Master of Technology in
Materials and Energy Engineering (MEE)

Programme Level	Post Graduate
Year of Commencement	2014
Minimum Duration	2 Years (4 Semesters)
Maximum Duration	3 Years (6 Semesters)
Senate Meeting Reference	6.5/8.6/18.5/22.7/30.6

School of Engineering

(Restructuring and renaming of M. Tech. in Energy Engineering Specialization in Materials to M. Tech. in Materials and Energy Engineering (MEE) has been approved by the Senate in its 30th meeting held on 03-02-2021)

What the new program can offer

With ever increasing energy requirement and clear ill-effects of our dependence on fossil-fuel on the climate, impact of well-established studies on energy management is undeniable; especially the non-conventional energy sector and material development for such or existing energy systems are of national and international importance. Amongst others, a major emphasis is bestowed upon novel material synthesis and their application in renewable/non-conventional energy conversion and storage on a global scale. Over recent years there has been a steady growth in the renewable energy sector, which is vastly driven by boost of research in novel material incorporation in existing systems. The recent changes in government policies favoring non-conventional/renewable energy sectors, focused research on development of 'energy materials'/ efficient systems have clear implication on increased demand for specialists and engineers in this evolving scenario, both understanding the science and technology of material development followed by system improvement and its management for allied policy regulation. This program intends to fill the void between the two with a holistic approach of course curriculum consisting of deep understanding of the present infrastructure, policies, scope of improvement and development of new materials/technology useful for both conventional and non-conventional energy systems. Hence, *M Tech MEE* aims to train students who can walk both the shoes of an energy engineer/technologist and policy regulator.

Description of the program

The proposed revision to EEM is an amalgamation of conventional and non-conventional energy related courses focusing on emerging energy source and economical aspects, basics of materials for energy engineering with focus towards renewable energy related studies, computational methodologies etc. The course curriculum consists of one-year course work followed by a one year of post-graduation project work. This curriculum envisages to prepare the students for a professional or research career either in industries or academia after the completion of the program.

Features of this program

- Courses with in-depth understanding of Materials for Energy Engineering along with hands-on experimental facilities
- Detailed materials characterization-based laboratory experiments with support from Advanced Materials Research Laboratory at IIT Mandi

- ❖ Computational methods-oriented laboratory course which is a must for modern material engineers
- ❖ Vast choice of discipline electives to be chosen from pool of courses of IIT Mandi pertaining to Energy Engineering
- ❖ Scope of focused research on materials-energy-materials for energy nexus

Apart from these, a few added benefits of this revision may not be ignored, albeit they do not strictly contribute to the main harvests of revised curriculum -

- More useful courses for MS/PhD students who hail from the said area and envisage to research on same
- Possible rejuvenation in B Tech Minors in Materials.

Program structure

Eligibility criteria

The eligibility criteria of the said program are –

a) B Tech in Mechanical, Metallurgical, Production, Manufacturing, Materials, Chemical and Electrical/relevant Engineering with Valid GATE score (GATE paper code EC: Electronics and Communication Engineering not allowed)
b) M Sc. in Physics, Chemistry, or relevant degree with Valid GATE Score

* Engineering Stream who has chosen Engineering Science (XE) as GATE examination with only relevant paper codes (exam paper codes- D, G and H: Solid mechanics, food technology and atmospheric and ocean sciences are not allowed)

Credit distribution

Total credits requirements: 72

Dissertation: 32 Credits

Course work: 39 Credits

Industrial training/research internship: 4-6 weeks (1 Credit)

Courses	Credits
Core courses (including Laboratory)	**23**
Discipline elective courses	**9**
Technical communication, Industrial visits/Research internship	**2**
Outside discipline elective courses	**6**
Final Year project	**32**

Proposed Curriculum

	Semester I				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
1.	C1: Emerging Energy Sources (EN 502)	3	0	0	3
2.	C2: Functional Materials for Energy Engineering *(modified)* (ME609)	3	0	0	3
3.	C3: Electrochemical Systems for Energy Engineering *(proposed)*	3	0	2	4
4.	L1: ***Structure-Property Correlations for Energy Applications*** *(modified)* (EN612)	1	0	4	3
5.	Discipline Elective-1	3	0	0	3
6.	Outside Discipline Elective-1	3	0	0	3
7.	Technical Communication	1	0	0	1
	Total				**20**

	WINTER BREAK				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
8.	ME695P: Post Graduate Project 1 *(proposed)*	0	0	4	**2**

	Semester II				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
9.	C4: Photovoltaic Materials and Fabrication (EM 651)	3	0	0	3
10.	C5: Computational Methods in Material Science *(proposed)*	1	0	6	4
11.	C6: Durability Behaviour of Energy Materials *(modified)* (EN611)	3	0	0	3
12.	Discipline Elective-2	3	0	0	3
13.	Discipline Elective-3	3	0	0	3
14.	Outside Discipline Elective-2	3	0	0	3
15.	Industrial/Research Internship **(SUMMER TERM)**				1
	Total				**20**

	Semester III				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
16.	ME696P: Post Graduate Project 2	0	0	28	**14**

	Semester IV				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
17.	ME697P: Post Graduate Project 3	0	0	32	**16**

List of possible discipline electives

1. Energy Storage Technology* (Approved in 9th Senate Meeting) (EN503)
2. Nanomanufacturing* (Approved in 8th Senate Meeting) (ME509)
3. Nano-electronics and nano-microfabrication* (Approved in 6th Senate Meeting) (EE615)
4. Carbon Materials and Technology* (ME 515)

5. Science and Technology of Nanomaterials* (Approved in 9th Senate Meeting) (CY554)
6. Hydrogen Generation and Storage*(Approved in 9th Senate Meeting) (CY552)
7. Convective Heat and Mass Transfer* (Approved in 9th Senate Meeting) (ME 616)
8. Heat Transfer and Fluid Flow in Energy Systems* (Approved in 10th Senate Meeting) (ME 631)
9. Introduction to High Voltage Engineering and Dielectric Breakdown* (Approved in 5th Senate Meeting) (EE 606)
10. Renewable Energy and Smart Grid (Approved in 2nd Senate Meeting) (EE603)*
11. Manufacturing for Energy Systems (Approved in 10th Senate Meeting) (ME635)*
12. Advanced Thermodynamics (Approved in 2nd Senate Meeting) (ME 610)*
13. Energy Economics (HS 582)*
14. Polymer Technology for Engineers
15. Materials Processing Technology
16. Energy Materials and Devices
17. Materials Recycling and Waste Management
18. Power sources for electric vehicles
19. Fuel Cell Technology
20. Energy storage systems coupled with Microgrids

* Courses which are already running at IIT Mandi

Rationale behind the change

The core of Energy Engineering is largely intertwined with the concepts of Material Science and the engineering thereof. To walk on the shoes of an Energy Engineer with in-depth knowledge of Materials, one must appreciate the intricacies of materials' roles eventually. From the time of inception of Energy Engineering with Specialization in Materials, aka EEM, till date, faculty members associated with teaching and most importantly, the students could feel that the existing curriculum lacked in-depth understanding of certain aspects of the curriculum vision and provided a broader outlook to it. Several internal meetings with students allowed the concerned faculty members to introspect the curriculum. Apart from missing the flavor of the vision of this program, the confusion among recruiters with the program name, the skewed course load distribution along with lack of synergy between theory and project work were few other concerns.

Event Timeline

The internal meetings between faculty members of School of Engineering took place thrice- dated- 03.07/07.08/ and 03.09.2020, followed by in-depth discussion with PFG-EEM on 16.11.2020. The feedbacks from students were collected over a significant period. The industrial expert review was conducted by 02.12.2020. Finally, the proposal was placed before Board of Academics on 22.01.2021 for further discussion.

Annexure I

Previous Curriculum

	Semester I				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
1.	F1. Foundation 1: EN501: Energy Sources and Power Plants	3	0	0	3
2.	F2. Foundation 2: EN502: Emerging Energy Sources	3	0	0	3
3.	F3. Foundation 3: HS 540: Energy: Environment Policy and Law	3	0	0	3
4.	C1. EN503: Energy Storage Technology	2	0	2	3
5.	EN505P: Energy Systems Laboratory	0	0	4	2
6.	DP500P: Research Practicum	0	0	6	3
7.	HS541: Technical Communication	1	0	0	1
8.	Free Elective-1	3	0	0	3

	Semester II				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
9.	C2. ME 620: Modelling and Simulation	2	0	2	3
10.	C3. EN611: Durability Behaviour of Energy Materials	3	0	0	3
11.	C4. EN612: Structure- Property correlation in materials for Energy Applications	3	0	0	3
12.	Specialization Elective-1	3	0	0	3
13.	Free Elective-1	3	0	0	3
14	Free Elective-2	3	0	0	3
	Summer Term				
15.	DP 512 P: Industrial/ Research Internship				1

	Semester III				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
16.	C5. EN613 Creep-Fatigue Interaction	3	0	0	3
17.	ME596P: Dissertation	0	0	28	14

	Semester IV				
	Course Name	**Credit Structure**			
		L	**T**	**P**	**C**
18.	ME597P: Dissertation	0	0	36	18