Your Dreams Our Goal

POORNIMA UNIVERSITY

Member of Association of Indian Universities & Approved by UGC (Govt. of India) under 2(f) & 12(B)

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF CIVIL ENGINEERING

M.TECH IN ENERGY AND ENVIRONMENT

SCHEME & SYLLABUS BOOKLET

BATCH 2023-2025

SCHEME & SYLLABUS

BATCH: 2023-25

INDEX

Disclaimer: The scheme, syllabus and other materials published in this booklet may be changed or modified as per the requirement after approval of competent authority. The decision taken by the management of Poornima University will be final and abiding to all.

Student Details

Name of Student:

Name of Program:

Semester:

Your Dreams Our Goal

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VISION

To create knowledge based society with scientific temper, team spirit and dignity of labor to face global competitive challenges.

Mission

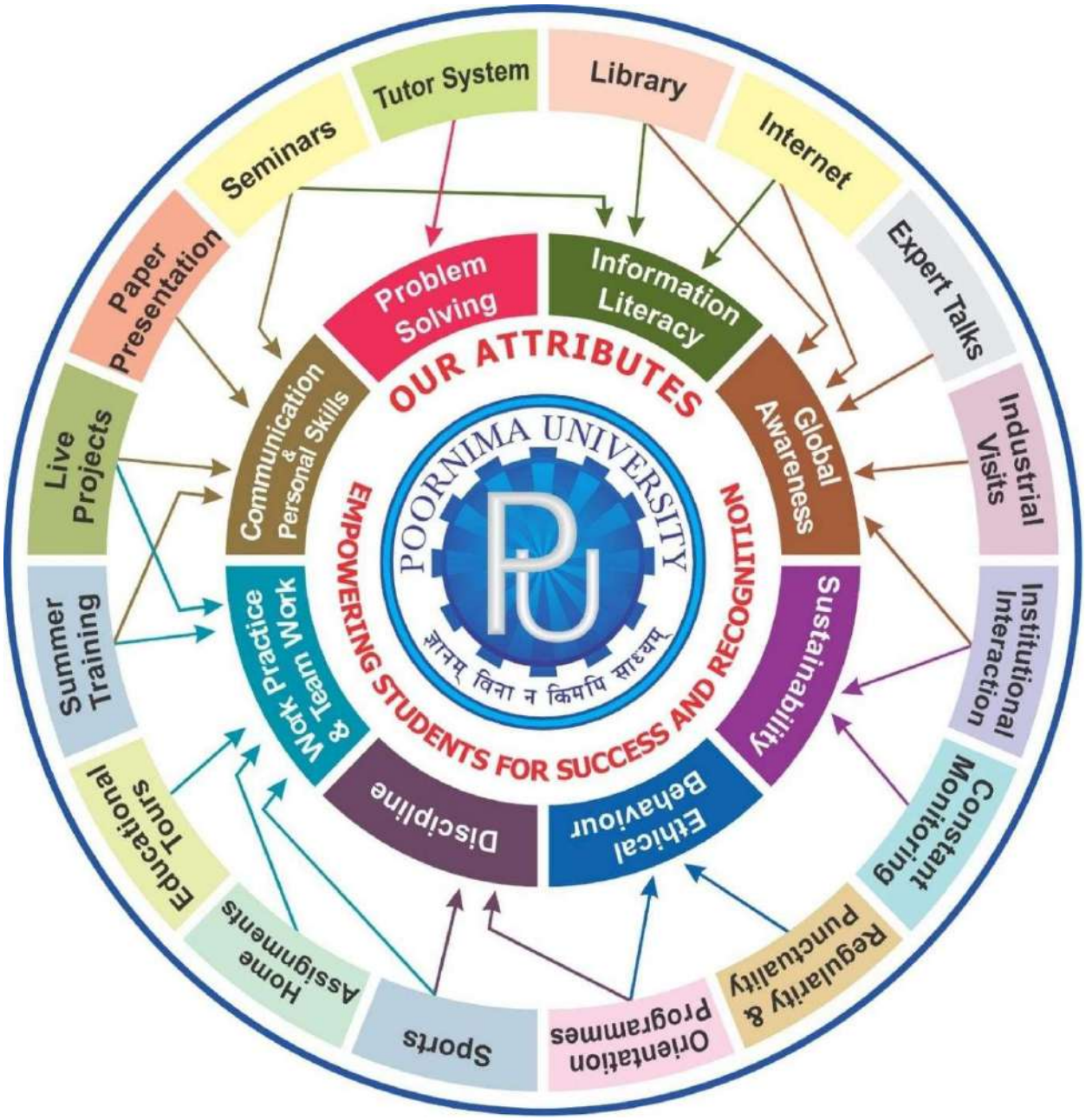
To evolve and develop skill based systems for effective delivery of knowledge so as to equip young professionals with dedication and commitment to excellence in all spheres of life.

Quality Policy

To provide Quality Education through Faculty development, updating of facilities and continual improvement meeting University norms and keeping stake holders satisfied

Knowledge Wheel

At Poornima, the academic atmosphere is a rare blend of modern technical aswell as soft skills and traditional systems of learning processes.



About Program and Program Outcomes (PO):

Title of the Programme: Bachelor of Technology (B. Tech.)

Nature of the Programme: B. Tech. is four year full-time programme.

Program Outcomes (PO) :

Engineering Graduates will be able to:

A. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

B. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

C. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

D. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

E. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

F. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

G. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

H. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

I. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

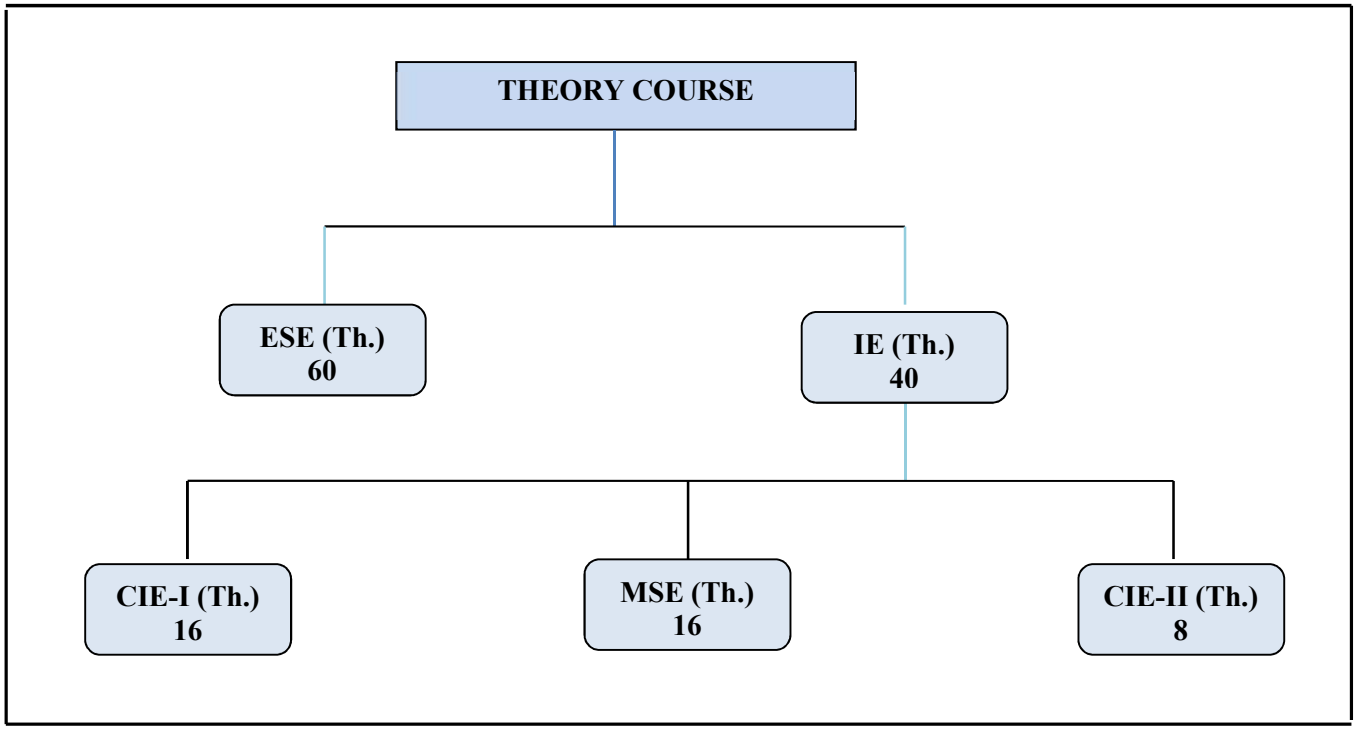
J. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

K. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

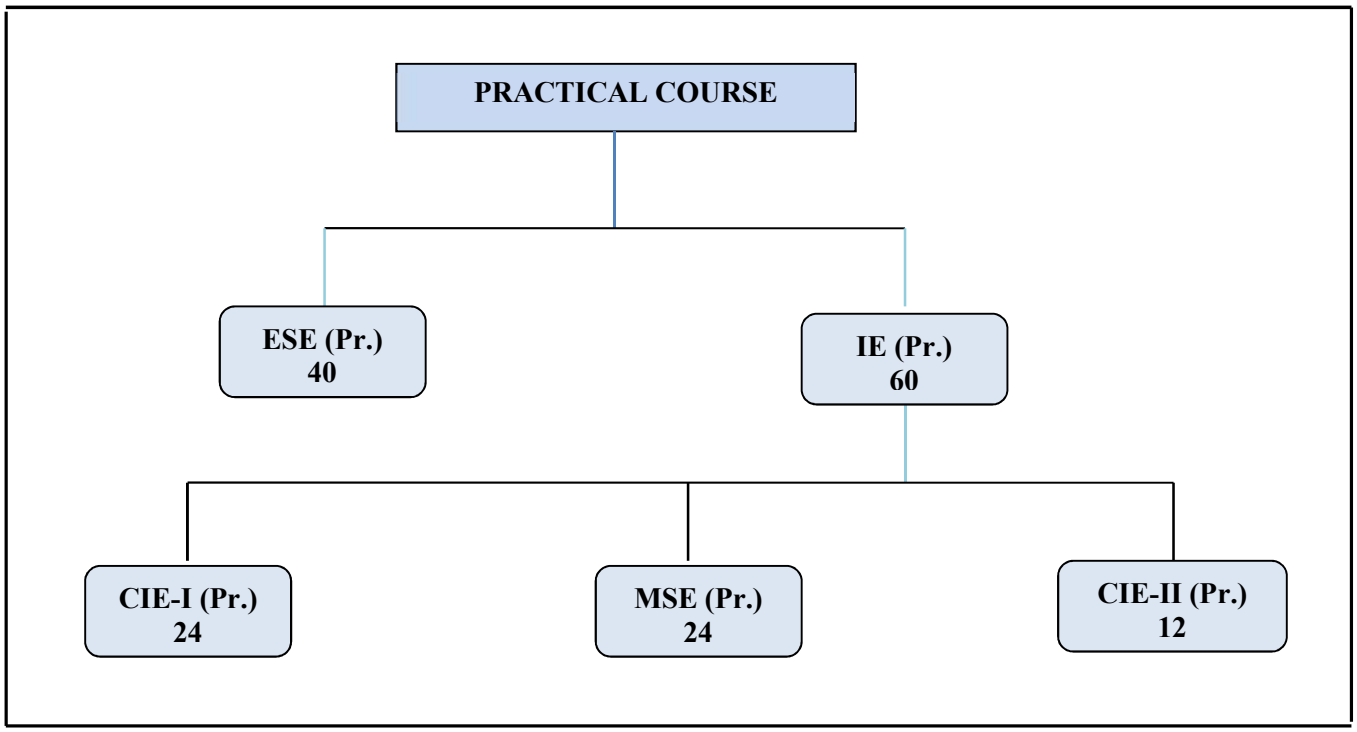
L. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Examination System :

A. Marks Distribution of Theory Course:



B. Marks Distribution of Practical Course :



Th.: Theory, Pr.: Practical, **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **CIE:** Continuous Internal Evaluation.

CO Wise Marks Distribution:

Exam Entity	Theory Subject		Practical/ Studio Subject	
	Maximum Marks	CO to be Covered	CO to be Covered	Maximum Marks
CIE-I	16 (8 + 8)	1 & 2	1 & 2	24 (12 + 12)
MSE	16 (8 + 8)	3 & 4	3 & 4	24 (12 + 12)
CIE-II (Activity/ Assignment)	8 (8)	5	5	12 (12)
ESE	60	-	-	40
TOTAL	100	-	-	100

Minimum Passing Percentage in All Exams:

S No.	Program Name	Minimum Passing Percentage in		
		IE Component	ESE Component	Total Component
1	Course Work for PhD Registration	-	-	50%
2	B. Arch.	-	45%	50%
3	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH	-	40%	40%
4	MBA, MCA, M.Des., M.Tech., M.Plan, MHA, MPH	-	35%	35%

SGPA Calculation

$$SGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$SGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course in the semester

CGPA Calculation

$$CGPA = \frac{C_1G_1 + C_2G_2 + \ldots\ldots\ldots + C_nG_n}{C_1 + C_2 + \ldots\ldots + C_n}$$

$$CGPA = \frac{\sum_i C_i \times G_i}{\sum_i C_i}$$

where (as per teaching scheme & syllabus):

C_i is the number of credits of subject i,

G_i is the Grade Point for the subject I and i = 1 to n,

n = number of subjects in a course of all the semesters up to which CGPA is computed

Grading Table:

Applicable for B.Arch. & Ph.D. Courses

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Fail	F	0	x <50
Absent	Ab	0	Absent

Applicable for All Courses except B.Arch. & Ph.D.

Academic Performance	Grade	Grade Point	Marks Range (in %)
Outstanding	O	10	90≤ x ≤100
Excellent	A+	9	80≤ x <90
Very Good	A	8	70≤ x <80
Good	B+	7	60≤ x <70
Above Average	B	6	50≤ x <60
Average	C	5	40≤ x <50
Pass	P	4	35≤ x <40
Fail	F	0	x <35
Absent	Ab	0	Absent

CGPA to percentage conversion rule:

Equivalent % of Marks in the Program = *CGPA* *10

Award of Class

CGPA	Percentage	Equivalent Division
7.50 ≤ CGPA	75% or more	First Division with Distinction
6.00 ≤ CGPA < 7.50	60% ≤ x <75%	First Division
5.00 ≤ CGPA < 6.00	50% ≤ x <60%	Second Division
4.00 ≤ CGPA < 5.00	40% ≤ x < 50%	Pass Class

Guidelines for Massive Open Online Courses (MOOCs)

(Session 2023-24)

Poornima University, in its never ending endeavor to equip students with best-of-class learning and knowledge, has undertaken to include MOOC courses as part of its credit scheme from session 2023-24 onwards. The objective behind this is to enable students to study courses designed by the best teachers in the country and to scale their knowledge base with the rest of learners from the nation. The MOOCs which are included under this scheme is can be chosen from SWAYAM and NPTEL.

1. Introduction of MOOCs: SWAYAM and NPTEL

About SWAYAM:

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through a platform that facilitates hosting of all the courses, taught in classrooms to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to any learner. However learners wanting a SWAYAM certificate should register for the final proctored exams that come at a fee and attend in-person at designated centers on specified dates. Eligibility for the certificate will be announced on the course page and learners will get certificates only if this criteria is matched.

The courses hosted on SWAYAM are in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology.

In order to ensure that best quality content is produced and delivered, nine National Coordinators have been appointed. They are:

1. AICTE (All India Council for Technical Education) for self-paced and international courses
2. NPTEL (National Programme on Technology Enhanced Learning) for Engineering
3. UGC (University Grants Commission) for non-technical post-graduation education
4. CEC (Consortium for Educational Communication) for under-graduate education
5. NCERT (National Council of Educational Research and Training) for school education
6. NIOS (National Institute of Open Schooling) for school education
7. IGNOU (Indira Gandhi National Open University) for out-of-school students
8. IIMB (Indian Institute of Management, Bangalore) for management studies
9. NITTTR (National Institute of Technical Teachers Training and Research) for Teacher Training programme

Two types of courses are offered on SWAYAM platform: Credit Courses and Non- Credit Courses. Credit courses are offered for each semester in January and July every year. The list is available on SWAYAM official website: https://onlinecourses.swayam2.ac.in/

About NPTEL:

NPTEL (National Programme on Technology Enhanced Learning), is a joint venture of the IITs and IISc, funded by the Ministry of Education (MoE) Government of India, and was launched in 2003. Initially started as a project to take quality education to all corners of the country, NPTEL now offers close to 600+ courses for certification every semester in about 22 disciplines.

Some highlights:

- Largest online repository in the world of courses in engineering, basic sciences and selected humanities and management subjects
- YouTube channel for NPTEL – most subscribed educational channel, 1.3 billion views and 40+ lakhs subscribers

- More than 56000 hours of video content, transcribed and subtitled
- Most accessed library of peer-reviewed educational content in the world
- Translation of more than 12000 hrs of English transcripts in regional Indian languages

NPTEL Online Certification:

The objective of enabling students obtain certificates for courses is to make students employable in the industry or pursue a suitable higher education programme. Through an online portal, 4, 8, or 12-week online courses, typically on topics relevant to students in all years of higher education along with basic core courses in sciences and humanities with exposure to relevant tools and technologies, are being offered. Enrolment to and learning from these courses is free. Following these online courses, an in-person, proctored certification exam is conducted and a certificate is provided through the participating institutions and industry, as applicable.
Some statistics regarding the open online courses since March 2014 till Dec 2021
Completed courses: 3496;
Enrollments across courses: 1.58 CRORE +
Number of exam registrations: 15.1 LAKH +
All the statistics pertaining to completed courses are available at https://beta.nptel.ac.in/courses. All courses are completely free to enroll and learn from. The certification exam is optional and comes at a fee of Rs 1000/course exam.

2. MOOCs at Poornima University:

MOOCs envelops best in class teaching - learning processes along with meeting the requirements of various courses in terms of quality of teaching and evaluation system. To promote the MOOCs among students of Poornima University, it is decided to consider the credits earned through MOOCs.

(a) Options for MOOCs at Poornima University

(For this document, only those MOOCs will be considered which are available on SWAYAM & NPTEL platforms)

- Credit and Non-credit SWAYAM MOOCs can be opted by anyone, anytime, anywhere and in any language. However, prior-permission of the University Authorities is mandatory if the credits are to be transferred to regular degree.
- In case of credit courses, there are two ways to opt these courses for the purpose of credit transfer to PU system as given below:

OPTION–I: As Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards):

Open Elective (for batches entered till 2022) / Multidisciplinary Courses (for batches admitted from 2023-24 onwards) are available at University level in offline mode for which relevant booklets are already published. **These courses carries 02 credits.** These category/type of courses (similar/different) are also available as MOOC courses. The respective Deans / HODs shall provide both the options to all the students to either select offline courses or MOOCs as per details given below:

- Deans / HODs shall prepare a list of upto 05 appropriate MOOC courses of 02/03 credits each, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students so that they can select any one course from the list, the credits **(only 02)** of which will be counted against Open Elective/ Multidisciplinary courses pertaining to that particular semester.
- If the students are not willing to opt for MOOC Open Elective/ Multidisciplinary course, they can proceed with the current offline practice of opting for Multidisciplinary courses.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.

OR

OPTION–II: As Major / Minor Courses:

- Deans / HODs shall identify a course of **03 credits** for each semester, well in advance (at-least 15 days prior to commencement of semester) and take approval from the Office of Dean, Academics / Pro-President, PU.
- After approval, the respective Deans / HODs shall circulate a notice to all their respective students citing that the particular course will be conducted through MOOCs only and is compulsory for all respective students. The credits of this course will be counted against Major/Minor courses pertaining to that particular semester.
- The tutor of the class shall monitor the progress (assignments, feedback, any problem etc.) on weekly basis and report to Head/Dean.
- This is to be noted that if Deans / HODs decide to conduct any major/minor course in any semester through MOOCs, no offline course will be conducted against that.

(b) Important points related to MOOCs at Poornima University

- Only one MOOC shall be allowed in a particular semester for the purpose of credit transfer in the beginning.
- No attendance will be taken for MOOC courses.
- Last period of T/T/S shall be taken for MOOC courses which shall be in self-study mode.
- The method of assessments of MOOC such as assignments and examination are completely associated with that particular MOOC and no exam will be conducted by the department as well as by the Examination Cell.
- The respective Dean / HOD must submit the detail of course i.e., code, name and credit of MOOC opted against that particular course in particular semester attached with highlighting in the related examination scheme of syllabus of that semester signed by BOS Convener / HoD and Dean of Faculty to the office of Pro-President before commencement of the classes.
- SWAYAM will award a certificate to all the students passing the examination along with the credit earned. The center of examination for SWAYAM MOOCs will be finalized by SWAYAM. All the responsibility related to registration for MOOCs, timely submission of assignments, examinations etc. will be borne by the students only.
- The list of registered students in MOOC along with name of course will be submitted to the Examination Cell by the Deans / HoDs before commencement of the classes.
- Any student who would not be able to register/present/clear/pass the MOOC in the stipulated time, it is the choice of the student that he or she may register in next semester (odd or even) with MOOC again or appear as a back exam candidate of the University as per PU norms.
- There will be no provision of re-evaluation of MOOC.
- The scorecard and related certificate of MOOC along with a consolidated list of students with marks of assignment and final exam will be submitted to the examination cell by the concerned Dean / HOD for further process. It is also recommended that alteration/changes/scaling in marks obtained by the students in any MOOC will not be considered.
- The exam registration fee of MOOC up to Max. INR 1000/- will be reimbursed to the student only after successful completion of the course in first attempt and submission of the fee receipt, score-card and certificate of the MOOC to the concerned department within stipulated time after declaration of the results.

NOTE: This is to be noted that the procedure for getting approval from BOS, Faculty Board, Academic Council and BoM is to be followed as per regular process.

Attached Items:

Open Elective Booklet	Annexure-1
Soft Skills Booklet	Annexure-2
Value Added Course Booklet	Annexure-3

Required credits for Honors:

S.No	Program Duration	Required credits for Honors
1.	2- Year	10- Credits
2.	3- Year	15- Credits
3.	4-Year	20- Credits

S. No	NPTEL/ SWAYAM Course duration (in weeks)	Equivalent Credits
1	4	2
2	8	3
3	12	4

Attached Items:

Open Elective Booklet	Annexure-1
Soft Skills Booklet	Annexure-2
Value Added Course Booklet	Annexure-3

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment** **Duration: 2 Years** **Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-I								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV1101	Energy and Environmental Policies	3	1	-	-	40	60	100	4
MEECCV1102	Wind and Hydro Energy Systems	3	1	-	-	40	60	100	4
A.2	**Practical**								
MEECCV1201	Energy & Environment Lab-I	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MEEECV1101	Energy, Environment and Climate Change	3	1	-	-	40	60	100	4
MEEECV1102	Hydrology and Hygrometry			-	-	40	60	100	
MEEECV1103	Solar Energy Technologies			-	-	40	60	100	
MEEECV1104	Environmental Remote Sensing	3	1	-	-	40	60	100	4
MEEECV1105	Wind Energy Technology			-	-	40	60	100	
MEEECV1106	Energy in Built Environment			-	-	40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
		-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
MULCHM1201	Soft Skills - I	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE1201	Skill Enhancement Technical Course	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV1401	Seminar-I	-	-	4		60	40	100	2
Total		12	4	10					**21**
Total Teaching Hours		**26**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment Duration: 2 Year Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-II								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV2101	Physicochemical, Biological Principles and Processes	3	1	-		40	60	100	4
MEECCV2102	Environmental Quality Monitoring	3	1	-		40	60	100	4
A.2	**Practical**								
MEECCV2201	Energy & Environment Lab-II	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MEEECV2101	Biomass Energy Systems	3	1	-	-	40	60	100	4
MEEECV2102	Remote Sensing and GIS Applications			-	-	40	60	100	
MEEECV2103	Management and Modeling of Environmental Systems			-	-	40	60	100	
MEEECV2104	New and Renewable Energy Sources and Technologies	3	0	-	-	40	60	100	3
MEEECV2105	Groundwater Contamination and Remediation			-	-	40	60	100	
MEEECV2106	Environmental Impact Assessment			-	-	40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
MULEBX2109	Engineering Economics	3	-	-	-	60	40	100	3
D		**Ability Enhancement Courses (AEC)**							
MULCHM2201	Soft Skills - II	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE2201	Skill Enhancement Technical Course-II	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV2401	Seminar-II	-	-	2		60	40	100	1
Total		15	3	8					**22**
Total Teaching Hours		**26**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment** **Duration: 2 Years** **Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-III								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV3101	Advanced Statistical Methods	3	1	-		40	60	100	4
MEECCV3102	Research Methodology	3	1	-		40	60	100	4
A.2	**Practical**								
MEECCV3201	Energy & Environment Lab-III	-	-	2		60	40	100	1
MEECCV3401	Review/Research Paper	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives/*Open Elective***							
B.1	**Theory**								
MULEEE3107	E-Commerce and Knowledge Management	3	1	-		40	60	100	3
MULECV3108	Water and Environmental Pollution			-		40	60	100	
MULEME3109	IPR & Patents			-		40	60	100	
MULEEE3110	Robotics			-		40	60	100	
MULEEE3111	Digital India Implementation			-		40	60	100	
MULECV3112	Smart City Design			-		40	60	100	
MULEEE3113	Renewable Energy			-		40	60	100	
B.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
MSTEMC3121	MOOC Course - I	3	-	-	-	-	-	-	3
D		**Ability Enhancement Courses (AEC)**							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
G		**Summer Internship / Research Project / Dissertation**							
MEECCV3402	Dissertation Part - I	-	-	12		60	40	100	6
Total		12	3	16					**22**
Total Teaching Hours		**31**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment Duration: 2 Years Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-IV								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
A.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
B.		**Minor Stream Courses/ Department Electives/*Core Elective***							
B.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
B.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
-	-	-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
-	-	-							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV4401	Dissertation Part - II	-	-	30		250	250	500	15
Total		0	0	30					**15**
Total Teaching Hours		**30**							

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment** **Duration: 2 Years** **Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-I								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV1101	Energy and Environmental Policies	3	1	-	-	40	60	100	4
MEECCV1102	Wind and Hydro Energy Systems	3	1	-	-	40	60	100	4
A.2	**Practical**								
MEECCV1201	Energy & Environment Lab-I	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MEEECV1101	Energy, Environment and Climate Change	3	1	-	-	40	60	100	4
MEEECV1102	Hydrology and Hygrometry			-	-	40	60	100	
MEEECV1103	Solar Energy Technologies			-	-	40	60	100	
MEEECV1104	Environmental Remote Sensing	3	1	-	-	40	60	100	4
MEEECV1105	Wind Energy Technology			-	-	40	60	100	
MEEECV1106	Energy in Built Environment			-	-	40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
		-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
MULCHM1201	Soft Skills - I	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE1201	Skill Enhancement Technical Course	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV1401	Seminar-I	-	-	4		60	40	100	2
Total		12	4	10					**21**
Total Teaching Hours		**26**							

PO's and PSO's are as follows

PO No.	PO's
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and designsystem components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. Considerations.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions insocietal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports anddesign documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO No.	**PSO's**
1	A civil engineering graduate is efficient in fundamentals of civil engineering, mathematical & scientific reasoning and are able to plan, design the building structure, roads, sewage and water supply networks & other component of infrastructure system considering environmental, safety & health aspects.
2	A civil engineer is able to use modern tools, techniques, software's to solve complex engineering problems
3	A civil Engineer able to prepare BOQ & cost estimation & able to execute the projects in lined with set project goals.
4	A civil engineer is able to compile detailed project report & give technical specifications to provide required quality of work.
5	A civil engineer is able to access the quality of material used for construction & able to find out deviations & able to suggest preventative and corrective measures for sustainable development.

Major (Core Courses)

Code: **MEECCV1101**	**Energy and Environmental Policies**	**4 Credits [LTP: 3-1-0]**

COURSE OVERVIEW AND OBJECTIVES: This is a middle level course in energy and environment which will focus on use of various area. The course has been designed in a way that the energy required by various area in future courses like environment, fluid mechanics, geotechnical engineering etc. In this course specific applications/case studies related to energy and environment shall be focused.

COURSE OUTCOMES:

After completion of this course, student will be able to:

CO No.	Description
CO1101.1	To understand the energy carriers, energy technologies, energy challenges
CO1101.2	To able to know the geopolitics national and international energy and and environment policy.
CO1101.3	To understand the relationships between energy, risk, societal safety, sustainable development and energy economics.
CO1101.4	Apply the fundamental concepts of funding agencies for various project.
CO1101.5	Analyze of various policy tool in respective area.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Energy codes and policies	**9**
2.	International scenario	**9**
3.	Financial tools	**10**
4.	Funding agencies	**10**
5.	Policy Tools	**10**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Energy codes and policies**
	Introduction to Energy codes and policies: Energy Conservation act, Electricity Act, Solar policy, Hydro policy, Biomass policy.
2.	**International scenario**
	International scenario: world energy outlook, international protocols for energy and Environment ,governing and nodal national/international agencies and their role.
3.	**Financial tools**
	Financial tools: incentives and subsidies, calculation of required subsidy for penetration, concept of shadow price Concept of micro-financing for RE.
4.	**Funding agencies**
	For RE projects in India, application development for RE funding Tariff policies,.
5.	**Policy Tools**
	Use of Demand Side Management as a policy tool.

C. RECOMMENDED STUDY MATERIAL:

Sr. No	Reference Book	Author	Edition	Publications
1.	Energy Economics, Concepts, Issues,	SC Bhattacharyya	Latest	Springer Science & Business Media

	Markets and Governance			
2.	Understanding Energy and Energy Policy	TF Braun & MG Lisa	Latest	Zed Books
3.	Financial evaluation of renewable energy technologies	Kandpal, Tara Chandra, and Hari Prakash Garg	Latest	Mac Millam India Limited
Websites				
https://nptel.ac.in/courses/122107036/ https://nptel.ac.in/courses/122104017/ https://nptel.ac.in/courses/111107127/ https://nptel.ac.in/courses/111107119/ https://nptel.ac.in/courses/111105035/ https://nptel.ac.in/courses/111105134/ https://nptel.ac.in/courses/111105121/				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1101.1	1	1	-	3	-	1	-	-	-	-	1	-
CO1101.2	1	3	-	2	1	-	-	-	-	-	-	-
CO1101.3	1	-	-	3	1	-	-	-	-	-	1	-
CO1101.4	1	1	3	-	-	-	1	-	-	-	1	-
CO1101.5	1	1	3	-	1	1	-	-	-	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1101.1	1	2	3	1	-
CO1101.2	-	2	2	-	3
CO1101.3	1	1	-	3	2
CO1101.4	1	3	-	2	-
CO1101.5	1	3	-	2	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MEECCV1102	Wind and Hydro Energy Systems	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

This subject deals with various types of wind energy and their applications, working principles of windenergy, Components of a wind energy converter, Working principles of Hydropower, Hydraulic turbines

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1102.1	To understand basic of wind and hydro energy systems and resource assessment techniques
CO1102.2	To create understanding and design aspects of wind/hydro plant, components, operation and control
CO1102.3	To create understanding on wind/hydro power generation, grid integration and environmental impacts
CO1102.4	Apply various working principles of Hydropower.
CO1102.5	Evaluate of hydraulic turbines.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Wind Energy Basics	**7**
2.	Working principles of wind energy	**11**
3.	Components of a wind energy converter	**11**
4.	Working principles of Hydropower	**10**
5.	Hydraulic turbines	**9**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	Wind Energy Basics
	Wind Energy Basics: Status, Advantages and disadvantages of wind energy systems, Advantages and disadvantages, Types of wind energy converters, local Effects on wind, site selection: roughness length, wind shear, Wind Speed Variability, Obstacles to wind flow
2.	Working principles of wind energy
	Working principles of wind energy: Energy content in wind, Energy Conversion at the Blade, Wind variations: Weibull distribution
3.	Components of a wind energy converter
	Rotor Blades, Gearboxes, Synchronous or Asynchronous Generators, Towers, Miscellaneous components, Turbine Selection Operation and Control of Wind Energy Converters: grid requirements, Issue of Noise and Its Control, Power Curve and Capacity Factor, Pitch control, Stall Control, Yaw Control Hydropower basics: Water Cycle in Nature, Classification of Hydropower Plants, Status of Hydropower Worldwide, Advantages and Disadvantages of Hydropower, Operational Terminology, Legal Requirements.
4.	Working principles of Hydropower
	Working principles: Locating a Hydropower Plant, Basics of Fluid Mechanics for hydropower, single and multiple reservoir system, cascaded power plants Important Parts of Hydropower Station: Turbine, Electric Generator, Transformer and Power House, Structural parts: Dam and Spillway, Surge Chambers, Stilling

	Basins, Penstock and Spiral Casing, Tailrace, Pressure Pipes, Caverns, auxiliary parts
5.	Hydraulic turbines:
	Hydraulic turbines: Classification of Hydraulic Turbines, Theory of Hydro Turbines: Francis, Kaplan, Pelton turbines, efficiency and selection of turbine

C. RECOMMENDED STUDY MATERIAL:

S . No	Reference Book	Author	Edition	Publisher
1.	Wind Energy Conversion Systems	Freris L.L	Latest	Prentice Hall
2.	Wind Turbine Technology: Fundamental Concepts of Wind Turbine Engineering, ,	Spera D.A	Latest	Prentice Hall,;
3.	“Hand book of Hydroelectric Engineering”, Nem Chand and Brothers8 Clemen, D.M., “Hydro Plant Electrical Systems”,	Brown, G.	Latest	HCI Publication
4.	Wind Energy for the Rest of Us: A Comprehensive Guide to Wind Power and Howto Use it,	Paul Gipe,	Latest	Chelsea Green Publishing Co
5.	Hydro-electric Engineering Practice”, Vol. I, II & III,	Brown, G	Latest	CBS Publication

Websites

https://nptel.ac.in/courses/112104118/
https://nptel.ac.in/courses/112105171/
https://nptel.ac.in/courses/103104043/
https://swayam.gov.in/nd1_noc19_ce28/preview
https://nptel.ac.in/courses/105103192/
https://nptel.ac.in/courses/105101082/
https://nptel.ac.in/courses/105103095/
https://nptel.ac.in/courses/112105269/
https://nptel.ac.in/courses/112105183/

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1102.1	1	1	1	-	-	2	1	-	-	-	-	1
CO1102.2	1	1	2	1	1	-	1	-	-	-	-	-
CO1102.3	1	1	3	1	1	-	-	-	1	-	-	-
CO1102.4	1	1	3	-	-	-	1	-	1	1	1	-
CO1102.5	1	1	3	-	1	1	-	-	-	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1102.1	2	3	-	-	1
CO1102.2	1	3	-	2	1
CO1102.3	3	1	1	1	-
CO1102.4	3	2	2	-	-
CO1102.5	3	2	-	-	2

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MEECCV1201	Energy & Environment Lab-I	1 Credits [LTP: 0-0-2]

COURSE OVERVIEWAND OBJECTIVES:

This subject deals with the various types of Solar water heating, solar cooking and Solar concentrator, PV module characterization and Inverter performance analysis. This subject will make the students capable to understand the concept of Solar water heating and how they affect the environment.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1201.1	Evaluate of Solar water heating
CO1201.2	Analyze the solar cooking and Solar concentrator
CO1201.3	Analyze of PV module characterization and Inverter performance analysis
CO1201.4	Analyze of Wind energy convertor and Biomass for energy
CO1201.5	Analyze the Solar passive concepts and thermal comfort.

A. DETAILED SYLLABUS

Unit	Unit Details
1.	**Name of Experiments**
	1. Solar water heating 2. Solar cooking 3. Solar concentrator 4. PV module characterization 5. Inverter performance analysis 6. Wind energy convertor 7. Biomass for energy 8. Solar passive concepts and thermal comfort .

B. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1201.1	3	2		1	-	-	-	-	-	-	-	-
CO1201.2	2	2	1	2	-	-	-	-	-	-	-	-
CO1201.3	2	3	-	1	-	-	-	-	-	-	-	-
CO1201.4	2	-	3	-	1	-	-	-	-	-	-	-
CO1201.5	2	2	2	1	-	-	-	-	-	-	-	-

C. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1201.1	3	-	2	-	1
CO1201.2	2	3	-	1	-
CO1201.3	1	2	3	1	-
CO1201.4	-	2	2	-	3
CO1201.5	1	1	-	3	2

Note: On the basis of mapping of COs with POs, this course is related to Employability

Department Elective-I

Code: MEEECV1101	Energy, Environment and Climate Change	4 Credit [LTP: 3-1-0]

COURSE OBJECTIVE: The Earth's Energy Budget, Environment and the processes leading to climate change. 2. The inter-relatedness of the Terrestrial Energy-Environment-Climate System. 3. The perturbing effects of anthropogenic activities on this system. 4. A meaningful climate change quantification and hencethe means of ameliorating adverse climate change impacts

COURSE OUTCOMES:
After completion of the course, students will be able to:

CO	Description
CO1101.1	Understand the terrestrial eco-system comprising of 3 principal components: Energy, Environment and Climate Change
CO1101.2	Comprehend a global picture of the inter-relatedness of the Energy-Environment-Climate system.
CO1101.3	Assess as qualified professionals, the perturbing effects of human activities on the earth's climate
CO1101.4	Predict emerging climate change trends globally as well as within the Indian Subcontinent
CO1101.5	Understand environmental impacts on a local, regional and global scale.

A. **OUTLINE OF THE COURSE**

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction	**7**
2	Global Atmospheric Issues	**11**
3	Energy Balance	**11**
4	Atmospheric Chemistry and Climate	**10**
5	Environmental Variability	**9**

B. **DETAILED SYLLABUS**

Unit	Details of Unit
1.	Introduction
	Overview on the Earth's energy requirement vis-à-vis Climate Change. Origins of the terrestrial atmosphere. Earth's early atmosphere. Introduction to Climate. Layers of the atmosphere,
2.	Global Atmospheric Issues
	Composition of the present day atmosphere. Introduction to Atmospheric chemistry, Green House Gases, and the O3 depletion problem. Post Industrial Revolution Scenario
3.	Energy Balance
	Earth –Atmosphere System. Solar and Terrestrial Radiation. Absorption of Radiation by gases. Energy balance. Solar variability and the Earth's Energy Balance
4.	Atmospheric Chemistry and Climate
	The Global Temperature Record. Possible effects of Global Warming. – Indian Context. Atmospheric Chemistry and Climate Change. Atmospheric Aerosol and Cloud Effects on Climate.
5.	Environmental Variability

	Natural (volcanoes, forest fires) and Anthropogenic (Antarctic Ozone Hole, Global Warming). Green House Gas theory. Effects of urbanization, Landscape changes, Influence of Irrigation, Desertification and Deforestation

VIRTUAL LABS:

- https://www.youtube.com/watch?v=-7hrElZrul4
- https://www.youtube.com/watch?v=cmR9cfWJRUU

COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1101.1	1	-	2	-	2	-	-	-	-	-	-	2
CO1101.2	2	-	2	-	2	-	-	-	-	-	-	2
CO1101.3	2	-	2	-	2	-	-	-	-	-	-	2
CO1101.4	1	-	2	-	2	-	-	-	-	-	-	2
CO1101.5	1	-	-	-	-	1	-	-	-	-	-	-

COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1101.1	2	-	1	-	-
CO1101.2	2	2	-	3	-
CO1101.3	1	3	-	2	1
CO1101.4	3	1	1	1	-
CO1101.5	3	2	2	-	-

Note: On the basis of mapping of COs with POs, this course is related to Entrepreneur

Code: MEEECV1102	Hydrology and Hygrometry	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

To provide knowledge to students to accessible, aesthetics, cost effective, functional/operational, historic preservation, productive, secure/safe and sustainable and their inter relationships must be understood, evaluated and appropriately applied.

COURSE OUTCOMES:

After completion of the course, student will be able to:

CO	Description
CO1102.1	Compute the various hydrological phenomenon.
CO1102.2	Analyze of various type of hydrograph and black-box type & physical based models.
CO1102.3	Examine the various statistical method
CO1102.4	Computation of various types of flow generation from the catchment.
CO1102.5	Demonstrate the flood and draught method.

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	Introduction	8
2	Hydrograph	6
3	Statistical Methods	8
4	Flow Generation	6
5	Floods and Droughts	8

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Introduction**
	Introduction: Historical background, Hydrological cycle, forms of precipitation, its Arial and time variation, missing records, hydrological abstraction, runoff
2	**Hydrograph**
	Hydrograph analysis, unit hydrograph, IUH, Nash and Clarke models. Rainfall runoff models, black-box type and physical based models.
3	**Statistical Methods**
	Statistical Methods: Correlation coefficient, curve fitting, regression analysis, multiple regression. Various distribution and their use in hydrology, plotting positions, frequency factors, extreme value theory. Generation of random numbers and synthetic data when persistence is absent
4	**Flow Generation**
	Introduction: Flow Generation: Stochastic processes, their classification, time series and its components, correlogram, autoregressive processes. Synthetic generation of yearly and monthly flows in hydrology.
5	**Floods and Droughts**
	Floods and Droughts: Flood estimation by various methods, design for various hydraulic structures, flood forecasting, droughts. grid and ribbed floors.

A. RECOMMENDED STUDY MATERIAL

S. No	Book	Author	Edition	Publication
1	Engineering hydrology	K. Subramaniam	Latest	Laxmi Publication
Websites				
https://www.bdcnetwork.com/building-types https://en.wikipedia.org/wiki/Building_design https://nptel.ac.in/courses/105106177/				

B. COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1102.1	3	2	-	1	-	-	-	-	-	-	-	1
CO1102.2	3	1	-	1	-	-	-	-	-	-	-	1
CO1102.3	3	2	-	1	-	-	-	-	-	-	-	1
CO1102.4	3	1	2	1	-	-	-	-	-	-	-	1
CO1102.5	3	-	-	1	1	-	-	-	-	-	-	1

C. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1102.1	3	-	-	2	-
CO1102.2	3	-	-	2	-
CO1102.3	3	-	-	2	-
CO1102.4	3	-	-	2	1
CO1102.5	3	1	-	-	1

Note: On the basis of mapping of COs with POs, this course is related to Employability / SkillDevelopment

Code: MEEECV1103	Solar Energy Technologies	Credits 4 [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

1. To understand the fundamentals of solar energy conversion technologies.
2. To obtain knowledge on the energy utilization techniques employed for various solar thermal energy devices
3. To know the limitations involved on the conversion efficiency of different solar energy devices
4. To apply knowledge on how to assess the performance of solar thermal and solar photovoltaic systemsusing fundamentals of heat transfer and optical properties.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1103.1	Estimate and assess the solar thermal radiation input for the solar thermal collectors and panels.
CO1103.2	Understand the working of solar water heater based on heat transfer analysis
CO1103.3	Identify various parameters that influences the performance of devices/processes
CO1103.4	Understand the fundamentals of solar air heater based on heat transfer analysis and basics of concentrating collectors
CO1103.5	Understand the basics of solar photovoltaic cell and PV cell configurations

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Introduction	**8**
2.	Heat transfer	**6**
3.	Performance analysis	**6**
4.	Solar air heaters	**8**
5.	PV cells	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction**
	Solar radiation relations: Radiation on horizontal and tilted surfaces, Extraterrestrial radiation, Estimation of clear sky radiation, Total radiation on fixed sloped surfaces
2.	**Heat transfer**
	Heat transfer aspects in solar thermal, Radiation absorbed by a solar collector, Theory of Flat Plate Collectors.
3.	**Performance analysis**
	Flat Plate Collectors, Mean fluid and plate temperature calculation, Collector performance, numerical simulation
4.	**Solar air heaters**
	Theory of solar air heaters, Basics of concentrating collectors.
5.	**PV cells**

	Characteristics of PV cells and modules, Performance parameters, PV system configurations

C. RECOMMENDED STUDY MATERIAL:

S. No.	Reference Book	Author	Edition	Edition
1.	Solar Engineering of Thermal Process,3rd Edition	John A. Duffie and William A. Beckman	Latest	John Wiley & Sons
2.	Solar Electricity, 2nd Edition,	Tomas Markvart	Latest	John Wiley & Sons..
3.	Solar Electricity: Practical Guide to Designing and Installing Small Photovoltaic Systems,	Simon Roberts	Latest	Prentice-Hall
Websites:				
http://www.nptelvideos.in/2012/11/building-materials-and-construction.html https://nptel.ac.in/content/syllabus_pdf/105102088.pdf https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2330 https://nptel.ac.in/courses/105102088/				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1103.1	3	-	-	2	1	-	-	-	-	-	-	-
CO1103.2	3	-	-	-	2	-	-	-	-	-	-	-
CO1103.3	3	-	-	-	1	-	-	-	-	-	-	1
CO1103.4	3	-	-	-	-	1	-	-	-	-	-	-
CO1103.5	2	-	1	-	2	-	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1103.1	2	-	-	1	3
CO1103.2	2	-	-	1	3
CO1103.3	2	-	-	1	3
CO1103.4	3	-	-	2	1
CO1103.5	3	-	-	2	1

Note: On the basis of mapping of COs with POs, this course is related to Skill Development

Department Elective-II

MEEECV2104	Environmental Remote Sensing	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

This is the course work which gives the knowledge of Spectral Characteristics of various earth features,Global Positioning System (GPS). Applications of Remote Sensing for Environmental studies.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2104.1	Analyze of various imageries
CO2104.2	Analyze of various Photographic images
CO2104.3	Analyze of Techniques of photo-interpretation.
CO2104.4	Analyze of Machine processing of remotely sensed data
CO2104.5	Analyze of Flood Zoning and Damage

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	Imageries	**8**
2	Data Collection	**6**
3	Remotely sensed data	**8**
4	Application of RS	**6**
5	Flood Zoning	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Imageries**
	Definition of terms, Space and Airborne imageries, Characteristics of Photographic images, Color, Tone and texture, Techniques of photo-interpretation.
2.	**Data Collection**
	Ground truth collection and verification, Principles of remote sensing, Spectral Characteristics of various earth features. The Multi-concept, Remote Sensing through Visible and other Spectral Regions.
3.	**Remotely sensed data**
	Different methods of remotely sensed data interpretation, Machine processing of remotely sensed data, Geographical Information System (GIS), Global Positioning System (GPS).
4.	**Application of RS**
	Applications of Remote Sensing for Environmental studies, Land use and land cover analysis, Water resources management,
5.	**Flood Zoning**
	Flood Zoning and Damage Estimation, Pollution Studies, Survey and Management of Natural Resource.

D.RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author	Edition	Publisher
1.	Biomass – Thermo-chemical Characteristics.	PVR Iyer; T R Rao; P D Grover and N P Singh,,	Latest	Biomass gasifier Action Research Centre, Dept of Chemical Engineering , IIT Delhi
2.	Hand book of biomass down draft gasifier engine systems"	Reed, T. B. and Das, A	Latest	Solar Energy Research Institute, U.S. Dept. of Energy
Websites				
https://nptel.ac.in/courses/120108005/ https://nptel.ac.in/courses/105/106/105106056/ https://nptel.ac.in/courses/105105160/				

E. COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2104.1	2	-	2	-	1	1	1	-	-	-	-	1
CO2104..2	2	-	3	2	-	-	-	-	-	-	-	-
CO2104..3	-	1	1	-	2	2	-	-	-	-	-	-
CO2104..4	2	2	3	-	-	-	-	-	-	-	-	-
CO2104..5	-	-	3	-	2	2	-	-	-	-	-	-

D. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2104.1	3		-	-	2
CO2104.2	-	-	2	2	2
CO2104.3	2		2	-	1
CO2104.4	2		-	2	-
CO2104.5	-		2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Skill Development

Code: MEEECV1105	Wind Energy Technology	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

1. To understand the processes of generation of wind, its potential and energy extraction
2. To identify and estimate wind resource potential of an area.
3. To understand the aerodynamic principles of turbine blade design.
4. To understand the functioning of wind electric generators and the operation wind forms

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1105.1	Assess the wind energy resources potential and site selection techniques.
CO1105.2	Understand the basics of the wind resources, wind energy distribution, and utilization of wind energy
CO1105.3	Identify various parameters that influences the performance of devices / processes using aerodynamic techniques.
CO1105.4	Study the basics of wind energy conversion systems and its configurations.
CO1105.5	Examine the site preference for wind farm and analysis of environmental impacts.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Introduction	**6**
2.	Basics of Wind Resource Assessment	**8**
3.	Aerodynamics	**8**
4.	Wind Farm Design and Health (Condition) Monitoring	**6**
5.	Wind Energy Conversion Systems	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Introduction**
	Historical Perspectives on Wind Turbines, Indian Energy Scenario, Global Energy Scenario, Introduction to Indian Wind Industry, Wind Energy potential of India and Global Wind Installations.
2.	**Basics of Wind Resource Assessment**
	Introduction, Climatic and comfort Consideration: Elements of climate, global climate, climatic zones of India, climate modulating devices. Orientation: Meaning, factors affecting orientation, orientation criteria for tropical climate. Building Bye Laws and NBC Regulations: Objective of by-laws, Regulation regarding; means of access, lines of building frontages, covered area, floor area ratio, open spaces

	around buildings, height & sizes of rooms, plinth regulation and sanitation provisions.
3.	**Aerodynamics**
	Introduction, Principles of Planning: Different factors affecting planning viz-aspect, prospect, furniture requirement, roominess, grouping, circulation, elegance, privacy etc. VastuShastra in Modern Building planning: Factors considered in Vastu, site selection, orientation, planning and design of residential buildings.
4.	**Wind Farm Design and Health (Condition) Monitoring**
	Planning of wind farm, Site selection, Micros ting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Impacts.
5.	**Wind Energy Conversion Systems**
	Types, Components of Modern Wind Turbine (HAWT and VAWT), Fixed and Variable Speed operations, Power Control (Passive stall, Active pitch, Passive pitch and Active stall), Electrical aspects of wind turbine, Safety of wind turbines.

C. RECOMMENDED STUDY MATERIAL:

S.No	Reference Book	Author	Edition	Publisher
1.	Wind Turbine Technology	A. R. Jha	Latest	by CRC Press,
2.	Wind Energy Handbook 2nd	Tony Burton , Nick Jenkins, David Sharpe , Ervin Bossanyi	Latest	Wiley; 2 edition.
3.	Small Wind Turbines, Analysis, Design, and Application	David Wood	Latest	Verlag London
Websites				
https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/124107006/lec21.pdf http://www.nptelvideos.in/2012/11/building-materials-and-construction.html				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1105.1	2	1	2	-	1	-	1	-	-	-	-	1
CO1105.2	1	1	2	-	1	-	-	-	-	-	-	-
CO1105.3	1	-	3	-	1	-	-	-	-	-	-	1
CO1105.4	2	-	3	-	1	-	-	-	-	-	-	-
CO1105.5	2	1	2	-	1	-	-	-	-	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1105.1	2	-	2	2	-
CO1105.2	2	-	1	3	1
CO1105.3	1	-	3	1	-
CO1105.4	2	-	3	-	-
CO1105.5	2	-	1	3	1

Code: MEEECV1106	Energy in Built Environment	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

To enable essential and practical understanding of the basic energy requirements in buildings for different applications 2. To understand the external and internal energy processes which control the built environment 3. To study emerging technologies in building energy management.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1106.1	Understand the various energy use and energy processes involved for building comfort.
CO1106.2	Infer the knowledge on using proper passive techniques to achieve amicable light energy in building
CO1106.3	Understand the interaction of various external parameters influencing the thermal performance in building envelopes through the walls.
CO1106.4	Choose proper methodology for energy audit in order to conserve energy in buildings.
CO1106.5	Select the energy conservation measures for proper ventilation in buildings.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	Introduction	**6**
2	Solar energy and day-lighting	**8**
3	Thermal performance	**8**
4	Energy requirements in buildings	**6**
5	Energy Audit	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1	**Introduction**
	Indoor activities and environmental control - Internal and external factors on energy use - Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications - Thermal comfort - Ventilation and air quality - Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.
2	**Solar energy and day-lighting**
	The sun-earth relationship - Climate, wind, solar radiation and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings – Lighting and daylighting: Characteristics and estimation, methods of day-lighting - Architectural considerations for day-lighting.
3	**Thermal performance**

	Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer.
4	**Energy requirements in buildings**
	Thermal gain and net heat gain - End-use energy requirements - Status of energy use in buildings - Estimation of energy use in a building.
5	**Energy Audit**
	Energy audit and energy targeting - Technological options for energy management - Natural and forced ventilation – Indoor environment and air quality - Airflow and air pressure on buildings - Flow due to stack effect.

C. RECOMMENDED STUDY MATERIAL:

S.No	Reference Book	Author	Edition	Publisher
1	Heating and Cooling of Buildings: Design for Efficiency	Syed R. Qasim, Edward M. Motley and Guang Zhu	Latest	by CRC Press,
Websites				
https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/124107006/lec21.pdf http://www.nptelvideos.in/2012/11/building-materials-and-construction.html				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1106.1	2	1	2	-	1	-	1	-	-	-	-	1
CO1106.2	1	1	2	-	1	-	-	-	-	-	-	-
CO1106.3	1	-	3	-	1	-	-	-	-	-	-	1
CO1106.4	2	-	3	-	1	-	-	-	-	-	-	-
CO1106.5	2	1	2	-	1	-	-	-	-	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1106.1	2	-	2	2	-
CO1106.2	2	-	1	3	1
CO1106.3	1	-	3	1	-
CO1106.4	2	-	3	-	-
CO1106.5	2	-	1	3	1

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MULCHM1201	Soft Skills-I	1 Credits [LTP: 0-0-2]

COURSE OUTCOME

CO01201.1: To present themselves in an effective manner and know about their short-term and long-term goals.

CO01201.2 To works in a team by managing time properly and focus on personal grooming, etiquettes and bodylanguage.

CO01201.3 To demonstrate their abilities by improving skills of LSRW (Listening /Speaking/Reading/Writing).

CO01201.4 To present different viewpoints or ways of thinking about a situation, expand their abilities to resolvesituations and get experience within the given context

CO01201.5To enhance their employability skills by working on the presentation of Résumé and giving impactful performance during Group Discussion.

A. DETAILED SYLLABUS

1.	Self-Introduction & knowing your environment
2.	Goal Setting & Planning
3.	Etiquettes (Personal, Social, Professional & Corporate) etiquettes
4.	Personal Grooming and Body language
5.	Time Management & Team Work
6.	Negotiation and conflict management
7.	Oral Communication &Writing Skills: Extempore & Paper Presentations.
8.	Resume Writing
9.	Group Discussion
10.	Interview Skills

Code: MEECCV1401	SEMINAR-I	4 Credits [LTP: 0-0-4]

A. SYLLABUS

Unit	Contents
	Students will be grouped in two to three, will have to decide final thesis area, download research papers from IEEE, ACM, Elsevier, Springer etc. Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of Their approach, the drawbacks of the papers. Generalize results from a research paper to related research problems. Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject. Practice sessions on how to read, analyze and summarize research papers. Students in group will have to deliver seminar, prepare a report and a review paper based on analysis.

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment Duration: 2 Year Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-II								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV2101	Physicochemical, Biological Principles and Processes	3	1	-		40	60	100	4
MEECCV2102	Environmental Quality Monitoring	3	1	-		40	60	100	4
A.2	**Practical**								
MEECCV2201	Energy & Environment Lab-II	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives I and II**							
B.1	**Theory**								
MEEECV2101	Biomass Energy Systems	3	1	-	-	40	60	100	4
MEEECV2102	Remote Sensing and GIS Applications			-	-	40	60	100	
MEEECV2103	Management and Modeling of Environmental Systems			-	-	40	60	100	
MEEECV2104	New and Renewable Energy Sources and Technologies	3	0	-	-	40	60	100	3
MEEECV2105	Groundwater Contamination and Remediation			-	-	40	60	100	
MEEECV2106	Environmental Impact Assessment			-	-	40	60	100	
B.2	**Practical**								
	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
MULEBX2109	Engineering Economics	3	-	-	-	60	40	100	3
D		**Ability Enhancement Courses (AEC)**							
MULCHM2201	Soft Skills - II	-	-	2		60	40	100	1
E		**Skill Enhancement Courses (SEC)**							
MULCSE2201	Skill Enhancement Technical Course-II	-	-	2		60	40	100	1
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV2401	Seminar-II	-	-	2		60	40	100	1
Total		15	3	8					**22**
Total Teaching Hours		**26**							

PO's and PSO's are as follows

PO No.	PO's
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. Considerations.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO No.	**PSO's**
1	A civil engineering graduate is efficient in fundamentals of civil engineering, mathematical & scientific reasoning and are able to plan, design the building structure, roads, sewage and water supply networks & other component of infrastructure system considering environmental, safety & health aspects.
2	A civil engineer is able to use modern tools, techniques, software's to solve complex engineering problems
3	A civil Engineer able to prepare BOQ & cost estimation & able to execute the projects in lined with set project goals.
4	A civil engineer is able to compile detailed project report & give technical specifications to provide required quality of work.
5	A civil engineer is able to access the quality of material used for construction & able to find out deviations & able to suggest preventative and corrective measures for sustainable development.

Major (Core Courses)

Code: MEECCV2101 Physicochemical, Biological Principles and Processes 4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

1.To study about the solid- liquid- gas interactions

2. To understand about process kinetics

3. To deal with themicrobial applications in environmental engineering.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2101.1	Understand the significance of water in the environment
CO2101.2	Relate the mass transfer and transport of impurities in the system.
CO21011.3	Understand the chemical kinetics and isotherm model
CO2101.4	Infer the significance of ecosystem and biodiversity
CO2101.5	Appraise the biochemistry and enzyme kinetics.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Resource management and chemistry	**9**
2.	Chemical kinetics and isotherm models	**10**
3.	Fundamental of ecosystem and biodiversity	**9**
4.	Biochemistry of wastewater treatment	**12**
5.	Principles of biological processes	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Resource management and chemistry**
	Water resources management, Water management plan, Water Chemistry – Fundamentals, Solid-Liquid-Gas interactions.
2.	**Chemical kinetics and isotherm models**
	Fundamental concepts of chemical kinetics, Kinetics of complex systems, Kinetic reaction in gas, liquid and solid states, Non – isothermal methods in kinetics, Chemical equilibrium – Rate laws and rate constant.
3.	**Fundamental of ecosystem and biodiversity**
	Ecosystems; Fundamental processes – Ecological flow, tradeoff and biodiversity, Ecological hyper cycles, Ecosystem services in carbon dynamics/ carbon sequestration, biodiversity, land – surface energy balance.
4.	Biochemistry of wastewater treatment
	Biochemistry – Fundamentals, Enzymes – Enzyme kinetics, immobilization techniques, industrial application of enzymes.
5.	Principles of biological processes
	Cells – Fundamentals, Cell cultivation, Cell kinetics and fermenter design Genetic engineering. Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching

C. RECOMMENDED STUDY MATERIAL:

S. No	Reference Book	Author	Edition	Publisher
1.	Microbial Ecology Book	Larry L. Barton, Diana E. Northup	Latest	Wiley, Blackwell
2.	Ecology of Fresh Waters - A View for the Twenty-First Century Book	Brian Moss	Latest	Wiley, Blackwell
Websites				
https://nptel.ac.in/content/syllabus_pdf/105105166.pdf https://nptel.ac.in/courses/105105166/ https://nptel.ac.in/courses/105101085/				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2101.1	1	2	2	-	1	-	1	-	-	-	-	-
CO2101.2	1	1	2	-	1	-	-	-	1	-	-	1
CO21011.3	3	-	-	2	1	-	-	-	-	1	-	-
CO2101.4	-	3	-	1	-	-	-	-	-	-	-	-
CO2101.5	1	-	1	3	-	-	-	-	-	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2101.1	2	-	3	-	-
CO2101.2	1	3	-	1	1
CO21011.3	2	-	3	-	-
CO2101.4	2	3	-	1	-
CO2101.5	-	-	-	2	3

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MEECCV2102	Environmental Quality Monitoring	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

1. To provide an overall understanding of the environment
2. To Understand the sampling techniques
3. To Analyze the physicochemical and microbial qualities of water and wastewater
4. To Know the sampling and analysis of water, air and soil
5. To understand the standard methodologies for sampling and analysis of samples
6. To learn the working principles of various instruments used in environmental analysis.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2102.1	Understand the sampling techniques.
CO2102.2	Analyze the physicochemical and microbial qualities of water and wastewater.
CO2102.3	Perform the sampling and analysis of water, air and soil.
CO2102.4	Analyze particulates and chemical air pollutant
CO2102.5	Understand the standard methodologies for sampling and analysis of samples.

OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	General Sampling and Analytical Techniques	**10**
2.	General Sampling and Analytical Techniques	**8**
3.	Biological Methods and Microbiology	**7**
4.	Air Pollution Measurements	**5**
5.	Spectroscopic methods	**6**

DETAILED SYLLABUS

Unit	Unit Details
1.	General Sampling and Analytical Techniques
	General principles for collection of representative sample, frequency of sampling, validation, interpretation and analysis of data, various statistical techniques, quality control, assessment and management.
2.	General Sampling and Analytical Techniques
	Gravimetric methods for water and wastewater, determination of various physicochemical parameters, working principles of electrodes, different types of electrodes.
3.	Biological Methods and Microbiology
	Biochemical oxygen demand (BOD), MPN test for microbial pollution, plate counts; confirmatory tests for various microbiological agents.
4.	Air Pollution Measurements
	Sampling techniques for air pollution measurements; analysis of particulates and common chemical air pollutants, analysis of oxides of nitrogen, oxides of sulphur, carbon monoxide, hydrocarbon and poly aromatic hydro carbons.
5.	Spectroscopic methods

	Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry, Atomic Emission Spectrometry, Inducted Coupled Plasma (ICP) – TOC Analyzer.

RECOMMENDED STUDY MATERIAL:

S. No.	Reference Book	Author	Edition	Publisher
1.	Environmental Chemistry,	Stanley E. Manahan	Latest	CRC Press.
2.	Environmental Microbiology	Maier, R.M., I.L. Pepper and C.P. Gerba	Latest	Academic Press, NewYork
Websites:				
http://www.nptelvideos.in/2012/11/surveying.html https://nptel.ac.in/courses/105107122/ https://nptel.ac.in/courses/105108077/ https://nptel.ac.in/courses/105102015/				

COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2102.1	1	2	-	-	3	-	-	-	-	-	1	-
CO2102.2	1	1	-	-	3	-	-	-	-	-	1	-
CO2102.3	1	-	-	-	3	-	-	-	1	-	1	-
CO2102.4	1	1	-	-	3	-	-	-	-	-	1	-
CO2102.5	1	1	-	-	3	-	-	-	1	-	1	-

COs AND POs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2102.1	1	3	-	2	-
CO2102.2	1	3	-	2	-
CO2102.3	1	3	-	2	-
CO2102.4	1	3	-	2	-
CO2102.5	1	3	-	2	-

Note: On the basis of mapping of COs with POs, this course is related to Entrepreneur

Code: MEECCV2201	Energy & Environment Lab-II	1 Credits [LTP: 0-0-2]

Details of Syllabus as per theory

COURSE OUTCOMES

A. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2201.1	2	1	-	-	-	-	-	-	-	-	-	-
CO2201.2	1	2	2	-	-	-	-	-	-	-	-	-
CO2201.3	2	-	2	2	-	-	-	-	-	-	-	-
CO2201.4	1	-	1	2	-	-	-	-	-	-	-	-
CO2201.5	1	2	1	1	-	-	-	-	-	-	-	-

B. COs AND POs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2201.1	2	-	1	-	-
CO2201.2	2	2	-	3	-
CO2201.3	-	2	-	2	-
CO2201.4	2	-	-	2	-
CO2201.5	-	2	2	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability

Department Elective-I

Code: MEEECV2101	BIOMASS ENERGY SYSTEMS	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

The fundamental principles of this course include Biomass: Thermochemical Conversion: Direct combustion, incineration, pyrolysis. Biomass gasifies fluid flow, Biological Conversion, Chemical Conversion.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2101.1	To enable students for analyzing and describing the nature and principles of bioenergy systems
CO2101.2	To develop, designs and distinguish the bioenergy systems and learn technical analysis.
CO2101.3	To create understanding to critically evaluate the environmental benefits and consequences of bioenergy production.
CO2101.4	Analyze the various chemical conversion.
CO2101.5	Analyze of co-firing and co-generation.

A. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Biomass	**8**
2.	Thermochemical Conversion	**8**
3.	Biological Conversion:	**6**
4.	Chemical Conversion	**6**
5.	Co-firing and co-generation	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	Biomass
	Biomass: Biomass resources, types, production, classification and characterization; Techniques for biomass assessment. Concept of Waste segregation, management and treatment.
2.	Thermochemical Conversion
	Thermochemical Conversion: Direct combustion, incineration, pyrolysis. Biomass gasifiers; types of gasifiers, Sizing selection and design of gasifiers. Biomass stoves, improved chulha and designs. Biomass fired boilers and types; Biomass pyrolysis – types, manufacture of charcoal, manufacture of pyrolytic oils and gases; Design and operation of pyrolysis units. Plastic waste management, plastic pyrolysis type of technologies.
3.	Biological Conversion
	Biological Conversion: Biodegradation substrate; Anaerobic digestion, process parameters of bio methanation; chemical kinetics and biomethanation process, biogas plant types, biogas plant design, biogas purification and utilisation; environmental and social impacts; bioconversion of substrates into bioethanol. Concept of Biorefinery and Circular Economy

4.	Chemical Conversion
	Chemical Conversion: Biodiesel and biohydrogen production, Fischer-Tropsch diesel hydrolysis and hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood; biocrude; catalytic distillation
5.	Co-firing and co-generation
	Co-firing and co-generation, Biomass integrated gasification/combined cycles systems, Energy Plantation/crops, food security and environmental impacts of biomass conversion to energy; energy from waste.

C. RECOMMENDED STUDY MATERIAL:

S. No	Reference Book	Author	Edition	
1.	Introduction to biomass energy conversion	Capareda S,	22nd edition (2017)	CRS Press
2.	Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power	Brown RC and Stevens C	Latest	Wiley and Sons
3.	Introduction to Bioenergy (Energy and the Environment),	Vaughn C. Nelson, Kenneth L. Starcher	Tenth edition (2018)	CRS Press
4.	Bioenergy: Principles and Applications	Yebo Li and Samir Kumar Khanal,	Eighth edition	Wiley-Blackwell
Websites				
https://nptel.ac.in/courses/105103096/ https://nptel.ac.in/courses/105103021/ https://nptel.ac.in/courses/112105182/ https://nptel.ac.in/courses/112104117/ https://nptel.ac.in/courses/112/105/112105206/				

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2101.1	2	1	2	-	1	-	-	-	-	-	-	1
CO2101.2	1	2	2	-	1	-	1	-	-	-	-	-
CO2101.3	1	1	2	-	1	-	-	-	1	-	-	1
CO2101.4	1	-	2	-	2	-	-	1	-	-	-	1
CO2101.5	1	1	2	-	1	-	-	-	1	-	-	1

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2101.1	-	2	3	-	1
CO2101.2	3	1	-	2	-
CO2101.3	1	3	-	1	1
CO2101.4	2	-	1	-	3

CO2101.5	3	2	1	-	1

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MEEECV1104 Remote Sensing and GIS applications 4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

1. To understand the basic concepts of remote sensing.
2. To learn basic concepts of Geo-graphical Information Systems (GIS).
3. To know various applications of Remote Sensing and GIS applications in Civil Engineering
4. To know the importance of decision-making system.
5. To understand the importance of Remote Sensing and GIS in Disaster Mitigation and Management.
6. To understand the importance of digital elevation model (DEM) in various water resources engineeringapplications.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO1104.1	Infer the Indian remote sensing satellites and their platforms.
CO1104.2	Present available GIS and Remote Sensing software like ARC GIS, QGIS and ERDAS Imagine
CO1104.3	Develop the Digital Elevation Model (DEM).
CO1104.4	Analyze the land use and land cover to develop NDVI and EVI.
CO1104.5	Understand the Importance of GIS and Remote Sensing in Environmental Management

B. OUTLINE OF THE COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1.	Basic concepts of Remote sensing	**6**
2.	Sensors and Scanning Systems in Remote Sensing	**6**
3.	Image Classification	**6**
4.	Basic concepts of GIS	**6**
5.	Spatial Analysis tools	**6**

C. DETAILED SYLLABUS

Unit	Unit Details
1.	**Basic concepts of Remote sensing**
	Introduction to Remote Sensing, Electromagnetic Spectram and radiation, Remote Sensing Platforms and Satellite Sensors
2.	**Sensors and Scanning Systems in Remote Sensing**
	Indian Remote Satellites (IRS), Spectral characteristics earth surface features i.e, vegetation, water and soil, Understanding the spectral curves to create spectral library. Digital Image processing of satellite data, Elements of photo / image interpretation , Concepts of digital image processing
3.	**Image Classification**

	Filters, Image registration, Feature extraction techniques, Image classification, Land use and Land cover analysis.
4.	**Basic concepts of GIS**
	Introduction to GIS, History of development of GIS, Elements of GIS - Computer hardware and software, Map reading, various maps in GIS. Map overlay and Overlay operations
5.	**Spatial Analysis tools**
	Vector and Raster data model, Data storage and database management, Spatial data analysis techniques.

D. RECOMMENDED STUDY MATERIAL:

S. No	Reference Book	Author	Edition	Publication/Edition
1.	Elements of Photogrammetry with Application in GIS,	Paul Wolf, Bon DeWitt and Benjamin Wilkinson	Latest	McGraw-Hill Education; 4th Edition
2.	Remote Sensing and Image Interpretation,	ThomosLillesand, Ralph W. Kiefer and Jonathan Chripman	Latest	Wiley Publisher
3.	Principles of Geographical Information Systems	Peter A. Burrough, Rachael A. McDonnell and Christopher D. Lloyd	Latest	Oxford University Press,
Websites				
http://www.nptelvideos.in/2012/11/engineering-geology.html https://nptel.ac.in/content/syllabus_pdf/105105106.pdf https://nptel.ac.in/courses/105105106/ https://nptel.ac.in/courses/105106055/ https://nptel.ac.in/content/syllabus_pdf/105106055.pdf https://nptel.ac.in/content/storage2/courses/105106055/Mod1/Lecture1.pdf				

E. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1104.1	2	1	2	-	-	-	1	-	-	-	-	1
CO1104.2	2	1	2	-	1	-	-	-	-	-	-	2
CO1104.3	-	3	-	2	-	-	-	-	-	1	-	-
CO1104.4	1	1	-	2	1	-	-	-	-	1	-	-
CO1104.5	-	1	-	2	1	-	-	-	-	1	-	1

F. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1104.1	2	1	1	2	2
CO1104.2	2	1	1	2	1
CO1104.3	3	2	-	1	-
CO1104.4	1	1	3	1	-
CO1104.5	-	-	-	2	3

Note: On the basis of mapping of COs with POs, this course is related to Skill Development

Code: MEEECV2103 Management and Modeling of Environmental Systems 4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

This is the course work which gives the knowledge of Human-environment relationship, Environmental andnatural resources economics, Numerical/mathematical modelling of environmental systems.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2103.1	To design energy systems for engineering applications and model their performance
CO2103.2	To analyze energy systems under design and off-design operating conditions
CO2103.3	To optimize the performance of different energy systems
CO2103.4	Analyze of planning and management of environmental system.
CO2103.5	Analyze the large-scale system.

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	Human	**8**
2	Environmental and natural resources economics	**6**
3	Numerical/mathematical modelling of environmental systems	**8**
4	Planning and management of environmental systems	**6**
5	Large scale systems	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Human**
	Human-environment relationship, normative criteria, descriptive and prescriptive models, limits of growth.
2.	**Environmental and natural resources economics**
	Environmental and natural resources economics, pollution control policy, growth in a finite environment; Environmental protection laws.
3.	**Numerical/mathematical modelling of environmental systems**
	Numerical/mathematical modelling of environmental systems, subsystems, and pollutant transport processes.
4.	**Planning and management of environmental systems**
	Planning and management of environmental systems: optimization techniques, stochastic modelling, statistical inferences.
5.	**Large scale systems**
	Large scale systems; Optimal monitoring network design, identification of sources; Risk reliability and uncertainty in environmental systems; Topics in groundwater and surface water quality management.

C. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author	Edition	Publisher
1.	Modeling the Environment: An Introduction To System Dynamics Modeling Of Environmental Systems.	Andrew Ford,	Latest	Island Press
2.	Concepts of Environmental Management for Sustainable Development	M. C. Das	Latest	I K International Publishing House Pvt. Ltd
Websites				
https://nptel.ac.in/courses/120108005/ https://nptel.ac.in/courses/105/106/105106056/ https://nptel.ac.in/courses/105105160/				

D. COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2103.1	2	-	2	-	1	1	1	-	-	-	-	1
CO2103.2	2	-	3	2	-	-	-	-	-	-	-	-
CO2103.3	-	1	1	-	2	2	-	-	-	-	-	-
CO2103.4	2	2	3	-	-	-	-	-	-	-	-	-
CO2103.5	-	-	3	-	2	2	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2103.1	3		-	-	2
CO2103.2	-	-	2	2	2
CO2103.3	2		2	-	1
CO2103.4	2		-	2	-
CO2103.5	-		2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Skill Devel

Code: MEEECV2104 New and Renewable Energy Sources and Technologies 3 Credits [LTP: 3-0-0]

COURSE OVERVIEW AND OBJECTIVES:

This is the course work which gives the knowledge of Energy Consumption in various sectors, Performance Estimation of Wind turbines, Mini and Micro Hydel Projects.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2104.1	Analyze of Energy Consumption in various sectors
CO21042	Analyze of Performance Estimation of Wind turbines
CO2104.3	Design of Mini and Micro Hydel Projects
CO2104.4	Analyze of Applications of Geothermal Energy, Environmental Issues.
CO2104.5	Analyze of Wind-Hydel systems, Gasifier DG- Wind systems

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	World Energy Scenario	**8**
2	Wind Energy	**6**
3	Small Scale Hydroelectric (Mini & Micro Hydel)	**8**
4	Geothermal Energy	**6**
5	Hybrid systems	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**World Energy Scenario**
	Use and their availability and overall energy demand. Energy Consumption in various sectors and its changing pattern, exponential increase in energy consumption and projected future demands. Sustainable Development, Role of Renewable Energy sources in Sustainable development, Energy Consumption and its impact on environmental climatic change. Indian Energy Scenario: Commercial and non-commercial forms of energy, Fossil fuels, Renewable sources including Bio-fuels in India, their utilization pattern in the past, present and future projections of consumption pattern, Sector wise energy consumption.
2.	**Wind Energy**
	Wind potential in India and world, basic principle of wind energy Conservation characteristics of wind power, Extractable wind power, Site selection, wind data analysis and predictions, Use of statistical tools, Different types of Wind Machines Electricity generating stand alone systems & grid connected systems, Performance Estimation of Wind turbines, Aerodynamic construction of rotor blades, Wind Farms, wind mills & their applications, Cost economics, case studies.

3.	**Small Scale Hydroelectric (Mini & Micro Hydel)**
	Classification of Small Hydro Power Stations, Components of a Hydroelectric Scheme, Civil Works Design Considerations for Mini and Micro Hydel Projects, Turbines and Generators for Small Scale Hydro Electric, Protection, Control and Management of Equipment's, Advantages and Limitations of Small Scale Hydro-Electric, Hybrid Systems, Hydraulic Ram and its Applications.
4.	**Geothermal Energy**
	Potential Sites, Estimations of Geothermal Power, Nature of Geothermal Sites, Hot-Dry Rocks Resources, Magma Resources, Systems for Energy Generation, Applications of Geothermal Energy, Environmental Issues. Basic Theory of OTEC, Potential and application of Technologies, Basic Theory of Wave Energy, Potential and Technologies, Basic Theory of Tidal Energy, Potential and Technologies
5.	**Hybrid systems**
	Wind-PV systems, Wind-DG systems, Wind-Hydel systems, Gasifier DG- Wind systems

C. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author	Edition	Publisher
1.	Renewable energy resources	Twidell & AW. Wier	Latest	FN Spon
2.	Renewable conversion technology,	N.K. Bansal., M. Kleeman & M. Mielee	Latest	Tata McGraw Hill, New Delhi
Websites				
https://nptel.ac.in/courses/120108005/ https://nptel.ac.in/courses/105/106/105106056/ https://nptel.ac.in/courses/105105160/				

D. COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2104.1	2	-	2	-	1	1	1	-	-	-	-	1
CO21042	2	-	3	2	-	-	-	-	-	-	-	-
CO2104.3	-	1	1	-	2	2	-	-	-	-	-	-
CO2104.4	2	2	3	-	-	-	-	-	-	-	-	-
CO2104.5	-	-	3	-	2	2	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2104.1	3		-	-	2
CO21042	-	-	2	2	2
CO2104.3	2		2	-	1
CO2104.4	2		-	2	-
CO2104.5	-		2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Skill Development

Code: MEEECV2105 Groundwater Contamination and Remediation 3 Credits [LTP: 3-0-0]

COURSE OVERVIEW AND OBJECTIVES:

This is the course work which gives the knowledge of hydrological processes in various sectors, Performance Estimation of hydrological cycle.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2105.1	Analyze of hydrological cycle
CO2105.2	Analyze of Data collection Methods
CO2105.3	Analyze of Groundwater Remediation,
CO2105.4	Analyze of Flow and transport in the Unsaturated Zone,
CO2105.5	Analyze of water yield from catchments

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	Hydrological cycle	**8**
2	Data collection Methods	**6**
3	Groundwater Remediation	**8**
4	Transport in the Unsaturated Zone	**6**
5	Water Harvesting	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Hydrological cycle**
	Introduction, hydrologic Cycle, Groundwater Contaminant and Transport Mechanism.
2.	**Data collection Methods**
	Data collection Methods: Introduction, Geological data acquisition and Hydrological data acquisition, acquisition of soil and groundwater quality data,
3.	**Groundwater Remediation**
	Groundwater Remediation, Sorption and other chemical reactions,
4.	**Transport in the Unsaturated Zone**
	Flow and transport in the Unsaturated Zone, Non-aqueous phase Liquids: Characterization, types, remediation at sites
5.	**Water Harvesting**
	Water Harvesting: Types of storage structures, water yield from catchments, runoff diversion, pond and reservoirs, earth embankments

C. .RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author	Edition	Publisher
1.	Ground water contamination (Transport and remediation)	Phlip.B.Bedient, Hanadi.S. Rifai & Charles	Latest	J.Newell Publishers: Prentice Hall.
Websites				
https://nptel.ac.in/courses/120108005/ https://nptel.ac.in/courses/105/106/105106056/ https://nptel.ac.in/courses/105105160/				

D. . COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2105.1	2	-	2	-	1	1	1	-	-	-	-	1
CO2105.2	2	-	3	2	-	-	-	-	-	-	-	-
CO2105.3	-	1	1	-	2	2	-	-	-	-	-	-
CO2105.4	2	2	3	-	-	-	-	-	-	-	-	-
CO2105.5	-	-	3	-	2	2	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2105.1	3		-	-	2
CO2105.2	-	-	2	2	2
CO2105.3	2		2	-	1
CO2105.4	2		-	2	-
CO2105.5	-		2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Skill Developme

MEEECV2106	ENVIRONMENTAL IMPACT ASSESSMENT	3 Credits [LTP: 3-0-0]

COURSE OVERVIEW AND OBJECTIVES:

To understand the concepts of EIA and also emphasis the role of engineers in EIA and Environmental impactfactors.

2. To know the legislations to be used for enforcement of environmental acts and the role of public participation

3. To discuss the methods to be used in EIA and legal systems related to environmental management systems (EMS) (EIA, Environmental Audit (EA), Life cycle Assessment (LCA)) for cleaner production and sustainable development.

4. To know the impacts occurred to physical environment by the projects

5. To know the impacts occurred to biological environment by the projects

6. To know the impacts occurred to human resources by the projects

7. To draft an EIA for specific projects and understanding the mitigation and monitoring methods

8. To get exposed to practical experience for drafting an EIA through consultant / Government.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO2106.1	Explain the philosophy and art of environmental management systems
CO2106.2	Understand the role of government in approving the projects and the laws to be enforced
CO2106.3	Apply the mechanism of EIA for Project Appraisal, Decision making and Implementation
CO2106.4	Identify the methods in handling the data collected during the EIA processes
CO2106.5	Understand the impacts that could occur for physical, biological and human resources by the project.

A. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	General Sampling and Analytical Techniques	**8**
2	EIA Legislation	**6**
3	EIA Process and Methods	**8**
4	Prediction and Assessment of Impacts on Physical Environment	**6**
5	Prediction and Assessment of Impacts on Biological Environment	**8**

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**General Sampling and Analytical Techniques**
	EIA for Environmental Engineers–Environmental Impact Statement – Environmental Appraisal– Environmental Impact Factor
2.	**EIA Legislation**
	Criteria and Standards for Assessing Significant Impacts – Risk Assessment – Public Participation and Involvement
3.	**EIA Process and Methods**

	Criteria for the Selection of EIA Methodology – Screening – Scoping – Predictive Models for Impact Assessment – Mitigation, Monitoring, Auditing, Evaluation of Alternatives and Decision Making –Methods of Strategic Environmental Assessment. Environmental management plan.
4.	**Prediction and Assessment of Impacts on Physical Environment**
	Geology –Soils – Minerals – Climate – Water Resources – Water Quality – Air Quality – Noise.
5.	**Prediction and Assessment of Impacts on Biological Environment**
	Terrestrial Ecosystems – Wetland Ecosystems – Aquatic Ecosystems – Threatened and Endangered Species

C. .RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author	Edition	Publisher
1.	'Handbook of Environmental Impact Assessment- Volume 1 & 2'	Judith Petts	Latest	Blackwell Science
2.	'Environmental Impact Assessment: Theory and Practice	Peter Wathern, Routledge-T	Latest	Taylor & Francis Group
Websites				
https://nptel.ac.in/courses/120108005/ https://nptel.ac.in/courses/105/106/105106056/ https://nptel.ac.in/courses/105105160/				

D. COs AND POs MAPPING

COs and LOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO2106.1	2	-	2	-	1	1	1	-	-	-	-	1
CO2106.2	2	-	3	2	-	-	-	-	-	-	-	-
CO2106.3	-	1	1	-	2	2	-	-	-	-	-	-
CO2106.4	2	2	3	-	-	-	-	-	-	-	-	-
CO2106.5	-	-	3	-	2	2	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO2106.1	3		-	-	2
CO2106.2	-	-	2	2	2
CO2106.3	2		2	-	1
CO2106.4	2		-	2	-
CO2106.5	-		2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Skill Development

Code: MULEBX2109	Engineering Economics	3 Credits [LTP:3-0-0]

COURSE OVERVIEW AND OBJECTIVES:

This course Acquire knowledge of economics to facilitate the process of economic decision making.
Acquire knowledge on basic financial management aspects.
Develop the skills to analyze financial statements.

COURSE OUTCOME
The student would be able
CO1101.1. Evaluate the economic theories, cost concepts and pricing policies.
CO1101.2 Understand the market structures and integration concepts
CO1101.3 Understand the measures of national income, the functions of banks and concepts of globalization
C01101.4 Apply the concepts of financial management for project appraisal
CO1101.5 Understand accounting systems and analyze financial statements using ratio analysis

A.	Outline of the Course	
Unit No.	**Title of the unit**	**Time required for the Unit (Hours)**
1	Economics, Cost and Pricing Concepts	9
2	Concepts on Firms and Manufacturing Practices.	9
3	National Income, Money and Banking, Economic Environment	9
4	Concepts of Financial Management	9
5	Accounting System, Statement and Financial Analysis	9

B.	DETAILED SYLLABUS
1	**Economics, Cost and Pricing Concepts**
	Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual cost and opportunity cost – Incremental cost and sunk cost – Fixed and variable cost – Marginal costing – Total cost – Elements of cost – Cost curves – Breakeven point and breakeven chart – Limitations of breakeven chart – Interpretation of breakeven chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods
2	**Concepts on Firms and Manufacturing Practices**.
	Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration
3	**National Income, Money And Banking, Economic Environment**
	National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization
4	**Concepts of Financial Management**
	Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital
5	**Accounting System, Statement And Financial Analysis**
	Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial

	statements – Ratio analysis – Types of ratios – Significance – Limitations

C.	RECOMMENDED STUDY MATERIAL:	
S. No	**Title of the Book**	**Author**
1	Financial Management‖ (Theory & Practice) TMH	Prasanna Chandra
2	Essentials of Managerial Finance	Weston & Brigham
3	Financial Management	Pandey, I. M
4	Fundamentals of Financial Management	James C. Van Horne
Important Web links		
1	https://www.youtube.com/watch?v=mX9nd0eQ-6g&ab_channel=KrassimirPetrov	
2	https://www.youtube.com/watch?v=CCQwz_Gwo6o&ab_channel=IITRoorkeeJuly2018	

D	COs AND POs MAPPING											
COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1101.1	1	1	-	3	-	1	-	-	-	-	1	-
CO1101.2	1	3	-	2	1	-	-	-	-	-	-	-
CO1101.3	1	-	-	3	1	-	-	-	-	-	1	-
CO1101.4	1	1	3	-	-	-	1	-	-	-	1	-
CO1101.5	1	1	3	-	1	1	-	-	-	-	-	1

E	COs AND PSOs MAPPING				
COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1101.1	1	2	3	1	-
CO1101.2	-	2	2	-	3
CO1101.3	1	1	-	3	2
CO1101.4	1	3	-	2	-
CO1101.5	1	3	-	2	-

Note: On the basis of mapping of COs with POs, this course is related to Employability/ Skill Development

Code: MULCHM2201	Soft Skills-II	1 Credits [LTP: 0-0-2]

COURSE OUTCOME

CO01201.1: To present themselves in an effective manner and know about their short-term and long-term goals.
CO01201.2 To works in a team by managing time properly and focus on personal grooming, etiquettes and bodylanguage.
CO01201.3 To demonstrate their abilities by improving skills of LSRW (Listening /Speaking/Reading/Writing).
CO01201.4To present different viewpoints or ways of thinking about a situation, expand their abilities to resolvesituations and get experience within the given context
CO01201.5To enhance their employability skills by working on the presentation of Résumé and giving impactful performance during Group Discussion.

A. DETAILED SYLLABUS

1	Self-Introduction& knowing your environment
2	Goal Setting & Planning
3	Etiquettes (Personal, Social, Professional & Corporate) etiquettes
4	Personal Grooming and Body language
5	Time Management & Team Work
6	Negotiation and conflict management
7	Oral Communication &Writing Skills: Extempore & Paper Presentations.
8	Resume Writing
9	Group Discussion
10	Interview Skills

Code: MEECCV2401	**SEMINAR-II**	**1 Credits [LTP: 0-0-2]**

A. SYLLABUS

Unit	Contents
	Students will be grouped in two to three, will have to decide final thesis area, download research papers from IEEE, ACM, Elsevier, Springer etc. Summarizing paper – Reading abstracts and finding ideas, conclusion, Advantages of Their approach, and the drawbacks of the papers. Generalize results froma research paper to related research problems. Comparing the approach - Identify weaknesses and strengths in recent research articles in the subject. Practice sessions on how to read, analyze and summarize research papers. Students in group will have to deliver seminar, prepare a report and a review paper based on analysis.

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment** **Duration: 2 Years** **Total Credits: 80**								
	<u>Teaching Scheme for Batch 2023-25</u>								
	Semester-III								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
MEECCV3101	Advanced Statistical Methods	3	1	-		40	60	100	4
MEECCV3102	Research Methodology	3	1	-		40	60	100	4
A.2	**Practical**								
MEECCV3201	Energy & Environment Lab-III	-	-	2		60	40	100	1
MEECCV3401	Review/Research Paper	-	-	2		60	40	100	1
B.		**Minor Stream Courses/ Department Electives/*<u>Open Elective</u>***							
B.1	**Theory**								
MULEEE3107	E-Commerce and Knowledge Management	3	1	-		40	60	100	3
MULECV3108	Water and Environmental Pollution			-		40	60	100	
MULEME3109	IPR & Patents			-		40	60	100	
MULEEE3110	Robotics			-		40	60	100	
MULEEE3111	Digital India Implementation			-		40	60	100	
MULECV3112	Smart City Design			-		40	60	100	
MULEEE3113	Renewable Energy			-		40	60	100	
B.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
MSTEMC3121	MOOC Course - I	3	-	-	-	-	-	-	3
D		**Ability Enhancement Courses (AEC)**							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
G		**Summer Internship / Research Project / Dissertation**							
MEECCV3402	Dissertation Part - I	-	-	12		60	40	100	6
Total		12	3	16					**22**
Total Teaching Hours		**31**							

PO's and PSO's are as follows

PO No.	PO's
1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. Considerations.
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO No.	**PSO's**
1	A civil engineering graduate is efficient in fundamentals of civil engineering, mathematical & scientific reasoning and are able to plan, design the building structure, roads, sewage and water supply networks & other component of infrastructure system considering environmental, safety & health aspects.
2	A civil engineer is able to use modern tools, techniques, software's to solve complex engineering problems
3	A civil Engineer able to prepare BOQ & cost estimation & able to execute the projects in lined with set project goals.
4	A civil engineer is able to compile detailed project report & give technical specifications to provide required quality of work.
5	A civil engineer is able to access the quality of material used for construction & able to find out deviations & able to suggest preventative and corrective measures for sustainable development.

Major (Core Courses)

Code: MEECCV3101	Advanced Statistical Methods	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES: To provide students with a framework that will help them choose the appropriate descriptive statistics in various data analysis situations. 2. To analyse distributions and relationships of real-time data. 3. To apply estimation and testing methods to make inference and modelling techniques for decision making using various techniques including multivariate analysis.

COURSE OUTCOMES

After completion of the course, student will be able to:

CO	Description
CO3101.1	Understand the concept of correlation and regression model and able to interpret the effect of variables, regression coefficients, coefficient of determination.
CO3101.2	Make appropriate decisions using inferential statistical tools that are central to experimental research.
CO3101.3	Understand the statistical forecasting methods and model fitting by graphical interpretation of time series data.
CO3101.4	Construct standard experimental designs and describe what statistical models can be estimated using the data.
CO3101.5	Demonstrate R programming for statistical data

i. OUTLINE OF THE COURSE

Unit	Title of the unit	Time Required for the Unit (Hours)
1	Basic Statistical Tools for Analysis:	**6**
2	Statistical inference	**8**
3	Modelling and Forecasting Methods:	**8**
4	Design of Experiments:	**8**
5	Contemporary Issues	**6**

ii. DETAILED SYLLABUS

Unit	Unit Details
1	**Basic Statistical Tools for Analysis**
	Summary Statistics, Correlation and Regression, Concept of R2 and Adjusted R2 and Partial and Multiple Correlation, Fitting of simple and Multiple Linear regression, Explanation and Assumptions of Regression Diagnostics.
2	**Statistical inference**
	Basic Concepts, Normal distribution-Area properties, Steps in tests of significance –large sample tests-Z tests for Means and Proportions, Small sample tests –t-test for Means, F test for Equality of Variances, Chi-square test for independence of Attributes
3	**Modelling and Forecasting Methods**
	Introduction: Concept of Linear and Non Liner Forecasting model , Concepts of Trend, Exponential Smoothing, Linear and Compound Growth model, Fitting of Logistic curve and

	their Applications, Moving Averages, Forecasting accuracy tests. Probability models for time series: Concepts of AR, ARMA and ARIMA models.
4	**Design of Experiments:**
	Analysis of variance – one and two way classifications – Principle of design of experiments, CRD – RBD – LSD, Concepts of and factorial experiments.
5	**Contemporary Issues**
	Industry Expert Lecture

iii. RECOMMENDED STUDY MATERIAL

Sr. No.	Book	Author	Publication
1	The Elements of Statistical Learning: Data Mining, Inference, and Prediction.	Trevor Hastie and Robert Tibshirani	Springer Series
2	Introduction to Probability and Statistics: Principles and Applications for Engineering and the Computing Sciences.	J. Susan Milton and Jesse Arnold,	McGraw Hill education
Websites			
https://nptel.ac.in/courses/105105166/ https://nptel.ac.in/courses/105101085/ https://nptel.ac.in/courses/105105109/ https://nptel.ac.in/courses/105105109/			

iv. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3101.1	2	3	-	-	1	-	-	-	-	-	-	-
CO3101.2	3	1	2	1	-	-	-	-	-	-	-	-
CO3101.3	1	-	3	2	1	-	-	-	-	-	-	-
CO3101.4	-	2	-	2	3	-	-	-	-	-	-	-
CO3101.5	2	-	2	3	-	-	-	-	-	-	-	-

v. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3101.1	3	-	2	-	2
CO3101.2	1	3	-	2	1
CO3101.3	2	1	3	1	-
CO3101.4	-	2	-	3	2
CO3101.5	2	-	2	-	3

Note: On the basis of mapping of COs with POs, this course is related to Employability / SkillDevelopment

Code: MEECCV3102	Research Methodology	4 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES

To familiarize students with basic of research and the research process. To enable the students in conducting research work and formulating research synopsis and report. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling

COURSE OUTCOME

The student will be able to:
CO3102.1 To be able to distinguish a purpose statement, a research question or hypothesis, and a research objective.
CO3102.2 To be able to define the meaning of a variable, and to be able to identify independent, dependent,and mediating variables
CO3102.3 To be able to distinguish between categorical and continuous measures
CO3102.4 To be able to design a good quantitative purpose statement and good quantitative research questions and hypotheses
CO3102.5 To understand the link between quantitative research questions and data collection and howresearch questions are operationalized in educational practice.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	**General**	9
2.	**Connections**	10
3.	**Towers**	8
4.	**Plastic Analysis**	9
5.	**Industrial Building**	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Overview of Research Methodology** Introduction, Mathematical tools for analysis, Research problems in management,Types of research, Research Process, Data Collection & Presentation: Introduction, Primary data, Secondary data, Data Presentation
2.	**Review of Basic Statistical Measures & Basic Multivariate Analysis** Introduction, Measures of Central Tendencies, Measures of Variation, Measures of Skewness. Basic Multivariate Analysis: Introduction, Correlation analysis, Forecasting, Linear regression & Timeseries
3.	**Design and Analysis of Experiments** Introduction, Analysis of Variance, Completely Randomized design, Randomized complete block design, Latin square design, Duncan‟s multiple Range Test, Functional design, second factorial experiment, Expected Mean Square.

4.	**Algorithmic Research &Simulation** Introduction, Algorithmic Research Problems, Types, Types of Solution Procedures, Steps of development, Steps of Algorithmic Research, Design of Experiments, Meta Heuristics for Combinational Problems. Simulation: Introduction, Need for simulation, Types, SimulationLanguages, case study.
5.	**Report Writing and Presentation** Introduction, Types of report, Guidelines for review draft, Report format, Typing Instructions, Oral Presentations

C. RECOMMENDED STUDYMATERIAL:

S. No	Title of the Book	Author
1.	Research Methodology	R. Panneerselvam, PHI
2.	Research Methodology: Methods and Trends	Dr. C. R. Kothari
3.	Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar

Important Web Links

1. https://libguides.wits.ac.za/c.php?g=693518&p=4914913
2. https://www.scribbr.com/dissertation/methodology/
3. https://www.open.edu/openlearn/money-management/understanding-different-research-perspectives/content-section-8
4. https://www.researchgate.net/publication/270956555_CHAPTER_3_-_RESEARCH_METHODOLOGY_Data_collection_method_and_Research_tools
5. https://www.youtube.com/watch?v=ze5bS-DNERk

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3201.1	3	2	1	1	-	-	-	-	-	-	-	-
CO3201.2	-	2	3	-	2	-	-	-	-	-	-	-
CO3201.3	2	1	3	-	1	-	-	-	-	-	-	-
CO3201.4	2	3	-	2	-	-	-	-	-	-	-	-
CO3201.5	1	1	2	3	-	-	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3201.1	3	2	1	-	1
CO3201.2	2	-	3	2	-
CO3201.3	1	-	3	1	2
CO3201.4	-	2	2	-	3
CO3201.5	2	1	-	3	1

Note: On the basis of mapping of COs with POs, this course is related to Employability / SkillDevelopment

Code: MEECCV3201	Energy & Environment Lab-III	1 Credits [LTP: 0-0-2]

As per Theory syllabus.

Code: MTECCV3401	Review/Research Paper	1 Credits [LTP: 0-0-2]

A. COURSE OVERVIEW AND OBJECTIVES

To familiarize students with basic of research and the research process. To enable the students in conducting research work and formulating research synopsis and report. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling

COURSE OUTCOME

The student will be able to:

CO02102.1 To be able to distinguish a purpose statement, a research question or hypothesis, and a research objective.

CO02102.2 To be able to define the meaning of a variable, and to be able to identify independent, dependent, and mediating variables

CO02102.3 To be able to distinguish between categorical and continuous measures

CO02102.4 To be able to design a good quantitative purpose statement and good quantitative research questions and hypotheses.

CO02102.5 To understand the link between quantitative research questions and data collection and how research questions are operationalized in educational practice.

A. DETAILED SYLLABUS

Unit	Contents
1.	**Foundations of Research**
	Foundations of Research: Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method – Understanding the language of research – Concept, Construct, Definition, Variable. Research Process
2.	**Problem Identification & Formulation**
	Problem Identification & Formulation – Research Question – Investigation Question – Measurement Issues – Hypothesis – Qualities of a good Hypothesis –Null Hypothesis & Alternative Hypothesis. Hypothesis Testing – Logic & Importance
3.	**Research Design**
	Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables.
4.	**Qualitative and Quantitative**
	Qualitative and Quantitative Research: Qualitative research – Quantitative research – Concept of measurement, causality, generalization, replication. Merging the two approaches.
5.	**Data Analysis**
	Data Analysis: Data Preparation – Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis – Cross tabulations and Chi-square test including testing hypothesis of association.
6.	**Interpretation of Data and Paper Writing**

	Interpretation of Data and Paper Writing – Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish ? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.
7.	**Use of Encyclopedias, Research Guides, Handbook**
	Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline
8.	**Use of tools / techniques for Research**
	Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

B. RECOMMENDED STUDY MATERIAL:

S.No	Title of the Book	Author
1.	Research Methodology	R. Panneerselvam, PHI
2.	Research Methodology: Methods and Trends	Dr. C. R. Kothari
3.	Research Methodology: A Step by Step Guide for Beginners	Ranjit Kumar

Code: MULEEE3107	E- Commerce & Knowledge Management	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES

This course provides an introduction to information systems for business and management. It is designed to familiarize students with organizational and managerial foundations of systems, the technical foundation for understanding information systems

COURSE OUTCOME

The student would be able to

CO3107.1 Understand the basic concepts and technologies used in the field of management information systems;

CO3107.2To impart the knowledge of the different types of management information systems;

CO3107.3 To Understand the processes of developing and implementing information systems;

CO3107.4 To aware of the ethical, social, and security issues of information systems;

CO3107.5 To familiarize students with organizational and managerial foundations of systems

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	**INTRODUCTION TO ELECTRONIC COMMERCE**	9
2.	**BUILDING OWN WEBSITE**	8
3.	**INTERNET AND EXTRANET**	9
4.	**ELECTRONIC DATA INTERCHANGE**	9
5.	**PLANNING FOR ELECTRONIC COMMERCE**	9

B. Detailed Syllabus

Unit	Unit Details
Unit 1	**INTRODUCTION TO ELECTRONIC COMMERCE** Introduction of Unit, what is E-Commerce (Introduction and Definition), Main activities E-Commerce, Goals of E-Commerce, Technical Components of E-commerce, Functions of E-commerce, Advantages and Disadvantages of E-commerce, Scope of E-commerce, Electronic commerce Applications, Electronic commerce and Electronic Business, Conclusion of Unit.
Unit 2	**BUILDING OWN WEBSITE** Introduction of Unit, Reasons for building own website, Benefits of website, Bandwidth requirements, Cost, Time, Reach, Registering a Domain Name, Web promotion, Target email, Banner Exchange, Shopping Bots, Conclusion of Unit
Unit 3	**INTERNET AND EXTRANET** Introduction of Unit, Definition of Internet, Advantages and Disadvantages of the Internet, Component of an Intranet Information technology structure, Development of a Intranet, Extranet and Intranet Difference, Role of Intranet in B2B Application, Conclusion of Unit.

Unit 4	**ELECTRONIC DATA INTERCHANGE** Introduction of Unit, Concepts of EDI and Limitation, Application of EDI, Disadvantages of EDI, EDI model, Conclusion of Unit.
Unit 5	**PLANNING FOR ELECTRONIC COMMERCE** Introduction of Unit, planning electronic commerce initiatives, linking objectives to business strategies, measuring cost objectives, comparing benefits to costs, strategies for developing electronic commerce web sites, Conclusion of Unit.

A. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author
1.	E-Commerce	Greenstein &Feinman, Tata McGrew Hill
2.	Frontiers of Electronic Commerce	KalakotaWinston ,Pearson Education

Important Web Links:

1. https://www.kmslh.com/3-reasons-why-ecommerce-must-have-knowledge-management/
2. https://link.springer.com/chapter/10.1007/978-3-642-23993-9_31
3. https://ieeexplore.ieee.org/document/5279962
4. https://www.sciencedirect.com/science/article/pii/S0268401207001120
5. https://www.slideshare.net/monoaziz/knowledge-management-1852596

B. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3107.1	2	-	-	-	-	2	-	-	-	-	-	-
CO3107.2	2	-	-	-	-	2	2	-	-	-	-	-
CO3107.3	2	-	-	-	-	2	2	-	-	-	-	-
CO3107.4	2	-	-	-	-	1	-	-	-	-	-	-
CO3107.5	2	-	-	-	-	2	2	-	-	-	-	-

C. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3107.1	2	-	-	-	2
CO3107.2	2	-	-	-	2
CO3107.3	2		1	-	2
CO3107.4	2	-	-	-	2

CO3107.5	1	-	-	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development / Entrepreneur

Code: MULECV3108	Water and Environmental Pollution	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES

The aim of this course is to teach students about current environmental problems. From an environmental perspective, the student will learn how to develop an activity using various strategies to control, reduce and monitor all environmental problems that might arise as a result.

COURSE OUTCOME

The student would be able to

CO3108.1 To be able to identify and value the effect of the pollutants on the environment: atmosphere, water and soil.

CO3108.2 To be able to analyse an industrial activity and identify the environmental problems.

CO3108.3 TO be able to plan strategies to control, reduce and monitor pollution.

CO3108.4 To be able to select the most appropriate technique to purify and/or control the emission of pollutants.

CO3108.5 To be able to apply the basis of an Environmental Management System (EMS) to an industrial activity.

A.OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	**WATER AND WATER ANALYSIS**	9
2.	**WASTEWATER AND THEIR TREATMENT**	8
3.	**GLOBAL ATMOSPHERIC CHANGE**	9
4.	**AIR POLLUTION & METEOROLOGY**	9
5.	**SOLID WASTE MANAGEMENT**	9

DETAILED SYLLABUS

Unit 1	**WATER AND WATER ANALYSIS** Water resources, Sources of water, characteristics of water, water pollutants, oxygen demanding wastes, surface water quality, ground water quality. Municipal water supply: Requisites of drinking water, Steps involved in treatment of water
Unit 2	**WASTEWATER AND THEIR TREATMENT** Wastewater Characteristics: Quality parameters: BOD, COD, TOC, Solids, DO, Nitrogen, Phosphorus, Standards of disposal into natural watercourses and on land, Indian standards. wastewater treatment systems, disposal scope
Unit 3	**GLOBAL ATMOSPHERIC CHANGE** The atmosphere of earth, greenhouse effect, radiative forcing of climate change, global warming potential, carbon cycle, carbon emissions from fossil fuels, regional impacts of temperature change, global initiatives.

Unit 4	**AIR POLLUTION & METEOROLOGY** Atmospheric motion, Lapse rate, atmospheric stability, inversion, atmospheric dispersion, maximum mixing depth, Air quality standards, plume rise, emission controls. Air pollution control methods in industries. **NOISE POLLUTION:** Effect of noise on people, rating systems, community noise sources and criteria, traffic noise prediction, noise control
Unit 5	**SOLID WASTE MANAGEMENT** Integrated solid waste management, hazardous waste management, biomedical waste treatment technologies and disposal options, e-waste management, waste minimization for sustainability, waste management – Indian scenario.

RECOMMENDED STUDYMATERIAL:

S.No	Title of the Book	Author
1.	Environmental Engineering	Howard S Peavy, Donald RRowe, George Tchobanoglous
2.	Engineering: Treatment, and Reuse, 4th edition, Tata McGraw Hill, 2007.	Metcalf and Eddy Inc
3.	Manual for Water Treatment.	Ministry of Urban development, Govt of India
4.	Manual for Sewage Treatment	Ministry of Urban development, Govt of India
5.	Air Pollution	M N Rao
6.	Air Pollution Control Engineering	De Nevers
7	Solid Wastes: Engineering principles and Management issues	Tchobanoglous G.

Important Web Links:

1. https://www.google.co.in/search?biw=1366&bih=608&ei=Y4HLXvytHffYz7sPn9eB4AY&q=water+and+enviroment+polluation+nptel&oq=water+and+enviroment+polluation+nptel&gs_lcp=CgZwc3ktYWIQAzIKCCEQFhAKEB0QHjIKCCEQFhAKEB0QHjIKCCEQFhAKEB0QHjoECAAQRzoGCAAQFhAeOgcIIRAKEKABUIsYWP4mYMItaABwAXgAgAG8AogBuw2SAQcwLjEuNS4xmAEAoAEBqgEHZ3dzLXdpeg&sclient=psy-ab&ved=0ahUKEwi868D4y87pAhV37HMBHZ9rAGwQ4dUDCAw&uact=5\
2. https://www.nrdc.org/stories/water-pollution-everything-you-need-know
3. https://www.environmentalpollutioncenters.org/water/
4. https://www.explainthatstuff.com/waterpollution.html
5. https://wwf.panda.org/knowledge_hub/teacher_resources/webfieldtrips/water_pollution/

COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3108.1	2	-	-	-	-	2	-	-	-	-	-	-
CO3108.2	2	-	-	-	-	2	2	-	-	-	-	-
CO3108.3	2	-	-	-	-	2	2	-	-	-	-	-
CO3108.4	2	-	-	-	-	1	-	-	-	-	-	-
CO3108.5	2	-	-	-	-	2	2	-	-	-	-	-

COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3108.1	2	-	-	-	2
CO3108.2	2	-	-	-	2
CO3108.3	2		1	-	2
CO3108.4	2	-	-	-	2
CO3108.5	1	-	-	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development / Entrepreneur

Code: MULEME3109	IR& Patents	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES: The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.Further teacher will have to demonstrate with products and ask the student to identify the different types of IPR's

COURSE OUTCOME:

CO3109.1 To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

CO3109.2 To disseminate knowledge on patents, patent regime in India and abroad and registration aspects

CO3109.3 To acquire knowledge on copyrights and its related rights and registration aspects

CO3109.4 To understand knowledge on trademarks and registration• aspects

CO3109.5 To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	**INTRODUCTION TO IPR**	9
2.	**TYPES OF IPR AND WIPO**	8
3.	**LEGAL AND COMMERCIAL ASPECTS OF IPR**	9
4.	**INTRODUCTIONS TO PATENTS**	9
5.	**PATENT PROCEDURES**	9

B. DETAILED SYLLABUS

Unit	Unit details
Unit 1	**INTRODUCTION TO IPR** General Regime of Intellectual Property Rights, Concept of Property vis-à-vis Intellectual Property, Concept of Property and Theories of Property - An Overview. Theories of Intellectual Property Rights, Intellectual Property as an Instrument of Development, Need for Protecting. Intellectual Property- Policy Consideration-National Perspectives and International demands.
Unit 2	**TYPES OF IPR AND WIPO** Types of Intellectual Property- Origin and Development- An Overview, Intellectual Property Rights as Human Right, Role of International Institutions, World Intellectual Property Organization (WIPO), Function of WIPO, Membership of WIPO, Agreement between the WIPO and the WTO.
Unit 3	**LEGAL AND COMMERCIAL ASPECTS OF IPR** Dispute Settlement- New Treaties, Commercialization of Intellectual Property Rights by Licensing, Determining Financial Value of Intellectual Property Rights, Negotiating Payments Terms in Intellectual Property Transaction, Intellectual Property Rights in the Cyber World.

Unit 4	**INTRODUCTIONS TO PATENTS** Introduction to Patent Law, Paris Convention, Patent Cooperation Treaty, WTO- TRIPS, Harmonization of CBD and TRIPs, Indian Patent Law, The Patents Act, 1970, Amendments to the Patents Act, Patentable Subject Matter, Patentability Criteria.
Unit 5	**PATENT PROCEDURES** Procedure for Filing Patent Applications, Patent Granting Procedure, Revocation, Patent Infringement and Remedies, Relevant Provisions of the Biological Diversity Act, 2002, Access and Benefit SharingIssues.

C. RECOMMENDED STUDY MATERIAL:

S. No	Title of the Book	Author
1.	Intellectual Property Rights in India	VK Ahuja (Lexis Nexis butter worths Publications)
Important Web Link:		
1. https://www.cencenelec.eu/ipr/Pages/default.aspx		
2. http://www.ipindia.nic.in/		
3. https://en.wikipedia.org/wiki/Intellectual_property		
4. https://en.wikipedia.org/wiki/Intellectual_propert		
5. https://www.itu.int/en/ITU-T/ipr/Pages/default.aspx		

COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3109.1	2	-	-	-	-	2	-	-	-	-	-	-
CO3109.2	2	-	-	-	-	2	2	-	-	-	-	-
CO3109.3	2	-	-	-	-	2	2	-	-	-	-	-
CO3109.4	2	-	-	-	-	1	-	-	-	-	-	-
CO3109.5	2	-	-	-	-	2	2	-	-	-	-	-

COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3109.1	2	-	-	-	2
CO3109.2	2	-	-	-	2
CO3109.3	2		1	-	2
CO3109.4	2	-	-	-	2
CO3109.5	1	-	-	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development / Entrepreneur

Code: MULEEE3110	Robotics	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES: To understand the basic concepts associated with the design and Functioning and applications of Robots To study about the drives and sensors used in Robots To learn about analyzing robot kinematics and robot programming.

COURSE OUTCOME:

The student would be able to:

CO3110.1 To be able to introduce basics of robotics.

CO3110.2 To understand robot kinematics and robot programming

CO3110.3 To understand the application of Robots

CO3110.4 To learn about force and torque sensing

CO3110.5 To acquire knowledge of robotics programming.

A. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	FUNDAMENTALS	9
2.	ROBOT KINEMATICS	9
3.	ROBOT DYNAMIC ANALYSIS AND FORCES	8
4.	ACTUATORS AND SENSORS	9
5.	ROBOT PROGRAMMING, SYSTEMS AND APPLICATIONS	9

B. Detailed Syllabus

Unit	Unit details
Unit 1	**FUNDAMENTALS** Historical information, robot components, Robot characteristics, Robot anatomy, Basic structure of robots, Resolution, Accuracy and repeatability, Position Analysis forward and inverse kinematics of robots, Including frame representations.
Unit 2	**ROBOT KINEMATICS** Transformations, position and orientation analysis and the Denavit-Hartenberg representation of robot kinematics, The manipulators, The wrist motion and grippers. Differential motions, Inverse Manipulator Kinematics: Differential motions andvelocity analysis of robots and frames.
Unit 3	**ROBOT DYNAMIC ANALYSIS AND FORCES** Analysis of robot dynamics and forces, Lagrangian mechanics is used as the primary method of analysis and development. Trajectory Planning: Methods of path and trajectory planning, Both in joint-space and in Cartesian-space.
Unit 4	**ACTUATORS AND SENSORS** Actuators, including hydraulic devices, Electric motors such as DC servo motors and stepper motors,Pneumatic devices, as well as many other novel actuators, It also covers microprocessor control of these actuators, Mechatronics, Tactile sensors, Proximity and range sensors, Force and torque sensors, Uses of sensors in robotics.

Unit 5	**ROBOT PROGRAMMING, SYSTEMS AND APPLICATIONS** Robot languages, Method of robots programming, Lead through programming methods, A robot programs as a path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and limitation of lead through methods and robotic applications. Basic principles of fuzzy logic and its applications in microprocessor control and robotics.

C. RECOMMENDED STUDYMATERIAL:

S.No	Title of the Book	Author
1.	Robotics Control Sensing, Vision and Intelligence	McGraw Hill Gonzalez, R. C., Fu, K. S. and Lee, C.S.G.
2.	Robotics for Engineers	McGraw Hill Koren,Y
3.	Introduction to Robotics, Analysis, Systems, Applications,	Dorling Kingsley, Dorling Kingsley Niku, S.B
4.	Programming robot controllers	McGraw Hill Predko, M

Important Web Links:

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101099/
3. https://nptel.ac.in/courses/112/101/112101098/
4. https://swayam.gov.in/nd1_noc20_me03
5. https://www.youtube.com/watch?v=DaWMvEY3Qgc

COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3110.1	2	-	-	-	-	2	-	-	-	-	-	-
CO3110.2	2	-	-	-	-	2	2	-	-	-	-	-
CO3110.3	2	-	-	-	-	2	2	-	-	-	-	-
CO3110.4	2	-	-	-	-	1	-	-	-	-	-	-
CO3110.5	2	-	-	-	-	2	2	-	-	-	-	-

COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3110.1	2	-	-	-	2
CO3110.2	2	-	-	-	2
CO3110.3	2		1	-	2
CO3110.4	2	-	-	-	2
CO3110.5	1	-	-	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development / Entrepreneur

Code: MULEEE3111	Digital India Implementation	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES: The Digital India programme aims to provide broadband highways, universal access to mobile connectivity, public internet access programme, e-governance: Reforming government through technology, eKranti - Electronic delivery of services, Information for all, Electronics manufacturing: Target net zero imports, IT for jobs and early harvest programmes

COURSE OUTCOME:

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

CO3111.1. Understand concepts and objectives digital India and digital infrastructure.

CO3111.2 Understand the pillars of the digital India.

CO31111.3 Understand the concept of new digital services and platforms for implementations purpose.

CO3111.4 Understand the various digital facilities to empower citizen.

CO3111.5 Apply the digital India initiative for training objective.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Digital India Initiative	8
2.	Focus Area	8
3.	Implementation	9
4.	Facilities To Digitally Empower Citizen	7
5.	Training	8

B. DETAILEDSYLLABUS

Unit	Unit Details
1.	**Digital India Initiative**
	Concept, aims and objectives, opportunities, inclusive growth in areas of electronic services, products, manufacturing and job opportunities, centered on three keyareas– Digital Infrastructure as a Utility to Every Citizen, Governance & Services on Demand and Digital Empowerment of Citizens.
2.	**Focus Area**
	The Government of India specifically targets nine 'Pillars of the Digital India' as follows: Broadband Highway, Universal Access to Mobile connectivity, Public Internet Access Programme, E-Governance, reforming Government through Technology, E- Kranti, electronic delivery of services, Information for All, Electronics Manufacturing,IT for Jobs
3.	**Implementation**
	New digital services, MyGov.in is a platform to share inputs and ideas on matters of policy and governance, UMANG (Unified Mobile Application for New-age Governance) ,AADHAR,Digi-Locker,BharatBill Payment System, PAN, EPFO services, PMKVY services, Indian railway tickets bookings, birth certificates, e-District, e-Panchayat, e-Sign framework, Swachh Bharat Mission(SBM) Mobile app, e-Hospital application, Digital attendance.
4.	**Facilities To Digitally Empower Citizen**
	Digital locker facility, eliminating the use of physical documents and enables the sharing of verified electronic documents across government agencies, three key stakeholders of citizen, issuer and requester. BPO and job growth, government is planning to create 28,000 seats of bpos in various states and set up at least one common service centre in each of the gram panchayats in the state.Easy access to a common services center (CSC), Shareable private space on a public cloud, Safe and secure cyberspace, Universally accessible digital resources, Collaborative digital platforms for intergovernmental operations. E- Samparkvernacular email service: connect rural India with the

	digital India, the government of India impelled email services provider giants including Gmail, office and rediff to provide the email address in regional languages, anIndian-based company, data Xgen technologies pvt.ltd, has launched world‟s first free linguistic email address under the name „Data mail‟ which allows creating email ids in 8 Indian languages, English; and 3 foreign languages – Arabic, Russian and Chinese. Overthe period of time the email service in 22 languages will be offered by Data Xgen technologies.
5.	**Training**
	PradhanMantriGramin, Digital SakshartaAbhiyan, PMG Disha, Ongoing awareness campaign, reception within country and the outside world, criticism and impact.

C. RECOMMENDED STUDY MATERIAL:

S.No	Book	Author	Publication
a. Reference Books			
1.	Digital India: Understanding Information,Communication and Social Change	PradipNinan Thomas	SAGE
2.	Book on Digital India (Special Edition) by National e-governance mission, Government of India		
Important Web Links:			
1. https://economictimes.indiatimes.com/tech/internet/digital-india-15-salient-things-to-know-about-pm-narendra-modis-project/articleshow/47893380.cms			
2. https://en.wikipedia.org/wiki/Digital_India			
3. https://www.researchgate.net/publication/303643369_Digital_India_Objectives_Initiatives_and_Inherent_Challenges			
4. https://digitalindia.gov.in/content/programme-pillars			
5. https://www.civilserviceindia.com/subject/Essay/digital-india-or-green-india-discuss3.html			

D.COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3111.1	2	-	-	-	-	2	-	-	-	-	-	-
CO3111.2	2	-	-	-	-	2	2	-	-	-	-	-
CO3111.3	2	-	-	-	-	2	2	-	-	-	-	-
CO3111.4	2	-	-	-	-	1	-	-	-	-	-	-
CO3111.5	2	-	-	-	-	2	2	-	-	-	-	-

E.COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3111.1	2	-	-	-	2
CO3111.2	2	-	-	-	2
CO3111.3	2		1	-	2
CO3111.4	2	-	-	-	2
CO3111.5	1	-	-	-	-

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development / Entrepreneur

Code: MULECV3112	SMART CITY DESIGN	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES:

The objective of the Smart Cities **Mission** is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and **application** of 'Smart' Solutions.

COURSE OUTCOME:

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

C03112.1 Understand the concept of smart city and smart energy business concepts.

CO3112.2 Apply governance of smart city by various techniques like Augmented Reality for City Planning.

CO3112.3. Understand the concept and characteristics of Smart City Intelligent Buildings and Urban Spaces.

CO3112.4 Understand the environmental and economic impacts on buildings by Multi-objective optimization.

CO3112.5 Apply the energy management and Smart City Distributed Energy.

A. OUTLINE OF THE COURSE

Unit No.	Title of the Unit	Time required for the Unit (Hours)
1.	Smart City Introduction And Concept	7
2.	Smart City Governance	8
3.	Smart City Intelligent Buildings And Urban Spaces	7
4.	Multi Objective Optimization- Smart City	7
5.	Smart City Distributed Energy	8

B. DETAILED SYLLABUS

Unit	Unit Details
1.	**Smart City Introduction And Concept**
	Smart City: local but networked, distributed but integrated Smart City, City monitoring and operation systems. Vision of an open smart city inter-operability environment Road maps for research and innovation policy Smart energy business concepts for Energy Hub districts Identifying development trends in smart city technologies – VTT Trend generator Public procurement of innovation for smart city solutions.
2.	**Smart City Governance**
	Real-time decision support systems for city management, Boosting collaborative planning with visualisation technology, Virtual Model Facilitating Citizen Interaction, Mobile Augmented Reality for City Planning, Co-creating future smart cities - Visual and participative urban planning services Citizen-driven co- design for a smarter city Social media for citizen participation Gamification as an enabler of mutual learning in complex health care systems Decision-making support: A smart city perspective
3.	**Smart City Intelligent Buildings And Urban Spaces**
	Intelligent buildings and urban spaces in smart cities Intelligent urban spaces– automatic real-time responses to people behavior Occupancy in smart buildings of smart cities – case hospital smart lighting Mobile augmented reality for building maintenance Autonomous management system for buildings and districts
4.	**Multi Objective Optimization- Smart City**

	Multi-objective optimization for the minimization of environmental and economic impacts on buildings at district level Intelligent Street lights adapt to conditions City mills leading the positive change in recycling.
5.	**Smart City Distributed Energy**
	Distributed renewable energy and energy management Highlights from the Smart Grids and Energy Systems programme. Active distribution networks with full integration of demand and distributed resources Integration of variable power generation into urban energy systems Future district heating solutions for residential districts Smart metering cyber security ICT for neighborhoods‟ energy management Energy-Hub for residential and commercial districts and transport ICT-supported business in energy positive neighborhood‟s Renewable energy and energy efficiency in new districts – how to accelerate systemic change towards smart cities Internet of Energy: Electric Mobility with Smart Grids.

C. RECOMMENDED STUDY MATERIAL:

S.No	Book	Author	Publication
a. Reference Books			
1.	Building smart cities-Analytics, design building and thinking	Carol l. Stimmel	Auerbach Publications
2.	Smart City- Foundation, principles and application	Houbing Song	JOHN WILEY
3.	Smart city and urban development of India	N. Mani	New Century Publications
b. Important Web Links:			
1.	https://nptel.ac.in/courses/105/105/105105160/		
2.	https://nptel.ac.in/courses/124/107/124107007/		
3.	https://swayam.gov.in/nd1_noc20_ce43/preview		
4.	https://www.youtube.com/watch?v=8G8ewFxE_V8		
5.	http://www.digimat.in/nptel/courses/video/105105160/L41.html		

D.COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3112.1	1	-	-	-	-	2	2	-	-	-	-	-
CO3112.2	2	-	-	1	1	1	1	-	-	-	-	-
CO3112.3	2	1	1	1	-	1	-	-	1	-	1	-
CO3112.4	2	-	-	1	-	1	-	-	1	-	-	1
CO3112.5	-	-	2	-	1	2	-	-	-	-	1	-

E.COs AND POs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3112.1	3	1	1	1	1
CO3112.2	1	-	3	-	2
CO3112.3	2	2	-	2	1
CO3112.4	1	1	1	-	2
CO3112.5	1	1	3	2	-

Note: On the basis of mapping of COs with POs, this course is related to Skill Development / Entrepreneur

Code: MULEEE3113	Renewable Energy	3 Credits [LTP: 3-1-0]

COURSE OVERVIEW AND OBJECTIVES

The course should enable the students to:
1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. Analyse the environmental aspects of renewable energy resources.

COURSE OUTCOME

The student would be able to

CO03113.1 Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations

CO03113.2 Know the need of renewable energy resources, historical and latest developments.

CO03113.3 Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc

CO03113.4 Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.

CO03113.5 Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications

B. OUTLINE OF COURSE

Unit No.	Title of the unit	Time required for the Unit (Hours)
1	CLASSIFICATION OF ENERGY	**9**
2	APPLICATIONS OF SOLAR ENERGY	**10**
3	BIO ENERGY SOURCES	**8**
4	WIND ENERGY & SMALL HYDRO POWER SYSTEMS	**10**
5	OCEAN & GEOTHERMAL ENERGY	**7**

C. Detailed Syllabus

Unit No.	Description
UNIT 1	**CLASSIFICATION OF ENERGY** Energy chain and common forms of usable energy- Present energy scenario-World energy status-Energy scenario in India - Introduction to renewable energy resources Introduction to Solar Energy-Energy from sun-Spectral distribution of Solar radiation- Instruments for measurement of solar radiation-Solar radiation data analysis

UNIT 2	**APPLICATIONS OF SOLAR ENERGY** Thermal applications -Introduction to Solar thermal collectors- Types - Principle of operation of different collectors - Flat plate- Evacuated tube collectors-Compound parabolic collectors-
	Solar air heaters - Solar dryers-solar cookers- solar stills - Solar ponds - concentrating collectors- line type - point type - Methods of Solar power generation - Power towers. Physics of solar cells - Cell and module Characteristics of cells and module - Performance parameters -BoS- PV System applications - Stand- alone- Grid connected systems
UNIT 3	**BIO ENERGY SOURCES** Energy through various processes - Energy through fermentation - Gasification - various types of gasifiers -Pyrolysis - Fixed bed and fast Pyrolysis - Bio energy through digestion - Types of Digesters- Factors affecting the yield of products
UNIT 4	**WIND ENERGY & SMALL HYDRO POWER SYSTEMS** Resource assessment - types of wind turbines - selection of components - blade materials - power regulation - various methods of control - wind farms - site selection - off shore wind farms - Solar Wind Hybrid energy systems. Introduction - types - system components, discharge curve and estimation of power potential- Turbines for SHP
UNIT 5	**OCEAN & GEOTHERMAL ENERGY** Power generation through OTEC systems - various types - Energy through waves and tides - Energy generation through geothermal systems - types

D. COs AND POs MAPPING

COs and POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO3113.1	3	2	1	1	-	1	-	-	-	-	-	-
CO3113.2	3	2	3	-	1	-	-	-	-	-	-	-
CO3113.3	2	2	3	1	1	-	-	-	-	-	-	-
CO3113.4	1	3	-	2	2	1	-	-	-	-	-	-
CO3113.5	1	1	2	3	1	-	-	-	-	-	-	-

E. COs AND PSOs MAPPING

COs and PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO3113.1	3	2	-	-	2
CO3113.2	-	3	2	-	1
CO3113.3	2	3	-	1	-
CO3113.4	1	3	-	2	-
CO3113.5	-	3	2	-	2

Note: On the basis of mapping of COs with POs, this course is related to Employability / Skill Development

Code: MEECCV3402	Dissertation Part-I	6 Credits [LTP:-0-0-12]

The Project can be carried out in the Institution/Industry/Research laboratory or any other competent institutions.

	POORNIMA UNIVERSITY, JAIPUR								
	Faculty of Engineering and Technology								
Name of Program:	**M.Tech. in Energy and Environment Duration: 2 Years Total Credits: 80**								
	Teaching Scheme for Batch 2023-25								
	Semester-IV								
Course Code	**Name of Course**	**Teaching Scheme**				**Marks Distribution**			**Credits**
		Lecture (L)	**Tutorial (T)**	**Practical**	**SH**	**IE**	**ESE**	**Total**	
A.		**Major (Core Courses)**							
A.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
A.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
B.		**Minor Stream Courses/ Department Electives/*Core Elective***							
B.1	**Theory**								
-	-	-	-	-	-	-	-	-	-
B.2	**Practical**								
-	-	-	-	-	-	-	-	-	-
C		**Multidisciplinary Courses**							
-	-	-	-	-	-	-	-	-	-
D		**Ability Enhancement Courses (AEC)**							
-	-	-							
E		**Skill Enhancement Courses (SEC)**							
-	-	-	-	-	-	-	-	-	-
F		**Value Added Courses (VAC)**							
	-	-	-	-	-	-	-	-	-
G		**Summer Internship / Research Project / Dissertation**							
MEECCV4401	Dissertation Part - II	-	-	30		250	250	500	15
Total		0	0	30					**15**
Total Teaching Hours		**30**							

Code: MEECCV4401	Dissertation Part-II	15 Credits [LTP:-0-0-30]

The Project can be carried out in the Institution/Industry/Research laboratory or any other competent institutions.

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