PG Course Structure and Templates (Revised for 2023 batch and onwards)

A brief outline of the requirements is given here. For details regarding the course structure and other details the students are requested to consult other sources, including the PG manual (https://www.iitk.ac.in/doaa/ › PG students).

1. Overview

The requirements related to PG programmes can be broadly divided into:

(i) Coursework requirements

(ii) Thesis research work

(iii) TA duty (towards institute/other scholarship)

(iv) Other requirements

2. Coursework and Thesis Requirements (PG Programmes)

- For a full-time student, the normal semester load is defined as equivalent of 36 credits. For a well-merited case, the SPGC may permit a student to register for a maximum of 45 credits or a minimum of 27 credits.
- A full-time student is required to register in the summer term for up to a maximum of half the normal semester load.
- The course work credits listed here are minimum and students can credit more courses as per the norms specified in the PG manual. The thesis credits registered for in the summer term is not included in Table 1.
- In terms of the requirements: (i) B.S. in science (4 year) degree will be considered equivalent to M.Sc, (ii) B.S. in engineering (4 year) will be considered equivalent to B.Tech.
- For scholarship via other funding sources (e.g. project funding) refer to the PG manual and other relevant documents.

Table 1. Coursework and thesis requirements for M.Tech., M.S.(R), and Ph.D. programmes in Sustainable Energy Engineering

Program admitted to	Highest Degree qualified	Min. Course Credits	Min. Thesis Credits	Min. Total	Scholarship period *	Minimum Duration	Maximum Duration**
M.Tech.	B.Tech.	72	72	144	22 months	4 semesters	4 years
	M.Sc.	72	72	144			
M.S. (R)	B.Tech.	36 + 18$	108 - 18$	144	22 months	4 semesters	4 years
	M.Sc.	36 +18$	108 - 18$	144			
Ph.D.	B.Tech.	72 +18$	144 - 18$	216	5 years	6 semesters	7 years
	M.Sc.	72 + 18$	144 - 18$	216		6 semesters	7 years
	M.Tech.	36 + 18$	108 - 18$	144		4 semesters	6 years

* Scholarship refers to financial assistance provided by MHRD via the Institute. The period refers to the maximum period the full scholarship can be received. Other details can be found in the PG manual.

** For external students or part time students one additional year is added to the maximum duration.

$Applicable for the admitted students from 2023-24, Semester I, and onwards.

2.1 Minimum Academic Requirements (Section 7.7 PG manual)

- The minimum CPI requirement for continuing in the programme or for graduation is as follows.
- M.Tech./M.S. by Research is 6.5 and that for the Ph.D. programme is 7.0.
- In the first semester in which the student registers, the minimum CPI (SPI) may be relaxed to 6.0 and the student may be allowed to continue in the following semester on the recommendations of the DPGC and with the approval of the SPGC. A letter of warning will be issued by the Head of the Department/IDP of the student.
- In subsequent semesters, if a M.Tech./M.S. by Research secures a CPI between 6.0 and 6.5 or a Ph.D. student secures a CPI between 6.5 and 7.0, he/she may be allowed to continue in the following semester on the recommendation of the DPGC and with the approval of the SPGC. A letter of warning will be issued by the Head of the Department/IDP of the student.

3. Course Requirements (M.Tech., M.S.(R), and Ph.D.)

The following template is dependent on the on actual offering of electives in a given semester. PG students have to register for and clear SEE690 and SEE691 courses as found later in the document.

- Note: Students can always take a compulsory course from the basket *as an elective* (guide/DPGC is expected to give its advice on the matter, taking into account the background of the student).

Table 2. Compulsory and elective courses in DSEE and other relevant courses for UG & PG students.

The courses are distributed over Semester I (odd) and II (even)	Credits
SCHEME basket course (for UG students)	**L-T-P-C**
SEE-211: Energy, Climate Change and Sustainability [*Semester II*]	3-0-0-9
PG Core Basket (minimum 2 for M.Tech., M.S.(R), and Ph.D. students)	
SEE-601: Thermo-Fluid Engineering [*Semester I*]	3-0-0-9
SEE-602: Physics of Energy Materials [*Semester I*]	3-0-0-9
SEE-603: Electrical Power Engineering [*Semester I*]	3-0-0-9
SEE-609: Mathematical and Computational Tools for Engineering* [*Semester I*]	3-0-0-9
SEE-612: Manufacturing of energy systems [*Semester II*]	3-0-0-9
SEE-604: Thermodynamics of Energy Systems [*Semester II*]	3-0-0-9
Compulsory (for all M.Tech., M.S.(R), and Ph.D. students)	
SEE-605: An Introduction to Sustainable Energy Technologies (with Laboratory) [*Semester II*]	2-0-3-9
SEE-690: Seminar Course I [both semesters]	0-0-0-0
SEE-691: Seminar Course II [both semesters]	0-0-0-0
Compulsory (only for Ph.D. students)	
SEE-888: Introduction to profession and communication [Semester I]	1-0-0-3
Department Electives	
SEE-606: Electrochemical Energy Systems	3-0-0-9
SEE-607: Hydrogen Energy: Production, Storage and Utilization	3-0-0-9
SEE-608: Introduction to Bioenergy and Biofuels	3-0-0-9
SEE-610: Introduction to Materials Modelling and Simulations$	3-0-0-9
SEE-611: Energy Systems: Modelling and Analysis	3-0-0-9
SEE 613: Solar Photovoltaics	3-0-0-9
SEE-614: Wind Energy	3-0-0-9
SEE-615: Solar Thermal Engineering	3-0-0-9
SEE-616: Renewables Integrated Smart Power System	3-0-0-9
SEE-617: Introduction to sustainable energy policy	3-0-0-9
SEE-618: Energy Efficient Building Design	3-0-0-9
SEE-619: Finite Volume Methods for Engineers	3-0-0-9
SEE-620: Heat Driven Cooling Systems	3-0-0-9
SEE-621: Biomass Conversion and Biorefineries	3-0-0-9
SEE-622: Sustainable Energy- Enabling Net Zero Emissions	3-0-0-9
SEE-623: Fuel Cell Electrical Energy Systems	3-0-0-9
SEE-624: Design Strategies for Net-Zero Energy Buildings	3-0-0-9
SEE-625: Structural, Microstructural and Spectroscopic Characterization of Materials	3-0-0-9

SEE-626M: Ecological Principles and Biodiversity for Sustainability	3-0-0-5
SEE-627: Electric Vehicles	3-0-0-9
SEE-628: Policy Processes and Analytical Methods: Application to Climate Policies	3-0-0-9
SEE-629M: Ecology, Equity and the Economy	3-0-0-5
SEE-631 Sustainable Forest Management	3-0-0-5
SEE-632: Heating, Ventilation, and Air-conditioning of Buildings	3-0-0-9
SEE-633: Power electronics for electric vehicles	3-0-0-9

Open Electives	
EE698D: Smart Grid Technology	3-0-0-9
EE630A: Simulations of Power Systems	3-0-0-9
EE660A: Basics of Power Electronic Converters	3-0-0-9
EE631A: Advanced Power System Stability	3-0-0-9
MSE673: Fundamentals and Applications of Electrochemistry	3-0-0-9
ME743: Fuel Cells	3-0-0-9
ME685A: Applied Numerical Methods*	3-0-0-9
AE603: Introduction to Scientific Computing*	3-0-0-9
CHE622A: Molecular Simulations[$]	3-0-0-9
ChE626A: Practical Introduction to Quantum Mechanical Methods for Scientists and Engineers[$]	3-0-0-9
Any other suitable elective in the Institute	3-0-0-9
[#] Designated as an elective only for the students admitted in May-July 2023 and onwards.	
[#]This is designated as a core course only for the students' of 2022 batch. However, those who have already taken SEE 603 are exempted from SEE 616 as core/compulsory.	

*,[$]Students should take only one of these courses (i.e. Students can take ONLY one of the following set: CHE642A, ME685A, AE603, SEE-609 and ONLY one of the following two: CHE622A, ChE626A)

Students can chose choose other electives from across the institute in consultation with their guide (supervisor). The following is a list of additional relevant electives offered by other departments.

3.1.1 Other Relevant Institute Electives (subject to the changes)

- MBA681A: Energy and Carbon Markets: Economics, Policy and Regulation
- MBA782A: Renewable Energy - Economics, Policy and Regulation
- MBA683A: Power Sector Reform & Reform and Regulation
- MSE604: Science and Technology of Thin Films and Device Fabrication
- MSE624A: Energy Materials and Applications
- MSE624A: Electronic Devices and Characterization
- MSE679: Optoelectronic Materials and Devices
- ME648A: Design of Thermal Systems
- ME613: Thermal Environmental Control
- ME639: Liquid-Vapour Phase Change Technologies
- ME742: Thermal Phase Change Systems
- EE662: Control Techniques in Power Electronics
- EE632: Economic Operation & Control of Power Systems
- HSSXXX: Sociology of Energy and Sustainable Development
- MSE681A: Mathematics for Engineers
- AE603: Introduction to Scientific Computing
- AE602A: Mathematics for Aerospace Engg.

4. COURSE TEMPLATES

The templates given below are as a guide to the student. The actual template *may* vary depending on other factors. Summer term registration is not shown in this section.

Master's Students who wish (or are keeping the option open) to convert to a PhD programme, are requested to keep a note of this in view during exercising the choices.

Students are strongly recommended to take a course on **technical communications** (SEE690/SEE691)

4.1 Typical Template for M.Tech. (for both Regular and Dual-degree)

Table 3. A typical M.Tech. template. A detailed template can be found elsewhere.

Semester→ Year ↓	Odd	Even
1	36 Credits 1-2 from core basket* [9-18] 2-3 Electives# [0-27]	36 Credits 1 Compulsory: SEE 605 [9] 0-1 from core basket* [0-9] 2-3 Electives# [18-27] SEE690 course [0]
2	36 Credits 4 Research units (SEE699) SEE 691 course [0]	36 Credits 4 Research units (SEE699)

* Core basket courses: SEE 601 [9], SEE 602 [9], SEE 603 [9], SEE 604 [9], SEE 609 [9], and SEE 612[9]. A student should take **two** courses [18 credits] from this basket.

The electives should include at the least 3DE's.

In addition, the students are recommended to register up to 18 thesis credits in the summer term.

4.2 Typical MS(R) Template (First 4 Semesters)

Students are strongly recommended to take more courses than the minimum requirement (especially in the first three semesters).

Table 4. A typical M.S. (R) template. A detailed template can be found elsewhere.

Semester→ Year ↓	Odd	Even
1	36 Credits 1-2 from core basket [9-18] 0-2 Electives# [0-18] 0-2 Research Units (SEE899)	36 Credits 1 Compulsory: SEE 605 [9] 0-1 from core basket [0-9] 0-2 Electives# [0-18] SEE690 course [0] 0-2 Research Units (SEE899)
2	36 Credits 4 Research units (SEE899) SEE 691 course [0]	36 Credits 4 Research units (SEE899)

* Core basket courses: SEE 601 [9], SEE 602 [9], SEE 603 [9], SEE 604 [9], SEE 609 [9], and SEE 612[9]. A student should take **two** courses [18 credits] from this basket.

The electives should include at the least 2DE's.

In addition, the students are recommended to register up to 18 thesis credits in the summer term.

4.3 Typical PhD Template (First 4 Semesters)

Students are strongly recommended to take more courses than the minimum requirement (especially in the first four semesters). I.e. in addition to minimum course credit requirement as mandated by the Department, a PhD student can credit extra courses depending on his/her requirement at any time in their programme.

Table 5. A typical Ph.D. template: for students with M.Tech. background. A detailed template can be found elsewhere.

Semester→ Year ↓	Odd	Even
1	39 Credits 1 compulsory: SEE600 course [3] 1-2 from core basket* [9-18] 2-3 Electives# [18-27]	36 Credits 1 Compulsory: SEE 605 [9] 0-1 from core basket* [0-9] 2-3 Electives# [18-27] SEE690 course [0] 0-2 Research Units (SEE799)
2	36 Credits 4 Research units (SEE799) SEE691 course [0]	36 Credits 4 Research units (SEE799)

* Core basket courses: SEE 601 [9], SEE 602 [9], SEE 603 [9], SEE 604 [9], SEE 609 [9], and SEE 612[9]. A student should take **two** courses [18 credits] from this basket. The SEE 600 [3] is on the top of the minimum requirements.

The electives should include at the least 2DE's.

In addition, the student should register up to 18 thesis credits in the summer term.

Table 6. A typical Ph.D. template: for students with B.Tech./M.Sc. background. A detailed template can be found elsewhere.

Semester→ Year ↓	Odd	Even
1	39 Credits 1 compulsory: SEE600 course [3] 1-2 from core basket* [9-18] 2-3 Electives# [18-27]	36 Credits 1 Compulsory: SEE 605 [9] 1-2 from core basket* [9-18] 0-2 Electives# [0-18] SEE690 course [0] 0-2 Research Units (SEE799)
2	36 Credits 2 Research units (SEE799) 2 Electives# [18] SEE691 course [0]	36 Credits 4 Research units (SEE799)

* Core basket courses: SEE 601 [9], SEE 602 [9], SEE 603 [9], SEE 604 [9], SEE 609 [9], and SEE 612[9]. A student should take **three** courses [27 credits] from this basket. The SEE 600 [3] is on the top of the minimum requirements.

The electives should include at the least 4DE's.

In addition, the student should register up to 18 thesis credits in the summer term.

5. Other Requirements/Duties during the PG Programmes

5.1 Teaching Assistant (TA) duty

PG Students on institute assistantship will have to perform 8 hours of TA work/week. The TA assignment will be done every semester by the DPGC.

5.2 Other Requirements towards the completion of PG degree

Only a brief outline is given here. Students are requested to consult the PG manual for more details.

5.2.1 Registration for regular semesters and the summer term

(Details in section 4 of the PG manual).

In every academic year during his/her programme, a student is required to register for ODD (I) semester, EVEN (II) semester and the Summer term for the courses/thesis credits that he/she intends to pursue in that semester/term. The registration process involves:

i) submitting a duly approved course programme to be followed in the semester/term,

ii) payment of fees for that semester/term and clearance of any outstanding dues, and

iii) signing the registration roll with the office of the Dean of Students Affairs.

5.2.2 M.Tech./BT-MT (Dual Degree)

After completion of credits as per the programme requirements (see Table 1), the following requirements need to be completed by a M.Tech. student (sections 8-11 PG manual).

(i) Thesis submission

(ii) Oral Examination is to be conducted within four months from the date of submission of the thesis

5.2.3 M.S. (R)

After completion of credits as per the programme requirements (see Table 1), the following requirements need to be completed by a M.S.(R) student (sections 8-11 PG manual).

The following requirements need to be completed by a M.S. (R) student (sections 8-11 PG manual).

(i) Thesis submission

(ii) Oral Examination is to be conducted within four months from the date of submission of the thesis

5.2.4 Ph.D.

After completion of credits as per the programme requirements (see Table 1), the following requirements need to be completed by a Ph.D. student (sections 8-11 PG manual).

(i) Comprehensive examination. The *Doctoral Monitoring Committee (DMC)* should be formed after the comprehensive exam.
(ii) State of the Art (SOTA) Seminar.
(iii) The *Peer Review Committee (PRC)* Should be formed for extension of scholarship beyond the 5th year.
(iv) Open Seminar
(v) Synopsis submission and Thesis submission

Oral Exams

- **Comprehensive exam.** Students registered in the Ph.D. programme must pass a comprehensive examination designed to test the overall comprehension of the student in the various subjects. A student can appear in the comprehensive examination only after he/she has completed the course requirements (including SEE690 & SEE691) and satisfied the minimum specified CPI requirement.
  Students admitted with B.Tech. or M.Sc. degrees may appear in the comprehensive examination earliest at the end of the second semester but must pass it before the end of the fifth semester after their first registration. Students admitted with M.Tech. or equivalent degrees may appear in the comprehensive examination earliest at the end of the first semester but must pass it before the end of the fourth semester after their first registration. The above time limits are exclusive of the period of sanctioned leave, if any.
- **SOTA seminar.** Every Ph.D. student admitted to the candidacy for the Ph.D. degree is required to give a general seminar in the Department covering the State of Art of the area of research. This seminar must be given within six months of passing the comprehensive examination. A report of satisfactory completion of this requirement is to be communicated to Chairperson, SPGC by the thesis supervisor through the Convener, DPGC.
- **Open Seminar.** Before proceeding to finalize the thesis, each Ph.D. student must deliver a seminar open to faculty and students in which the research work will be presented to obtain comments and criticism which may be incorporated in his/her thesis. A notice of the seminar must be displayed at least four days in advance. A thesis can be submitted only after the satisfactory fulfilment of this requirement. The intimation that the open seminar has been given should be communicated by the thesis supervisor through the Convener, DPGC to the Academic Section.

6. Conversion from M.Tech. and MS(R) degrees to PhD (section 4.6 PG manual)

Depending on their academic performance as prescribed in the PG Manual, a student registered for the M.Tech./M.Des./M.S. by Research programme may be allowed in the beginning of the second / third / fourth / fifth semester to change his/her registration to that of the Ph.D. programme in Engineering. The application has to be submitted at least two weeks before the start of the semester.