshops, extensive literature review, stakeholder discussions and perusal of course structures developed by IIT Roorkee (shared by GiZ)

Load of 1-Credit

- In the past, REEM introduced subjects on evolving technologies/ applications (like Carbon, EV, GH2, Storage) all with an academic load of 1 Cr
- This was to create an interest among the student community and test their uptake
- Topics under 'Other RETs' (Tidal, Wave, OTEC) also have a size of 0.5 credits (under course ENR 164)
- Course outlines shall be improved upon/ restructured based on learning outcomes, student feedback and market developments (technological, policy) in both these sectors. This will ensure that curriculum remains aligned with industry trends and meet the stakeholder aspirations (both students and companies).

To be offered in Sem-II

- The courses are intended to be offered in Sem-II due to sufficient time available with students (credit load is not very high)
- Sem-I would be too early –
- By Sem-II, students would have got understanding on basics (tech, resource, policy) – enable them grasp these subjects with ease
- Courses on new tech (Carbon, EV, GH2, Storage) are being offered in Sem-II
- Sem-III is packed in terms of credit load (this pertains to both REEM as well as most other programmes)

As an Elective

- The courses are to be offered as an Elective so that only the interested students opt for them

Course Outlines

Course title: Building Integrated Photo-Voltaics (BIPV)					
No. of credits: 1	**L-T-P**: 12-03-00		**Learning hours:** 15		
Pre-requisites: NA					
Course type: Elective					
Course description The course has been designed to provide a comprehensive overview on Building-Integrated Photo-Voltaics (BIPV), an upcoming solar application that combines energy generation with architectural design. Students will get acquainted with BIPV applications, in terms of potential, technology, policies, techno-commercial assessment, design, implementation and O&M aspects.					
Course objectives Upon completing this course, students will: ▪ Gain foundational knowledge on BIPV and its role in sustainable building practices ▪ Explore various stages of BIPV project development, from site assessment to system optimization, focusing on practical applications ▪ Develop an ability to assess techno-commercial viability of BIPV projects ▪ Appreciate how BIPV systems enhance building design and reduce carbon footprint					
Course content					
Module	**Topic**			**L**	**T**	**P**

1	**Overview on Solar Energy and BIPV Technology** • Solar Energy Development Trends • Basics on Solar Technology, Components (Cells, Panels, Inverters, Batteries, Structures) • Project configuration modes - Utility Scale, DERs, Off-grid, rooftops • Evolution of BIPV and BaPV • BIPV Case Studies on National and International Projects • Building Rating Systems and Concept of Net Zero Energy Buildings	4		
2	**BIPV Project Design, Development & Management** • Understanding building characteristics and energy demand • Assessing BIPV Potential - Green and Brown field development • BIPV Project Configuration - Roof-integrated, Façade-integrated, Window-integrated and Shading-integrated • Material Selection based on building design and local climate (like solar shingles, solar glass) • Estimating Power Output and Energy Payback Time • Relation between sustainability and architectural aspects (influence of BIPV on thermal loads and daylighting) • Project Maintenance and Safety Considerations	4		
3	**Policy & Economic Aspects** • Policies, Regulations, and Standards- Global and Indian • Financing Models- Subsidies, Grants, Fiscal Instruments, Business Models (RESCO/ CAPEX) • Feasibility Assessment- Installation costs, Payback Period, LCOE, NPV • Life Cycle Assessment (LCA)- Environmental Impact, Carbon Footprint Reduction	4		
4	**Practical Sessions & Capstone Project** • Hands-On Experience using Software Tools • Capstone Project for designing a BIPV Plant • Field Visit to BIPV Projects (as and when possible)		3	
		12	**03**	**0**

Evaluation criteria (Percentage)

Test 1   20
Test 2   20
Project/ Assignment   30
Test 3   30

Learning outcomes

After completing this course, the students would:
▪ Get an overview on BIPV technology, components and applications
▪ Understand BIPV resource assessment and project design
▪ Assess BIPV system performance, energy yield, and its sustainability aspects
▪ Undertake techno-enviro-economic assessment for BIPV projects

Pedagogical approach

The course will be delivered through classroom lectures. Relevant case studies shall be discussed in class to expose students on the latest project management techniques and the students can share their work on hypothetical projects via presentations.

References / Reports/ Web Sources

- Analysis of Technological Innovation Systems for BIPV in Different IEA Countries" by IEA, 2025
- "Sustainable Homes: Potential of BIPV to Reshape India's Urban Architecture" By Shantanu Roy, published by Center for Study of Science, Technology and Policy (CSTEP), July 2024
- "Guidelines on BIPV for India", published and prepared by GIZ, May 2025
- "Building Integrated and Urban PV in India", published and prepared by GIZ, January 2024
- "Global Market Outlook for Solar Power 2023-2027", by Solar Power Europe, June 2023
- "Building resilient global solar PV supply chains", by International Solar Alliance, April 2023
- "Building Integrated Photovoltaics: A practical handbook for solar building", stakeholders, Report by SUPSI – Swiss BIPV Competence Centre, 2020
- "Future of Solar Photovoltaic: Deployment, investment, technology, grid integration and socioeconomic aspects" by International Renewable Energy Agency, November 2019
- "Solar Electric System Design, Operation and Installation", by Washington State University, October 2009
- "Building Integrated Photovoltaic Power Systems, Guidelines for Economic Evaluation" prepared by the International Energy Agency, 2002
- "Photovoltaic Power Systems Programme" reports and publications, on solar technologies and module types, prepared by the International Energy Agency
- WBDG (Whole Building Design Guide) - Information on Building-Integrated Photovoltaics (BiPV). Link: https://www.wbdg.org/resources/building-integrated-photovoltaics-BiPV
- Natural Resources Canada - Overview of solar photovoltaic energy in buildings, including BiPV. Link: https://natural-resources.canada.ca/energy-efficiency/data-research-insights-energy-efficiency/buildings-innovation/solar-photovoltaic-energy-buildings/building-integrated-photovoltaics/21280
- NREL Sourcebook - "Building-Integrated Photovoltaic Designs for Commercial and Institutional Structures: A Sourcebook for Architects," providing detailed insights into BiPV systems for architects and engineers. Link: https://www.nrel.gov/docs/fy00osti/25272.pdf
- STAAI - Solar Technology & Application Atlas of India- provides resources and information related to sustainable technology, including BiPV systems. Link: https://staai.cstep.in/staai/

Books

- Building-Integrated Photovoltaics for Commercial and Institutional Structures: A Sourcebook for Architects and Engineers, by Patrina Eiffert, Ph.D. and Gregory J. Kiss, NREL, USA
- Building Integrated Photovoltaic Systems (BIPV) Testing and Certification, e-book, by UL Solutions
- Solar Skyscrapers: Transforming India's Buildings with BIPV Innovation by Dr. Pierluigi Bonomo.
- Photovoltaics in Buildings, 'A Design Handbook for Architects and Engineers' by International Energy Agency
- Large-scale solar power systems, Construction and Economics By Peter Gevorkian, Published by: Cambridge University Press

Additional information (if any):
The student opting for this course must have a bachelor's degree in any of the following fields: Science, Mathematics, Environmental Science, Engineering, Energy, Biotechnology, Applied Sciences, Economics, Management.

Student responsibilities

The students are expected to be regular in class, participate in discussions, submit assignments on time and come prepared with the presentations as and when asked for.

Course Outline Prepared by -
Dr Sapan Thapar, Faculty, TERI SAS

Course Outline Reviewed by -
- **Dr Mayank Bhatnagar, Associate Director, Environmental Design Solutions**
- **Mr Shantanu Roy, Sector Coordinator, Renewables and Energy Conservation, C-STEP**

Course title: Agri-Photovoltaics (Agri-PV)			

No. of credits: 1	L-T-P: 12-03-00	Learning hours: 15

Pre-requisites: NA

Course type: Elective

Course description

Agri-Photovoltaics, an upcoming application of solar energy, provides an important opportunity to co-optimize energy yield and agricultural output, thus enabling an increase in farmers' income, while generating clean energy.
The course has been designed to provide an insight to students on different aspects of this evolving application.
It intends to familiarize students with the science and technology behind it, resource potential, policy structure, project design and configuration, socio-enviro impacts, besides exposing them to innovative business models.
Students will learn an Agri-PV project is developed, considering the associated risk factors and their effective management.

Course Objectives
- Appreciate relevance and potential of AgriPV for India
- Exposure to policy structure, market trends as well as case studies
- Overview on scientific, technological and project design aspects
- Understand techno-commercial viability of Agri-PV projects
- Fathom associated social and environmental impacts (Energy vs Crop yield)
- Gain insight on operational and managerial aspects of AgriPV projects

Course content

Module	Topic	L	T	P
1	**Introduction to Solar Energy & Agri-PV Concept** • Development trends of Renewable Energy Sector including solar energy • Overview on Solar PV technologies, type of solar cells, components of PV System and Sizing, distribution and control • Solar Applications in different sectors, issues and challenges • Importance of distributed solar generation • Introduction to AgriPV Concept– Definition, History / Evolution, Technology, Relevance, Potential, Opportunities, and challenges, types of AgriPV systems	3		
2	**Project Development Aspects** • Potential assessment based on land use, crop type, climate, solar insolation • Techno-economic evaluation/ Cost-benefit analysis (LCOE, IRR, NPV) • Agri-PV Project Configurations and Business models (RESCO/ FPO/ Investor led) • National and international policies (KUSUM, State Schemes)	4		
3	**Environmental and Social Impacts** • Life Cycle Assessment (LCA)- Environmental Impact, Carbon Footprint Reduction, resource productivity, carbon credits • Elaborate on impact on food water energy nexus • Empowering farmer communities/ Creation of jobs/ increase in farmer income • Enabling value add via post production processing.	2		
4	**Scientific methods for Agrvoltaics design** • Basic theory on how solar panels affect crop growth & vice versa • Focus on synergies between Agri & Solar • Optimize Agri PV design for maximizing crop yield and solar generation	2		

4	**Case Studies/ Capstone Project** • Analyzing national and international projects • Working on a capstone project - site selection, study cropping pattern and solar insolation, design of suitable project configuration (can use IT tools), develop appropriate business model and undertake LCA analysis • Field visit to Agri-PV site (whenever possible)	1	3	
		12	**03**	**0**

Evaluation criteria (Percentage)

Test 1	20
Test 2	20
Project/ Assignment	30
Test 3	30

Learning outcomes

After completing this course, students would be able to assess:
- Concept and technologies involved in an Agri-PV project
- Methodology to undertake site-assessment for a project
- Project development related aspects, including cost-benefit analysis

Enviro-socio challenges associated with an Agri-PV project

Pedagogical approach

The course will be delivered through classroom lectures. Relevant case studies shall be discussed in class to expose students on the latest project management techniques and the students can share their work on hypothetical projects via presentations.

References / Reports/ Web Sources

- STAAI - Solar Technology & Application Atlas of India- provides resources and information related to sustainable technology, including Agri-PV. Link: https://staai.cstep.in/staai/
- Dual Land Use for Agriculture and Solar Power Production: Overview and Performance of Agrivoltaic Systems by IEA, 2025.
  https://iea-pvps.org/key-topics/dual-land-use-agriculturesolar-power-production/
- Agrivoltaics in India: Challenges and opportunities for scale-up by IISD, 2023.
  https://www.iisd.org/system/files/2023-05/agrivoltaics-in-india.pdf
- Agrivoltaics in India: Overview of projects and relevant policies by NSEFI and IGEF, 2023.
  https://energyforum.in/fileadmin/india/media_elements/Photos_And_Gallery/20201210_SmarterE_AgroPV/20201212_NSEFI_on_AgriPV_in_India_1__01.pdf
- Agrivoltaics in India by GIZ, 2024. https://staai.cstep.in/staai/assets/manual/APV.pdf
- India Energy Scenario 2023-24, BEE, Ministry of Power
- Types of Solar Cells and Applications, Mohsen, August 2015
- Integrated Value Chain Approach for Agrivoltaic Systems, CSTEP, February 2024
- AgriPV – an introduction, ISES
- Agrivoltaics In India, IEEFA, December 2021
- Agrivoltaics: Opportunities for Agriculture and the Energy Transition, Fraunhofer, February 2024

Books
- Muñoz-García, M.-Á., & Hernández-Callejo, L. (n.d.). Photovoltaics and Electrification in Agriculture. www.mdpi.com/journal/agronomy

Additional information (if any)
The student must have a bachelor's degree in any of the following fields: Science, Mathematics, Environmental Science, Engineering, Energy, Biotechnology, Applied Sciences, Economics, Management.

Student responsibilities
The students are expected to be regular in class, participate in discussions, submit assignments on time and come prepared with the presentations as and when asked for.

Course Outline Prepared by -
Dr Sapan Thapar, Faculty, TERI SAS

Course Outline Reviewed by -
- Dr TK Khura, Principal Scientist, Division of Agricultural Engineering, ICAR-IARI, New Delhi
- Mr Shantanu Roy, Sector Coordinator, Renewables and Energy Conservation, C-STEP
- Mr Vivek Saraf, Founder & CEO, SunSeed APV (An Agri-PV Company)

Course Title: Applied Machine Learning				
Course Code:	**No. of credits:** 4	**L-T-P:** 30-15-30		**Learning hours:**
				L: Lectures**; T:** Tutorials**; P:** Practical
Pre-requisite Course Code and Title (if any):				
Department: Natural and Applied Sciences				
Course Coordinator: Dr. Priyanka Singh		**Course Instructor:**		
Contact Details: priyanka.singh@terisas.ac.in				
Course Type:		**Course Offered in:** Semester-3		

Course Description

The course bridges that gap by emphasizing applied, intuitive, and tool-based learning, with gradual exposure to coding (Python). The focus is on practical applications, conceptual understanding, and low-code/no-code tools, progressing gradually to basic coding with Python.

Course Objectives

- Understand the basic concepts of machine learning and data science
- Apply ML techniques to solve real-world problems in climate, environment, and resource management
- Use data visualization and basic analytics to inform policy and decision-making
- Work with real environmental datasets (e.g., climate data)
- Build and interpret simple ML models using no-code/low-code tools and Python

Course Content

Module	Topic	L	T	P
1	**Introduction to Machine Learning (ML) and Artificial Intelligence (AI)**			
	This module introduces the basic concepts of machine learning (ML) and data science and application of ML techniques to solve real-world problems in climate, environment, and resource management. Following topics are as follows: Introduction to ML and AI in Environmental and Climatic Sciences – Definitions of AI, ML, Data Science, Big Data, Historical evolution of ML in climate studies, Importance of ML in environmental and climate studies; Case studies: ML for predicting floods, air pollution, crop yield, etc.	6	2	2
2	**Introduction to Python**			
	This module helps students in learning in performing basic coding tasks and data visualization using Python in Google Colab or Jupyter Notebooks. The major topics will include:	8	3	8

	Introduction to Jupyter Notebooks and Google Colab; Python basics: variables, loops, data structures; Using pandas for data manipulation, Visual analytics: Line plots, histograms, scatter plots			
3	**Understanding Machine Learning: Supervised vs Unsupervised**			
	This module focuses to build and interpret simple ML models and applying machine learning models (regression, classification, clustering) to real environmental datasets. The topics as follows: Core concepts: features, labels, training, testing; Conceptual understanding of regression and classification; Supervised - Regression, Classification, and Unsupervised - Clustering, Dimensionality Reduction; Confusion matrix and model evaluation	8	8	12
4	**Applications of Machine Learning**			
	This module provides a comprehensive introduction to deep learning and neural networks, along with its application in environmental and climate science. Following topics will be covered in course delivery: Real-world applications: Image recognition for environmental monitoring; Teachable Machine demo: Train your own image classifier; Meteostat & CliMetLab; OceanParcels; TorchGeo; Air Temperature Downscaling; ClimaX; Case-based Discussion: Can AI and ML replace environmental scientists?	8	2	8
	Total	**30**	**15**	**30**

Practical Sessions	Tools Overview; Data handling and pre-processing	-	-	6
	Data Visualization; Regression and Classification Modelling			8
	Unsupervised ML modelling	-	-	8
	Real-world case studies	-	-	8
	Total Practical Sessions	**-**	**-**	**30**

Evaluation Criteria

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

Learning Outcomes

By the end of the course, students will:

- Explain the basic principles of machine learning and data science.
- Use tools for data analysis and visualization.
- Apply machine learning models (regression, classification, clustering) to real environmental datasets.
- Perform basic coding tasks using Python in Google Colab or Jupyter Notebooks.

Pedagogical Approach

- The course will provide blended learning approach - lecture-based instruction, hands-on labs & coding assignments, flipped classroom and Project-Based Learning (PBL)
- The course is dedicated to Concept-first, code-later approach
- This course will have formative assessments (mini-projects, coding exercises), summative assessments (Mid-term and final project evaluations), and continuous evaluation.

Reading Resources (* = compulsory readings)

- * Andreas C. Müller & Sarah Guido. (2016). *Introduction to Machine Learning with Python.* Greyscale Indian Edition
- *Jerry D. Davis. (2023). *Introduction to Environmental Data Science.* Chapman and Hall/CRC
- *Julian, David. (2016). Designing Machine Learning Systems with Python. Packt Publishing
- Jung, Alexander. (2022). Machine Learning: The Basics. Springer
- Kelleher, J. D., Mac Namee, B., & D'arcy, A. (2020). Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies. MIT press.

Coding Practice & Interactive Platforms

- Free platforms: Google Colab, Teachable Machine

Student Responsibilities: The students are required:

- To be regular and attentive in theory classes and lab sessions
- To come prepared with readings that would be given in the theory class
- To come prepared in lab with readings from respective theory concepts taught in class
- To sincerely participate in the day-to-day lab activities
- To incorporate real-word datasets as case-studies in project-based learning
- To submit assignments and project works on or before the deadlines

Course Designed by:

- Dr Priyanka 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. Dharmveer Singh Rajpoot, Professor, School of Engineering and Technology, Central University of Punjab, Punjab.
- Dr. Tanupriya Choudhury, Professor, School of Computer Science, UPES, Uttarakhand

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
VAC 106	Constitutional Values and Fundamental Duties	VAC	2
UES XXX	Sustainability Communication	Minor	3
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	3
	Vocational course/ Summer internship (8-weeks) to Exit with UG-Certificate	Vocational/ Internship	4
Semester 3		**Total credits = 22**	
UES 201	Sustainable Built Environment	Major	3
UES 203	Biodiversity Conservation	Major	3
UES 205	Soil Conservation and Management	Major	3
UES 207	Conventional and Renewable Energy Resources	Minor	3
MDC 201	Environmental Statistics	MDC	4
AEC 201	Modern Indian Language 2	AEC	3
SEC 201	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 = 20**	
UES 202	Sustainable Natural Resource Management	Major	4
UES 204	Environmental Policy, Law and Governance	Major	4
UES 206	Water and Soil Pollution	Major	4
UES 208	Environmental Laboratory-I	Major	3
UES 210	Spatial Data Modelling and Analysis	Minor	3
UES 212	Global Climate Change	Minor	2

	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 with UG-Diploma	Vocational/ Internship	4
Semester 5		**Total credits = 20**	
	Solid and Hazardous Waste Management	Major	4
	Water and Wastewater treatment	Major	4
	Introduction to Environmental and Resource Economics	Major	4
	Atmosphere and Ocean	Minor	4
	Software Engineering	Minor	4
	Any Major Course from Economics/ Management/Data Science can also be taken as Minor	Minor	4
Semester 6		**Total credits = 22**	
	Research Methodology and Ethics	Major	2
	Natural Hazards and Disaster Risk Reduction	Major	4
	Coastal and Marine Environment	Major	3
	Air and Noise Pollution	Major	4
	Environmental Laboratory-II	Major	2
	Science Policy and Sustainability Communication	Minor	4
	Digital Image Processing	Minor	3
	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 3-Years BSc Degree	Vocational/ Internship	4
Semester 7		**Total credits = 20**	
	Climate Science and Policy	Major	4
	Integrated Watershed Management	Major	4
	Environmental Health and Risk Assessment	Major	4
	Geocomputation	Minor	4
	Agriculture and Forest Management	Minor	4
	Development and Resource Economics	Minor	3
	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 modelling	Major	4
	Geospatial Applications for Resource Management	Minor	4
	Geopolitics 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 Studies	Vocational/ Internship	4*

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
MDC 101	Environment and Society	MDC	2
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/ Environmental Studies can also be taken as Minor	Minor	3
	Vocational course/ Summer internship (8-weeks) to Exit with UG-Certificate	Vocational/ Internship	4
Semester 3		Total credits = 22	
UDS 201	Data Wrangling and Visualization	Major	3
UDS 203	Cybersecurity	**Major**	**3**
UDS 205	Data Mining and Analysis	Major	3
MDC 201	Environmental Statistics	MDC	4
AEC 201	Modern Indian Language 2	AEC	3
SEC 201	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	
UDS201	Time Series Analysis in Data Science	Major	4
UDS204	Open Source Programming	Major	4
UDS206	Network Science	Major	4
UBA 202	Management Information System	Major	4
UES 210	Spatial Data Modelling and Analysis	Minor	3
UES 212	Global Climate Change	Minor	2
	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 with UG-Diploma	Vocational/ Internship	4
Semester 5		**Total credits = 20**	
	Machine Learning and Applications	Major	4
	Software Engineering	Major	4
	Java Programming and Web Technologies	Major	4
	Atmosphere and Oceans	Minor	4
	Any Major Course from Economics/ Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 6		**Total credits = 21**	
	Deep Learning	Major	4
	Big Data Analytics	Major	4
	Natural Language Processing	Major	4
	Research Methodology and Ethics	Major	2
	Digital Image Processing	Minor	3
	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 3-Years BSc Degree	Vocational/ Internship	4
Semester 7		**Total credits = 20**	
	Computer Vision	Major	4
	Blockchain Technology	Major	4
	Cloud Computing: Architecture & Deployment	Major	4
	Geocomputation	Minor	4
	Strategic Management	Minor	4
	Any Major Course from Economics/Management/Environmental Studies can also be taken as Minor	Minor	4
Semester 8		**Total credits = 22**	
	Soft Computing	Major	4
	Robotics and Internet of Things	Major	4
	Generative AI	Major	4
	Geospatial Applications for Resource Management	Minor	4
	Environmental Modeling	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

Course Title: Introduction to Environmental and Resource Economics			
Course code:	**No. of credits: 4**	**L-T-P: 48-12-0**	**Learning hours: 60**
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 5	

Course Description
This undergraduate course provides a foundation in economic principles for students from diverse backgrounds to explore and address global environmental challenges. Students will learn to apply economic tools, analyze policies, and use decision-making frameworks to address critical issues such as natural resource depletion, unsustainable agricultural practices, pollution, energy security, and climate change.

Course objectives
The course aims to build the following basic understanding among students:
- Explore the fundamentals of environmental economics and resource management.
- Examine worldwide challenges - such as natural resource depletion, pollution, and climate change - through an economic perspective.
- Foster foundational skills such as conducting cost-benefit analyses and valuing non-market goods
- Assess the economic impacts of various environmental policies.

Course content

Module	Topic	L	T	P
1	**Foundations of Economics**			
	Being introductory, this module builds a general foundation by highlighting the following basic economic principles: Key microeconomic and macroeconomic concepts: demand, supply, market equilibrium, pricing mechanisms and elasticities, income and inequality, global markets, Gross Domestic Product (GDP), Gross National Product (GNP), Green-GDP; Limits to growth and sustainable development.	12	4	0
2	**Core Environmental Economics Concepts**			
	This module introduces students to economic concepts and analytical tools essential for environmental decision-making: Net Present Value (NPV), externalities and market failure; pure public goods; introduction to cost-benefit analysis for environmental decision-making (cost of action vs inaction), opportunity cost; Environmental Kuznets Curve (EKC)	6	2	0
3	**Economic Valuation of Environmental Goods and Services**			
	This module introduces economic concepts and analytical tools essential for valuation of environmental goods and services: Willingness to Pay (WTP) and Willingness to Accept (WTA); Economic valuation of environmental goods and services (e.g., hedonic pricing, contingent valuation, etc.)	8	0	0
4	**Key Principles of Natural Resource Economics**			
	This module introduces the key principles of natural resource economics, focusing on balanced and efficient consumption. The contents of this module are as follows: Economic approaches to sustainable and efficient use of natural resources, demand and scarcity, trade-offs in resource allocation, optimal use of non-renewable resources and resource depletion, renewable resources – optimal harvest; Pareto efficiency	8	2	0

5	**Economics of Environmental Regulation**			
	This module introduces students to the economic aspects of controlling environmental pollution. The contents of this module are as follows: Economic instruments and mechanisms for pollution control (taxes, permits and subsidies), polluter pays principle, regulatory approaches: standards vs. market-based incentives, transboundary pollution issues and global cooperation frameworks.	6	0	0
6	**Economics of Climate Change**			
	This module exposes students to the economic aspects of climate change, mitigation and adaptation, and planning for carbon reduction. The contents of this module are as follows: Economic impacts of climate change on agriculture, ecosystems, and human societies; economics of mitigation and adaptation measures (e.g. social cost of carbon); policy tools for carbon reduction: carbon pricing mechanisms (e.g., carbon tax and cap-and-trade), emissions trading systems	8	4	0
	Total	48	12	0

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 modules 3 and 4] -- 15%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment and Presentation: Term paper -- 30%

Learning outcomes
Upon completion of the course, the students will be able to
- understand and explain fundamental environmental economics concepts and their application to critical issues [Minor Tests, Major Test]
- develop skills to evaluate environmental policies using economic tools [Tests, Assignment and Presentation]
- apply economic reasoning to real-world case studies and understand policies addressing environmental challenges. [Assignment and Presentation]

Pedagogical approach
- The course will be delivered through lectures, tutorials and discussion of case studies.
- The course will also include guided assignments and associated student presentations.

Reading resources
- Anderson, D.A. (2024). *Environmental economics and natural resource management*. Routledge.
- Bhattacharya, R. N. (2002). *Environmental economics: An Indian perspective*. Oxford University Press
- Conrad J.M. (1999) *Resource economics.* Cambridge University Press.
- Harris, J., & Roach, B. (2021). *Environmental and natural resource economics: A contemporary approach - international student edition* (5th ed.). Routledge.
- Karpagam, M. (2019). *Environmental economics: A textbook*. Sterling.
- Kerr J.M., Marothia D.K., Singh K., Ramasamy C., Bentley W.M. (1997) *Natural resource economics: theory and applications in India.* Oxford and IBH Company Private Limited.
- Muthukrishan, S. (2024). *Introduction to environmental economics* (3rd ed.). PHI Learning.
- Phaneuf, D. J., & Requate, T. (2016). *A course in environmental economics: Theory, policy, and practice*. Cambridge University Press.
- Tietenberg, T. H., & Lewis, L. (2024). *Environmental and natural resource economics*. Routledge
- Turner, R. K., Pearce, D., & Bateman, I. (1993). *Environmental economics: An elementary introduction*. Johns Hopkins University Press.

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 and case studies.

Course Designed By:

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

Course Reviewers

The course is reviewed by following reviewers:

- Dr Sangeeta Bansal, Professor, Centre for the Study of the World Economy, School of International Studies, Jawaharlal Nehru University, New Delhi
- Dr Chandan Singha, Associate Professor, Department of Economics, Hindu College, University of Delhi, Delhi

Course Title: Solid and Hazardous Waste Management				

Course code:	No. of credits: 4	L-T-P: 48-12-0	Learning hours: 60

Pre-requisite course code and title (if any): No

Department: Natural and Applied Sciences

Course coordinator:	Course instructor:
Contact details:	
Course type: Major	Course offered in: Semester 5

Course Description

This course provides a comprehensive understanding of solid waste management, covering waste generation, characterization, collection, treatment, disposal, and resource recovery. Students will explore municipal solid waste, hazardous waste, construction & demolition waste and e-waste, environmental and health implications of solid waste, regulatory frameworks, and technological advancements in waste treatment. The course emphasizes sustainable solid and hazardous waste management strategies, including waste minimization, circular economy approaches, and greenhouse gas mitigation techniques.

Course objectives

The course aims to develop students' understanding of:
- the sources, types, and composition of solid waste, along with global and local waste generation trends
- waste collection, sampling, and characterization methods, including associated health and environmental risks
- waste minimization strategies and resource recovery techniques for sustainable waste management
- hazardous waste management and solid waste treatment and disposal technologies including landfill design
- the interconnections between waste management and greenhouse gas emissions
- e-waste management strategies, and innovations in e-waste recycling

Course content

Module	Topic	L	T	P
1	**Introduction to solid waste**			
	This module introduces the key concepts of solid waste. General introduction including relevant definitions; types of waste; sources and composition of solid waste; global and local waste generation trends; overview of relevant laws and regulations, roles and responsibilities of MoEFCC; national programmes like SBM; health and environmental issues related to solid waste management.	6	1	
2	**Collection, sampling and characterization of solid waste**			
	This module covers waste collection systems, design factors, sampling techniques, health and safety protocols, environmental risks, and challenges in waste characterization. types of waste collection systems; factors influencing waste collection system design; sampling techniques; QA/QC issues and chain of custody; health and safety protocols during waste collection and sampling.	5	2	
3	**Solid waste treatment and disposal technologies**			
	This module covers waste treatment and disposal methods, including composting, thermal techniques, landfilling, resource recovery, and economic aspects of waste management.	8	2	

	composting; vermicomposting; autoclaving; microwaving; incineration; non-incineration thermal techniques; use of refuse derived fuels; landfilling.			
4	**Hazardous waste management**			
	This module introduces hazardous waste, including its definition, classification, sources, health and environmental impacts, treatment, disposal, storage, transport, and site remediation. definition, classification and sources of hazardous waste; biomedical waste handling and disposal; environmental and health impacts of hazardous waste; treatment and disposal methods; storage and transport; hazardous waste site remediation.	7	2	
5	**Waste minimization, resource recovery and plastic and e-waste management**			
	Students learn about waste reduction, resource recovery, recycling, industrial ecology and industrial symbiosis, e-waste characteristics, global generation trends, recycling innovations and system design for monitoring and segregation. waste reduction at source – municipal and industrial wastes; waste to energy; material and resource recovery/recycling from solid wastes; waste minimization and concept of industrial ecology and industrial symbiosis. definition and characteristics of plastic and e-waste; global trends in e-waste generation; innovations in e-waste recycling technologies; design of e-waste monitoring, segregation and recycling system; role of EPR and circular economy in reducing plastic and e-waste.	9	2	
6	**Waste management and Greenhouse Gas (GHG) emissions**			
	This module explores greenhouse gas emissions from waste management, including landfills and treatment technologies, and examines low-emission strategies and emerging technologies. key GHGs related to waste management, GHG emissions from landfills, GHG emissions from waste treatment technologies, organic waste management and GHG emissions; emerging technologies for low-emission waste management	6	1	
7	**Landfill design and operation**			
	This module covers landfill design and management, including site selection, construction, waste compaction, groundwater protection, gas emissions control, and post-closure monitoring. concept and purpose of landfills; landfill site selection criteria; landfill components; design standards and construction phases; compaction and layering of waste; groundwater contamination risks and management; gas emissions (methane) control and collection systems; monitoring and maintenance after landfill closure.	7	2	
	Total	48	12	

Evaluation criteria

- Minor Test I: Written test [at the end of teaching of modules 1, 2] -- 20%
- Minor Test II: Written test [at the end of teaching of modules 3, 4,5] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignments/Presentations: 20%

Learning outcomes

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

- understand the key concepts: learn the key concepts and regulations related to solid waste management and analyse waste generation, composition, and collection systems [Minor Test I and Major Test].

- gain analysis and investigation skills: evaluate waste minimization strategies and resource recovery techniques and assess the effectiveness of various waste treatment and disposal technologies [Minor Test II and Major Test].
- develop critical thinking and problem-solving skills: identify solutions to mitigate the environmental and health risks associated with hazardous waste and landfills [Minor Test II and Major Test].
- evaluate and assess: critically assess the effectiveness of e-waste management strategies and the role of waste management in GHG emissions [Minor Test II and Major Test].

Pedagogical approach
- The course will be delivered through lectures, tutorials, discussion of case studies and site visit to a MRF facility.

Reading materials
Required readings
- Municipal Solid Waste Management Manual, Central Public Health and Environmental Engineering Organization (CPHEEO) (2016), Ministry of Urban Development
- Solid Waste Management Rules, 2016, Ministry of Environment, Forest and Climate Change (MoEF&CC)
- Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016, MoEF&CC
Suggested readings
- Bhatia, S., 2023. *Solid and Hazardous Waste Management.* Atlantic Publishers and Distributors.
- Rao, M.N., Sultana, R. and Kota, S.H., 2016. *Solid and Hazardous Waste Management: Science and Engineering*. Butterworth-Heinemann.
- Vesilind P.A., Worrell W.A. and Reinhart D.R., 2007. *Solid Waste Engineering*, Australia, Cengage Learning.
- Tchbanoglous, G. and Kreith, F., 2002. *Handbook of solid waste management,* 2nd Edition. The McGraw-Hill Companies, Inc.

Journals
- Critical Reviews in Environmental Science and Technology
- Waste Management
- Journal of Environmental Management
- Journal of Hazardous Materials
- Resources, Conservation and Recycling
- Science of the Total Environment

Student Responsibilities
The students must attend the classes regularly and ensure timely submissions of tutorials and assignments. Their other responsibilities include feedback and discipline in the class.

Course Designed by:
- Dr. Saumya Arya, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies
- Dr. Ranjana Ray Chaudhuri, Associate Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies

Course Reviewers:
- Dr. Suneel Pandey, Director, Circular Economy and Waste Management Division, The Energy and Resources Institute, New Delhi
- Dr. Naved Ahsan, Professor, Department of Civil Engineering, Jamia Millia Islamia, New Delhi

Course Title:	Water and Wastewater Treatment				
Course code:		**No. of credits:** 4	**L-T-P:** 40-20-0	**Learning hours: 60**	
				L: Lecture**; T:** Tutorial**; P:** Practical	

Pre-requisite course code and title (if any):	
Department: Department of Natural and Applied Sciences	

Course coordinator:		**Course instructor:**
Contact details:		
Course type: Major		**Course offered in:** Semester 5

Course Description

This course provides a comprehensive exploration of the fundamental principles and technologies related to water and wastewater treatment, focusing on source characteristics, quality standards, diverse treatment processes (conventional and advanced), and the Indian policy context alongside real-world challenges and case studies in achieving sustainable water quality and public health.

Course objectives

- Develop an understanding of fundamental concepts of water and wastewater treatment, including water sources, quality parameters, and treatment objectives
- Imbibe knowledge on key water treatment processes, from basic aeration to advanced methods such as desalination and ozonation.
- Introduce wastewater treatment stages, including primary, secondary, and tertiary treatments, and emerging technologies for wastewater reuse and zero discharge.
- Develop an understanding on key policies, challenges, and case studies in water quality management, with a focus on India's regulatory framework and innovative treatment solutions.

Course content

Module	Topic	L	T	P
1	**Introduction to water and wastewater treatment**			
	This module comprehensively explores water sources, quality, the imperative for treatment, fundamental processes, quality standards, pollution impacts, public health significance, and demand dynamics. Objectives and necessity for treatment of water; traditional practices of water treatment; water treatment processes: fundamentals and types; drinking water quality requirements as per BIS & WHO guidelines; sources of water pollution; types of wastewater; diseases and control; public health significance; water demand and factors affecting water demand.	8	2	
2	**Water treatment processes**			
	This module outlines the goals and fundamental treatment steps—from initial aeration to advanced methods like desalination and ozonation—employed to purify water for safe consumption. Unit operation and processes; aerators and flash mixers; coagulation and flocculation; pulsator clarifier; sand filtration, softening and removal of iron/manganese; desalination; reverse osmosis; ozonation; emerging water treatment techniques.	14	2	
3	**Waste water treatment processes**			
	This module presents the different progressive stages of municipal wastewater treatment, encompassing preliminary, primary, secondary (including advanced biological methods), and tertiary treatments for reuse and zero discharge. Preliminary treatment: definition and purpose of preliminary treatment, scree ning, grit removal and equalization; primary treatment: sedimentation tanks; secondary treatment: activated sludge process; trickling filter; sequencing batch reactor; upflow anaerobic sludge blanket; floatation process; advanced biological nutrient removal	16	4	

		(BNR) processes; sludge treatment and valorization; decentralized and nature-based solutions for sewage treatment. tertiary treatment: ion exchange and membrane techniques, disinfection byproduct removal and control, treatment for emerging contaminants; filtration, application of nanotechnology, Reuse of waste water; capturing energy (biogas), nutrients (struvite), and water reuse in non-potable and potable applications, zero liquid discharge systems,			
4	**Policy, challenges and case studies**			
	This module provides an overview of water quality management, examining key Indian policies and initiatives, prevalent challenges, the evolution of relevant regulations, and illustrative water treatment case studies. Introduction to water quality management, key polices and initiatives for water quality management, challenges in water quality management, evolution of national water policies and regulatory framework, case studies in water treatment.	10	4	
	Total	48	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%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Assignment/Field visit: -- 20%

Learning outcomes
By the end of the course, students will be able to:
- Understand water sources, quality parameters, pollution impacts, and essential treatment processes [Minor test 1 and Major test].
- Demonstrate knowledge of water and wastewater treatment methods, including biological, chemical, and advanced techniques for safe water supply and effective wastewater management. [Minor test 1, Minor test 2 and Major test]
- Analyze water quality management frameworks, key policies, challenges, and regulatory evolution in India, supported by case studies in water treatment [Assignments]

Pedagogical approach
- The course will be delivered through class lectures, tutorials and case study discussions.

Reading Resources (* = compulsory readings)
- Cheremisinoff, P. N. (2019). Handbook of water and wastewater treatment technology. Routledge.
- Davis, M. L. (2010). Water and wastewater engineering: design principles and practice. McGraw-Hill.
- Eckenfelder, W. W. (2000). Industrial water pollution control (McGraw-Hill). Boston, EUA.
- Garg S.K. (2007). Water Supply Engineering, 18th ed, Vol.I, New Delhi, Khanna Publisher.
- Garg S.K. (2007)*. Sewage Disposal and Air Pollution Engineering, 20th ed, Vol. II, New Delhi, Khanna Publisher.
- Gilbert M. Masters and Wendell P. Ela (2017). Introduction to Environment Engineering and
- Metcalf, L., Eddy, H. P., & Tchobanoglous, G. (1991)*. Wastewater engineering: treatment, disposal, and reuse (Vol. 4). New York: McGraw-Hill.
- Peavy, H. S., Matthews, D. R., & Tchobanoglous, G. (1985). Environmental engineering. (No Title). Science. 3rd ed. Pearson,

Suggested Readings
- Birde G.S. and Birde J.S. (2004) Water Supply and Sanitary Engineering, 7th ed., New Delhi, Dhanpat Rai Publishing.
- Chatterjee A.K. (2010) Water Supply, Waste Disposal and Environmental Engineering, 8th ed., New Delhi, Khanna Publisher.
- Eckenfelder W.Jr. (1999) Industrial Water Pollution Control, 3rd ed., New York, McGraw-Hill. McGraw-Hill.
- Nathanson J.A. (2009) Basic Environmental Technology: Water Supply, Waste Management and Pollution Control, 4th ed., New Delhi, PHI Learning.

Journals:
   • Chemosphere
   • Journal of water process engineering
   • Desalination and water treatment

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 Adil Masood, Assistant Professor, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi
- Dr Chandrashekhar Azad Vishwakarma, Department of Natural and Applied Sciences, TERI School of Advanced Studies, New Delhi

Course reviewed by:

- Dr. Azhar Husain, Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, Jamia Nagar
- Dr. Vijay K. Minocha, Professor, Department of Civil Engineering, Delhi Technological University, Shahbad Daulatpur, Main Bawana Road

Course Title: Atmosphere and Oceans				
Course Code:	**No. of Credits: 4**	**L-T-P: 42-18-0**		**Learning Hours: 60**
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 5		

Course Description

The course has been designed to introduce the students to the basics of atmosphere and oceans. It provides a fundamental understanding of the atmosphere's evolution, structure and dynamics, including atmospheric circulations and water in the atmosphere. The course enables learners to identify oceanic processes, circulations and dynamics. It further introduces atmosphere-ocean interactions and the human impacts on these interactions.

Course Objectives

- To understand the origin, structure, and dynamics of the atmosphere and oceans.
- To explore the key processes such as circulation patterns and interactions between the atmosphere and ocean systems.
- To assess climatic and human impacts on atmospheric and oceanic systems.

Course Content

Module	Topic	L	T	P
1	**Introduction to Atmosphere**			
	This module focuses on introductory knowledge about atmosphere, its structure, and key processes including heat transfer. It also sets the context for the subsequent modules. Structure of the atmosphere and atmospheric layers; pressure-altitude relationship, latent and sensible heat; types of heat transfer, greenhouse effect, Earth's energy budget.	8	2	
2	**Water in the Atmosphere**			
	This module explains the atmospheric moisture and different measurements of humidity. Students will explore cloud formation and air saturation processes, including adiabatic cooling. The module will also cover different precipitation processes and atmospheric liftings. Relative humidity, saturation vapor pressure, dew point; cloud formation, cloud condensation nuclei, adiabatic cooling; precipitation processes	8	2	
3	**Atmospheric Circulations**			
	This module will discuss tricellular meridional circulation. It will also cover different air masses, fronts, cyclones, anti-cyclones, and climate zones. Pressure belts: Hadley, Ferrel, and Polar cells; air masses, fronts, atmospheric stability and instability; cyclones: temperate and tropical cyclones, climate zones and classification; Indian Monsoon	8	2	
4	**Oceans**			
	This module will help students understand the origin and three-layered structure of the oceans. It will also incorporate different properties of ocean water such as temperature, salinity, density, and their variations. Earth's oceans; physical properties of ocean water: ocean temperature and salinity and their distributions, thermocline, halocline; processes affecting ocean density, pycnocline	8	2	

5	**Ocean Circulations**			
	This module explains the oceanic circulations and dynamics. Students will explore surface and deep ocean currents, including the role of Ekman transport and the global conveyor belt. Surface currents: Coriolis force, Ekman spiral and transport; upwelling, downwelling, gyres; deep ocean currents: thermohaline circulations and global conveyor belt.	8	2	
6	**Atmosphere-Ocean Interactions and Their Significance**			
	This module focuses on atmosphere-ocean interactions and the significance of these interactions. It also discusses the impact of the changing climate on these interactions. Differential heating of atmosphere and oceans, land and sea breezes; Atmosphere-ocean interactions and impacts of climate change; El Niño-Southern Oscillation (ENSO) and its impacts, Indian Ocean Dipole (IOD)	8	2	
	Total	48	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%
- Major Test: Written test [at the end of the semester, full syllabus] -- 50%
- Tutorials/assignment: -- 10%

Learning Outcomes

Upon completion of the course, the students will be able to
- Develop a fundamental understanding of the atmosphere and the water in the atmosphere. [Module 1 and 2, Minor Test 1, Major Test]
- Gain knowledge about tricellular meridional circulation, air masses, fronts, cyclones, and Indian monsoons. [Module 3, Minor Test 2, Major Test]
- Develop an understanding of the oceans, its three-layered structure, and physical properties. [Module 4, Minor Test 2, Major Test]
- Understand surface currents, deep ocean circulations, atmosphere-ocean interactions, human impacts on these interactions, and Indian monsoons teleconnection with ENSO, IOD and Atlantic Nino. [Module 5 and 6, Tutorials, Major Test]

Pedagogical Approach
- The course will be delivered through classroom lectures, class exercises, and tutorials. It 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
- Neil C Wells (2001). *The Atmosphere and Ocean - A Physical Introduction*. 3rd Edition, Wiley.
- Geoffrey K Vallis (2019). *Essentials of Atmospheric and Oceanic Dynamics*. Cambridge University Press.
- John Marshall, R Alan Plumb (2007). *Atmosphere, Ocean and Climate Dynamics: An Introductory Text*. Academic Press.
- Frederick Lutgens, Edward Tarbuck, Redina Herman (2018). *The Atmosphere: An Introduction to Meteorology*. 14th Edition, Pearson.
- C Donald Ahrens, Robert Henson (2017). *Essentials of Meteorology*. 8th Edition, Brooks Cole.
- Lynne Talley, George Pickard, William Emery, James Swift (2011). *Descriptive Physical Oceanography: An Introduction*. 6th Edition, Academic Press.
- Robert H Stewart (2009). *Introduction to Physical Oceanography*. Orange Grove Books
- M Grant Gross (1990). *Oceanography, a View of the Earth*. Prentice Hall.
- Holton, J.R., An Introduction to Dynamic Meteorology, 4th Edn , Elsevier, 2004.
- Tropical Meteorology: GC Asnani

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 reviewed by:

- Dr. Ramesh Kumar Yadav, Scientist - 'F', Indian Institute of Tropical Meteorology (IITM), Ministry of Earth Sciences (MoES), Government of India, Pune,Maharashtra
- Dr. Lakshmi Kumar T V, Associate Professor (Atmospheric Science), School of Environmental Sciences, Jawaharlal Nehru University

Course Title:	Machine Learning and Applications			
Course Code:		**No. of credits: 4**	**L-T-P:** 30-15-30	**Learning hours: 60**
				L: Lectures; **T:** Tutorials; **P:** Practicals
Pre-requisite (if any): Data Mining & Analysis (UDS 205)				
Department: Natural and Applied Sciences				
Course Coordinator: Dr Adwitiya Sinha			**Course Instructor:**	
Contact Details:				
Course Type: Major			**Course Offered in:** Semester-4	

Course Description

This course introduces fundamental machine learning paradigms, models, and their applications in artificial intelligence driven solutions. It covers supervised and unsupervised learning, model evaluation techniques, explainable AI, and performance analysis. Through hands-on programming using Python and tools like Scikit-Learn, Shap, Optuna, and PyCaret. Students will develop practical skills in building and optimizing machine learning models. By the end, students will learn to integrate theoretical concepts with real-world case studies, thus enabling them to explore AI-based decision-making and predictive analytics.

Course Objectives

- Understand fundamentals of machine learning techniques and their applications in AI.
- Apply supervised and unsupervised learning models to real-world datasets.
- Design and evaluate machine learning solutions with performance optimization techniques.

Course Content

Module	Topic	L	T	P
1	**Introduction to Machine Learning and AI**			
	The focus of this module is on the basic fundamentals, paradigms, importance, and applications of machine learning. Following topics will be covered: Significance of Machine Learning, Applications in AI, Evolution, Paradigms of Machine Learning: Descriptive and Predictive Models; Types: Supervised, Unsupervised, Semi-Supervised, Reinforcement Learning, Ensemble Learning, Active Learning, and other methods of learning, Machine Learning algorithms. Introductory ML hands-on session with Python programming using Scipy and Scikit Learn.	6	2	4
2	**Model Building & Performance Analysis**			
	This module highlights the model building process and broad ways of evaluating performance. Following topics will be addressed in this module: Concept of Model Building, Class Balancing, Data Augmentation, Overfitting, Underfitting, Model Features and Hyperparameters, Target Function, Loss function, Error Function, Objective Function, Model Training Methods (Holdout, k-Fold Cross-validation, Bootsrapping), Performance Parameters, Explainable AI (XAI). Practical sessions with baseline machine learning models	8	3	6

	using Scikit Learn and Imbalanced-Learn. Introductory hands-on with XAI using Shap.			
3	**Supervised Machine Leaning**			
	The purpose of this module is to introduce the importance and implementation of supervised machine learning models. The major topics to be covered in module include: Supervised Machine Learning Algorithms: Regression methods, SVM, k-NN, Tree-based models, Hyperparameter Tuning and Optimization, Confusion Matrix, Model Accuracy, Sensitivity, Specificity, Precision, Recall, Kappa, ROC and AUC curves, Error Handling, Residual Analysis and Transformation, Regularization, Feature Importance Analysis, Explainable Models, Building Pipelines. Practical using Python hands-on session with case studies in Shap, Scikit Learn, and Optuna.	8	5	10
4	**Unsupervised Machine Leaning**			
	This module encompasses through the understanding of unsupervised models in machine learning and dimensionality reduction for improving model performance. This will include the following contents: Unsupervised Machine Learning: Clustering and Association Analysis, Elbow Method, Silhouette Coefficient, density-based clustering, grid-based clustering. Applications of Dimensionality Reduction, Lasso and Ridge Regularization, Feature Extraction, Principal Component Analysis, Linear Discriminant Analysis, Singular Value Decomposition. Hands-on session with real-world case studies using YellowBrick and PyCaret.	8	5	10
	Total	**30**	**15**	**30**

Practical Sessions	Introductory ML hands-on session with Python programming using Scipy and Scikit Learn.	-	-	4
	Practical sessions with baseline machine learning models using Scikit Learn and Imbalanced-Learn. Introductory hands-on with XAI using Shap.			6
	Python hands-on session with case studies using Shap, Scikit Learn, Optuna	-	-	10
	Hands-on session with real-world case studies using Yellow-Brick and PyCaret.	-	-	10
	Total Practical Sessions	**-**	**-**	**30**

Evaluation Criteria
- Minor Test: Written test [at the end of teaching of modules 1 and 2] -- 20%
- Major Test: Written test [end of semester, full syllabus, modules 1, 2, 3, and 4] -- 40%
- Practical Test: Practical test [including modules 2, 3 and 4] -- 20%
- Project-based learning: Project demonstration and report [at end of module 4] -- 20%

Learning Outcomes

By the end of the course, students will:

- understand real-world significance of machine learning and AI
  [Module 1 and 2; Minor Test]
- develop in-depth knowledge of supervised and unsupervised learning
  [Module 2 and 3; Practical Test]
- gain insights on performance analysis of machine learning models
  [Module 1, 2, 3, and 4; Project-based learning and Major Test]

Pedagogical Approach

- The course will provide knowledge on the application and implementation of machine learning through classroom discussions, lectures, tutorials, and assessments.
- The course will enable students to explore different techniques of AI-centric model building.

Reading Resources Recommended (* = suggested readings)

- * Jung, Alexander. (2022). *Machine Learning: The Basics*. Springer
- Carbonell, J.G., Michalski, R.S. & Mitchell, T.M. (2013). *Machine Learning: An Artificial Intelligence Approach*. Springer Berlin Heidelberg Publications, Springer.
- Julian, David. (2016). *Designing Machine Learning Systems with Python*. Packt Publishing.
- Andreas C. Müller & Sarah Guido. (2016). *Introduction to Machine Learning with Python*. O'Reilly Publications.
- Kelleher, J. D., Mac Namee, B., & D'arcy, A. (2020). *Fundamentals of Machine Learning for Predictive Data Analytics*: Algorithms, Worked Examples, and Case Studies. MIT press.

Official Documentations of Tools/Libraries

- ScikitLearn, URL: scikit-learn.org/stable
- PyCaret, URL: pycaret.readthedocs.io/en/latest
- Yellow Brick, URL: scikit-yb.org/en/latest
- Optuna, A hyperparameter optimization framework, URL: optuna.readthedocs.io/en/stable
- Shap, URL: shap.readthedocs.io/en/latest

Student Responsibilities: The students are required:

- To be regular and attentive in theory classes and lab sessions
- To come prepared with readings that would be given in the theory class
- To come prepared in lab with readings from respective theory concepts taught in the class
- To sincerely participate in the day-to-day lab activities
- To incorporate real-word datasets as case-studies in project-based learning
- To submit assignments and project works on or before the deadlines

Course Designed by:

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

Course Reviewers:

- Dr. D.K. Lobiyal, Professor, School of Computer & 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: Software Engineering				
Course Code:	**No. of credits:** 4	**L-T-P:** 40-20-0		**Learning hours:** 60
			L: Lectures; T: Tutorials; P: Practical	
Pre-requisite Course Code and Title (if any): None				
Department: Natural and Applied Sciences				
Course Coordinator: Dr. Priyanka Singh		**Course Instructor:**		
Contact Details: priyanka.singh@terisas.ac.in				
Course Type: Major		**Course Offered in:** Semester-5		

Course Description

This course introduces students to the fundamental principles, methodologies, and tools used in software engineering and project management. It covers the software development lifecycle (SDLC), agile methodologies, software design, testing, quality assurance, and maintenance. Additionally, the course focuses on project management principles, including planning, scheduling, risk management, budgeting, and team collaboration. Students will gain hands-on experience with project management tools and techniques to effectively manage software projects.

Course Objectives
- Understand the Software Development Lifecycle (SDLC) and apply software engineering principles
- Develop software design, implement software testing and quality assurance
- Apply project management tools and techniques
- Collaborate in software development teams

Course Content

Module	Topic	L	T	P
1	**Introduction to Software Engineering**			
	This module is to understand phases and life cycle models of software development. The students will learn following concepts: Nature of Software, Software Engineering, Software Myths, Software characteristics and applications, Software development life cycle; Software processes and Life Cycle Models – Waterfall (classical and iterative), the evolutionary model, Spiral, incremental process model, Prototyping & RAD Models, Agile Models and various Agile methodologies; Scope of each model and their comparison in real-world case studies; Software Project Management Complexities, Responsibilities of a Software Project Manager, Project selection, and Approval.	6	4	0
2	**Software Project Management and Planning**			
	The focus of this module is for comprehensive understanding of project management and enhancing problem-solving abilities. This will include: Software Project Planning – Sliding Window, Project charter; Project Scope management: Scope definition and Project Scope management. Software configuration management activities. Relationship between people and Effort - organization and team structures; Metrics understanding for project size and cost estimation - size metrics (LOC, Function Count, Albrecht FPA), COCOMO, COCOMO2, resource allocation models, cost estimation techniques (static,	10	4	0

	single variable, multivariable models), staffing level estimation; Project Scheduling - Creating the Work Breakdown Structures, GANTT charts, PERT charts; Risk Management – risk identification, assessment and mitigation; Software Maintenance Process Models - Need for Software Maintenance, Estimation of Maintenance Cost. Software Reuse Approach - Domain Analysis, Component Classification, Searching, Repository Maintenance, Reuse without Modifications, Reuse at Organisation Level.			
3	**Software Requirement Analysis, Design and Implementation**			
	The purpose of this module is to make students gain a deep understanding of the software development lifecycle, from requirement gathering to design and implementation. The topics to be covered in this module include: System and software requirements, Feasibility Study, Types of Requirements - Functional and non-functional requirements; Domain requirements; User requirements; Requirement Elicitation: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST); Software Design concepts – Design principles, low level design - Pseudo Codes, Flow Charts, Coupling and Cohesion, Function Oriented Design, Object Oriented Design and Detailed Design; Role of Software Architecture: Use case diagrams, Data Flow Diagrams (DFD), Data Dictionary; Software requirements specification (SRS) - Desirable characteristics of an SRS, structure of an SRS document, SRS Case study; Software Coding - Programming principles and coding guidelines - method of incrementally developing code - managing the evolving code; Case Studies and Real-world Applications.	12	6	0
4	**Software Testing and Quality Assurance**			
	This module encompasses through feature-based analysis, especially the ranking and selection methods that are considered eminent for building machine learning models. This module will include the following contents: Software Testing fundamentals - Overview of Functional Testing (Black Box Testing), Structural Testing (White Box Testing), Non-Functional Testing (Stress Testing, Regression Testing, Performance Testing), unit, integration, validation, and system testing, Alpha & Beta Testing of Products; Testing process, Software Testing Life Cycle (STLC), design of Test cases, testing techniques - boundary value analysis - equivalence class testing - decision table testing, debugging techniques; Testing tools and standards such as Jira and Selenium; Software verification and validation techniques; Introduction to Software Reliability - Hardware reliability vs. Software reliability. Computer Aided Software Engineering (CASE) – Scope, Characteristics and support in SDLC; Case Studies and Real-world Applications.	12	6	0
	Total	40	20	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 module 3] -- 20%
- Major Test: Written test [at the end of the semester, full syllabus] -- 40%
- Project-based learning: Real-world Problem Specific Study [at the end of module 4] -- 20%

Learning Outcomes

By the end of the course, students will:

- understand the need of software engineering, and various phases of Software Development
  [Module 1 and 2; Minor Test 1]
- understand requirement analysis and specifications, preparation of SRS document and software coding guidelines, and risks
  [Module 2 and 3; Minor Test 2]
- gain insights on software testing, quality controls and standards
  [Module 1, 2, 3, and 4; Minor Project; Major Test]

Pedagogical Approach

- The course will provide knowledge and awareness on concepts of engineering and management of software project through classroom discussions, lectures, tutorials, assessments, and experimental learning
- The course will encourage collaborative (group learning) learning in the class and use of Video/Animation to explain functioning of various concepts
- Implementation of activity-based learning to enhances students' analytical skills and cultivates design thinking abilities, enabling them to design, evaluate, generalize, and analyze information rather than merely memorize it.

Reading Resources (* = compulsory readings)

- * Rajib Mall. (2018). *Fundamentals of software engineering*. PHI Learning Pvt. Ltd.
- * Roger S. Pressman. (2009). *Software Engineering: A Practitioners Approach*, 7th Edition, Tata McGraw Hill.
- Bob Hughes, Mike Cotterell, Rajib Mall. (2018) *Software Project Management*, 6th Edition, McGraw Hill Education
- Hans van Vliet. (2010). *Software Engineering: Principles and Practice*, Wiley India, 3rd Edition

E-resources

- Project Management. onlinecourses.nptel.ac.in/noc24_mg01/preview
- Software Engineering. onlinecourses.nptel.ac.in/noc20_cs68/preview

Student Responsibilities: The students are required:

- To be regular and attentive in all classes
- To come prepared with readings that would be given in the theory class
- To sincerely participate in the day-to-day activities
- To incorporate real-word datasets as problem-specific studies in project-based learning
- To submit assignments and project works on or before the deadlines

Course Designed by:

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

Course Reviewed by:

- Dr. Sushil Kumar, Associate Professor, School of Computer & Systems Sciences, Jawaharlal Nehru University, Delhi
- Dr. Mayank Sharma, Senior Consultant, PwC India, Gurgaon, Haryana.

Course Title: Java Programming and Web Technologies			
Course Code:	**No. of credits:** 4	**L-T-P:** 30-15-30	**Learning hours:** 60
			L: Lectures**; T:** Tutorials**; P:** Practical

Pre-requisite Course Code and Title (if any): UDS 106: Database Management System, UDS 104: Fundamentals of Information Technology

Department: Natural and Applied Sciences

Course Coordinator: Dr. Priyanka Singh	**Course Instructor:**

Contact Details: priyanka.singh@terisas.ac.in

Course Type: Major	**Course Offered in:** Semester-5

Course Description

This course is designed to provide students with a strong foundation in Java programming and web technologies equipping students with the necessary skills to develop robust, scalable, and dynamic applications. It covers core Java concepts, object-oriented programming (OOP), graphical user interfaces (GUI), database connectivity, and server-side development. Additionally, students will explore web technologies such as HTML, CSS, JavaScript, Servlets and JSP. By the end of the course, students will be able to design, develop, and deploy Java-based applications and dynamic web applications.

Course Objectives

- Understand object-oriented programming (OOP) concepts such as classes, objects, inheritance, polymorphism, abstraction, and encapsulation.
- Develop graphical user interfaces (GUIs) Applications using Java
- Understand Database Connectivity with Server-Side Programming
- Work on industry-oriented case studies and best practices

Course Content

Module	Topic	L	T	P
1	**Fundamentals of JAVA**			
	This module introduces the core concepts of Java programming, laying the foundation for object-oriented programming (OOP) and software development. Following topics are as follows: Introduction to Java - Overview of Java programming language, History and evolution of Java, Features and advantages of Java; Basic Syntax - Structure of a Java program; Data types, variables, and constants, comments and documentation; Control structures/Statements - Conditional statements (if, else, if, else); Switch-case statements, Looping statements (for, for-each, while, do-while); Object-Oriented Programming concepts: objects, classes, Inheritance, polymorphism, encapsulation, and abstraction, Constructors and Destructors.	4	2	6
2	**Exception handling, Collections and Framework**			
	This module delves into advanced Java programming concepts, focusing on modularity, exception handling, file operations, data structures, and concurrency. The major topics will include:			

	Packages and Interfaces, Exception Handling: Understanding exceptions and errors, Try-catch blocks, Custom exception handling; File Handling: Reading and writing to files, Working with input and output streams; Collections Framework: Overview of collections (List, Set, Map), Iterators and Enumerations, ArrayList, LinkedList, HashMap, etc.; Multithreading: Introduction to threads, Synchronization and coordination, Thread safety and deadlock.	8	3	8
3	**JDBC & Transaction Management**			
	This module focuses on Java Database Connectivity (JDBC), enabling students to interact with relational databases using Java. It covers the fundamentals of database connectivity, executing SQL queries, and other topics as follows: Java applets - Life cycle of an applet, adding images to an applet, adding sound to an applet, passing parameters to an applet, event handling; Introducing AWT - working with windows graphics and text, AWT controls, layout managers and menus; Introduction to Java API - working with java standard libraries, utilizing predefined classes and methods; Java Database Connectivity (JDBC) - JDBC architecture, JDBC drivers, connection pooling, handling SQL queries; Java Servlets: Servlet life cycle, Servlet containers, Servlet Configurations and Parameters.	8	5	8
4	**JAVA for Web Technologies**			
	This module provides a comprehensive introduction to web page designing using HTML, client-side scripting (JavaScript), and server-side scripting (JSP). Following topics will be covered in course delivery: Web page Designing using HTML - Client side and server-side scripting. Java Script-Object, names, literals, operators and expressions- statements and features- events- windows- documents- frames- data types- built-in functions; JavaServer Pages (JSP) - Introduction to JSP, JSP life cycle, JSP expressions and declarations, Page directives, JSP actions and implicit objects, JSP Tag Libraries; Session Management: HttpSession and Cookies; Handling Form Data- REST APIs (GET and POST methods); Model-View-Controller (MVC) Architecture, MVP, MVVM	10	5	8
	Total	30	15	30

Practical Sessions	Object-Oriented Programming concepts of objects and classes, Inheritance, polymorphism, encapsulation, and abstraction	-	-	6
	List, set, map, threads, deadlocks, synchronization, multithreading			8
	Java applets, AWT, Java API, JDBC – architecture, drivers, connection pooling, SQL handling, Servlets	-	-	8
	client and server-side scripting, JavaScript, JSP – basics, lifecycle, expressions, HttpSession and cookies, GET/POST, MVC architecture	-	-	8
	Total Practical Sessions	-	-	30

Evaluation Criteria

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

Learning Outcomes

By the end of the course, students will:
- Understand Java programming competencies [Module 1 and 2; Minor Test 1]
- Able to design and develop a full-stack web application using Java, JSP/Servlets, and databases (MySQL, PostgreSQL)
  [Module 3 and 4; Minor Test 2; Practical Test]
- Gain OOPs knowledge and web technologies skills
  [Module 1, 2, 3, and 4; Minor Project; Major Test]

Pedagogical Approach

- The course will provide blended learning approach - lecture-based instruction, hands-on labs & coding assignments, flipped classroom and Project-Based Learning (PBL)
- The course is dedicated to incremental learning starting from basic to advanced progression, i.e. starting from Java basics (variables, loops, OOP) and gradually introduce complex topics like multithreading, JDBC, and web frameworks
- This course will have formative assessments (mini-projects, coding exercises), summative assessments (Mid-term and final project evaluations), and continuous evaluation (online coding platforms for auto-grading assignments).

Reading Resources (* = compulsory readings)

- * Herbert Schildt. (2021). *Java The Complete Reference*, *Twelfth Edition*. Tata McGrawHill Edition.
- C Xavier. (2011). *Java Programming - A Practical Approach.* Tata McGraw-Hill Edition
- * John Pollock. (2016). *Javascript A Beginners Guide, 3rd Edition*. Tata McGraw-Hill Edition.
- K. Arnold and J. Gosling. (2000). *The JAVA programming language, Third edition.* Pearson Education.
- R. Nageswara Rao. (2016). *Core JAVA: An Integrated Approach, Includes All Versions upto Java 8.* Dreamtech Press.

Coding Practice & Interactive Platforms

- LeetCode (Java Coding Challenges) – leetcode.com
- HackerRank (Java & Web Technologies Challenges) –hackerrank.com/domains/tutorials/10-days-of-java
- CodeGym (Java Learning Platform) – codegym.cc
- Project Euler (Java Programming Problems) – projecteuler.net

Student Responsibilities:

The students are required:
- To be regular and attentive in theory classes and lab sessions
- To come prepared with readings that would be given in the theory class

- To come prepared in lab with readings from respective theory concepts taught in class
- To sincerely participate in the day-to-day lab activities
- To incorporate real-word datasets as case-studies in project-based learning
- To submit assignments and project works on or before the deadlines

Course Designed by:

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

Course Reviewed by:

- Dr. Satish Chand, Professor, School of Computer & Systems Sciences, Jawaharlal Nehru University, Delhi
- Dr. Abhijit Kumar, Senior Associate Professor, School of Computer Science, UPES, Uttarakhand

**Department of Natural and
Applied Sciences TERI School of
Advanced Studies (TERI SAS)**

Guidelines for Minor Project work of B.Sc. Environmental Studies and B.Sc. Data Science

Course No. UES XXX

1. Background

The students are directed to undertake a project in an industry/institution related to their specialisation for 6-8 weeks from June 2026 to August 2026. Upon successful completion of the period mentioned above in the host organization students are expected to submit a project report (in the prescribed format) and present their project work to the evaluation committee consisting of internal faculty members and externals (if required) *(Annexure 1).*

2. Timeline for minor project activities

Activity	Due date
Joining Reporting to the host organisation	
Joining report Dispatch of joining report from the host organisation	
Joining back to the TERI SAS for seventh semester registration	
Feedback form of the supervisor Response/Feedback from the Host organization/Supervisor submission.	
Project Report for similarity and AI plagiarism check	
Project Report for Evaluation The report should be emailed to the minor project coordinator along with a copy to the Department Assistant (Ms Avantika Singh) for evaluation in both .pdf and .docx file formats.	
Oral examination of minor project Presentation and viva voce	
Final Report submission Submit a soft copy (by email only) of the final report to the department assistant, failure to do so will result in non-submission of the report.	

The final report will only be admitted when comments from examiners and panel members were incorporated and duly approved by the minor project coordinator.	
The student should provide an enclosure showing a list of amendments along with the final copy to report to the minor project coordinator.	
Failure to submit the final report before the deadline will be considered incomplete, and the student will be assigned zero marks in the evaluation.	

Note:

- If two or more students were assigned to do the minor project in a group, the students should seek prior approval from the placement coordinator and the same to be communicated with department assistant; in case, it is not reported in the beginning the students are not allowed for presentation.
- The naming convention for the project report should come after your name, report name (i.e. Name of Student _Minor Project Report). Not following the naming convention would be disregarded as report submission.

3. Evaluation Criteria

The marks obtained by students in the minor project would be graded as per absolute grading scale given by the university (Table 1).

The distribution of marks for the minor project work as follows:

a. Timeline adherence – 10% [the marks are distributed among timely submission of joining report, feedback form and project report]

b. Supervisor feedback – 20% [A feedback e-form would be sent to the supervisor of the host organization at the end of the course]

c. Minor Project Report – 30 % [Report submitted in the format prescribed in the guideline will be evaluated by the examiner/s. The report submitted by the student will undergo a similarity and AI plagiarism check, and a penalty for plagiarism would be imposed as per the university standards and policy (Table 2)]

d. Oral presentation and viva voce – 40% [An evaluation panel consisting of internal faculty members and External/s (whenever necessary) would evaluate the oral presentation at the end of the course].

4. Format of the Project Report *(Annexure 4 to Annexure 6)*

The length of the report should be limited to 25 to 30 pages (counting both sides) only. The basic elements of a minor project report are title, *acknowledgement, declaration, a certificate from the organisation*, abstract, introduction, literature review, results and

discussion, conclusion, references and appendix/annexure (if necessary). The structure of the project report will be as follows:

- **Abstract**: This is a summary of the work done within 300 words. Broadly, it defines the concepts studied and key findings.

- **Introduction**: This is the beginning section, which states the purpose and goals of the work. It is supported by the background of the work done and some ideas about the achievements in the area. It ends with a few lines that introduce in the chapters of your work.

- **Literature Review**: It provides all the concepts that affect your project. The reference sources shall be textbooks, journal, statutory and legal report and publications. Limit yourself to authentic sources. All references are to be reported in the references section appropriately. Use the Harvard style of referencing.

- **Aims and objective:** Your project may be purely science-based or address corporate/industrial topics. Whatever your work is on, it will try to achieve on output/aim. State this aim here and objectives leading to this aim (if any) as clear as possible.

- **Methodology:** Here, you explain what you have done in your project to achieve your aim/objectives. Please organise this chapter according to your objective so that the reader understands which methodology was applied to which objective.

- **Results**: This is the outcome of the work done during this period. It is to be expressed qualitatively or quantitatively. Please organise this chapter also according to your objectives. This will help the reader to link your results with the methodology applied and will help you to be clear.

- **Discussion and Conclusion:** This section should have a reflection of your findings against the state-of-art-knowledge in the field. If you have done a literature review in the Background chapter, here is the space to compare the findings of this with your findings. You can address further the important advances in the field of study, critics, gaps, limitations and scope for further research.

- **References**: Refer guide to Harvard System of Referencing (https://lib.ugm.ac.id/en/harvard-referencing-style/). Ensure that the references listed do appear as citations in the text and vice versa.

- **Annexure/Appendix**: Any graphs, boxes and tables that could not be accommodated in the main section can be arranged in this section.

Page setup compulsory for project report
- A page size of A4
- Left margin: 42 mm, right margin: 30 mm, top: 15 mm, bottom: 20 mm
- Times New Roman 12 point as the base font and 1.5 lines spacing
- Page number in the bottom margin, centred and printed on both sides
- Captions must explain table/figures without reference to the text (Position:

above tables and below figures).

5. Minor project grading scale

Table 1. The absolute grading scale for minor project

Mark obtained	Grade
>90	A+
>80≤90	A
>70≤80	B+
>60≤70	B
>50≤60	C+
>45≤50	C
>40≤45	D
≤40	F

The students scoring overall marks less than or equal to 40% (≤ 40%) in the evaluation would be considered unsuccessful and would be graded F (fail).

Plagiarism in the Project Report

TERI SAS strongly encourages its students to submit the original work without similarity and AI plagiarism. TERI SAS has zero-tolerance for plagiarism. The similarity detected in the project report submitted by the student would be examined by the Department Integrity Panel (DIP). The DIP would determine the final percentage of plagiarism. The penalty for plagiarism shall be imposed as per Table 2 in line with the UGC notification dated 23rd July 2018 on "Promotion of academic integrity and prevention of plagiarism in higher education institutions, REGD. NO. D. L.-33004/99". The students are responsible for resolving the similarity in consultation with the supervisor, and for ensuring the document deemed fit for final submission upon written consent of the supervisors to the minor project coordinator along with the list of amendments.

Table 2. Different levels of similarity and AI plagiarism scores and its corresponding penalty (in line with UGC guidelines) for minor project report

Levels of Plagiarism	Percentage of Similarity & AI Plagiarism Scores[*]	Similarity Score	AI Plagiarism Score
Level 3	> 60%	The student repeats the minor project next year	The student repeats the minor project next year
Level 2	> 40% ≤ 60%	The student needs to revise and resubmit the project report within a stipulated period decided by the	The student needs to revise and resubmit the project report within a stipulated period decided by the

		BPEC not exceeding 6 months	BPEC not exceeding 6 months
Level 1	> 10% ≤ 40%	The student needs to revise and resubmit the project report within a stipulated period decided by the BPEC not exceeding 3 months	The student needs to revise and resubmit the project report within a stipulated period decided by the BPEC not exceeding 3 months
Level 0	≤ 10%	Minor similarities	Minor AI plagiarism

*Both plagiarism scores, i.e. similarity score and AI score, should be collectively less than the given percentage for a particular level. For instance, if similarity score is less than 10% and AI score is more than 60%, then it will be considered a case of *Level 3*.

6. Presentation and Viva Voce

The time allotted for the presentation is 5 minutes (maximum) which would be followed by 5 minutes question/answer by the panel and students. If two or more students present their research as a group, then, each of them will add 2 minutes extra to the total 5 minutes allocated, E.g. the duration is 5+2=7 minutes in case two are presenting together. The presentation should explain (a) Broad Structure of host organization; (b) Objective (s); (c) Results/Learning; (d) Limitations of the study.

7. Honour Code

If a student is found to be misrepresenting any fact concerning minor projects in any host organisation as well as at TERI SAS, this will be brought to the notice of Dean (Academic) by the BPEC. The Dean (academic) will decide on further action to be considered. The issue would be handled as per the honour code of TERI SAS. Remember your first contact point is Ms. Avantika Singh (avantika.singh@terisas.ac.in), Department Assistant, and Dr. Saumya Arya (saumya.arya@terisas.ac.in), Faculty Placement Coordinator (*Annexure 2*).

Annexure 1:

Program Name	Minimum Duration of Minor Project	Credits
BSc (Environmental Studies) and BSc (Data Science)	6 - 8 weeks	4

Annexure 2:

Program Name	Minor Project Coordinator	Department Assistant
BSc (Environmental Studies) and BSc (Data Science)	Dr. Saumya Arya (saumya.arya@terisas.ac.in)	Ms. Avantika Singh (avantika.singh@terisas.ac.in)

Annexure 3:

The students who are repeating the minor project should ascertain that the work carried out as part of repeated minor project should either be an extension of the research done in a previous minor project or should be an entirely different topic of research.

Annexure 4:

TITLE (Times New Roman, 16 font + Bold + Capital Letter)

Minor Project Report (Times New Roman14 font + Bold + Italics)

*Submitted by (Times New Roman 11 font + italics***)**

NAME OF CANDIDATE (Times New Roman 12 font + Bold + Capital Letter)

For the partial fulfillment of the (Times New Roman 11 font + italics)

Degree of Bachelor of Science in (Times New Roman 12 font + Bold) YOUR STREAM (Times New Roman 12 font + Bold + Capital Letter)

Submitted to (Times New Roman 11 font + italics**)**
Department of Natural and Applied Sciences (**12 font)**
TERI School of Advanced Studies (**12 font)**

October 2026 (Month Year) *(***12 font)**

Annexure 5:

DECLARATION

This is to certify that the work that forms the basis of this project "TITLE" (Times new Roman, 12 font size+ Capital Letter) is an original work carried out by me and has not been submitted anywhere else for the award of any degree.

I certify that all sources of information and data are fully acknowledged in the project report.

Signature of the candidate

Name of the candidate

Date:

Annexure 6:

<div align="center">

CERTIFICATE

</div>

This is to certify that "Name of candidate" has carried out his minor project in partial fulfilment of the requirement for the degree of Bachelor of Science in "Your stream" on the topic "Title" during June 2026 to August 2026. The project was carried out at the "Name of the organisation you are working with". (Times New Roman 12 font)

Date:

Name of the Supervisor	Dr. Ranjana Ray Chaudhuri
His/her Designation	Associate Professor and Head
Organization	Department of Natural and Applied Science
	TERI School of Advanced Studies

The MPEC proposed certain changes in the Four-Year Undergraduate programme to integrate with the Five-Year programme.

Features of the 5-Year Integrated Programme

Total number of credits offered : 207
Total number of credits offered with courses of Economics: 152

Features of the 4-year Undergraduate Programme [BSc in Economics (Hons. with Research/Academic Project]

Total number of credits offered: 167

Total number of credits offered with courses of Economics: 112

Features of the 3-year Undergraduate Programme [BSc in Economics (Hons)]

Total number of credits offered: 127

Total number of credits offered with courses in Economics: 76

The MPEC proposed that admissions for the 5th year of the Integrated Programme [Semesters 9 and 10] may be initiated from AY2026-27. To maintain continuity with the 5-year Integrated Programme, the MPEC proposed that the revised outline of the Four-Year Integrated programme in Semesters 7 and 8 will be operationalised in the AY2026-27.

The following are the credits that are offered [Total and the courses in Economics] in each of the semesters till Semester 4.

Semester 1:

Total number of credits offered: 20

Economics as a major: 8 credits

Semester 2:

Total number of credits offered: 24

Economics as a major: 8 credits

Semester 3:

Total number of credits offered: 23

Economics as a Major: 12 credits

Semester 4:

Total number of credits offered: 20

Economics a Major: 16 credits

Semester 5:

S No	Title of the course	Nature of the course	Credits offered
1	Game Theory	Major in Economics	4
2	Econometrics-I	Major in Economics	4
3	Growth Economics	Major in Economics	4
4	Issues in Indian Economy	Major in Economics	4
5	Minor in DS/ES	Minor	4
Total credits offered			20
Major in Economics			16

Semester 6:

S No	Title of the course	Nature of the course	Credits offered
1	Development Economics	Major in Economics	4
2	International Economics	Major in Economics	4
3	Econometrics-II	Major in Economics	4
4	Monetary and Banking Institutions	Major in Economics	4
5	Minor in DS/ES	Minor	4
Total credits offered			20
Major in Economics			16

A student may exit the 4-Year UG Programme after completing three years with a BSc (Hons) in Economics. By the end of Semester 6, the student will be completing 127 credits with 76 credits in Major courses in Economics.

Semester 7:

S No	Title of the course	Nature of the course	Credits offered
1	Mathematical Methods for Economics	Major in Economics	4
2	Topics in Microeconomics/Advanced Microeconomics	Major in Economics	4
3	Computational Methods in Economics	Major in Economics	4
4	Research Methodology	Major in Economics	4
5	Minor in DS/ES	Minor	4
Total credits offered			20
Major in Economics			16

For the students with lateral entry [taking new admissions for the Two-Year Master's Programme], Semester 7 of the Four-Year UG Programme will be the first semester of the two-year Master's Programme. Likewise, the Thesis/Project that will be offered in Semester 8 may be allotted dual code since this will offered in the second semester of the Two-Year Master's Programme.

Semester 8:

S No	Title of the course	Nature of the course	Credits offered
1	Thesis track OR Project track	Major in Economics	20
Total credits offered			20
Major in Economics			20

A student completing a Thesis at the end of Semester 8 will exit with a BSc (Hons with Research) with Economics as the Major discipline.

A student completing a Project at the end of Semester 8 will exit with a BSc (Hons with Academic Project) with Economics as the Major discipline.

Semester 9: [Three core courses of 4 credits each + 2 Electives among a basket of electives].

S No	Title of the course	Nature of the course	Credits offered
1	Topics in Macroeconomics/Advanced Macroeconomics	Core	4
2	Environmental Economics	Core	4
3	Advanced Development Economics/Topics in Development Economics	Core	4
4	Elective 1	Elective	4
5	Elective 2	Elective	4
Total credits offered			20

Possible Electives

Indian Agricultural Development: Contemporary Issues/Labour Economics/Theory of Contracts/ Natural Resource Economics/Trade, Development and Environment/Health and Environment/Climate Change Economics/Public Economics/Global Political Economy.

Semester 10:

S No	Title of the course	Nature of the course	Credits offered
1	Academic Project	Core	20
Total credits offered			20

 A student completing 40/80 credits of the One-year Master's Programme/Two Year Master's Programme, will exit with MSc (Economics).

Course Title: Game Theory			
Course Code: TBD	**No of credits:** 4	**L-T-P:** 44-16-0	**Learning Hours:** 60
Pre-requisite course code and Title: Intermediate Microeconomic theory I (UEO 203) and Intermediate Microeconomic theory II (UEO 202)			
Department: Department of Policy and Management Studies			
Course Coordinator:		**Course Instructor:**	
Contact Details:			
Course Type: Core		**Course offered in:** Semester 5	
Course Description: This course introduces students to the theoretical foundations and applied aspects of non-cooperative game theory. Students will learn to model, analyze, and interpret strategic behavior in both complete and incomplete information environments. The course emphasizes precision in formulation, depth in conceptual understanding, and advanced equilibrium analysis, preparing students for advanced research in microeconomics, public policy, and related disciplines.			
Course Objective: 1. Gain fluency in mathematical modeling of strategic situations. 2. Analyze static and dynamic games under various informational settings. 3. Apply equilibrium concepts to interpret institutional outcomes and agent behavior. 4. Understand the foundational principles of mechanism design and information economics. 5. Engage critically with academic literature and advanced problem sets.			

Course Contents:

Module	Topics	L	T	P
1	- Fundamentals of Game Theory Mathematical preliminaries, formal definition of games, strategic vs. extensive form, preferences and utility functions, information partitions.	3	2	
2	- Static Games of Complete Information Strict and weak dominance, best response functions, Nash equilibrium: existence characterization, and applications in oligopoly, voting, and public goods.	3	2	
3	- Mixed Strategy Equilibria and Refinements Randomization, payoff equivalence, expected utility, mixed-strategy Nash equilibrium, strategic uncertainty, and equilibrium refinements (e.g., trembling-hand perfection).	4	2	
4	- Dynamic Games of Perfect Information Extensive form with perfect recall, backward induction, subgames and credibility, applications in bargaining, entry deterrence, and strategic commitment. Application of Common property resource use.	7	2	
5.	- Repeated Games and Long-run Interaction Finitely and infinitely repeated games, subgame perfection in repeated settings, folk theorems, punishment strategies, and cooperation under enforcement constraints.	12	4	
6	- Static Games of Incomplete Information (Bayesian Games) Harsanyi type spaces, belief systems, Bayesian Nash equilibrium, auctions, and strategic market interaction under private information (Cournot's Model), provision of public goods and adverse selection. Application of climate negotiations.	15	4	
	Total	**44**	**16**	

Evaluation Criteria:

Minor 1: Written examination (Module 1, 2 and 3) – 25%

Minor 2: Written examination (Module 4 and 5) – 25%
Major: Written examination (Module 1 to 6) – 50%

Learning Outcomes:

At the end of the course the student must be able to:

1. Formulate normal form of a game, and able to solve for pure and mixed strategy equilibriums (Based on Minor 1)
2. Draw game tree and solve games of perfect and imperfect information using various solution concepts (Based on Minor 2)
3. To apply various game theoretic solution concepts to economic applications (Based on Minor1, Minor 2 and Major)

Core Readings:

1. Gibbons, R. (1992). *Game Theory for Applied Economists*. Princeton University Press.
2. Dutta, P. K. (1999). *Strategies and Games: Theory and Practice*. MIT Press.
3. Watson, J. (2002). *Strategy: an introduction to game theory*. Norton.

Additional Readings:

1. Osborne, M. J. (2004). *An introduction to game theory*. New York: Oxford university press.
2. Watson, J. (2002). *Strategy: an introduction to game theory*. Norton.
3. Fudenberg, D., & Tirole, J. (1991). *Game Theory*. MIT Press (selected chapters).

Module wise chapters from the core readings

Module 1: Gibbons Ch. 1; Dutta Ch. 1; Watson Ch.1

Module 2: Gibbons Ch. 2; Dutta Ch. 2–3; Watson Ch. 3

Module 3: Gibbons Ch. 3; Dutta Ch. 4; Watson Ch. 4 and Ch. 9

Module 4: Gibbons Ch. 4; Dutta Ch. 5; Watson Ch. 5

Module 5: Gibbons Ch. 5; Dutta Ch. 6; Watson Ch.10

Module 6: Gibbons Ch. 6; Dutta Ch. 7; Watson Ch. 7

Pedagogical Approach: Classroom teaching and problem-solving sessions.

Additional information:

Course prepared by Dr. Aditi Singhal

Student responsibilities:

Attendance, feedback, discipline: as per university rules

Course reviewers:

1. Dr Sonal Dua, Associate Professor, Jindal School of Governance and Public Policy, O.P. Jindal Global University, Sonepat, Haryana, India.
2. Dr Sanyyam Khurana, Assistant Professor, Ashoka University, Sonepat, Haryana, India.

Course Title: Growth Economics				
Course Code: BPE XXX	**No. of credits:** 4	**L-T-P:** 60-0-0		**Learning Hours:** 60
Pre-requisite course code and title (if any): Intermediate Macroeconomics-I or Intermediate Macroeconomics-II				
Department: Department of Policy and Management Studies				
Course Coordinator: XXX		**Course Instructor:** XXX		
Contact Details: XXX				
Course Type: Major		**Course offered in:** Semester 5		
Course Description: This course focuses on the diverse thoughts of the economics of growth. In Module 1 of this course, there are discussions on the importance of economic growth, the determinants of the divergent growth experiences across economies, and their historical origins. This is followed by discussions on the growth models of Harrod and Domar that connects the growth rate of the economy on an exogenously given saving rate and the capital-output ratio. In Module 3, important contributions of Solow and Swan in growth economics is discussed. The role of technology in economic growth is the focus of discussions in Modules 4 and 5. The baseline AK model is discussed in Module 4; quality improvements with technological progress with a given variety and market-size effects of technological progress will be discussed in Module 5. The consequences of economic growth when there is depletion of arable land and non-renewable resources and the relationship between economic growth and environmental quality will be the core discussion points in Module 6. Module 7 focuses on the role of demand in the growth processes of the economies. In Module 7, the discussion shifts from the supply side to the demand side of the economy as a crucial determinant of growth. Finally in Module 8, the Indian growth experiences is discussed. Discussions in this module are primarily centered on the growth processes of the Indian economy after the initiation of the structural adjustment programme in the 1990s from contrasting perspectives.				
Course Objectives: • To acquaint the students with the diverse thoughts of growth economics. • To understand the historical origins of the divergence in the growth rates of economies and to identify the determinants of the divergence. • To understand the role of technological progress in economic growth. • To understand the relationship between economic growth and sustainability. • To understand the Indian growth experiences at various phases since its independence from identify the determinants of the Indian growth processes from divergent perspectives.				
Course Contents:				

Module	Topic	L	T	P
1.	**Introduction to Economic Growth** • Why study economic growth? • The facts of economic growth	4		
2.	**Harrod-Domar Model of Economic Growth** • Warranted, natural and actual rates of growth and the knife-edge problem • Dual roles of investment and the razor's edge	6		
3.	**The Solow-Swan Model: Growth Economics with Exogenous Saving Rates** • Basic structure • Steady state and the Golden Rule of capital accumulation	8		

	• Transitional dynamics in the Solow-Swan model				
4.	**Endogenous Growth Model** • The AK model • Transitional dynamics in the basic endogenous growth model	6		
5.	**Technological Progress and Growth** • Growth through creative destruction • Market-size and technical change	10		
6.	**Environment, Natural Resources and Growth** • Growth and sustainability	6		
7.	**Role of Aggregate Demand in Economic Growth** • Fundamental critique of the neoclassical distribution and growth theory • Reconciling the growth of aggregate demand and aggregate supply	10		
8.	**Analyzing India's Growth Experiences** • Trends and patterns of economic growth in India • Sources of economic growth in India • Determinants and contradictions of economic growth in India	10		
	Total	60		

Evaluation Criteria:
1. Minor 1: Written test [after the completion of Modules 1, 2 and 3] – 25% [learning outcome 1]
2. Minor 2: Written test [after the completion of Modules 4 and 5] – 35% [learning outcome 2]
3. Major exam: Written test [after the completion of the course; based on Modules 6, 7 and 8] – 40 % [learning outcomes 3 and 4]

Learning Outcomes:
After the completion of the course, students will develop:
1. Comprehensive understanding of diverse theories of economic growth in terms of core features, determinants of the growth process and possible policy implications.
2. Understanding the role of technology in the growth processes.
3. Enables to understand the relationship between growth and sustainability and the role of demand in the growth process.
4. Understanding of the growth processes of the Indian economy since its independence.

References

Textbooks
- Weil, D. N. (2013). *Economic Growth (3rd Edition)*, Pearson Education.
- Jones, Charles I and Vollrath, Dietrich (2013). *Introduction to Economic Growth (3rd Edition)*, W.W. Norton and Company.
- Aghion, P. and Howitt, P. (2009). *The Economics of Growth*, MIT Press.
- Acemoglu, D. (2009). *Introduction to Modern Economic Growth*, Princeton University Press.
- Barro, R. J. and Sala-i-Martin, X. (2004). *Economic Growth (2nd Edition)*, MIT Press.

CORE reading materials (module-wise):

Module 1: Introduction to Economic Growth

Weil, D. N. (2013). Chapters 1 and 2 in *Economic Growth* (*3rd Edition*), Pearson Education.
Jones, Charles I and Vollrath, Dietrich (2013). Chapter 1 in *Introduction to Economic Growth* (*3rd Edition*), W.W. Norton and Company.
Acemoglu, D. (2009). Chapter 1 in *Introduction to Modern Economic Growth*, Princeton University Press.

Module 2: Harrod-Domar Model of Economic Growth
Ray, D. (1998). Chapter 3 in *Development Economics* (*27th Edition*), Oxford University Press.
Chiang, A.C. (1984). Chapter 13 in *Fundamental Methods in Mathematical Economics*, McGraw-Hill Book Company.

Module 3: The Solow-Swan Model: Growth Economics with Exogenous Saving Rates
Barro, R. J. and Sala-i-Martin, X. (2004). Chapter 1 in *Economic Growth* (*2nd Edition*), MIT Press.
Ray, D. (1998). Chapter 3 in *Development Economics* (*27th Edition*), Oxford University Press.

Module 4: Endogenous Growth Model
Jones, Charles I and Vollrath, Dietrich (2013). Chapter 9 in *Introduction to Economic Growth* (*3rd Edition*), W.W. Norton and Company.
[**Additional readings**: Barro, R. J. and Sala-i-Martin, X. (2004). Chapter 1 in *Economic Growth* (*2nd Edition*), MIT Press].

Module 5: Technological Progress and Growth
Jones, Charles I and Vollrath, Dietrich (2013). Chapter 5 in *Introduction to Economic Growth* (*3rd Edition*), W.W. Norton and Company.
Aghion, P. and Howitt, P. (2009). Chapter 8 in *The Economics of Growth*, MIT Press.
[**Additional reading**: Chapters 3, 4 and 9 in *The Economics of Growth*, MIT Press].

Module 6: Growth and Sustainability
Jones, Charles I and Vollrath, Dietrich (2013). Chapter 10 in *Introduction to Economic Growth* (*3rd Edition*), W.W. Norton and Company.
[**Additional reading**: Arrow, K. J., Dasgupta, P., Goulder, L. H., Mumford, K. J., & Oleson, K. (2012). Sustainability and the measurement of wealth. *Environment and Development Economics*, *17*(3), 317-353.]

Module 7: Role of Aggregate Demand in Economic Growth
Dutt. A. K. (2010). 'Reconciling the growth of aggregate demand and aggregate supply (Chapter 11)', in Setterfield, M. (ed.), *Handbook of Alternative Theories of Economic Growth*, Edward Elgar Publishing Limited.
Hein, E. (2014). Chapter 3 in *Distribution and Growth after Keynes: A Post-Keynesian Guide*. Edward Elgar Publishing Limited.
[**Additional reading:** Foley, D. and Michl, T. R. (2010). 'The classical theory of growth and distribution (Chapter 2)', in Setterfield, M. (ed.), *Handbook of Alternative Theories of Economic Growth*, Edward Elgar Publishing Limited.]

Module 8: Analysing India's Growth Experiences
Subramanian, A., & Felman, J. (2019). 'India's great slowdown: what happened? What's the way out?'. Faculty Working Paper No. 370, Centre for International Development, Harvard University.
Azad, R. and Bose, P. (2021). 'India's growth story: a model of 'riskless capitalism'? (Chapter 15)', In Basu, D. and Das, D. (eds.), *Conflict, Demand and Economic Development: Essays in Honour of Amit Bhaduri*. Routledge.

[**Additional readings:**
-   Robertson, Peter E. (2010). "Investment led growth in India: fact or mythology", *Economic and Political Weekly*, 45(40): 120-124.

- Kotwal, A., Ramaswami, B., & Wadhwa, W. (2011). "Economic liberalization and Indian economic growth: What's the evidence?" *Journal of Economic Literature*, 49(4), 1152-1199].
- Basu, D. and Das, D. (2021). *Conflict, Demand and Economic Development: Essays in Honour of Amit Bhaduri*. Routledge.
- DeLong, J. B. (2003)."India since Independence: An analytic growth narrative." In *In Search of Prosperity: Analytic Narratives on Economic Growth*, edited by D. Rodrik: 184-204. Princeton NJ: Princeton University Press.
- Bosworth, Barry & Collins, Susan M. & Virmani, A. (2007). "Sources of growth in the Indian economy," India Policy Forum, National Council of Applied Economic Research, vol. 3(1), pages 1-69]
- Balakrishnan, P., Das, M. and Parameswaran, M. (2020). "Growth transitions in India: myth and reality", Economics Discussion Paper No. 39, Ashoka University, National Capital Region, India.

Pedagogical Approach: Classroom lectures
Additional information (if any):   **Course prepared by:** Dr. Shantanu De Roy
Student responsibilities: Attendance, feedback, discipline: as per university rules.

Course reviewers:

1. Dr. Jyotirmoy Bhattacharya, Associate Professor, School of Liberal Studies, Ambedkar University Delhi.
2. Dr. Seema Sangita, Associate Professor, Centre for Economic Studies and Planning, Jawaharlal Nehru University.

Course Title: Issues in Indian Economy			
Course Code: BPE XXX	**No. of credits:** 4	**L-T-P:** 60-0-0	**Learning hours:** 60
Pre-requisite course code and title (if any): None			
Department: Department of Policy and Management Studies			
Course Coordinator: XXX		**Course Instructor:** XXX	
Contact Details: XXX			
Course Type: Major		**Course offered in:** Semester 4	

Course Description: This course introduces students to contemporary and emerging growth and development challenges faced by the Indian economy, while taking them through the growth story of India post-independence in a manner that not only looks at the economy as a whole, but also sector specific issues, with consequences for growth and development outcomes, requiring policies and reforms to efficaciously steer the economy.

Course Objectives:
1. Introduce students to evolution of policy debates on issues pertaining to economic growth and development of India.
2. Familiarize students with contemporary and emerging economic growth and development issues, overall as well as sector-wise
3. Introduce students to reforms and policies to address challenges arising in the backdrop of the above issues
4. Develop a holistic understanding of the multifaceted nature of economic development issues faced by the Indian economy.

Course Contents:

Module	Topic	L	T	P
1.	Overview of economic growth and development policies in India since Independence, Planning and the Market, Fiscal and Budgetary Developments	16		
2.	Agriculture: Policies and Performance (Green Revolution, New Agricultural Strategy); Growth; productivity; agrarian structure and technology; capital formation; trade; pricing and procurement.	8		
3.	Industry: Policies and performance; production trends; small scale industries; public sector; foreign investment, labour regulation;	8		
4.	Services: Policies and performance, trends, patterns, composition, drivers	6		
5.	Employment **:** Occupational structure in the organised and unorganised sectors (informalization); open-, under- and disguised- unemployment (rural and urban); employment schemes and their impact; AI and Future of Work	8		
6.	Growth and Distribution: Trends in poverty, inequality and unemployment, Policies; Population and Economic Development: Demographic trends and issues, Education, Health and Malnutrition; Environment & Sustainability	8		

7.	International Trade: Performance and Policies, trends and patterns of imports and exports, FDI, FII	6		
	Total	**60**		

Evaluation Criteria:
1. Minor 1: Written test - 30% [Syllabus: 1-2, learning outcomes 1-2, 4-5].
2. Minor 2: Presentation - 30% [Syllabus: 3-5, Learning outcomes 2-3, 4-5].
3. Major exam: Written test- 40% [Syllabus: 1-7, Learning outcomes 1-5].

Learning outcomes:
Students would be:
1) Equipped with understanding of issues in Indian economic development and ensuing evolution of policy debates
2) Understanding of sector specific as well as broader issues that the Indian economy faces
3) Understanding of employment, growth and demographic consequences of such issues
4) Understanding of the above in the context of current and emerging challenges of inclusiveness, sustainability and technological revolution
5) Able to have a broad perspective of the multifaceted nature of the economic growth and development challenge

References (*additional reading):

Module 1:

Mohan, Rakesh. "Growth record of the Indian economy, 1950-2008: A story of sustained savings and investment." Economic and Political Weekly (2008): 61-71.
Vijay Joshi, 2016, India's Long Road: The Search for Prosperity, Allen Lane, Gurgaon, Ch 2.
Kapila, Uma, ed. *Indian Economy since independence*. Academic Foundation, 2008 (Ch 2, 5)
Kumar, Utsav, and Arvind Subramanian. "Growth in India's states in the first decade of the 21st century: four facts." *Economic and Political Weekly* (2012): 48-57.
Kumar, Utsav, and Arvind Subramanian. "Growth in India's states in the first decade of the 21st century: four facts." *Economic and Political Weekly* (2012): 48-57.
Kotwal, Ashok, Bharat Ramaswami, and Wilima Wadhwa. "Economic liberalization and Indian economic growth: What's the evidence?." *Journal of Economic Literature* 49.4 (2011): 1152-1199.

Module 2:
Gulati, A., Saini, S. (2017) 25 years of Policy Tinkering in Agriculture. In R. Mohan (Ed.): *India Transformed: 25 Years of Economic Reforms.* Penguin.
Overview, 2014 in Republic of India, Accelerating Agriculture Productivity Growth, *World Bank Group*
Chandrasekhar Rao and Mahendra Dev (2010). Agricultural Price Policy, Farm Profitability and Food Security. *Economic & Political Weekly*
Himanshu. "The Crisis in Indian Agriculture: Genesis, Response and Future Prospects." *India's Economy and Society: Lateral Explorations* (2021): 27-51*

Module 3:
Kochhar, Kalpana, et al. "India's pattern of development: What happened, what follows?." *Journal of monetary economics* 53.5 (2006): 981-1019.
Chakraborty, J., & Nagaraj, R. (2020). Has India Deindustrialised Prematurely? *Economic & Political Weekly*
Singh, Shiwangi, Meenakshi Sharma, and Sanjay Dhir. "Modeling the effects of digital transformation in Indian manufacturing industry." *Technology in Society* 67 (2021): 101763.
Somanathan, Eswaran, et al. "The impact of temperature on productivity and labor supply: Evidence from Indian manufacturing." Journal of Political Economy 129.6 (2021): 1797-1827.

Module 4:

Chanda, R. (2019). India's Services Sector; trends, opportunities and challenges, in Uma Kapila(ed.), Indian economy-2; Macroeconomic policies, Sectoral Developments and Performance. (Chp.29)

Eichengreen, Barry, and Poonam Gupta. *The service sector as India's road to economic growth*. No. w16757. National Bureau of Economic Research, 2011.

Mukherjee, Arpita. *The service sector in India*. No. 352. ADB economics working paper series, 2013.

Gordon, James, and Poonam Gupta. "Understanding India's services revolution." *India's and China's recent experience with reform and growth*. London: Palgrave Macmillan UK, 2005. 229-263.

Module 5:
Bhagwati and Panagariya (2012). A Multitude of Labour Laws and their Reforms in India's Tryst with Destiny. *Collins Business*

J.J. Thomas (2012). India's Labour Market during the 2000s: Surveying the Changes. *Economic & Political Weekly*

Jha, Praveen. "Prospects for labour and contemporary capitalism: An assessment with reference to India." *The Indian Journal of Labour Economics* 62 (2019): 319-340

Himanshu (2008) "Growth, employment and poverty reduction: post-reform Indian experience."

Module 6:
Datt, Gaurav, Martin Ravallion, and Rinku Murgai. "Poverty and growth in India over six decades." *American Journal of Agricultural Economics* 102.1 (2020): 4-27.

Banerjee, A. V., & Duflo, E. (2011). Poor economics: A radical rethinking of the way to fight global poverty (Ch 6-9)

Piketty, T., Saez, E. (2014). Inequality in the Long Run, *Science**

Dreze, J., Sen, A. (2013). *India: An Uncertain Glory*. Allen Lane (Chptrs 5-7)

S. Mehrotra (2015). Realising the Demographic Dividend, Policies to achieve Inclusive Growth in India, *Cambridge University Press**

Roy, T., & Swamy, A. V. (2021). Law and the economy in a Young Democracy: India 1947 and beyond. University of Chicago Press. (Ch. 6), 112-115 and 121-134

"An Analysis of Physical and Monetary Losses of Environmental Health and Natural Resources in India", World Bank Working Paper

Ahluwalia, Montek S., Himanshu Gupta, and Nicholas H. Stern. A more sustainable energy strategy for India. No. 328. Working Paper, 2016.

Gielen, Dolf, and Peter Taylor. "Indicators for industrial energy efficiency in India." Energy 34.8 (2009): 962-969.*

Bandyopadhyay, Arunava, and Soumen Rej. "Can nuclear energy fuel an environmentally sustainable economic growth? Revisiting the EKC hypothesis for India." Environmental Science and Pollution Research 28.44 (2021): 63065-63086.*

Datt, Gaurav, and Martin Ravallion. "Has India's economic growth become more pro-poor in the wake of economic reforms?." *The World Bank Economic Review* 25.2 (2011): 157-189.*

Module 7:
Banga, R. (2014). Trade facilitation and `hollowing-out' of Indian manufacturing. *Economic and Political Weekly,* 49(40), 57-63*

Mukherjee, Deeparghya (2021) Is India Moving Up the Global Value Chain? A Sectoral Study of Indian Exports. Economic and Political Weekly, 56(20), 12-15*

Biswajit Dhar (2015). India's New Foreign Trade Policy. *Economic & Political Weekly*

Batra, A. (2022). India's Trade Policy in the 21st Century. Ch-8 Conclusions & Reform Priorities , 156-165. Routledge.

Pedagogical Approach: Classroom lectures

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

Course reviewers:

1. Debasis Mondal, Professor of Economics, Indian Institute of Technology Delhi
2. Devi Prasad Dash, Assistant Professor of Economics, Indian Institute of Technology Jodhpur

Course Title: Econometrics 1				
Course Code: TBD		**No. of credits:** 4	**L-T-P:** 44-16-0	**Learning Hours:** 60
Pre-requisite course code and title: UEO 204 Intermediate Statistical Methods for Economics; UDS 101 Statistics for Data Science				
Department: Department of Policy and Management Studies				
Course Coordinator:			**Course Instructor:**	
Contact Details:				
Course Type: Core			**Course offered in:** 5th Semester	
Course Description: The course is a first introduction to concepts in Econometrics. It assumes knowledge of distributions, statistical inference, estimation and hypothesis testing. It starts from simple linear regression model (CLRM) and extends it to multiple linear regression. Dummy variable regression is further discussed in this course along with the violations of the CLRM.				

Course Objective:
1. To get started with the fundamental concepts in econometrics.
2. To understand how simple econometric concepts can be applied and studied in the context of economic analysis.

Course Contents:

Module	Topics	L	T	P
1	**Introduction to Econometrics** Types of Data, Observational versus experimental data, Structure of economic data	2	0	
2	**Simple Linear Regression** Ordinary least squares, properties of OLS estimators, goodness of fit, scaling and units of measurement, functional forms, confidence intervals, the Gauss-Markov theorem testing of hypotheses (T and F tests)	10	4	
3	**Multiple Linear Regression** Extending the Simple Linear regression to one with many variables, OLS and it's properties, FWL Theorem, Gauss Markov Theorem	12	5	
4	**Dummy Variable Regression** Categorical variables, two categories and multiple categories, dummy variable trap, policy analysis. Introduction to linear probability models, logic and probit regressions.	10	4	
5	**Violations of classical assumptions** Heteroskedasticity, Normailty Tests , Multicollinearity and autocorrelation	7	2	
6	**Endogeniety** Omitted variable bias, module misspecification	3	1	

	Total	44	16	

Evaluation Criteria:
Minor 1: Written Examination - 25% [Syllabus: 1-2, Learning outcomes: 1-3]
Minor 2: Written Examination - 25% [Syllabus : 3-4 , Learning outcomes: 1-3]
Major: Written Examination - 50% [Syllabus: Complete course, Learning outcomes: 1-3]

Learning Outcomes:
At the end of the course, the students will be able to:
1. Understand the core concepts of econometrics [Modules 1-6]
2. Understand economic applications of econometric methods [Modules 1-6]
3. Formulate econometric models, interpret them and use them for economic analysis [Modules 2-6]

Core Reading:
1. Wooldridge, J. (2023). Introductory Econometrics : A modern approach, 7th *ed.* Cengage Learning. [JW]

Additional Readings:
1. Dougherty, C. (2011). Introduction to econometrics, 4th ed. Oxford University Press. [CD]
2. D. N. Gujarati and D.C.Porter, Essentials of Econometrics, 4th Edition, McGraw Hill, International
   Edition, 2010. [GP]

Module-wise chapters from the core readings:
1. Module 1: JW, Chapter 1
2. Module 2 : JW, Chapter 2
3. Module 3: JW, Chapters 3, 4 and 6
4. Module 4: JW, Chapter 7
5. Module 5: JW, Chapter 8 and 12

Pedagogical Approach:
Classroom teaching and problem-solving sessions.

Course prepared by: Priyanka Arora

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

Course reviewers:
1. Dr. Divya Gupta, Associate Professor of Economics, Jindal Global Law School, Jindal Global
   University.
2. Dr. Anshika Sagar, Assistant Professor, Department of Economics, Hindu College, University of
   Delhi.

Course title: Development Economics				
Course code:	**No. of credits:** 4		**L-T-P:** 58-0-4	**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 type: Core		**Course offered in:** Semester 1		

Course description:
This course introduces the students to challenges of economic development in India and the rest of the world. The introductory module offers a foundation for the course. The course offers an understanding of both historical trends and the present status of poverty, inequality and well-being in developing countries with an emphasis on empirical challenges in the estimation of these indicators. It also offers a microeconomic perspective of aspects that enable (or act as barriers) to economic development broadly categorized into functioning of markets (of the factors of production), political and social institutions. In each module, the students will examine the relevant theories, empirical validity of the theories (especially in the context of the Indian economy) and the associated policy implications.

Course objectives:
1. To introduce the students to theoretical and empirical issues pertaining to economic development.
2. To expose students to data and measurement issues of development indicators.
3. To enable students in analysing constraints to economic development.
4. To develop an understanding on India's economic development challenges.
5. To equip the students with tools and techniques used in the research in economic development.
6. To develop capacity among the students for research in policy domain.

Course contents

Module	Topic	L	T	P
1	**Introduction** Evolution of development economics Understanding the economic lives of the poor Development Analysis: Selected issues pertaining to data and causal inference. Practical: Introduction to development data in India, with a focus on national level household surveys like NSSO, IHDS, etc. Understanding data documentations, identifying methodology of survey and compilation of data and assessing the limitations of the data.	2 2 6		4
2	**Outcomes of the Development Process** Conceptualizing well-being and poverty; measurement of poverty; debates onassessment of poverty in India; Anti-poverty programs. Understanding Inequality; Measurement of Inequality; Inequality in India.	8 6		
3	**Markets and Market Failures** Employment and wage determination in developing countries; mobility of labour; informal labour markets. Rural land markets, property rights, tenancy contracts. Role of financial capital markets in developmental process; credit and insurance markets in agrarian economies; evaluation of microfinance model as analternate to traditional banking.	6 6 6		

4	**Institutions and Development**			
	Government failure as barrier to development: case studies of corruption and ineffective provisioning of public goods Social institutions as barrier to development: social discrimination; impact of caste, religion and gender discrimination on developmental outcomes in India. Social institutions as enablers of development: social networks	6		
		4		
		4		
5	**Way Forward**	2		
	Total (in hours)	**58**		**4**

Evaluation Criteria

Minor I [Modules 1-2]   20%
Minor II [Module 3]   20%
Major examination [Modules 1-4]   40%
Policy assignment [Modules 1-4]   20%

Learning outcomes:
At the end of this course, students will be able to
   1. Conceptualize the developmental challenges in India and other developing nations. (Evaluation: All components)
   2. Understand theories and empirics in Development Economics. (Evaluation: All components)
   3. Understand data and empirical methods used in development analysis (Evaluation: Empirical Exercise)
   4. Critically appreciate the literature in Development Economics (Evaluation: Critical Review of Literature)
   5. Synthesize Evidence for Policy (Evaluation: Policy Brief Assignment)
   6. Demonstrate Soft skills: written and verbal communication; critical thinking; team work

References (* = compulsory readings) Books
Textbooks
*Bardhan, Pranab and Christopher Udry. 1999. *Development Microeconomics*, Oxford: Oxford University Press.(BU henceforth)
Ray, Debraj, (1998) *Development Economics*, Princeton: Princeton University Press. (DR henceforth)
Ghate, Chetan ed. 2012. *The Oxford Handbook of the Indian Economy*, New York: Oxford University Press (CGhenceforth)
Others
Banerjee, Abhijit, Roland Benabou and Dilip Mookherjee (2006), eds. *Understanding Poverty*, New York: OxfordUniversity Press.

Suggested Readings (module-wise)
a. *Introduction*
Evolution of Development Economics
DR – Ch 1
BU – Ch 1
*Bardhan, Pranab. 1993. "Economics of Development and the Development of Economics." *J. Econ. Perspectives*, 7(2): 129-42.
*Banerjee, Abhijit, and Esther Duflo. 2006. "Economic Lives of the Poor." *Journal of EconomicPerspectives* 21(1): 141-167.
Banerjee, Abhijit, and Esther Duflo. 2008. "What is Middle Class About the Middle Classes Aroundthe World?" *Journal of Economic Perspectives* 22(4): 3-28

Data and Methods for Development Economics
a. *Deaton, Angus. 1997. *The Analysis of Household Surveys: Microeconomic Analysis for Development Policy*. Baltimore: Johns Hopkins University Press for the World Bank.
b. Ravallion, M. 2001. "The mystery of the vanishing benefits: An introduction to impact evaluation."

World Bank Economic Review, vol 15(1) :115-140.
http://wber.oxfordjournals.org/content/vol15/issue1/index.dtl.

c.   Duflo, Esther, Rachel Glennerster, and Michael Kremer. 2008 "Using Randomization in Development Economics Research: A Toolkit." In *Handbook of Development Economics,* Vol. 4.. Edited by T. Schultz and John Strauss, Amsterdam: North Holland.

d.   Deaton, Angus, and Nancy Cartwright. 2018. "Understanding and misunderstanding randomized controlled trials." *Social Science & Medicine, in press.* https://www.sciencedirect.com/science/article/pii/S0277953617307359?via%3Dihub.

e.   Esther Duflo. 2005. "Field Experiments in Development Economics." *BREAD Policy Paper 12.*

f.   Basu, Kaushik. 2014. "Randomization, Causality and the Role of Reasoned Intuition," *Oxford Development Studies*, 42(4): 455-472. DOI: 10.1080/13600818.2014.961414.

g.   Athey, S., & Imbens, G. 2017. "The State of Applied Econometrics: Causality and Policy Evaluation." *The Journal of Economic Perspectives*, 31(2): 3-32. Retrieved from http://www.jstor.org/stable/44234997.

b. **Outcomes of the Development Process**

Poverty and Inequality

a.   DR – Chapters 6, 7, 8.

b.   BU – Chapter 11.

c.   *Haughton, Jonathan; Shahidur R Khandker. 2009 *Handbook on Poverty and Inequality*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/11985 License: CC BY 3.0 IGO.

d.   *Stephen P. Jenkins and Philippe Van Kerm. 2011 "The Measurement of Economic Inequality" In *TheOxford Handbook of Economic Inequality.* Edited by Brian Nolan, Wiemer Salverda, and Timothy M. Smeeding. Oxford: Oxford University Press DOI: 10.1093/oxfordhb/9780199606061.013.000.

e.   *Dreze, J and Deaton, A. 2002. "Poverty and Inequality in India: A Re-examination." *Economic andPolitical Weekly*, Vol. 37(36): 3729-3748.

f.   *Himanshu and Sen, K. 2014. "Revisiting the Great Indian Poverty Debate: Measurement, Patterns, andDeterminants" *BWPI Working Paper 203.* http://www.bwpi.manchester.ac.uk/medialibrary/publications/working_papers/bwpi-wp-20314.pdf

g.   Deaton, A. and V. Kozel, 2005. "Data and Dogma: The Great Indian Poverty Debate." *The World BankResearch Observer* 20 (2): 177-200. http://www.princeton.edu/~deaton/downloads/deaton_kozel_great_indian_poverty_debate_wbro_200 5.pdf

h.   *Martin Ravallion. 2008. "Evaluating Anti-Poverty Programs" In *Handbook of Development Economics,* Vol. 4. Edited by T. Schultz and John Strauss, Amsterdam: North Holland.

i.   *Alkire, Sabine and Suman Seth, 2015. "Multidimensional Poverty Reduction in India between 1999 and2006: Where and How?" *World Development* 72: 93-108. Also published as OPHI Working Papers 60, 2013.

j.   Borooah, Vani and Amaresh Dubey. 2007. "Measuring Regional Backwardness: Poverty Gender and Children in the districts of India." *Margin: The Journal of Applied Economic Research*, Vol 1(4): 403 – 440.

k.   Chancel, L. and Picketty, T. 2017 "Indian income inequality, 1922-2015: From British Raj to BillionaireRaj?" *WID.world Working Paper Series N° 2017/11.* Available at: http://wid.world/document/chancelpiketty2017widworld/.

c. **Markets and Market failures**

Labour Markets

a.   BU – Chapter 4, 5

b.   DR – Chapter 10, 13

c.   *Mark R. Rosenzweig. 1995. "Labor Markets in Low-Income Countries: Distortions, Mobility andMigration." *Handbook in Development Economics* (Alternate version: http://www.rrojasdatabank.info/edc87-05.pdf)

d.   *Freeman R. (2009) "Labor Regulations, Unions, and Social Protection in Developing Countries: MarketDistortion or Efficient Institutions." In: *Handbook of Development Economics*. Amsterdam:

North Holland (Alternate version: http://www.nber.org/papers/w14789.pdf)

e. Gordon Hanson (2008) "International Migration and Development." *Commission on Growth and Development Working Paper #42* http://siteresources.worldbank.org/EXTPREMNET/Resources/489960-1338997241035/Growth_Commission_Working_Paper_42_International_Migration_Development.pdf

f. Yang, Dean. 2008. "International Migration, Human Capital, and Entrepreneurship: Evidence fromPhilippine Migrants' Exchange Rate Shocks." *The Economic Journal*, Vol. 118 (April): 591-630.

g. *Deshingkar, Priya and Shaheen Akter. 2009. "Migration and Human Development in India." *MPRAPaper 19193*, University Library of Munich, Germany.

h. Nandi, Tushar Kanti and Saibal Kar. 2015. "Short-term Migration and Intergenerational Persistence ofIndustry in Rural India." *IZA Discussion Papers 9283*, Institute for the Study of Labor (IZA).

i. Czaika, M. (2012) "Internal and international migration as a response of double deprivation: someevidence from India." *Asian Population Studies*, 8(2), pp. 125–149

j. *Mitra, Arup and Dibyendu Maity. 2010. "Skills, Informality and Development." *IEG working paper#WP306,* http://iegindia.org/upload/publication/Workpap/wp306.pdf

k. Kanbur, Ravi. 2009. "Conceptualising Informality: Regulation and Enforcement." *Cornell University, Department of Applied Economics and Management, Working Paper 09-11*

l. CG – Chapter 9

m. Marjit, Sugata and Saibal Kar. 2012. "Informal Sector and Developing World: Relating Theory and Evidence to India" in: Ghate, Chetan ed. *The Oxford Handbook of the Indian Economy*, New York:Oxford University Press.

Land

a. *BU – Chapter 6

b. DR – Chapter 12

c. Besley, T. and R. Burgess. 2000. "Land Reform, Poverty Reduction, and Growth: Evidence from India." *Quarterly Journal of Economics*, vol. 115(2): 389-430.

d. *Banerjee, A., P. Gertler, and M. Ghatak. 2002. "Empowerment and Efficiency: Tenancy Reform in WestBengal." *Journal of Political Economy*, 110(2): 239-280. doi:10.1086/338744.

e. Galiani, Sebastian and Ernesto Schargrodsky. 2010. "Property rights for the poor: Effects of land titling." *Journal of Public Economics*, vol. 94(9-10): 700-729.

f. Binswanger-Mkhize, Hans P.,Camille Bourguignon and Rogier van den Brink. 2009. "Agricultural LandRedistribution: Toward Greater Consensus." World Bank Publications, The World Bank, https://openknowledge.worldbank.org/handle/10986/2653.

g. *Besley, Timothy and Maitreesh Ghatak,. 2010. "Property Rights and Economic Development." *Handbook of Development Economics*, Elsevier. (alternate version: Besley, Timothy and Maitreesh Ghatak. 2009. "Property rights and economic development." LSE Research Online Documents on Economics 25428, London School of mics and Political Science, LSE Library.)

h. *Binswanger, Hans, P. Deininger, Klaus and Feder, Gershon (1995) "Power, distortions, revolt, and reform in agricultural land relations", *Handbook of Development Economics*, Elsevier (alternative version: http://documents.worldbank.org/curated/en/304261468764712147/pdf/multi-page.pdf).

Capital, Credit, Insurance

    a. *BU – Chapter 7, 8

    b. DR – Chapter 14, 15

    c. CG – Chapter 5, 6.

a. Eswaran, Mukesh, and Ashok Kotwal. 1989. "Credit as Insurance in Agrarian Economies." *Journal of Development Economics* 31(1):37–53.

b. Jonathan Morduch. 2002. "Between the State and the Market: Can Informal Insurance Patch the SafetyNet?" *World Bank Research Observer,* 14, no. 2, 187–207.

c. *Karlan, D. and Morduch J. 2010. "Access to Finance." in *Handbook of Development Economics*. Alsoavailable at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.205.6947&rep=rep1&type=pdf.

d. *Besley, B. 1995. "Savings, Credit and Insurance." *Handbook of Development Economics*, Vol 3A. Alsoavailable at: https://www.princeton.edu/rpds/papers/Besley_Savings_Credit_and_Insurance_HDE1995.pdf.

e. .*Maitra, Pushkar, Sandip Mitra, Dilip Mookherjee, Alberto Motta and Sujata Visaria, (2014) "FinancingSmallholder Agriculture: An Experiment with Agent-Intermediated Microloans in India" *NBER WorkingPaper No. 20709* http://www.nber.org/papers/w20709.

f. *Field, Erica, Rohini Pande, John Papp, and Natalia Rigol. 2013 "Does the Classic Microfinance Model Discourage Entrepreneurship among the Poor? Experimental Evidence from India." *American EconomicReview* 103(6): 2196-2226.

Pande, Rohini, and Burgess, Robin. 2005. "Do Rural Banks Matter? Evidence from the Indian Social Banking Experiment." *American Economic Review,* 95(3): 780-794.

d. ***Institutions and Development***

Political Institutions

a. *Banerjee, A. , L. Iyer and Somanathan. R. (2008) "Public Action for Public Goods" *Handbook of Development Economics,* Vol. 4, *Ch II.1*. Edited by T. Schultz and John Strauss, Amsterdam: NorthHolland.

b. *Pande, Rohini. (2008) "Understanding Political Corruption in Low Income Countries" *Handbook ofDevelopment Economics*. Vol. 4. *Ch II.2*. Edited by T. Schultz and John Strauss, Vol. 4. Amsterdam:North Holland.

Social Discrimination and Social Networks

a. *Basu, Kaushik. 2015. "Discrimination as a Coordination Device: Markets and the Emergence ofIdentity." *World Bank Policy Research Working Paper 7490.*

b. Vegard Iversen. 2012. "Caste and Upward Mobility." In *The Oxford Handbook of the Indian Economy*,edited by Ghate, Chetan. New York: Oxford University Press.

c. *Munshi, Kaivan and Mark Rosenzweig (2009) "Why is Mobility in India so Low? Social Insurance,Inequality and Growth," *NBER Working Paper No. 14850.*

d. *Madheswaran, S and P. Attewell. 2007. "Caste Discrimination in the Indian Urban Labor Market: Evidence from the National Sample Survey", *Economic & Political Weekly,* vol. 42(41): 4146–4153.

e. Field, E., S. Jayachandran, and R. Pande. 2010. "Do Traditional Institutions Constrain Female Entrepreneurship? A Field Experiment on Business Training in India." *The American Economic Review*,Vol. 100(2):125-129 http://www.jstor.org/stable/27804976.

f. Munshi, K. 2007 "From Farming to International Business: The Social Auspices Of Entrepreneurship InA Growing Economy." *NBER Working Paper – 13065* http://www.nber.org/papers/w13065.

g. Singh, Prerna and Dean Spears. 2017. "How status inequality between ethnic groups affects public goodsprovision: Experimental evidence on caste and tolerance for teacher absenteeism in India." *WIDER Working Paper Series 129*, World Institute for Development Economic Research (UNU-WIDER).

h. *Kaivan Munshi and Mark Rosenzweig. 2006 "Traditional Institutions Meet the Modern World: Caste,Gender, and Schooling Choice in a Globalizing Economy." *American Economic Review*, American Economic Association, vol. 96(4): 1225-1252.

i. Greif, Avner. 1993. "Contract Enforceability and Economic Institutions in Early Trade: The MaghribiTraders' Coalition." *American Economic Review*, 83(3): 525-548.

5. *Way Forward*

a. Kotwal, A. 2012. "What more do we want to know about the Indian Economy" In *The Oxford Handbookof the Indian Economy*, edited by Ghate, Chetan, New York: Oxford University Press.

b. Banerjee, Abhijit Pranab Bardhan, Kaushik Basu, Ravi Kanbur and Dilip Mookherjee. 2005. "New Directions in Development Economics: Theory or Empirics? A Symposium in Economic and PoliticalWeekly, http://www.arts.cornell.edu/poverty/kanbur/NewDirectionsDevEcon.pdf

Pedagogical Approach:

Classroom teaching *Emphasis on reading and questioning empirical literature in Development Economics*
Additional information (if any): Suggested journals--Journal of Economic Perspectives, Journal of Development Economics, Indian Economic Review.
Student responsibilities: Attendance, feedback, discipline: as per university rules.

Course reviewers:

1. Prof. Bharat Ramaswamy, Indian Statistical Institute, Delhi Center, 7, S. J. S. Sansanwal Marg, New Delhi, Delhi. 110016.
2. Prof. Tridip Ray, Indian Statistical Institute, Delhi Center, 7, S. J. S. Sansanwal Marg, New Delhi, Delhi.110016

Course title: Methods of Research in Economics				
Course code: MPE 176	**No. of credits:** 4	**L-T-P:** 46-4-20		**Learning hours:** 60
Pre-requisite course code and title (if any): Microeconomics and Macroeconomics at Post Graduate Level or equivalent; MPE 185 Environment and Economic Development				
Department: Department of Policy and Management Studies				
Course coordinator(s): Dr. Sukanya Das		**Course instructor(s):** Dr. Sukanya Das		
Contact details: sukanya.das@terisas.ac.in				
Course type: Core		**Course offered in:** Semester 3		

Course description

This course provides a broad exposure on various steps in conducting meaningful and grounded research in economics with a focus on ecological, environmental and resource economics, the specialization of the MSc Economics programme. In the process, it walks the students through the entire spectrum of research design, that begin with theories, concepts, frameworks and models and end with a Research Proposal for the Masters' Thesis to
be written in the fourth semester.

Course objectives

1. To provide the students an exposure to some stages of research in economics, from conceptualisation to proposal writing.
2. To make the students understand the significance of academic rigour, logical consistency and expositional clarity in research.

Course content

Module	Topic	L	T	P
1.	**Introduction** Logical reasoning Statement of facts Facts – social and natural Values -- social construction, assumptions and interpretations Causation Explanations--evolutionary, functional and causal Method of scientific investigation: induction, inference, hypothetico-deductivemodel and falsification	10		
2.	**Theories, Concepts, Paradigms, Frameworks and Models** Illustration 1: Institutional Analysis and Development Framework Illustration 2: Socio-ecological systems Illustration 3: Sustainable Livelihood Framework	8		
3.	**Research Design: Research Problem, Research Questions and Research Method** Goals, aims, objectives Requirements for and of a Hypothesis Case study method Logical framework matrix Interdisciplinarity--potential and challenges	7		

4.	**Selected aspects of theoretical research** Preliminaries: specification of agents, action space, state space, strategies, payoffs, assumptions Notion of equilibrium/optimum used Results: characterization, comparative statics, robustness Interpretation and explanation	4		
5.	**Presentation of Research Concept Note**			8
6.	**Secondary Data** Metadata [with illustrations from National Accounts Statistics Sources and Methods 2007 and SDG Index and Dashboards Report 2017 - Metadata] Managing large database [with illustrations from IHDS and Cost of Cultivation	3	4	
	Dataset] 6.3 Cleaning of data [with illustrations from IHDS and Cost of Cultivation Dataset]			
7.	**Primary data** Type of Quantitative and qualitative data collection methods Potential and challenges of use of qualitative data in economics Sites of study Framing of questions and Design of questionnaire Conducting Field survey— issues and challenges	6		
8.	**Expressions for a proposal** Framing of Abstract: proposals and papers Framing of Introduction: motivations Aligning the question with theoretical ideas and concepts Reporting a Literature Survey or Review: meta analysis Description of the Research Method: appropriateness, justification of choice, limitations Listing of variables and their justification Data to be used and collection method: sampling plan, sample size, unit of analysis, study site description, if any Empirical Method for data analysis: prospects and limitations in answering the research question Anticipated results: local, regional and national policy implications, if any Matrix: linking hypothesis (if any), research design, variables, empirical method, data sources Presentation of results: description, interpretation, implication, prescription Professional Ethics in Research	6		
9.	**Overview of some of the General Parameters for Assessment, Evaluation and Review** Content, Structure and Form Academic Rigour Expositional clarity Logical consistency Integration and coherence Originality	2		
10.	**Presentations of Proposals**			12
		46	**4**	**20**

Evaluation criteria

1. **ASSESSMENT 1**: Research Concept Note – 20% (learning outcome 2)

   Structure

   A. Title: It should capture the essential theme(s) of the proposed research. It should show clearly what is being investigated. A concise and focused title is preferred (no more than 15 words).

   B. Motivation: Provide an account of (a) why do you want to inquire into this specific area and (b) its relevance (ecological, economic, social, political, philosophical, policy related, legal, etc.)

   C. Research Problem: Provide a clear and simple description of your research problem (maximum 200 words). What do you want to find out? What will be known after this research is conducted?

   D. Objectives: *Identify* overall study goals and specific research objectives (maximum 100 words)

   E. Background (a complete Literature Review is not necessary at this stage): A concise review of the main research work and current issues in the specific subject area. What is already known about this specific subject? What is/are the gap/s? Identify at least three papers whose methodology/ model you are most likely to apply. (300 words)

F. Hypotheses/research questions to be tested or answered (maximum 25 words each).
G. Analytical Methods: *Describe* economic theory/ies and concept/s that your work will rely on for testing hypotheses/ answering research questions (200 words)
H. Proposed Empirical Methods, if any (100 words): *Describe* type of models, tools of analysis, etc. and justify their employment.
I. Description of the Study Site (if any, but can be indicative), variables and data sources (100 words): definition of variables, indicators, etc.

Criteria and sub-criteria for assessment
A. Title: Extent of focus and relevance.
B. Research Problem: Expositional clarity and logical consistency.
C. Research objectives: Whether clear and achievable.
D. Background: Sufficiency of description of the state of knowledge and identification of gaps.
E. Research questions/hypothesis: How interesting the question/s is/are? How important are they? Does addressing it/them fill/s any gap in literature? Feasibility of answering them: does it require significant monetary expense, a duration of more than 9 months, access to and use of leased in equipment and materials, new technical knowledge and yet-to-be acquired skill, and access to a really large number of human subjects.
F. Methods and data: Level of clarity on proposed methods (analytical and empirical) and approaches of data collection.
G. Integration and Coherence across different components.
   Suggested weights in total marks:
   25% each on (a) research question and (b) method and data
   10% each on (c) title, (d) research problem, (e) research objectives, (f) background, and (g) integration & coherence.

2. **ASSESSMENT 2**: Presentation of Research Proposal – 30% (learning outcome 1)
   Criteria and sub-criteria for assessment
   A. Introduction, Problem Statement and Research Question: Relevance, Clarity, Innovativeness.
   B. Literature review: Coverage, Ability to review the relevant literature, Inferences of gaps in the literature.
   C. Method: Choice of method, Appropriateness of method, Comprehensive background, description andlimitations of the method; Discussion of conjectures/variables/data sources/sampling strategy and questionnaire (if relevant)
   D. Expected findings/Discussion of results: Clarity on expected outcome of the project; Interpretation and implications of results (in case of final presentation
   E. Integration and Coherence: Linkages between the introduction, problem statement, research question, method, results, conclusion, etc.
   F. Clarity of Presentation: Audible and comprehensible; Information is presented in logical sequence; Good language skills and pronunciation; Appropriate pace of presentation
   G. Quality of visual presentation: Clarity; Organization and layout.
   H. Responses during Q&A session: Response to questions and comments.
   Suggested Weights in total marks:
   20% each on (a) method of analysis, (b) integration & coherence and (c) clarity of presentation 10% each on (d) literature review, (e) expected findings/discussion of results, (f) quality of visual presentation and (g) responses during Q & A session.

3. **ASSESSMENT** 3: Research Proposal – 50% (learning outcome 2)
   Structure
   A. Abstract or a Summary of research proposal: a self-contained summary of the proposal with clear objective,

research question/s, research method, data, and anticipated results. [400 words]

B. Research Problem: a clear and simple description of your research problem, the socio-economic and environmental context and why it is important to investigate further (your contribution in the backdrop of existing literature), and potential policy implications of your work.

C. Study Goals: identify your overall goal of the study, specific objectives /research question. You should clearly state single but critical and interesting research question/s to address the issue that raisedin the 'Research Problem'.

D. Literature Review: an e*xhaustive* account of relevant knowledge domains. Review may be restricted to the works most pertinent to the study. You should clearly identify the research gaps and your likely contribution using latest literature.

E. Research Methods
  1. Theoretical ideas and relevant concepts: include logical/ theoretical/ behavioral model and link it with hypothesis, research question and empirical method/data.
  2. Hypothesis to be tested, if any.
  3. Clear indication of what variables to be used and why.
  4. Data to be used and collection methods (sampling plan, sample size, unit of analysis, etc.).
  5. A description of the study site, if any.
  6. Empirical methods for data analyses. It should be clearly linked with your research question, and how your proposed analysis answers the question.

F. Expected Results.

G. Policy implications: local, regional, or national.

H. Bibliography following an accepted citation style such as Chicago Manual of Style or APA or EPW.

I. Annexure: Draft questionnaire in case primary data are to be collected.

Criteria and sub-criteria for assessment

A. Abstract: Comprehensiveness.

B. Problem Statement and Research Question: Relevance; Clarity; Innovativeness.

C. Literature review: Coverage; Ability to review the relevant literature and Inferences of gaps in the literature.

D. Method: Choice of proposed method; Appropriateness of method; Comprehensive background, description and limitations of the method; Identification of variables and data sources (if relevant); Sampling strategy and questionnaire (if relevant); Formal Conjectures (if relevant).

E. Expected Findings: Clarity in the expected direction of thesis; Understanding on relevance of expected findings.

F. Integration and Coherence: Linkages between the problem statement, research question, method and expected findings.

G. List of references as per the Citation Style: Adequate use of references through-out the text; Link between list of references to text; Citation style, both in-text and in reference.

Suggested weights in total marks:

20% each on (a) problem statement and research question and (b) method of analysis

10% each on (c) abstract, (d) introduction, (e) literature review, (f) expected findings, (g) list of references and (h) integration & coherence.

A minimum grade of C is required to qualify for the next semester and submit the Master's thesis

Learning Outcomes
  a. Skills for making effective presentations.
  b. Ability to prepare a comprehensive research proposal.

Reading Materials
All readings are available here:
CORE:
Module 1

Module 4

HalR   Varian. 1989." What use is Economic Theory" available

online at

http://people.ischool.berkeley.edu/~hal/Papers/theory.pdf

Module 6

M R Saluja. 2017. 'Chapter 1: Indian and International Statistical Systems', 'Chapter 3: Agricultural Statistics', 'Chapter 12: National Accounts' and 'Chapter 14: Environmental Statistics'', in *Measuring India: The Nation's Statistical System*, 1-45, 96-135, 394-454 and 488-508, Delhi: Oxford

Module 7

Angus Deaton. 1997. *The Analysis of Household Surveys: Microeconomic Analysis for Development Policy*. Baltimore: Johns Hopkins University Press for the World Bank.

Priscilla Salant and Don A. Dillman. 1994. *How to Conduct your own Survey* Wiley

Module 8

William Thomson. 2011. "Chapter 3: Giving Talks" in *A Guide for the young economist*, 119-150. Second edition.

Cambridge: MIT Press.

George DeMartino. 2013. "Professional Economic Ethics: Why Heterodox Economists Should Care," *Economic Thought* 2(1): 43-53

George DeMartino. 2013. "Epistemic Aspects of Economic Practice and the Need for Professional Economic Ethics," *Review of Social Economy* 71 (2): 166-186

Eric Rasmusen. 2001. "Aphorisms on Writing, Speaking, and Listening" in Readings in Games and Information edited by Eric Rasmusen, Blackwell Publishers

Paul   Dudenhefe.   2009.   *A   Guide   to   Writing   in   Economics*   available   online at http://writing.ku.edu/sites/writing.drupal.ku.edu/files/docs/Guide_Writing_Economics.pdf

Module 9

William Thomson. 2011. "Chapter 4: Writing Referee Reports" in *A Guide for the young economist*, 151-165.

Second edition. Cambridge: MIT Press.

Deirdre N. McCloskey. 2019. *Economic Writing*. University of Chicago Press

Pedagogical Approach

Additional information (if any)

Useful material:

1. On presentation: Leslie Roldan available online at https://ocw.mit.edu/courses/brain-and-cognitive-sciences/9-85- infant-and-early-childhood-cognition-fall-2012/assignments/MIT9_85F12_Proposal.pdf

On Academic Integrity: MIT handbook for students available online at

http://integrity.mit.edu/handbook/writing- original-work

Student responsibilities

Prepared by: Nandan Nawn, with support from Soumendu Sarkar

Reviewers:
1. Anirban Dasgupta, South Asian University, Akbar Bhawan, Chanakyapuri, New Delhi 110021; dasgupta@econ.sau.ac.in
2. Arindam Banerjee, Ambedkar University Delhi, Kashmere Gate Campus, Lothian Road, Delhi 110006; arindam@aud.ac.in
3. Vikram Dayal, Institute of Economic Growth, University Enclave, North Campus, Delhi 110007; vikday@iegindia.org
4. Bharat Ramaswami, Ashoka University, Rajiv Gandhi Education City, Sonipat, Haryana 131029; bharat.ramaswami@ashoka.edu.in
5. Priya Shyamsundar, Lead Economist*,* Nature Conservancy, Arlington, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203-1606, USA; priya.shyamsundar@tnc.org

Approved by Academic Council in its 46th meeting held at Conference Hall, TERI School of Advanced Studies on 26th July 2019.

Course title: Principles and Concepts of Sustainability				
Course code: MPP 164	**No. of credits:** 3		**L-T-P**: 30-00-00	**Learning hours:** 30
Pre-requisite course code and title (if any): None				
Department: Policy & Management Studies				
Course coordinator(s): Dr Shruti S Rana		**Course instructor(s):** Ms Jayati Talapatra		
Contact details:				
Course Type: Core		**Course offered in:** Semester 1		

Course Description

Economic development and globalization have increased the production and consumption of the economics of the world over time. However, various economic and production and/or consumption activitiesare adversely impacting the environment and society. Naturally, several questions are arising against the business community and its role in environmental sustainability and duties for society.

Given the environmental and sustainability related challenges and issues faced by business and economies, understanding the concept of sustainability and practicing the concepts in real life is primarily important for every firm, organizations and communities. In addition to the basic understanding of the issues,employees with the ability to critically analyze different aspects of sustainability in production and consumption and the relation between sustainability and development is critically important. This course would try to discuss and sensitize students about various sustainability issues in business.

Course objectives

- To build an inter-disciplinary perspective on business sustainability.
- To enable students to discuss the concept of sustainability and be able to see how it translates into realities of organizations and communities.
- To empower students to critically analyze different, often competing, definitions of sustainability driven by perspectives and interests of societal stakeholders.
- It will help students understand the different challenges to sustainability, the role of business in addressing these challenges.

Course content

Module	Topic	L	T	P
1	**Sustainable development-evolution, approaches, interpretations** The students are requested to prepare and conduct two debates on the importance of environmental/social aspects of SD and on probabilities of various world scenarios. Changing Perspectives • Definitions & Principles of Sustainable Development • Millennium Development Goals: Status (global and Indian), Inclusive Growth and Poverty Reduction, Impact on approach to development policy and practice in India, future directions.	6	0	0
2	**Challenges to Sustainable Development** • Agriculture, Population & Food Security • Public Health and Nutrition • Education • Natural Resources (Forests, Energy, Water). • Climate Change **What drives business – issues and trends** What drives business; Social Role; Philanthropy; Corporate Social Responsibility; Creating Shared Values; Triple bottom line; Critical review of Base of the Pyramid Concept.	7	0	0

3	**Is the business of business, is business?** Through the group discussion and presentation, the students are requested to explore various forms of "corporations of the future". They will also work with analysis of a case of sustainable enterprise.	6	0	0
4	**Business (corporate) sustainability** The students are introduced to analyze a case relevant for understanding of stakeholder engagement and communication.	5	0	0
5	**Sustainable Production and Consumption** In addition to the discussion, the students will work with the study case of Rio Tinto focusing on the company's strategy in biodiversity and ecosystem serve	6	0	0
	TOTAL	**30**	**0**	**0**

Evaluation criteria:
- Minor 1: Group Presentation - 50 %
- Minor 2: Individual Presentation on a given topic - 20 %

Major exam: Individual Assignment - Essay / Reaction Paper in 1000 words - 30%

Learning outcomes:

On successful completion of the course, the students would be able to:
- Understand and internalize the concept of sustainability and to ensure the concept pervades through the layers of organization.
- Critically analyze different, often competing, definitions of sustainability driven by perspectives and interests of societal stakeholders.

Become familiar with the sustainability visions and practices relevant for the business community at thelevel of companies, supply chain, communities.

Pedagogical approach

Materials:

Dresner S. (2002) The Principles of Sustainability, Earthscan, London.

Robertson M. (2017) Sustainability Principles and Practice, Routledge, London & NY.

Materials:

Vanegas JA (2003) Road Map & Principles for Built Environment Sustainability, Environmental Science & Technology, Vol.37 (23), pp. 5363-72.

Lindsey TC. (2011) Sustainable Principles: Common Values for Achieving Sustainability, Journal ofCleaner Production, Vol.19(5), pp. 561-65.

Additional information (If any): None

Student responsibilities: None

Prepared by: Dr. Shruti Sharma Rana

Course reviewers:
1. Dr. Kamna Sachdeva, Professor, Delhi Skill University
2. Dr. Archana Poonia, Associate Professor, O.P. Jindal Global University

Course Title: Business communication				
Course code: PPM 101	**No. of credits:** 3	**L-T-P:** 30-00-00	**Learning hours:** 30	
Pre-requisite course code and title (if any): None				
Department: Policy & Management Studies				
Course coordinator(s):		**Course instructor(s):** Dr. Anjali Singh		
Contact details:				
Course type: Core		**Course offered:** Semester 1		

Course Description:

The ability to communicate is an essential skill. This course introduces the fundamental principles of business communication and prepares students to communicate effectively in a trans-national, globalized business environment. It introduces students to the basic formats and principles of business communication as well as strategies and abilities to adapt to different circumstances in business situations.

It covers communication structures briefly and introduces students to the ever more important area of cross-cultural communication. The course is designed to impart a basic understanding of written business communication, including letters, reports, presentations and email and valuable insights into listening and non-verbal communication. Every skill gained from this course will aid the learners in developing complete confidence to communicate professionally with different audiences.

Course Objectives

The course is *not* intended to teach the basics of the English language and assumes that students will have a good understanding of the English language. The course aims to:

- Enable students to develop new perspectives and equip themselves to meet the demands of a fast-changing world where technology and globalization and other forces have dramatically changed the practice of business communication in recent years
- Enhance proficiency and competencies in verbal and non- verbal communication skills with a holistic long-term perspective
- Guide the participants to manage cross cultural communication
- Develop technical communication skills
- Address contemporary skills, issues and concepts
- Familiarize the students with the major digital media formats available for business messages

Module	Topic	L	T	P
1.	**Module 1: Business Communication principles** The Communication Mode (b) The elements of good written communication, including spelling check and grammar (c) Purpose, audience, organization, tone and their role in communication. **Class exercises**	2		
2.	**Module 2: Introduction to Communication Models** Linear Model Lasswell Model Shannon Weaver Model Interactive Model	2		
3.	**Module 3: Interpersonal Communication & Non - Verbal Communication** Interpersonal Communication Emotional Quotient / Intelligence Non-Verbal Communication	3		
4.	**Module 4: Cross-Cultural Communication** a) The importance of understanding cross-cultural business communication Hofstede Cultural Model	5		

	Language, value systems, perceptions, philosophies Challenges of cross-cultural communication				
5.	**Module 5: Technical Communication I – Creating Written Presentations and Reports** PowerPoint and other tools Appropriate text and fonts Effective use of images – when and when not to use images	3			
6.	**Module 6: Technical Communication II – Making Effective Oral Presentations and Story Telling** Public speaking (b) Clarity, Voice control, Eye contact and use of humor c) Handling Questions **Individual Presentations**	5			
7.	**Module 7: E- Communication** New modes of communication E mail etiquette (c) When chat is an appropriate tool for communication (d) Blogs and other modes of self – expression as tools of business communication **Quiz and class exercises**	3			
8.	**Module 8: Negotiation - A Communication focus** Understanding the pie	3			
9.	The Negotiations Process BATNA and Power in Negotiations **Self - evaluation and quiz**				
10.	**Module 9: Employment related communication and preparing for a job interview** Structure and how to write job application letters Plan, organize and write a resume Succeed in online and in-person interviews	4			
	Total	**30**	**0**	**0**	

Evaluation Criteria

The evaluation process will be as follows:

Minor 1: Case Study Analysis and Presentation - 25% (Examination on Modules 1-4)

Minor 2: Presentation and Written Report 40% (Examination on Modules 5 &6)

Class participation - 10 %

Major: 25% (Assignments)

Learning outcomes

After the course, the students will be able to

1. Communicate with clarity using different communication channels.
2. Understand the various communication channels and use the appropriate channel for communication
3. Demonstrate cross - cultural skills in a trans-national business environment
4. Demonstrate presentation and oral speech skills

Pedagogical Tool:

Lectures, Case Study discussions Assignments

Reading Material:

Reading Material, Links, PPTS and videos will be shared during the course of the Module

Prepared by: Mr. Vinay Sharma & Montu Bose

Course Reviewer:
1.   Dr. Runa Sarkar, IIT Kanpur
2.   Prof. Asha Kaul, IIM Ahmedabad

Course title: Management concepts and Organizational Behavior			
Course code: PPM 118	**No. of credits:** 4	**L-T-P:** 40-00-00	**Learning hours:** 40
Pre-requisite course code and title (if any):			
Department: Policy and Management studies			
Program coordinator (s): Dr. Shruti Sharma Rana		**Course instructor (s):** Dr. Moumita Acharyya	
Contact details: moumita.acharyya@terisas.ac.in			
Course type: Core		**Course offered in:** Semester 1	

Course description: In today's dynamic environment, organizational behaviour and leadership are critical differentiating factors for organizational success and excellence. There are continuous changes in social, political, cultural, global as well as economic environment, and an understanding of management concepts and organizational behaviour is essential for future managers to manage such changes through strategic choices anchored in the vision of the organization and its people. This course will cover management concepts and organizational behaviour theory, research in the context of current realities. The purpose is to impart state-of-the-art knowledge in the field of organisational behaviors and imbibe professional and broad humanistic values that leaders must possess for steering the teams and organizations to achieve excellence while safeguarding the interest of all stakeholders, including society and environment.

Course objectives:
- To impart knowledge about different forms of organizations, and changing roles and responsibilities of a manager ·
- To explain and discuss historical evolution of management thought and contemporary management approaches
- To explore managerial challenges in different organizations and discuss choices and appropriate strategies.
- To impart knowledge about classical and contemporary organisational behaviors theories and concepts
- To sensitize students about managing diversity among people and dealing with behavioural issues in organizations.

Course content

Module	Topic	L	T	P
1.	**Sharpening your business acumen:** What is business acumen, why do you need business acumen skills, how to build Business Acumen. **Reading**: The C suite skills that matter the most. **Nature of management:** Management trends, what makes organizations thriving, Organization business models, Management functions. **Reading**: Time to define company's principles **Social responsibility and business strategy:** What is a business strategy, how strategy creates value for stakeholders. Importance of planning in business strategy. **Reading**: Evolving role Chief Sustainability Officer **Case study in class**. (Netflix)	8	0	0
2.	**Understanding Business Process Reengineering:** what is a business process, need for organizing, Organization Structure and Design; Authority and Responsibility Relationships. Building BPR mindset in organizations. **Reading:** Managers can't do it all; Organizing for future (McKinsey) **Managerial decision making:** What influences decision, why decision making is complex, Challenges for effective decision making, cultivate critical thinking, overcoming decision making traps, steps to effective decision making. **Reading:** Incorporating DEI into decision making.	6	0	0
3.	**Leadership fundamentals:** How will you lead, define yourself as a leader, build trust on your team, inspire collaboration across distance. **Reading:** Leadership for a new era of thriving organizations.	6	0	0

	Delegation of Authority and Decentralization. **Feedback essentials:** why feedback matters, give effective feedback, encourage feedback on your team. **Reading:** Overcoming your fear of feedback			
4.	**Managing yourself:** Perception and Learning; Personality and Individual Differences; Motivation and Job Performance; Values, Attitudes and Beliefs; Stress Management; Communication Types-Process; Barriers; Making; Communication Effective.	10	0	0
5.	**Developing interpersonal skills:** Handling difficult interactions, Conflict management.	6	0	0
6.	**Sustaining skills for organization success:** Innovation for all, make creative connections, collaborate to innovate. Reading: Don't let Gen AI limit your team's creativity Reading: Cultivating the four kinds of creativity.	4	0	0
	Working in Networked organisation.			
	Total	**40**	**0**	**0**

Evaluation criteria
Minor-1: Assignment-30%
Minor-2: Presentation -30%
Major exam 3: End-Term Exam-40%

Minor-1 (at the end of module 3)
Structure: The students will be required to analyze research papers. Based on best practices of management, a research paper will be given to the students followed by questions on identifying the objective, addressing the research question, important aspects of management being discussed, its implications for organizations etc.
Minor 2 (at the end of module 8) Structure: The students will be provided with real-world management scenarios that students need to analyze. The objective is to assess students' ability to apply management theories and principles to practical situations. Students will be presenting in groups of five.
Major exam 3 (End-Term Exam; at the end of all modules) This will be a closed book exam based on all the modules covered in the class.
Case Study discussion: A case may be studied keeping in mind the following:
1. a problem definition statement, which identifies the key issues facing management (not more than a few lines);
2. the objectives
3. alternative plan of action
4. an analysis section which synthesizes and integrates the answers to the key questions for the case, but does not repeat the facts themselves, and presents logical arguments in defense of both the problem definition and the recommended solution;
a set of detailed recommendations and suggestions for their implementation, including how to overcome any potential issues of implementation identified by the analysis.

Learning outcomes:
By the end of the course, the students should be able to:
▪ Demonstrate an understanding of organizations as complex and pluralistic places where both conflict and cooperation are normal occurrences (Test 1, 2 and 3)
▪ Ability to reflect on their personal leadership skills and ability to exhibit leadership qualities in organizations (Test 2)
▪ Ability to assimilate, and apply knowledge of basic theories and concepts to solve organizational behaviour problems (Test 1, 2 and 3)

Pedagogical approach
▪ Interactive Lectures
▪ Case discussions and presentations
▪ News crunching

Materials:

Textbook
- Robbins, SP, Organizational Behaviour, Pearson Education Suggested Books Bade, J, Bade, S, and Hilton, S, More Human (2015),
- Public Affairs Collins, J, Good to Great (2001),
- Willian Collins Horowitz, B, The Hard Thing about Hard Things (2014),
- Harper Business Sinek, S, Leaders Eat Last (2014),
- Penguin Books Slywotzky, A, and Weber, K (2011),
- Demand, HighBridge Wallace, A and Catmull, E (2014),
- Creativity Inc, Transworld Publishers Suggested Articles/Papers Amabile, T (1997).
- Motivating Creativity in Organizations.
- Available http://bear.warrington.ufl.edu/weitz/mar7786/articles/amabile%20ccal%20mgt%20review.pdf
- Available https://www.sciencedirect.com/science/article/pii/S0191308517300072.
- Giles, S (2016). The Most Important Leadership Competencies According to Leaders Around the World. Available https://hbr.org/2016/03/
- the-most-important-leadership-competencies-according-to-leaders-   around-the-world
- Grant, A, Gino, F and Hoffman, D. Reversing the Extraverted Leadership Advantage: The Role Of Employee Proactivity. Available https://static1.squarespace.com/static/GrantGinoHofmann_Reversing.pdf
- Harvey, EO (2018). 5 Behaviours of Leaders Who Embrace Change. Available at https://hbr.org/2018/05/5-behaviors-of-leaders-who-embrace-change
- Houser, O (2017). Innovation with field experiments: Studying organizational behaviors in actual organizations.

Additional information (if any): None

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**.** Moumita Acharyya, Assistant Professor, TERI School of Advanced Studies, New Delhi
.

Course Reviewer:
1. Dr. Damini Saini, IIM Raipur, P. O. - Kurru, Abhanpur, Chhattisgarh.
2. Dr. Shyamli Satpathy, IILM, Lodhi Road, New Delhi

Course title: Business Mathematics & Statistics					
Course code: PPM 119		**No. of credits:** 4	**L-T-P**: 40-00-00		**Learning hours:** 40
Pre-requisite course code and title (if any): None					
Department: Policy & Management Studies					
Course coordinator(s):			**Course instructor(s):**		
Contact details:					
Course Type: Core			**Course offered in:** 1		

Course Description

This course gives students an exhaustive introduction to statistical methods important in business and require basic mathematical exposure for it. For last few decades India's growth rate is impressive along with high competition in the economy. Economic growth, expansion of trade and business have forced us to invest in infrastructure. Given thisbackground, businessmen can no longer rely on the old system of hit-or-miss methods or leave their future on chances. They have now to proceed on scientific principles, prepare themselves for competitive markets and plan their business accordingly. The managers have therefore to depend on a variety of factors (like present labour conditions, prices of rawmaterials etc.). All these factors are statistically taken account of before fixing the price of new commodities or services,so that it may find a suitable place in the market. This course would be offered to M.B.A. (Sustainability Management).The course would equip the students with the necessary mathematical and statistical knowledge to be ready for various managerial decisions backed by scientific evidence.

Course objectives

In the course the students would be exposed to various examples of economics and business applications. The primary objective of this course is to motivate the use of statistical analysis and at the same time encourage students to go beyondthe mathematical applications of technique and to develop critical judgment through statistical analysis. The specific objectives of the course are to enable students:

To increase students understanding of economic way of thinking and analyzing business decision making problems
- to understand the role of mathematics in statistics
- to understand and use statistical methods ranging from graphical presentation of data to descriptive statisticalrepresentation of data for economics & business-related studies.
- to analyse data for understanding the characteristics of the business & economy related factors, their associationetc.
- apply statistical techniques to forecast the market situation and to take well-informed decisions.

Course content

Module	Topic	L	T	P
1	**Mathematics for Business** Introduction to matrix algebra, determinants, system of equations and solutions, Maximization & Minimization, permutation and combination	5	0	0
2	Introduction: Data and Statistics Introduction to Statistics, Data: Concept & types of data; importance of data in business; Data sources: introduction to business-related data & sources.	5	0	0
3	Descriptive Statistics Summarizing data: how to handle data scientifically to make proper decisions; Exploration & representation of business-related data: tabulation, cross tabulation, variability checking, measuring the distribution and location statistically, association among inputs and outputs; Use of diagrams in business projects and reporting.	6	0	0
4	**Probability Distribution** Introduction to set theory and probability; Additive & multiplicative rules, conditional & unconditional probability, Bayes theorem, Discrete and continuous distributions; Random variables; Discrete & continuous probability distributions: theory and its applications in management (Binomial, Poission, Negative Binomial, Geometric, Hypergeometric, Uniform, Exponential, Normal).	4	0	0
5	**Sampling and Sampling Distributions** Statistical Inference: concepts & relevance in business; Methods of Sampling:	5	0	0

	purposive, random, stratified, systematic, multi-stage; Concepts and estimation of - Point Estimation, Sampling Distribution of Mean, Sampling distribution of p, sample size determination; Interval estimation, confidence interval; Determining sample size.			
	Hypothesis Testing Null and alternative hypothesis; Test of significance; Type I and Type II errors;differences of means, proportions, difference of proportions, variances, ratio of variances, Practical issues, Standard normal, χ^2, t and F distributions.	5	0	0
	Analysis of Variance Introduction to analysis of variance; Assumptions and analysis of one-way classifieddata; Multiple comparisons, Assumptions and analysis of two-way classified data.	4	0	0
	Correlation and Simple linear regression – Introduction Correlation, coefficient of correlation, Simple regression model; Least square method;Coefficient of determination; Model assumptions; Testing of significance; Predictions; Residual analysis.	6	0	0
	Total	40	0	0

Evaluation criteria:

The break-up of the evaluation procedure is as follows:
- Test 1   : Written Examination (Module 1, 2 & 3)   - 20%
- Test 2   : Written Examination (Module 4)   - 20%
- Test 3   : Project Work (Primary data collection, analysis and presentation) (Module 2 -8) - 20%

[Indicators for assessment: (a) Identification of the problem; (b) Data collection; (c) Relevance of the data analysismethod; (d) Representation and explanation; (e) Punctuality and timeline adherence.

Note: (a), (b) and (c) would carry a weightage of 10% each; (c) would carry 30% weightage and (d) would carry 40 %weightage.]

  Major Exam: Written Examination (Module 4-9) - 40%

Learning outcomes:

After successful completion of the course, students will be able to:
- Develop a sense of the role of mathematics, statistics and data analysis in business (Test 1, 2 and 3)
- Apply the principles, techniques and approaches for statistical inferences (Test 3 & Major)
- Apply statistical concepts to business and economic models for predicting outcomes (All Tests)

  Application of data analysis for informed decision making (All Tests)

Pedagogical approach

  The course will be delivered through lectures and tutorials. Application of statistical tools in business & economicsrelated problems would also be a part of the pedagogical approach for the course.

References:

Textbooks:
1. Anderson DR., Dennis J. Sweeney and Thomas A. Williams. Statistics for Business and Economics, CengageLearning (latest edition), India.
2. Miller CD., Salzman SA. & Clendenen G. Business Mathematics. Addison Wesley (latest edition).
3. Gupta SC & Kapoor VK. Fundamentals of Mathematical Statistics, Sultan Chand & Sons. (latest edition). India.

Additional Readings:
1. Kohler, H. (2010). Statistics for Business & Economics, Harper Collins.
2. Levin, R. and Rubin, D. (2012). Statistics for Management, Pearson.
3. McClave J. and Benson, P.G. (2013). Statistics for Business and Economics, Pearson.
4. Richard I.L. and David S.R. (2011). Statistics for Management, Pearson.
5. Stine R. and D. Foster (2014). Decision making and Analysis, Pearson New International Edition.
6. Thukral J.K. (2015). Business Mathematics & Statistics, Mayur Paperback.
7. Triola M.F. and Franklin, L.A. (2015). Business Statistics.

8.   Watsnam TJ. and Keith P. (2014). Quantitative Methods in Finance, International Thompson Business Press.
Additional information (If any): None
Student responsibilities:
Attendance, feedback, discipline etc.

Prepared by: Dr. Anand Jaiswal

Course Reviewers:
1.   Dr. Vinaytosh Mishra, Associate Professor, Gulf Medical University, Ajman.
2.   Dr. Cherian Samuel, Associate Professor, IIT (BHU), Varanasi

Course title: Accounting for Managerial Decisions				
Course code: PPM 130	**No. of credits:** 4	**L-T-P**: 40-00-00		**Learning hours:** 40
Pre-requisite course code and title (if any): None				
Department: Policy & Management Studies				
Course coordinator(s):		**Course instructor(s):** Dr. Parul Behl		
Contact details:				
Course Type: Core		**Course offered in:** Semester 1		

Course Description

Accounting is the language of business. It attempts to measure and report corporate performance. Managers use accounting in making decisions, while investors use it for valuing stocks. The bankers and lender rely on accounting information to decide whether to lend money to business. The accounting information is also crucial in evaluating the performance of employees at various levels in an organization. Thus, this is a very useful course in management education in almost every graduate management program the world over, a full course on accounting and reporting remains an obvious choice. This course is indispensable as the first step towards understanding the financials of business.

Course objectives

The objectives of the course are to ensure that the participants:
- to understand the conceptual framework of Accounting and the process that leads to the preparation of financial statements;
- to develop the ability in them to use financial statements to assess a company's performance;
- to understand how the accounting information system works in a firm;
- to interpret the need of accounting information in managerial decision-making process;
- to analyse the performance vis-à-vis financial health of the firm.

Course content

Module	Topic	L	T	P
1	**Accounting and Economic Decisions** Accounting, Users of Accounting Information, Financial, Cost and Management Accounting, Accounting Information System, Generally Accepted Accounting Principles, Indian Accounting Standards and IFRS, Forms of Business Organization, Accounting Equation	2	0	0
2	**Recording of Business Transactions** Types of Accounts, Double Entry System of Accounting, Recording Transactions - Journal, Ledger and Trial Balance	3	0	0
3	**Understanding Income Statement** Income Measurement, Preparation of Income Statement, Incorporating Adjustments, Format as per Companies Act	3	0	0
4	**Understanding Balance Sheet** Liabilities and Shareholder's Equity, Classification of Assets and Liabilities, Preparation of Balance Sheet, Format as per Companies Act	3	0	0
5	**Revenue Recognition** Income and Revenue, Measurement of Revenue, Accrual Principle, Matching Principle, Sale of Goods, Service Revenues, Interests and Dividends; Expense Recognition, Relevant Accounting Standards	2	0	0
6	**Inventory Valuation** Nature of inventories, Measurement of Inventory Costs, Method of record, keeping of Inventories; Inventory Valuation, Net Realizable Value (NRV), Relevant Accounting Standards	1	0	0

7	**Accounting for Fixed Assets (Property, Plant, and Equipment)** Fixed Assets, Property, Plant and Equipment, determining cost of Acquisition, Depreciation Accounting- Methods, Relevant Accounting Standard	2	0	0
8	**Cash Flow Statement** Cash Flow Statement - Purpose and Use, Operating, Investing and Financing Activities, Preparation of Cash Flow Statement, Relevant Accounting Standard	4	0	0
9	**Annual Reports** Contents of Annual Reports, The Regulatory Framework, The Disclosure System, Qualitative and Quantitative Reporting, Component wise discussion	2	0	0
10	**Financial Statement Analysis** Common Size Statement, Comparative Statement Analysis, Trend Analysis and Ratio Analysis- Liquidity, Solvency, Turnover and Profitability, Intra and Inter Firm Comparisons, Du-Pont Analysis	5	0	0
11	**Basics of Cost Accounting** Cost Concepts, Elements of Cost and Cost Behaviour, Cost Sheet, Cost-Volume-Profit Relationship, Marginal Costing and Managerial Decision Making	5	0	0
12	**Management Accounting and Control** Standard Costing, Variance Analysis	2	0	0
13	**Accounting- Role, Ethics and Recent Developments** Role of Accounting in Capital Market and Corporate Governance, and Ethical Issues in Accounting, Recent developments in Accounting	1	0	0
14	**Project Presentation**	5	0	0
	TOTAL	**40**	**0**	**0**

Evaluation criteria:
- Minor Test 1   : Quiz 20%
- Minor Test 2   : Written Test 30%
- Assignments   : 20%
- Major Exam   : Written Test 30%

Learning outcomes:
Upon completion of this course, the students will be able to:
- Understanding of the various principles on which financial statements are prepared.
- Acquire critical thinking skills to analyse financial data, and demonstrate the ability to communicate such data effectively, as well as the ability to provide knowledgeable recommendations.
- Develop an overall understanding of emerging corporate reporting framework in the context of International Financial Reporting Standards (IFRS)
- Understanding and interpreting the various cost information for planning and control purposes in managerial decision making.
- Understanding the role of managerial accounting in decision making.

Pedagogical approach
The course will be delivered through lectures and discussion of case studies, videos, annual reports of the companies, research papers and newspaper articles.

References:
- Financial accounting: a managerial perspective by R Narayanaswamy Prentice-Hall of India, Sixth Edition.
- Principles and Practice of Cost Accounting by Ashish K. Bhattacharyya, Prentice-Hall of India, Third Edition
- Accounting: Text and Case, Robert N. Anthony, David F Hawkins, and Kenneth A Merchant (AHM), Tata McGraw Hill, Thirteenth Edition.
- Accounting for Management: Text and Cases by S.K. Bhattacharyya and John Dearden, Vikas Publishing House; Third edition

- Cost Accounting - A Managerial Emphasis by Charles T. Horngren, Srikant M. Datar and George Foster, Pearson Education, Thirteenth Edition.
- Introduction to Management Accounting by Charles T. Horngren, Gary L. Sundem, William O. Stratton, Pearson Education, Thirteenth Edition.

Websites and Web resources –
- Maria B. & Alexandru IC. (2005). Economic decision-making and the role of accounting information. retrieved from. http://www.oeconomica.uab.ro/upload/lucrari/1020081/17.pdf
- Damodaran A. (2006). Understanding Financial Statements. retrieved from
- http://people.stern.nyu.edu/adamodar/pdfiles/valn2ed/ch3.pdf
- The Institute of Company Secretaries of India. retrieved fromhttps://www.icsi.edu/
- Financial Times. Retrieved from https://www.ft.com/,
- Learn Accountancy the Easy Way. Retrieved from http://accounting-simplified.com/

Additional information (If any): None

Student responsibilities:
All students are expected to read the assigned readings prior to the class. Students are expected to analyse the case following the discussion questions. All students must maintain full attendance and do timely submission of assignments.

Prepared by: Dr Shikha Mittal Shrivastav

Course Reviewers:
1. Dr. Anjala Kalsie, Associate Professor, Faculty of Management Studies, University of Delhi
2. Prof. (Dr) Deepak Tandon, Professor, IMI, New Delhi
3. Prof. (Dr) K. P. Kaushik, Professor, AJNIFM, Faridabad

Course title: Managerial Economics			
Course code: PPM 148	**No. of credits:** 4	**L-T-P**: 40-00-00	**Learning hours:** 40
Pre-requisite course code and title (if any): None			
Department: Policy & Management Studies			
Course coordinator(s): Dr. Gopal Sarangi		**Course instructor(s):** Dr. Gopal Sarangi	
Contact details: gopal.sarangi@terisas.ac.in			
Course Type: Core		**Course offered in:** Semester 1	

Course Description

The basic objective is to equip students with skill sets in applying analytical approaches to the study of how individualsand business units deal with the fundamental problems of scarce resources, understanding of the nature of prices and ofmarkets, role of information and of interventions, etc. Specific topics to be covered include applications of supply and demand, market structure, laws of production, market failure, game theory and auctions and their applications in the context of business and decision making. Students would appreciate and understand how markets organize things and when markets fail and how market failures could be addressed. Examples from the services sectors, energy and infrastructure sectors would be particularly important in attaining course goals.

The course would provide the base for macroeconomics, organizational behaviour, marketing, finance and strategic management.

Course objective

The course objectives are:

- To increase students understanding of economic way of thinking and analyzing business decision makingproblems
- To develop students critical thinking skills and analytical abilities is resolving business problems by employingvarious tools and techniques of economics
- To make students understand the rigors of various economic models and their applications in business decisions.
- To make students understand how economic variables are interpreted, analyzed through the use of various tools andtechniques

Course content

Module	Topic	L	T	P
1.	**Introduction to Economics, Demand and Supply, Elasticity and MarketEfficiency** Human wants and scarce resources Basics of demand, supply and market Concept ofmarket Demand and supply schedules and equilibrium Changes in price when demand/supplyshifts Demand Analysis and demand estimation Derivation of demand curve Consumer surplus and producer's surplusMarket efficiency and their applications Concept of Elasticity – point, arc, income and cross elasticity'sElasticity and revenue Application of elasticity	10	0	0
2.	**Utility, Preferences and Choice** Utility Theory and utility function How people make decisions? Utility – total, marginalMarginal analysis and its use in economic analysis Preferences, budget constraints, choices, and optimal choices Consumer BehaviourIndifference curve analysis	8	0	0

	Changes in income and prices, income and substitution effects			
3.	**Theory of Firms and pricing strategies** Market and market structure Market equilibrium and price determination under different market structures Perfect Competition, monopoly, and price discrimination (definition and types of price discrimination, necessary conditions for the existence of price discrimination, price discrimination and the price elasticity of demand) Other pricing strategies of firms Monopolistic competition, models of oligopoly (Bertrand duopoly and Cournot duopoly Application of auctions and game theory in understanding the market structure,behaviour, and business strategy Average cost pricing, other pricing strategies	12	0	0
4.	**Market failure, Economics of regulation, Economics of information, and Role ofbehavioural economics in managerial decision making** Externalities and public goods Monopoly power and social costs Regulation of public monopolies Economics of Information and uncertainty, Search costs Asymmetric information and adverse selection and moral hazard, Market signalling,	10	0	0
	TOTAL	**40**	**0**	**00**

Evaluation criteria:
The overall course grade will be allocated as follows:
- Test 1   : Class exercises and participation: 10 %
- Test 2   : 20 %
- Test 3   : Assignment: 30 %
- Major Exam   : Written test: 40 %

Learning outcomes:
After the completion of the course, the students will:
- Understand the key concepts, models, tools and techniques of managerial economics (Test 1, 2, 3 & Test 4)
- Understand and appreciate the applications of various tools and techniques of managerial economics (Assignmentand Test 1)
- Develop abilities of applying tools, techniques and models in resolving real life business problems (Assignment& Test 3)

Pedagogical approach
  Pedagogical approach consists of classroom teaching and participation; interactive sessions; case study discussion,students' presentation.

Materials
Textbooks and Readings:
- Dominick S., (2012), Managerial Economics, 7th Ed., Oxford University Press.
- Karl Case, Ray Fair, and Sharon Oster, Principles of Economics.12th edition
- Frank, R. and B. Bernanke (2004), Principles of Economics, 2nd Ed., Tata McGraw Hill
- Dominick S., (2009), Principles of Microeconomics, International Version, 5th Ed., Oxford University Press.

- Varian, H. R., (2006), Intermediate Microeconomics, 8th ed. W. W. Norton & Company
- Sen, A., (2006), Microeconomics – Theory and Applications, 2nd Ed., Oxford University Press.
- Pindyck, R. S., D. J. Rubinfeld and P. L. Mehta (2009), Microeconomics, 7th Ed., Pearson Education, India.

Martin J. Osborne (2004), An Introduction to Game Theory, Oxford University Press, New Delhi.

Additional information (If any):

Attendance

  Attendance will be taken on a regular basis, and it is expected that all students attend ALL sessions.

Student responsibilities:

  Attendance, feedback, discipline etc.

Prepared by: Dr. Gopal K Sarangi

Course Reviewers:
1. Prof. Sajal Ghosh, Professor of Economics, MDI, Gurgaon
2. Prof. Ranjan Kumar Ghosh, Assistant Professor of Economics, IIM Ahmedabad

Course title: Sustainability Reporting				
Course code: PPM 168	**No. of credits:** 3	**L-T-P:** 30-00-00		**Learning hours:** 30
Pre-requisite course code and title (if any):				
Department: Policy and Management Studies				
Course coordinator (s):		**Course instructor (s):** Dr Shruti Sharma Rana		
Contact details: shruti.rana@terisas.ac.in				
Course type		Core	**Course offered in:** Semester 1	

Course description

Sustainability reporting is the practice adopted by organizations for measuring, communicating, and being accountable to internal and external stakeholders for organizational performance towards the goal of sustainable development. 'Sustainability reporting' is a broad term considered synonymous with others used to describe reporting on economic, environmental, and social impacts (e.g., triple bottom line, corporate responsibility reporting, etc.). As the stakeholders like government agencies, employees, investors, financial institutions, community, NGOs, consumers, etc. have become more demanding and are asking the companies to disclose information on its social, environmental and economic impacts, it has become necessary for the companies to communicate and engage all these stakeholders in the decision-process and hence sustainability reporting has emerged to be an important tool for stakeholder engagement and communication.

Course objectives

- To familiarize students with the rationale and process of sustainability reporting
- To equip students with the sustainability practices in Indian /Multinational firms
- To impart knowledge about sustainability guidelines, frameworks and standards and enable them to manage sustainability reporting process of a firm

Course content

Module	Topic	L	T	P
1.	**Introduction to Sustainability Reporting** The concept of Environment, Business and Society, Sustainability and the Role of Corporation, The Triple Bottom Line Approach to Business, Role of financial and non-financial disclosures and reporting What is sustainability Reporting, Need and benefits for Sustainability Reporting, Sustainability Report as a tool for sustainability risk assessment and stakeholder communication on sustainability performance. Case: Green IT at Wipro	2	0	0
2.	**Monitoring and Measuring Sustainability Performance** Establishing a sustainability management framework based of policy, system and procedures. Measuring, monitoring and improving sustainability performance. Establishing sustainability indicators and developing goals for organization Case: Sustainability at Millipore	4	0	0
3.	**Sustainability related management standards and Indices** GRI Standards, Framework: disclosure requirements, Performance Indicators [Economic, Environmental, Labour Practices, Human Rights, Society, Product Responsibility] UN Global compact; OECD guidelines for Multinational Enterprises; The CERES Principles; Social Accountability 8000; Ethical Trading Initiative's Base Code; ICC OECD principles of Corporate Governance, ISO9001 Quality Management Standard; ISO 14001 Environmental Management System Standard; ISO 26000Social responsibility Guidance Standard; OHSAS 18001; SIGMA Management Framework; AS8000-8004; IFC Social and Environmental Management System; SA8000; ISO27000 and 28000 Security management System Standards; ISO 50001 Energy Management System; Dow Jones Sustainability Index; FTSE4Good Indices; Domini Social Index; Ethibel	10	0	0

	Sustainability Index; BSE Greenex, Science based Targets Case: Dow-Chemicals			
4.	**Planning a Sustainability Report**	4	0	0
	Analysis and Research; Prerequisites of a sustainability Report, structure of a sustainability Report. The concept of sustainability Indicators, stakeholder Engagement including identification, mapping and prioritization, Indicator development (including performance measurement and monitoring) and materiality assessment information for inclusion in sustainability report, writing and designing the report Verification and Assurance of Sustainability Reports (Assurance Standards)			
5.	**Sustainability Reporting in India** Current and Future Trends in India, Role of Regulator, Institutional Framework, stakeholder Engagement, Future of Sustainability Reporting, Challenges before firms DPE Guidelines for PSUs on CSR and Sustainable Development, National Voluntary Guidelines, SEBI Guidelines, (Case Studies and Experience Sharing) Sustainability Reporting Practices by Corporate Sector (Experience sharing will be done by executives from companies from different sectors) Advocacy for Sustainability Reporting (Experience sharing by officials from GIZ, GRI)	5	0	0
6.	**Integrated Reporting** The IR Framework, Value creation for organization and others, the concept of capitals, The Value creation process, Guiding Principles and Materiality for Integrated Reporting Case: Novo-Nordisk: A Commitment to Sustainability Case: Natura Cosmeticos, S. A	5	0	0
	Total	**30**	**0**	**0**

Evaluation criteria

▪ Test 1: Written Test–   20%
▪ Test 2: Case Analysis –   20%
▪ Test 3: Project –   20%
▪ Test 4: Written Test –   40%

Learning Outcome

After attending the course, the student will:

☐ Gain ability to describe the history, need and benefits of sustainability reporting by firms (Test 1, Test 2, Case Analysis)

☐ Critically evaluate practices of sustainability reporting (Case Analysis, Test 2)

• Prepare sustainability reports in accordance with various guidelines, standards and frameworks (Project, Case analysis)

Pedagogical Approach

The course will have a mix of theory and applied coursework with a more practical approach. The teaching shall be done mainly through lectures/ case discussions/case presentations/exercises etc. The entire course has been divided into six modules. There will be 14 sessions (two hours each) as per the course outline. The students are also expected to work on cases as well as assignments given to them from time to time which will help them develop their analytical as well as conceptual skills. The students would be expected to solve case studies on sustainability assessments and sustainability reporting. To give them practical exposure, they would be asked to prepare a sustainability report for a selected company. Both case study presentations as well as projects are group assignments. Students are expected to work in the group of 4-5 for working out case solutions. The alternative solutions from all the groups will then be discussed in class. Since there is no specified textbook on sustainability, the instructor will largely depend on various articles and websites in the related area and these shall be provided to the students from time to time and will form part of class discussions. The course will also have an experience sharing module where various sustainability practitioners would be invited from industry, NGOs, PSUs to share their hands on experience on relevant topics pertaining to sustainability reporting

Materials
Rogers, Jalal & Boyd: An Introduction to Sustainable Development, PHI Learning,2007 Singh. Triple Bottom Line Reporting and Corporate Sustainability, PHI learning,2006 J.G. Stead & Edward Stead: Sustainable Strategic Management, M. E. Sharpe & Co., 2004. J.G. Stead & Edward Stead: Management for a Small Planet, M.E. Sharpe& Co.,2009 WebLinks: https://www.globalreporting.org/reporting/reporting- frameworkoverview/Pages/default.aspx http://www.sustreport.org/business/report/intro.html https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl- TechnicalProtocol.pdfhttp://www.enviroreporting.com/ http://www.tatamotors.com/sustainability/pdf/GRI-report-07- 08.pdfhttp://www.kpcindia.com/Pdf/Business/Sustainability%20Reporting%20(Under%20GRI).pdf http://www.sustainabledevelopment.in/services/corporate_substainability_management/actities/sustainabiliy_reporting.html
Additional information (if any)
Student responsibilities: attendance as per university rules

Prepared By: Dr Sapna A. Narula & Dr Montu Bose

Course Reviewers:
1. Dr. Yogendra Chaudhry, EPt. Head, Centre for Sustainable Development Westland Consulting, Ketek Group Inc,Canada & Chair, Public Education Division at Air and Waste Management Association, US.
2. Dr. Ambika Zutshi, Associate Professor, Faculty of Business and Law, Deakin University

Course title: Marketing Management				
Course code: PPM 196	**No. of credits:** 4	**L-T-P**: 40-00-00		**Learning hours:** 40
Pre-requisite course code and title (if any): None				
Department: Policy & Management Studies				
Course coordinator(s): Dr. Shruti Sharma Rana		**Course instructor(s):** Dr. Shruti Sharma Rana		
Contact details: shruti.rana@terisas.ac.in				
Course Type: Core		**Course offered in:** Semester 1		

Course Description

This is a core course in Marketing meant to build a foundation for students in the MBA Program. Marketing is a criticalfunction that determines the health of an organization. Marketing is a set of activities designed to scan and identify market opportunities and plan to design price, promotion and the distribution of products, services and ideas that satisfythe needs of chosen target market(s). The Marketing Manager uses his range of marketing tools to transform the identified opportunities in a manner that achieves the organizational objectives.

Course objectives

This course is a fundamental course on marketing and develops the basic 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 provide an in-depth understanding of the marketing process
- To give students an appreciation of the global and domestic marketing environment.
- To develop conceptual understanding of the STP process in the Indian environment.
- To learn about all the elements of the marketing-mix
- To sensitize the students about new developments like Multichannel and Omni channel marketing
- To develop the ability to formulate a marketing plan

Course content

Module	Topic	L	T	P
1.	**Introduction**: Marketing concepts and philosophies. Evolution of Marketing.Marketing Myopia What Business Are You In: Theodore Levitt HBR October 2006?(Marketing Myopia) Concept of Marketing Mix Marketing Plan teSixth P of Marketing The changing face of Marketing Mix.	7	0	0
2.	Strategic Marketing; PEST analysis Porter's Generic Strategies Michael Porter's Big Ideas Application and Evaluation of Strategy BCG Matrix, GE 9 Cell modelNokia's Strategy Derrick's Ice Cream Company Understanding Customer – Customer Value What have you done for me lately?Customer loyalty and satisfaction Why satisfied customer's defect.	7	0	0
3.	**Consumer Behavior:** Defining Consumer Behavior - Scope of Allocation of Consumer Behavior - Why Study Consumer Behavior - Evolution of Consumer Behavior as a Field of Study and Its Relationship with Marketing: Behavior Dimension - The Interdisciplinary Nature of Consumer Behavior	7	0	0
4.	Segmenting the consumer markets Basis of segmentationProduct diff and market segmentation strategies Targeting and positioning Lessons from faded Levi Strauss We try harder Dealing with competition Marketing warfare Guerilla marketing Gaining competitive advantage Kodak Vs. Fuji	7	0	0

5.	Introduction to brands and Brand Management. Customer Based Brand Equity: Brand Knowledge, Sources of Brand Equity, The Four Steps of Brand Building; Brand Positioning: Identifying and implementing brand positioning, Points of Parity, Points of Difference, Brand Audits.	6	0	0
6.	Pricing Strategies Distribution StrategiesRetailing Promotion Strategies Integrated Marketing Communications IMC. New Age Marketing concepts. Message evolution by McDonald's in India Services Marketing	6	0	0
	TOTAL	**40**	**0**	**0**

Important Sessions to Remember – (Remember no 'make-ups' allowed for any component) Session 21: Mid Term Test,Session 39: Submission of the group project report, Session 44-46: Group Presentation on the project

Evaluation criteria
▪ **Test 1: Class participation** 10% (Based on attentiveness and active participation during the entire course) ▪ **Test 2: News presentations** 10% (To pick and critically present the latest news about marketing activities done by anycompany) ▪ **Test 3:** 20% (Written exam after completion of 16 sessions –to test the understanding of concepts of marketing,strategic planning and consumer behavior) ▪ **Group Project** 20% (To develop the Marketing Plan for a product / service and apply all the knowledge of marketinggained throughout the course. Report to be submitted at the end of 28 sessions and presentation in the last 2 sessions) ▪ **Major Exam 5: Written Test** 40% (Written examination covering the entire course) **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 itsturn 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 a soft copy of 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: ▪ a problem definition statement, which identifies the key issues facing management (not more than a few lines). ▪ the objectives ▪ alternative plan of action ▪ an analysis section which synthesizes and integrates the answers to the key questions for the case, but does notrepeat the facts themselves, and presents logical arguments in defense of both the problem definition and the recommended solution. ▪ a set of detailed recommendations and suggestions for their implementation, including how to overcome anypotential issues of implementation identified by the analysis.
Learning outcomes: After attending this course, students will be able to: ▪ Develop an understanding of the role of marketing in the success of an organization (News presentation, Mid Termexam) ▪ Develop an ability to identify and assess strategic choices in marketing (Mid Term exam, End Term exam) ▪ Be able to propose innovative solutions to customer needs and continuous improvement of offerings (Newspresentation, Group Project) ▪ Be able to develop the Marketing Plan for any organization (Group Project, End Term exam)
Pedagogical approach ▪ Interactive Lectures ▪ Case discussions and presentations

▪ News crunching

Materials:
Textbook
Marketing Management by Philip Kotler, Kevin Keller, Pearson, New Delhi, 15th edition 2016, ISBN:978-81-317-3101-7

Reference Book
Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithleshwar Jha, "Marketing Management, A South Asian Perspective", 14th Ed (2013) by Pearson Education, New Delhi

Additional information (If any): None

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 Rana

Course Reviewers:
1. Dr.Ruchi Khandelwal, Amity University, Noida
2. Dr.Shampy Kambhoj, NIT Hamirpur

Course title: Corporate Governance and Business Ethics			
Course code: PPM 201	**No. of credits:** 4	**L-T-P**: 40-0-0	**Learning hours:** 40
Pre-requisite course code and title (if any): None			
Department: Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):** Dr. Kavita	
Contact details:			
Course Type: Core		**Course offered in:** Semester 1	

Course Description

The Enron and WorldCom implosions, that were discreet events involving fraud and loss to shareholders, employees andpensioners resulted in changes in policy and legal framework like the enactment of the Sarbanes-Oxley Act, 2002. This marked a significant increase in interest in the field of corporate governance.

The subsequent Global Financial crisis of 2007-2009 which resulted in various governments spending billions of taxpayermoney in bail-out packages to business organizations has led to a view that corporate governance reforms need to be muchmore profound and, possibly, even intrusive and has resulted in a debate on the role to be played by the state, as a regulator,in ensuring good governance. The impact of corporate mis-governance is quite significant and extends far beyond the affected organization; therefore, corporate governance has fast emerged as a significant academic discipline in the last fewdecades and today occupies a significance presence in the curricula at business schools.

Even though corporate governance reforms in India are of recent origin they are increasingly occupying centre stage in discussions. While the reform process got a kick start with the liberalization of the Indian Economy in the 90s and the progress in legislating and introducing corporate governance reforms in India in the last two decades has been quite significant, their effectiveness continues to be a matter of considerable debate.

Corporate India has also had its share of governance scams with Satyam, which has been described as India's Enron, beingthe most notable one.

The Companies Act, 2013 ushered in the new regime of corporate governance in India through enhanced disclosures, transparency and good governance. Further, with the evolving framework for responsible business in the country it becomes incumbent to acquaint the participants with the theoretical and practical aspects of corporate governance.

Course objectives

Given that effective corporate governance is crucial to a successful and sustainable corporate enterprise and also the factthat it is an evolving discipline, this course would help the participants to:

- Understand the theoretical underpinnings of ethics and governance for businesses.
- Appreciate how developments in corporate governance have been evolved and trace the history of developments in tisfield- internationally and in India.
- Analyze the models and frameworks that exist globally and domestically for corporate governance.
- Critically examine the roles, responsibilities, obligations, liabilities and effectiveness of boards of directors, management, shareholders, regulators and other corporate stakeholders with specific reference to the challenges thatare faced in a business environment.

Course content

Module	Topic	L	T	P
Module 1:	**Introduction andConceptual framework** Introduction to the course and discussion on the pedagogy, readings and evaluation pattern.	1	0	0
	Ethics, Morals & Values: Concepts of Utilitarianism and Universalism; Values & Value Orientation of theFirm; Theories and major sources of ethical values in business.	3	0	0

	The Theoretical Framework (s) for corporate governance: Agency Theory; Stakeholder Theory; Stewardship Theory: Resource DependencyTheory; Gandhian concept of Trusteeship.	3	0	0
	Corporate Governance: Why governance? The Global Financial Crisis of 2007-09: Its Antecedents and Consequences –the increasing relevance of Corporate Governance. Ethical Perspective to Corporate Governance. Ancient Indian Connections; History of Corporate form and models; CorporateObjectives and goals: Ownership pattern: Issues in managing public limited firms; Agency problems.	6	0	0
	Corporate Governance Mechanisms Internal Corporate Governance Mechanism: Board of Directors; Functional Committees of Board; Code of conduct, whistle blowers; Board and Committee Assurance Providers and Other Advisors. External Corporate Governance Mechanism: Regulators, Gate keepers, Institutional Investors, Corporate Raiders. Auditing, Internal Controls and Compliance	4	0	0
Module 2:	**Framework for Ethical and Responsible business** Principles of ethical conduct, ethical dilemma, how corporations manage ethics. Companies as a 'good' corporate citizens; Responsible business paradigm. Ethics v. social responsibility of business, Adoption and model of CSR agenda. Responsible business strategies, policies and practices. Multinational Corporations, ethics and responsible business. Principles of GBS Codex, The United Nations Global Compact, Responsible business reporting frameworks.	6	0	0
Module 3:	**Global Perspectives and Practices on Corporate Governance** Global Corporate Governance models; Anglo-Saxon model other models (Germany & Japan); Emergence and emerging trends of corporate governance in the US & UK; Cadbury Report, OECD Committee Recommendations; The Sarbanes Oxley Act. Case Study: Enron	6	0	0
Module 4:	**Corporate Governance in India: Emergence and Trends** Colonialism and emergence of corporate sector in India, Developments post- independence 50s to 90s; developments in Corporate Governance in India in nineties and 2000s; CII, Kumara Mangalam Birla, Narayana Murthy, Naresh Chandra, JJ Irani, Kotak Committee reports; Legal and Regulatory reforms; introduction and implication of Clause 49; The Companies Act, 2013: Key features, SEBI (Listing Obligations and Disclosure Requirements) Regulations, 2015 and recent developments.	5	0	0
	Challenges for Corporate Governance in India: The role of the dominant shareholder; legal rights and enforcement; differences in cultural and political factors and their impact on the CG framework; Corporate Governance in family-owned companies. Role of board committees, managerial remuneration, Efficacy of auditors, Independence' of independent directors, Reporting and Disclosures. Contemporary challenges and future direction for corporate governance. Case studies: Satyam Tata-Mistry IL&FS	6	0	0
	Group presentations	0	0	0
	TOTAL	**40**	**0**	**0**

Evaluation criteria:	
Test 1: Assignment	25%
Test 2: Group Presentation	25%
Major Exam: Written Test	50%

Learning outcomes:

By the end of this course, the students would have:

- Develop an understanding of the conceptual framework for Business Ethics & Values and appreciate ethical issuesand concerns that arise while taking decisions in personal and corporate life.
- Understood the various theoretical frameworks on which corporate governance theories are premised.
- Appraised the emergence of corporate governance models and frameworks as they have evolved internationally.
- Understood the specific roles, responsibilities, reporting obligations, liabilities and effectiveness of boards of directors, management, shareholders, regulators and other corporate stakeholders in good governance in organizations.
- Appreciate the challenges that are specific to the Indian context and understand why transplanting
- western concepts of corporate governance to the Indian setting may not give the desired solutions.
- Identify the direction for future corporate governance reforms.

Pedagogical approach

The pedagogy used for the course would be a blend of learning in the classroom and then applying theory to the analysis of encapsulated situations (case studies), group discussions and project assignments. In this course Learning is not intended to be a one-way transmission of information through lectures and the course is designed to be very practical and supported by strong theoretical foundations. Students would be encouraged to be constructively critical of the assumptions, arguments, positions, the status quo and prevailing theories of corporate governance presently put forward by regulators, academics and other stakeholders. The objective of the pedagogy to be followed is, therefore, to develop the student into an engaged, critically reflective practitioner, who is not necessarily engaged only in quiet self-reflection, but is social, action- oriented and is able to analyze the dominant thinking in this field. Through reflection, students would acquire new (and hopefully more powerful) understanding and appreciation of the phenomenon of corporate governance, individually and in concert with their colleagues.

The contact sessions for this course would be broadly organized:

- sessions for Classroom Lecture given by the course Instructor that would expound and package the theory and concepts with illustrations and relate with real life examples.
- sessions of Case Discussion, facilitated by the course Instructor and/or Guest Speakers with dynamic student interaction to simulate, apply and illustrate any given concept, theory or argument.
- sessions of Group discussion and Presentation, led by students, under the supervision of the course Instructor, to communicate, draft and develop the concepts, theory and arguments and make presentations in the class.

Materials:

- Bhattacharyya, A.K. (2016). Corporate Governance in India: change and continuity. Oxford University Press.
- Fernando, A.C. (2009). Corporate ethics, governance and social responsibility: Percepts and practices.
  Dorling Kindersley Pvt Ltd. Pearson
- Fernando, A.C., Satheesh, K.P. et.al. (2018). Corporate Governance: Principles, Policies and Practices. (3rd ed.). Dorling Kindersley Pvt Ltd. Pearson.
- Fernando, A.C., Muralidharan, K.P. et.al. (2019). Business Ethics: An Indian perspective. (3rd ed.). Dorling Kindersley Pvt Ltd. Pearson.
- Indian Institute of Corporate Affairs. (2015). Corporate Governance. Taxmann Publications Ltd.
- Steiner, J.F. & Steiner, G.A. (2012). Business, Government and Society: Texts and Cases. (12th ed.) McGraw Hill (India) Pvt. Ltd.
- Valasquez, M. G. (2011). Business Ethics: Concepts and Cases (7th ed.), USA: Prentice Hall.
- These texts will be supplemented with additional teaching aids such as academic papers, cases and

research studies in this field.
Additional information (If any): None
Student responsibilities:
Attendance, Pre-reading, Class participation, Presentation, Assessment and Feedback.

Prepared by: Dr. Vidhi M Chadda

Course Reviewers:

1. Prof. Deva Prasad M., IIM-Kozikode
2. Prof. Kiran Rai, Maharashtra National Law University, Mumbai

MBA (SM) First Semester Courses

Sl. No.	Code	Course	Core	Earlier Structure Credits	L-T-P		Before BoS Credits	L-T-P	Faculty	After BoS Credits	L-T-P	Faculty
1	PPM 130	Accounting for Managerial Decisions	Core	4	44-16-00		4	30-10-00	Dr. Parul Behl	4	40-00-00	Dr. Parul Behl
2	PPM 101	Business Communication	Core	3	45-00-00		3	30-00-00	Dr. Anjali Singh	3	30-00-00	Dr. Anjali Singh
3	MPP 164	Principles and Concepts of Sustainability	Core	3	31-14-00		3	20-10-00	Ms. Jayati Talpatra	3	30-00-00	Ms. Jayati Talpatra
4	PPM 196	Marketing Management	Core	3	35-08-04		4	40-00-00	Dr. Shruti Sharma Rana	4	40-00-00	Dr. Shruti Sharma Rana
5	PPM 118	Management Concepts and Organisational Behaviour	Core	3	35-08-04		4	40-00-00	Dr. Moumita Acharyya	4	40-00-00	Dr. Moumita Acharyya
6	PPM 148	Managerial Economics	Core	4	50-10-00		4	32-08-00	Dr. Gopal Sarangi	4	40-00-00	Dr. Gopal Sarangi
7	PPM 119	Business Mathematics and Statistics	Core	4	34-23-06		4	40-00-00	Dr. Anand Jaiswal	4	40-00-00	Dr. Anand Jaiswal
8	PPM 168	Sustainability Reporting	Core	2	20-10-00		3	20-10-00	Dr. Shruti Sharma Rana	3	30-00-00	Dr. Shruti Sharma Rana
9	PPM 201	Corporate Governance and Business Ethics	Core	3	36-6-6		4	31-6-6	Dr. Kavita	4	40-00-00	Dr. Kavita
			Total	29		Total	33			33		

Course title: Strategic Management				
Course code:	**No. of credits: 4**	**L-T-P :** 45-15-00		**Learning hours:** 60
Pre-requisite course code and title (if any): UBA 106, Marketing Management				
Department: Department of Policy and Management studies				
Course coordinator (s):			**Course instructor (s):**	
Contact details:				
Course type	**Core**		**Course offered in:** Semester 5	
Course description				

Course description

This course provides an overview of the strategic management process in organizations. It enables students to analyze internal and external business environments and formulate strategic choices. The focus is on developing strategic thinking and applying various tools and frameworks for strategy formulation, implementation, and evaluation in competitive and globalized markets.

Course objectives

The course aims to:
- Build an understanding of the strategic management process.
- Develop analytical skills to evaluate external and internal environments.
- Enable students to formulate and implement business-level and corporate-level strategies.
- Equip students to assess strategic decisions from a sustainability and stakeholder management perspective.

Course content

Module	Topic	L	T	P
1	Introduction to Strategic Management: Definition, nature, and scope of strategy; Levels of strategy; Strategic intent, vision, and mission; Strategic fit and flexibility. Examples & Cases: Vision-Mission exercises from Apple and Tata Group.	7	2	0
2	External Environment Analysis: PESTEL analysis, Porter's Five Forces, opportunities and threats, industry structure and dynamics. Examples & Cases: PESTEL analysis of the EV market; Five Forces in the airline industry.	7	2	0
3	Internal Environment Analysis: Resource-based view, VRIO framework, value chain analysis, core competencies and capabilities. Examples & Cases: VRIO analysis of Netflix; Value chain mapping at Infosys.	7	2	0
4	Business-Level Strategies: Cost leadership, differentiation, and focus strategies; Strategic group mapping. Examples & Cases: Differentiation at Zara; Cost leadership at Walmart.	7	2	0
5	Corporate-Level Strategies: Diversification, vertical integration, mergers and acquisitions, portfolio analysis (BCG Matrix, GE Matrix). Examples & Cases: M&A case of Microsoft–LinkedIn; BCG Matrix for Unilever's brands.	6	2	0
6	Strategy Implementation: Organizational structure and systems, leadership, culture, strategic control and performance metrics. Examples & Cases: Implementation challenges at Tata Motors; Balanced Scorecard at HDFC Bank.	6	2	0
7	Evaluation criteria session: Overview of assessment methods and feedback.	5	3	0
	TOTAL	**45**	**15**	**00**

Evaluation criteria

Continuous Assessment (Class participation, discussions, strategy news analysis & presentations) – 20%
Mid-Term Written Exam – 30%
End-Term Written Exam – 50%

Group Project: Strategic Analysis of a Business

Each group will select a company (real or hypothetical) and perform a complete strategic analysis using tools and frameworks taught in class. The analysis should cover external/internal environment, strategic options, and a final strategy with an implementation plan. A written report and 15-minute class presentation are mandatory.

Case Study Discussions
- Each case should cover:
- Problem statement
- Strategic objectives
- Alternatives and analysis
- Recommended strategy
- Implementation approach

Learning outcomes
- Understand strategic planning and analysis frameworks.
- Apply tools to evaluate internal and external business environments.
- Formulate strategies suitable for different business contexts.
- Appreciate the role of leadership, culture, and sustainability in strategic success.

Pedagogical approach
- Interactive lectures
- Real-life case discussions
- Group strategy simulations and presentations
- Strategy news crunching

Materials
Textbook:

Strategic Management: Concepts and Cases by Fred R. David & Forest R. David, Pearson, Latest edition.

Reference Books:

Crafting and Executing Strategy by Thompson, Strickland, and Gamble.
Competitive Strategy by Michael E. Porter.

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.

Course title: ESG: Environmental, Social, and Governance in Business Strategy				

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 (s): Dr.Shruti Sharma			**Course instructor (s):**	
Contact details:				
Course type	Core		**Course offered in:** Semester 5	

Course description

This course provides a comprehensive overview of ESG (Environmental, Social, and Governance) principles and their growing importance in business strategy. It enables students to understand how sustainability, ethical governance, and social responsibility can create long-term value for businesses. Students will learn to assess ESG risks and opportunities, understand regulatory and voluntary frameworks, and analyze how companies integrate ESG into decision-making processes.

Course objectives

The course aims to:

Introduce core concepts of ESG and their relevance in today's business environment.

Develop skills for analyzing ESG risks, metrics, and performance indicators.

Equip students to understand regulatory, investor, and stakeholder expectations on ESG.

Build capacity to critically evaluate ESG reports, disclosures, and ratings.

Explore how ESG integration influences strategic, financial, and operational performance.

Course content

Module	Topic	L	T	P
Introduction to ESG	**Why:** To grasp the strategic rationale for ESG and its links to CSR, SDGs and long-term value creation. **Objectives:** • Define ESG and distinguish it from CSR & sustainability • Explain how ESG drives corporate reputation, risk mitigation and stakeholder trust **Core Content & Frameworks:** • ESG evolution and global trends • Linkages to SDGs and CSR strategies **Cases & Examples:** • Indian: Tata Group's ESG road-map and CSR integration • Global: Unilever's Sustainable Living Plan	6	2	0
Environmental Responsibility	**Why:** To understand environmental risks (including climate change) and how companies measure and manage them. **Objectives:** • Analyze climate-change `Arisks and regulatory drivers • Apply carbon-accounting tools and circular-economy principles **Core Content & Frameworks:** • PESTEL-E (with climate risk scenarios) • Life-cycle assessment & materiality of resource use **Cases & Examples:** • Indian: Tata Steel's carbon-neutrality roadmap under MNRE guidelines • Global: Ørsted's transition from fossil fuels to offshore wind.	9	2	0
Social Impact and Inclusion	**Why:** To evaluate social risks/opportunities—labour, human rights and community relations—as a strategic asset. **Objectives:** • Map social-risk hotspots and stakeholder expectations • Design DEI and fair-supply-chain initiatives **Core Content & Frameworks:** • Human rights due diligence (UN Guiding Principles) • DEI metrics and impact assessments **Cases & Examples:**	6	2	0

	• Indian: Adani Group's community-engagement under SEBI's BRSR social KPI.			
Corporate Governance	**Why:** To link governance structures and ethics to ESG performance and regulatory compliance. **Objectives:** • Explain board roles in ESG oversight • Assess governance models for transparency and anti-corruption **Core Content & Frameworks:** • Board composition, independence & committee structures • ESG-linked executive compensation and whistle-blower systems. **Cases & Examples:** • Indian: Infosys board reforms and SEBI's clause on independent directors • Global: Volkswagen's post-Dieselgate governance overhaul.	7	2	0
ESG Metrics, Reporting & Standards	Why: To master key frameworks and the interoperability of standards for effective disclosure. Objectives: • Compare GRI, SASB, TCFD, ISSB and BRSR • Map how frameworks interconnect and share common metrics Core Content & Frameworks: • Materiality assessment & stakeholder mapping • Assurance processes and ESG ratings mechanics Cases & Examples: • Indian: SEBI BRSR implementation challenges and best practices • Global: How Microsoft aligns TCFD, SASB and ISSB disclosures in one report. Standards Connection: • Detailed interoperability matrix showing where GRI → SASB → TCFD → ISSB metrics align; overlay RBI's ESG-lending norms	4	2	0
ESG Integration in Strategy & Investment	**Why:** To embed ESG into corporate strategy, risk management and capital allocation. **Objectives:** • Integrate ESG factors into strategic planning and M&A due diligence • Assess ESG impacts on cost of capital and investor expectations **Core Content & Frameworks:** • ESG risk assessment tools (incl. climate stress-testing) • Sustainable finance instruments (green bonds, ESG-linked loans) **Cases & Examples: Indian: Adani Green's green bond issuance under SEBI guidelines** **• Global: BlackRock's ESG integration in portfolio management**	7	2	0
ESG in India: Regulatory and Corporate Trends	**Why:** To survey India-specific ESG mandates and how corporates are responding. **Objectives:** • Explain SEBI BRSR, RBI ESG financing guidelines and other local mandates • Critically evaluate Indian PSU and private-sector disclosures **Core Content & Frameworks:** • SEBI BRSR categories and scorecards • RBI's climate-risk stress-test framework **Cases & Examples:** • Indian PSU: Coal India's BRSR disclosures and compliance gaps.	6	3	0
	Total	**45**	**15**	**00**

Evaluation criteria
- Continuous Assessment (Class participation, discussions, strategy news analysis & presentations) – 20%
- Mid-Term Written Exam – 30%
- End-Term Written Exam – 50%

Group Project: ESG Company Assessment
Each group will select a company (Indian or global) and conduct an ESG assessment using relevant frameworks and disclosures. The final submission should include:

• ESG strategy and performance review • Use of ESG tools and frameworks • Evaluation of risks and opportunities • A presentation and written report
Case Study Discussions **Each case should cover:** • ESG challenge and context • Stakeholder mapping • Response strategy and execution • Outcomes and lessons learned
Learning Outcomes **By the end of the course, students will be able to:** • Understand the strategic relevance of ESG in business • Apply ESG frameworks and standards for reporting and assessment • Evaluate companies based on ESG metrics and disclosures • Recommend ESG strategies to enhance corporate sustainability
Pedagogical Approach • Interactive lectures • Live ESG case studies • Group presentations and debates • ESG news tracking and analysis • Simulated ESG risk assessment
Materials **Textbook:** • **"Principles for Responsible Investment: A Guide for Students" – UN PRI** • **ESG and Sustainable Business – Harvard Business Review curated readings** **Reference Books:** • **"**Green Swans" by John Elkington • "Sustainable Investing" by Cary Krosinsky & Nick Robins • SEBI BRSR Handbook and ESG Ratings Reports
Additional Information.
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 Review
1. Dr. Rachita Agarwal, Associate Professor, Department of Commerce, Delhi University
2. Ms. Jayati Talapatra, ESG Specialist and Lead Consultant, CII-ITC Centre of Excellence for Sustainable Development

Course title: Introduction to Corporate Social Responsibility			
Course code:	**No. of credits: 4**	**L-T-P:** 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 5	

Course description

This course explores the concept, evolution, and application of Corporate Social Responsibility (CSR) in businesses, with a special focus on the Indian regulatory framework and global good practices. It provides tools to understand CSR strategy, project lifecycle, stakeholder engagement, impact assessment, and the intersection of CSR with business ethics and sustainability. Real-world cases and projects help students develop a practical understanding of responsible business conduct.

Course objectives.

The course aims to:

- Develop a foundational understanding of CSR concepts, history, and significance.
- Explore CSR laws, policies, and standards with a focus on the Companies Act, 2013.
- Equip students to design, implement, and evaluate CSR projects.
- Promote critical thinking on ethical dilemmas, stakeholder needs, and shared value.
- Provide exposure to CSR reporting, ratings, and real-life success stories.

Course content

Module	Topic	L	T	P
1	Introduction to CSR & Context• Concept, evolution, types of CSR, CSR vs. charity vs. sustainability • Case Study: Tata Group's integrated CSR strategy.	9	3	0
2	CSR Policy and Strategy : Designing a CSR policy, alignment with SDGs, creating shared value, linking CSR to business strategy. Stakeholder Engagement & Need Assessment Identifying and prioritizing stakeholders, community consultations, need assessment surveys, participatory approach . Case: Mahindra & Mahindra's rural outreach• Case: Microsoft's global community engagement	1 0	3	0
3	Project Design and Implementation ; Logic models, project planning, budgeting, partnerships with NGOs, employee volunteering, risk management. Monitoring, Evaluation and Impact Assessment : Setting KPIs, theory of change, monitoring tools, SROI, third-party assessment, reporting templates. Case: ITC's watershed project (Indian)• Case: Patagonia's environmental impact audit (global)	9	4	0
4	CSR Reporting and Best Practices CSR disclosure under MCA, for CSR, awards and benchmarks, innovative CSR models in India Indian context: Section 135 Companies Act 2013, Schedule VII, CSR rules & amendments. Case: Hindustan Unilever's CSR reporting excellence• Case: Novo Nordisk's global CSR compliance model	8	2	0
5	Best CSR Case Studies – India and Global : Iconic CSR models: NTPC, Indian Oil, Infosys; global CSR pioneers: Tesla, Novo Nordisk• Innovations in CSR: circular models, social finance.	9	3	0
	Total	**45**	**15**	**00**

Evaluation Criteria
- Continuous Assessment (Class participation, discussions, strategy news analysis & presentations) – 20%
- Mid-Term Written Exam – 30%
- End-Term Written Exam – 50%

Group Project: Designing a CSR Project for a Company
Each group will choose a sector (education, health, environment, livelihoods, etc.) and design a CSR intervention for a company. The project should include:
- CSR Policy objectives
- Stakeholder needs
- Project design and implementation plan
- Monitoring framework
- Impact metrics and proposed reporting

The final output must include a written report and a class presentation.

Case Study Discussions
Each case will include:
- CSR challenge or opportunity
- Corporate response strategy
- Stakeholder and community feedback
- Lessons learned and business impact

Learning Outcomes
By the end of this course, students will be able to:
- Understand the strategic and legal context of CSR in India and globally
- Design CSR programs aligned to community needs and business goals
- Analyze and interpret CSR reports and assess project impacts
- Engage effectively with stakeholders and design impact-led solutions
- Critically evaluate CSR initiatives for innovation, ethics, and scalability

Pedagogical Approach
- **Concept lectures**
- **Real-life case studies and guest sessions**
- **CSR simulation exercises**
- **Field-based examples and NGO insights**
- **Stakeholder roleplay and reporting critique**

Materials
Textbooks:
- *Corporate Social Responsibility in India: Cases and Developments after the Legal Mandate* – **N. B. Bhaduri**
- *Creating Shared Value: CSR and Sustainable Business Strategies* – **Michael Porter & Mark Kramer (HBR Classics)**

Reference Reports and Frameworks:
- **Companies Act, 2013 (Section 135)**
- **Ministry of Corporate Affairs CSR Guidelines**
- **UN Sustainable Development Goals (SDGs)**
- **GRI and SEBI-BRSR**

Additional Information

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.

Course title: Logistics and Supply Chain Management			
Course code:	**No. of credits:** 4	**L-T-P**: 60-00-00	**Learning hours:** 60
Pre-requisite course code and title (if any): None			
Department: Policy & Management Studies			
Course coordinator(s):		**Course instructor(s):**	
Contact details:			
Course Type: Core		**Course offered in:** 5th Semester	

Course Description

This course introduces students to the fundamental concepts and practices of logistics and supply chain management (SCM). It focuses on the flow of goods, services, and information from the point of origin to the final customer. The course covers key functional areas including procurement, production, distribution, warehousing, inventory, transportation, and customer service. Emphasis is placed on understanding integrated planning, process alignment, and operational efficiency in supply chains.

Course objectives

By the end of this course, students will:
- Understand the role of statistics and logic in business decision-making.
- Apply descriptive statistical methods to real-world business problems.
- Develop logical reasoning skills for structured business analysis.
- Use statistical tools to forecast trends and evaluate business performance.

Course content

Module	Topic	L	T	P
1	**Introduction to Supply Chain Management:** Definition, Objectives, Importance, SCM vs. Logistics, Key Drivers of Supply Chain, Cycle view of supply chain processes, push / pull view of supply chain processes, supply chain macro processes. Role of LSCM in Business Management	5	0	0
2	**Supply chain performance:** Implied demand uncertainty, Supply chain capabilities, achieving strategic fit, efficient supply chain, responsive supply chain, methods to provide responsiveness, supply chain performance and business performance	7	0	0
3	**Supply Chain Drivers and Design:** Drivers: Facilities, inventory, transportation, information, sourcing, pricing, Supply Chain Network Design: Distribution strategies, facility location, network planning	8	0	0
4	**Inventory Management:** Types, EOQ and EPQ, safety stock, inventory control techniques (ABC, VED), JIT systems, Use of inventory models in business management	8	0	0
5	**Procurement and Sourcing:** Procurement process, supplier selection and evaluation, sourcing strategies, e-procurement	8	0	0
6	**Warehousing and Transportation:** Warehouse functions and design, transportation decisions, multimodal logistics, cost implications, Amazon Warehouse **Logistics:** Modes of transportation, direct shipment network, direct shipping with milk runs, all shipments via intermediate distribution center with storage, all shipments via intermediate transit point with cross-docking, Shipping via DC using milk runs, hub & spoke model, reverse logistics, green logistics,	14	0	0
8	**Technology and Coordination in Supply Chain Management:** Technology: Role of IT, ERP, SCM software, IoT, RFID, Blockchain, GPS Coordination: Bullwhip effect, rationing and shortage gaming, continuous replenishment and vendor managed inventory, collaborative planning, forecasting, and replenishment, Supply chain analytics and dashboard	6	0	0
9	**Global SCM and Sustainability**:	4	0	0

	Global logistics challenges, risk management, sustainable and green SCM, ethical sourcing, Role of LSCM for achieving SDGs			
	TOTAL	**60**	**00**	**00**

Evaluation criteria:

The break-up of the evaluation procedure is as follows:

- Test 1 : Written Examination/Assignment (Module 1, 2, 3, 4) - 30%
- Test 2 : Written Examination/Assignment (Module 5,6, 7, 8) - 30%
- Major Exam: Written Examination (Module 1-8) - 40%

Learning outcomes:

After successful completion of the course, students will be able to:

- Demonstrate understanding of logistics and SCM concepts and practices. (assessed by Test 1 and Major Exam)
- Design efficient supply networks and distribution strategies and utilize technology tools for enhancing supply chain visibility and efficiency. (assessed by Test 2 and Major Exam)
- Evaluate and make sustainable local and global supply chains (assessed by Major Exam)

Pedagogical approach

The course will be delivered through lectures and tutorials. Application of statistical tools in business & economicsrelated problems would also be a part of the pedagogical approach for the course.

References:

Textbooks:

1. Agarwal, D. K. (2007). Logistics and supply chain management. Macmillan India.
2. Altekar, R. V. (2005). *Supply chain management: Concepts and cases*. PHI Learning Pvt. Ltd.

Additional Readings:

3. Christopher, M. (Latest Edition), Logistics and Supply Chain Management, Pearson.
4. Rushton, A., Croucher, P., and Baker, P. (Latest Edition), The Handbook of Logistics and Distribution Management, Kogan Page.
5. Gopalakrishnan, P. and Sundaresan, M. (Latest Edition), Materials Management: An Integrated Approach, PHI Learning.
6. Chopra, S. and Meindl, P. (Latest Edition), *Supply Chain Management: Strategy, Planning, and Operation*, Pearson Education.
7. Ballou, R.H. (Latest Edition), *Business Logistics/Supply Chain Management*, Pearson Education.
8. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E. (Latest Edition), *Designing and Managing the Supply Chain*, McGraw-Hill.

Additional information (If any): None

Student responsibilities:

Attendance, feedback, discipline etc.

Course reviewers:

1. Dr. Cherian Samuel, Associate Professor, IIT (BHU), Varanasi.
2. Dr. Vinaytosh Mishra, Associate Professor and Director, Thumbay Institute of AI in Healthcare, GMU, UAE

Course title: Business Statistics & Logic				
Course code:	**No. of credits:** 4	**L-T-P**: 60-00-00		**Learning hours:** 60
Pre-requisite course code and title (if any): None				
Department: Policy & Management Studies				
Course coordinator(s):		**Course instructor(s):**		
Contact details:				
Course Type: Core		**Course offered in:** 3rd Semester		

Course Description

This course introduces fundamental statistical and logical reasoning techniques essential for business decision-making. In today's competitive economy, businesses rely on data-driven strategies rather than intuition. This course equips BBA students with the analytical tools to interpret data, assess business performance, and make informed decisions. Topics include descriptive statistics, probability, hypothesis testing, regression analysis, and logical frameworks for problem-solving.

Course objectives

By the end of this course, students will:
- Understand the role of statistics and logic in business decision-making.
- Apply descriptive statistical methods to real-world business problems.
- Develop logical reasoning skills for structured business analysis.
- Use statistical tools to forecast trends and evaluate business performance.

Course content

Module	Topic	L	T	P
1	**Introduction to Business Statistics & Logic** Definition of Business Statistics, Importance of Statistics in Business, Applications in Decision Making, Introduction to Logic in Business, Need for Logical Reasoning in Management	2	0	0
2	**Logic and Reasoning** Basic Concepts of Logic – Statements and Propositions, Deductive Reasoning, Inductive Reasoning, Logical Arguments, Syllogisms, Logical Fallacies in Business, Application of Logic for Business Decision Making	4	0	0
3	**Boolean Logic** Statements and Propositions, Logical Operators – AND, OR, NOT, Truth Tables, Logical Equivalence, Business Application of Boolean Logic	7	0	0
4	**Data and Statistics** Introduction to Data: Concept & types of data; importance of data inbusiness; Data sources: introduction to business-related data & sources. Scales of Measurement – Nominal, Ordinal, Interval, Ratio	8	0	0
5	**Summarizing Data: Visualization and Charts** Data Presentation in Tables, Frequency Distribution, Cross Tabulations, Data Visualization using Charts, Use of R Studio and Excel for Business Data Visualization	8	0	0
6	**Measures of Central Tendency** Arithmetic, Geometric and Harmonic Mean), Median and Mode. Quartiles, Percentiles and Deciles. Use of MCT for Business Decision Making.	7	0	0
7	**Measure of Dispersion and Distribution Characteristics** Range, Inter-Quartile Range, Q.D, Mean Deviation, Standard Deviation and Variance. C.V. Skewness and Kurtosis. Box-Whisker Plot. Five Number Summary, Elimination of Outliers from data set. How Measures of Dispersion can help understand business data	8	0	0
8	**Correlation & Regression** Correlation Analysis, Scatter Diagram, Karl Pearson's Correlation Coefficient, Coefficient of Determination, Coefficient of Alienation and Spearman's Rank Correlation, Simple Regression, Multiple Correlation, Correlation Vs Regression.	8	0	0

	Use of Correlation and Regression for Business Data			
9	**Probability:** Basic Probability Concepts, Rules of Probability, Conditional Probability, Bayes' Theorem, Random Variables, Business Use Cases	7	0	0
	TOTAL	**60**	**00**	**00**

Evaluation criteria:

The break-up of the evaluation procedure is as follows:

- Test 1   : Written Examination (Module 1, 2, 3,4)   - 30%
- Test 2   : Written Examination (Module 5,6,7,8,9)   - 30%
- Major Exam: Written Examination (Module 1-9)   - 40%

Learning outcomes:

After successful completion of the course, students will be able to:

- Understand the foundational role of statistics, logic, and data analysis in business decision-making. (Assessed in Minor Test 1, Minor Test 2, and Major Exam)
- Apply appropriate statistical techniques such as measures of central tendency, dispersion, correlation, regression and probability concepts to interpret business data. (Assessed in Minor Test 2 and Major Exam)
- Integrate statistical tools and logical frameworks to solve real-world business problems and predict outcomes (Assessed in Major Exam)

Pedagogical approach

The course will be delivered through lectures and hands-on sessions. Application of statistical tools (R studio, Excel and Minitab) in business & economicsrelated problems would also be a part of the pedagogical approach for the course.

References:

Textbooks:

1. Das, N (2017). Statistical methods (combined volume) (1st ed.). McGraw Hill Education.

Additional Readings:

9. Kohler, H. (2010). Statistics for Business & Economics, Harper Collins.
10. Levin, R. and Rubin, D. (2012). Statistics for Management, Pearson.
11. McClave J. and Benson, P.G. (2013). Statistics for Business and Economics, Pearson.
12. Richard I.L. and David S.R. (2011). Statistics for Management, Pearson.
13. Stine R. and D. Foster (2014). Decision making and Analysis, Pearson New International Edition.
14. Thukral J.K. (2015). Business Mathematics & Statistics, Mayur Paperback.
15. Triola M.F. and Franklin, L.A. (2015). Business Statistics.
16. Watsnam TJ. and Keith P. (2014). Quantitative Methods in Finance, International Thompson Business Press.

Additional information (If any): None

Student responsibilities:

Attendance, feedback, discipline etc.

Course reviewers:

3. Dr. Cherian Samuel, Associate Professor, IIT (BHU), Varanasi.
4. Dr. Pusha Negi, Associate Professor, New Delhi Institute of Management, New Delhi

Course title: Indian Knowledge Systems			
Course code: <mark>XXXXX</mark>	**No. of credits: 2**	**L-T-P:** 30-0-0	**Learning hours:** 30
Pre-requisite course code and title (if any): No pre-requisite required			
Department: Department of Policy and Management Sciences			
Course coordinator(s):		**Course instructor(s):**	
Contact details: nerajdr@yahoo.com			
Course type: Value Added Course under Indian Knowledge System		**Course offered in:** Semester 1	

Course description

The rich cultural heritage and intellectual lineage of Vedic knowledge encompasses many of the foundational ideas that inform today's knowledge systems. The extensive and detailed wisdom enshrined in the Vedas, Puranas, Shastras, and other significant "Dharmic texts" offers practical, scientific, and technical insights that remain relevant to contemporary discourse. India's traditional approaches to sustainability and holistic development contribute to a multidisciplinary and integrative perspective on understanding the world around us. The Indian Knowledge System (IKS), as emphasized in the National Education Policy (NEP) 2020 and promoted by the Ministry of Education (MoE), integrates *Jnan* (knowledge), *Vignan* (science), and *Jeevan Darshan* (philosophy of life) that have evolved through the lived experiences, careful observation, empirical experimentation, and critical analysis of the people of Bharat. This dynamic system has not only been continually validated over centuries but has also found practical applications in diverse fields such as education, management, research governance, arts, law, justice, healthcare, industry etc. These knowledge traditions have been preserved and transmitted through textual, oral, and artistic mediums in both classical and regional languages. In each of these a continuous and cumulative series of texts continues to be available in spite of widespread loss and historically recorded destruction.

A systematic understanding of Vedic wisdom interwoven with evolving, post-traditional, and contemporary knowledge frameworks offers valuable insights into a wide spectrum of academic and practical domains.

Course objectives

The course aims to achieve the following objectives

To apply interdisciplinary approaches to interpret ancient Indian wisdom

- To assess the foundations and conceptualisation of Indian Knowledge Systems
- To examine the contributions and correspondence of management and administration in Indian ancient texts with modern scientific techniques.
- To explore socio-psychological aspects in Sanskritic texts for overall well-being.

Course content

Module	Topic	L	T	P
1	➢ **Introduction to Indian Knowledge Systems** This module introduces students to the textual and philosophical roots of Indian Knowledge Systems. Through foundational texts like the Vedas, Upanishads, and Bhagavad Gita—along with the inclusive voices of Bhakti saints like Sant Kabir and Chaitanya Deva —learners explore ethical worldviews, leadership ideals, and knowledge typologies that laid the groundwork for Indian civilizational thought.	8	2	0

	• Introduction to IKS: Definition and Scope • Vedas and their Categorization (Upanishad, purana etc) • Introduction to Devotional Traditions: Ethical Teachings from Rahim Das's and Kabir's Dohas, Chaitanya Deva Shiksha and Prayers by Raskhan and Namdeva.				
2.	➢ **Applied Dimensions of IKS (Management, Leadership and Governance)** This module integrates ancient strategic thinking and ethical governance from texts like the Shrimad Bhagavad Gita Mahabharata, and Nitishastra with modern management principles. It explores applied dimensions such as leadership, decision-making, conflict resolution, and sustainable systems of management—demonstrating how IKS remains relevant in real- world professional settings. • Key Teachings for performance enhancement and communication from Shrimad Bhagavad Gita. • Assessing successful management tips from Vidura and Chanakya Niti • Assessing leadership skills and administrative qualities from Sabha Parva of Mahabharata: Conversation between Narada and King Yudhishthira.	8	2	0	
3.	➢ **Human Well-being and Society in IKS** Focusing on the holistic vision of human life in Indian philosophy, this module explores well-being through the lens of Yogic psychology, Ayurvedic insights, and the Panchakosha framework. It connects timeless wisdom to contemporary well- being models, time and stress management, and human development practices relevant in today's organizational and social contexts. • Understanding personality traits through Panchakosha • Patterns of time management, food habits, and sustainable living • Integrating Ayurvedic and Yogic concepts with contemporary psychology	8	2	0	
11	**Total**	**30**	**00**	**00**	

Evaluation criteria
- Test 1:   50% [Mid-Term Assessment]
- Test 2:   50% [End-Term Assessment]

Learning outcomes

After completing this course, the students will be able to:-
- Interpret key philosophical, ethical, and socio-cultural ideas from Indian Knowledge Systems and compare them with contemporary global thought.
- Apply ancient Indian principles of leadership, governance, and well-being to modern organizational, managerial, and societal challenges.
- Demonstrate a holistic understanding of personality, cognition, and time management through frameworks like Panchakosha, Yoga, and Ayurvedic models.

Analyze traditional systems of sustainability, resource management, and strategic governance to develop context-specific insights for modern practice.

References
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Additional information (if any)

Student responsibilities

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

Course Reviewers

1. Prof Sunil Maheshwari – Dean (Alumni and External Relations), Professor of Human Resource Management , Indian Institute of Management, Ahmedabad
2. Prof Laxmi Dhar Behera, Director – Indian Institute of Technology, Mandi, Himachal Pradesh

Department of Policy &Management Studies
Guidelines for Summer Internship Project

Course No.

1. **Objective**
This internship course aims to provide students with an integrative learning experience that combines professional work in a real-world organization with rigorous academic research. Students will develop and apply theoretical knowledge to practical challenges through an action research project, enhancing their problem-solving, critical thinking, and communication skills. This course aims to bridge the gap between academic study and professional practice, preparing students for successful careers in their chosen fields.

2. **Internship Student Engagement Process:**
An internship is a structured, hands-on learning experience integrating academic knowledge with pre-professional work activities. It mutually benefits both the student-intern and the host organization. Interns apply foundational skills from their studies to real-world tasks, enhancing their practical experience. They also offer regular supervision and feedback to guide the interns' development. This experiential learning helps students build valuable industry-specific skills, gain insights into their chosen field, and improve their employability upon graduation.

3. **Timeline for important activities**

Activity	Due date
Orientation	One week before internship starts
Joining Reporting to the host organization	Within one week of joining
Joining report (Form 1) Certified Letter from host organization/supervisor Attesting your joining date in the organization/supervisor.	Within one week of joining
Submission of Proposal/Synopsis	Within first 10 days of joining
Weekly progress report (Form 2) Brief progress report–I to VI First report should contain the working title and draft of objectives	Every week end
Internship report for plagiarism check The dissertation should be emailed as single.pdf file	TBD
Feedback form of the external supervisor Response/Feedback from the Host Organization/Supervisor-submission	One week after completion of internship
Presentation of Internship project Presentation of the entire project in front of the Panel members for 10 minutes followed by Questions and Answers.	TBD
Final Dissertation submission Submit soft copy (by email only) of the final project report to the internship project coordinator and with a copy to the internal supervisor and department assistant, failure to do so will result in non-submission. The project report will be allowed to be submitted only after it has been duly approved by internal supervisor stating that the revisions suggested by the presentation evaluation committee and the internal supervisor have been incorporated in the final version of the report. Failure to submit the final report by assigned date, minor project	TBD

will be considered incomplete and the student will be assigned zero marks in the evaluation)	

- Naming convention for the report should follow your name, report name (i.e. Raj_Progress report 1). Not following the naming convention would be disregarded as report submission.

4. Internal Supervisor

Each student is required to have one internal supervisor from TERI School of Advanced Studies (exceptions on the number can be granted if verified); the student must provide a list of two faculty members (first choice & alternative choice) of TERI School of Advanced Studies preferred as supervisor with the joining report failure to provide the two choices of supervisor will be considered as non-compliance to minor project guidelines and the department would take a call on whether the student is allowed to continue with the minor project or not. The students should choose the internal supervisor from the Department or outside the Department from TERI SAS. In case the preference is given for the faculty from any other department, the student should communicate with the concerned faculty well in advance and inform minor project coordinator about it marking a copy to internal supervisor. The preference for a supervisor should be purely based on area of the work during internship project. This must be done within a week of joining the organization or the date to submit Joining report, whichever is earlier. Department will nominate one of the faculty members as supervisor to the student. The preference for the supervisor given by the student should not be considered final and the allocation of the supervisor can be assigned beyond the given choices of the students.

5. External Supervisor

Each student has one external supervisor from her/his host organization (exceptions on the number can be granted if verified). External supervisors are to be identified by the host organization. It must be communicated to the TERI SAS within 10 days of joining or the date to submit Joining report, whichever is earlier. Guest/visiting faculty can act as external supervisor.

6. Evaluation Criteria

An evaluation committee will be formed to assess the minor project. The distribution of marks for the evaluation would be as per the following criteria (weights of each is indicated in parenthesis).Evaluation of the Project will be made based on, Presentation and Written Report (final copy submitted by the student with maximum similarity of 15%). Kindly note that plagiarism report is must before taking signatures of Internal supervisor and HOD .The break-up between these components is: *50% for Written Report and 50% for Presentation*. Presentations and reports will be evaluated by the Department Research Committee (DRC)/ panel and the internal supervisor, respectively.(The presentation will be evaluated based on the contents, delivery (structure and flow), research component and timing of the presentation) .

(a) The students scoring less than or equal to 50% (or ≤ 50%) overall marks in the evaluation would be considered fail.
(b) If the student fails to appear for the Internship presentation on the presentation date assigned by the TERI SAS, then the candidate will be assigned zero marks for the presentation and will be graded accordingly.
(c) It is the responsibility of the student to get the response/feedback duly filled from the affiliated organization/supervisor and email the same through the supervisor to Summer Internship Coordinator/department assistant as per the date mentioned in the guideline.
(d) Attending presentation is mandatory for all the students. An attendance for this will be maintained.
(e) If plagiarism is detected through the use of Turnitin software, it will be referred to the Internal Project Committee, which would take a decision and penalty to be imposed/ disciplinary action to be taken. The guidelines for the Minor Project Committee are as follows:

Levels of Plagiarism	Percentage of similarity	Maximum percentage marks to be deducted from report
Level 3	> 60%	Students registration to the program stands cancelled
Level 2	> 40% ≤ 60%	Student repeats the course next year
Level 1	> 10% ≤ 40%	The student is required to resubmit the report after necessary changes within the deadline
Level 0	≤ 10%	0%

(f) Grading of the Minor Project would be done as per the following criteria:

>90	A+
>85≤90	A
>80≤85	B+
>70≤80	B
>60≤70	C+
>55≤60	C
>50≤55	D
≤50	F

Evaluation distribution
   a. Internship project report   (20%)
   b. Internship project presentation   (30%)
   c. Question & answers/viva voce   (30%)
   d. Meeting timeline   (10%) (Consisting of: joining report (1), six progress reports (1 each), feedback form (1), final thesis (2).
   e. Response/feedback from the host organization/supervisor   (10%)

7.   Late submission
   (a) <u>Joining report</u>: No weekly progress report will be accepted until the completely filled joining report has been submitted.
   (b) <u>Weekly progress report</u>: The reports have to be submitted by the last working day of every week (Saturday).
   (c) Proposal/<u>Synopsis</u>: The proposal/synopsis has to be submitted on the date mentioned under point 2.
   (d) Submission of <u>final report</u> for evaluation: The softcopy for evaluation has to be submitted on the date mention under point 2. Project reports that are submitted after the mentioned date won't be considered for evaluation and "0" marks would be awarded for the same. Further, the regulations of the TERI School of Advanced Studies apply as laid down in the actual student handbook.

8.   **Orientation Session:** The orientation session for the internship project is designed to provide students with a comprehensive overview of what to expect and how to succeed in their upcoming professional experience. The session aims to bridge the gap between academic learning and practical application in a real-world setting.

9.   Submission of the report
The length of the report should be around 20 to 30 pages. The report should be structured as:
   - **Front Page: Student Name, Course,**
   - **Internship Company, Duration,**
   - **Mentor Internship Agreement Form Internship Certificate Introduction & background of the Company**
   - **Roles & responsibilities as an Intern**
   - **Weekly work allotment & completion report**
   - **Challenges & Solutions Learning from the internship**
   - **Conclusion**
   - **References**: Refer to Harvard System of Referencing Guide (http://libweb.anglia.ac.uk/referencing/harvard.htm).
   - **Annexure(s):** Any graphs, boxes and tables that could not be accommodated in the main section.

10. Format of Project Report The length of the project report should be limited to 30 to 40 pages. Please refer to the annexure at the end of document for detailed structure. The <u>report</u> will be evaluated chapter wise. Missing chapters will lead to loss of marks. The report should be structured as following:

- **Abstract:** This is a summary of the work done within 300 words. Broadly, it defines the concepts studied and key findings. (Use times new roman 10 font and italics in this section. It should be followed by five key words.
- **Introduction:** As above plus an introduction in the structure of your work.
- **Background.** This is a literature review giving an overview of the knowledge regarding your work and relevant concepts. The reference sources should be textbooks, journals, statutory and legal reports and publications. Limit yourself to authentic sources. All references are to be reported in the references section.
- **Material and Methods:** Study area, if applicable, should be part of this chapter. Mention further very explicitly the materials (data, software, equipment etc.) and methods you used to achieve your aim and objectives. Indicate clearly, which methodology you use for which objective.
- **Results and discussion:** This is the final outcome of the work done. It is to be expressed qualitatively or quantitatively. Please establish relation between the objectives defined and the results obtained. In this chapter, you should discuss the key findings of your research in the context of the overall study, existing studies and the state-of-the-art knowledge in the field. The results in this section should be structured in such a way that it follows and adheres to the methodology. You should also include the managerial implications and policy implications of your study in the discussion sections. Based on your work, you could also include the limitations of your study in this section.
- **Conclusion:** This section should have your assessment (in terms of important advances in the field of study, critics, gaps, limitations and scope for further research) against the background of the state-of-art-knowledge in the field. It helps if you follow the structure of the previous two chapters and address each objective separately.
- **References:** Refer to Harvard System of Referencing Guide. (http://libweb.anglia.ac.uk/referencing/harvard.htm).
- **Annexure(s):** Any graphs, boxes and tables that could not be accommodated in the main section.

Page setup compulsory for Synopsis/Final Report
- A page size of A4;
- Left margin: 42 mm, right margin: 30 mm, top: 15 mm, bottom: 20 mm;
- Times New Roman 12 point as the base font and 1.5 lines spacing;
- Page numbers in the bottom margin, centered and
- The Internship report should not extend beyond 60 pages in softcopy and 30 double sided print in hardcopy
- Captions must explain table/figures without reference to the text: Position: above tables and below figures

9. Presentation and Question & Answers/Viva Voce

The time allotted for the Presentation is only 10 minutes (maximum) which would be followed by 5 mins questions answer by the panel. The presentation should explain (a) Background/ Introduction; (b) Roles and responsibilities; (c) Objective(s); (d) Challenges (e) Learnings and discussion; (f) Conclusion.

10. Honor Code

If a student is found to be misrepresenting any fact with respect to internship project in any organization as well as at TERI SAS, this will be brought to the notice of Dean (Academic) by the Internship Project Committee. The Dean (Academic) will decide on further action to be taken. The matter would be dealt as per the honor code of TERI SAS.

Note: You must send emails regarding any concern to Dr. Anand Jaiswal (Summer Internship Project Coordinator) or Raj (Department Assistant)

IT related issues

In case of any IT related problem during minor project, student should send a mail to ITHELP ithelp@terisas.ac.in with the screenshot of the error. If the problem is not resolved within 2 working days, it should be forwarded to Dr. Anand Jaiswal. Students can expect a response within 3 working days.

Annexure 1:

Program Name	Minimum Duration of Minor Projects	Credits
BBA	6 weeks	04

DECLARATION

This is to certify that the work that forms the basis of this project "TITLE" is an original work carried out by me and has not been submitted anywhere else for the award of any degree.

I certify that all sources of information and data are fully acknowledged in the project thesis.

Your Name / Signature

Date:

CERTIFICATE

This is to certify that Name of Candidate has carried out his/her minor project in partial fulfillment of the requirement for the Degree of Bachelor of Business Administration in Sustainability Management on the topic "TITLE" during June 2025 to August 2025. The project was carried out at (the organisation you are working with).

Date:

Name   Name
(External Supervisor)   (Internal Supervisor)
Designation   Designation
Organisation   Department of Policy & Management Studies
                                                         TERI School of Advanced Studies

Dr Gopal Sarangi
Head of the Department
Department of Policy & Management Studies
TERI School of Advanced Studies

TERI School of Advanced Studies
Department of Policy & Management Studies

B.B.A. (Sustainability Management)

Joining Report -2025

Name:

Roll No.:

Company:

Department:

Date of Joining:

External Supervisor (with contact details):

Internal Supervisor:

About the Company:

Proposed Work:

Progress Report[1]

Summer Internship Work, TERI School of Advanced Studies, New Delhi

1	**Name of the student**	
2	**Title of the project**	
3	**Period of progress report**	
4	**Progress during the current reporting period** [X]	
	4a. Approved objectives	**4b. Progress made towards the objectives enlisted in (4a)**
5	**What have been the constraints during the current reporting period? What have you done to address this?**	
6	**Activities against approved objectives proposed for the next reporting period:**	
	Date:	**Comments of the Internal Supervisor (TERI SAS):**
	Date:	**Comments of the External Supervisor:**

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[1]Please ensure that file name is Nameofcandidate_stream_ProgressReport_X
X represents the number of the progress report

TITLE

Summer Internship Project

Submitted by

NAME OF CANDIDATE

For the partial fulfillment of the

Degree of Bachelors of Business Administration

Submitted to
Department of Policy & Management Studies
TERI School of Advanced Studies

August 2025

Feedback sheet from the external supervisor

1	Name of the student	
2	Title of the project	
3	Period of progress report	
4	Punctuality during the internship	
5	Overall learnability and acceptability	
6	Openness in accepting task other than his project work	
7	Behavior with other members of	
8	Behavior in vicinity of office space	