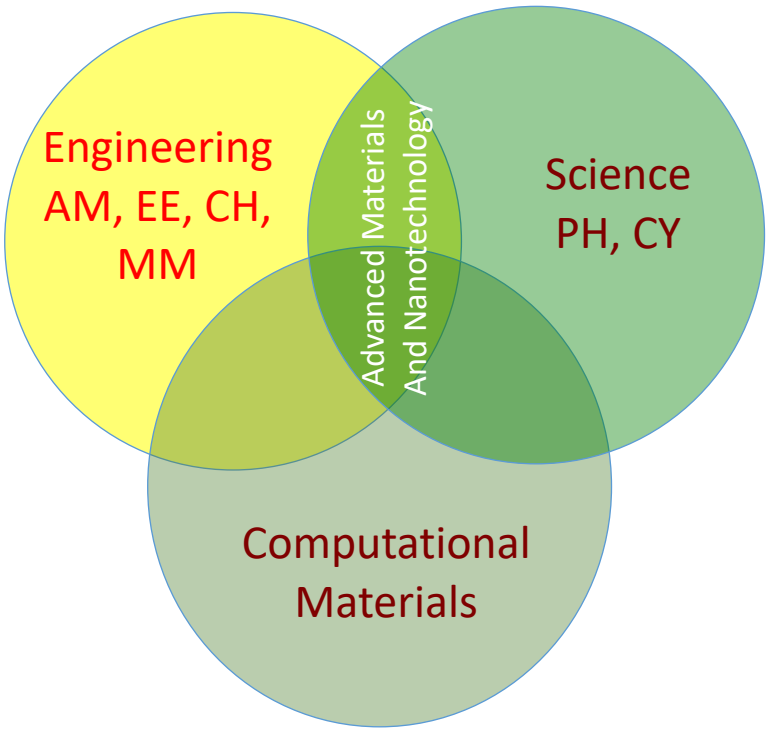
Interdisciplinary Dual Degree in Advanced Materials and Nano Technology

The world around us is made of materials of various kinds and many of these are at the heart of great technological innovations. In the recent times, with the development of nanotechnologies, the functionalities of conventional materials have advanced further and many novel applications are now being explored. Such advanced materials, both in the conventional (bulk) and nano form, are important in several fields such as energy conversion (solar cells) and storage (batteries), microelectronic devices, multiferroic materials, bio-compatible coatings and implants, high strength materials and functional materials for sensors, membranes *etc*. This interdisciplinary Dual Degree (ID-DD) program aims at equipping the students with an understanding of the fundamental science behind advanced materials and also training them with the practical tools and techniques of fabrication (materials and devices). The Department of Physics, IIT Madras is coordinating this new program with the active participation of several other departments.



The programme

The ID-DD programme in Advanced Materials and Nanotechnology designed with inputs from Engineering and Science disciplines. Departments currently offering courses towards this program are Applied Mechanics, Chemical, Chemistry, Electrical, Materials and Metallurgy, Physics. It is typically coordinated by one of these departments. Currently it is coordinated by the Department of Physics.

Eligiblity

B.Tech students (all branches) of IIT Madras can opt for this program. The minimum eligibility criteria prescribed by the senate is that the student should have a minimum of 8 CGPA at the end of 5th semester.

Curriculum

The Curriculum is designed with the understanding that the modern field of Advanced materials and Nanotechnology is based on the exchange of ideas between sciences and Engineering branches. Synthesizing novel materials involves a good knowledge of chemistry and the physical properties exhibited by these novel materials are studied by the Material Scientist (cutting across Physics, Chemistry and Materials departments). Application of these materials for wider usage needs the involvement of Engineers. Computational material science forms an integral part of the field of advanced materials both in terms of the design and understanding of the physics involved. Application of these materials encompasses a wide range of fields: Energy generation and storage materials, batteries, micro electronic devices, magnetic materials, water purification, high strength materials, sustainable plastics, sensors, etc.

The curriculum is expected to facilitate both short/long term internships with private and public companies having strong research and development wings. These internships can lead to final-year projects towards the Dual Degree programme. These internships and projects are expected to enhance industry-academia collaboration for development of novel engineering products based on advanced materials and nano systems

The list of courses to be offered for students opting for DD in Advanced Materials and Nano Technology will have both core courses and electives. The students are allowed to choose four electives out of a total of 33 electives cutting across different disciplines. There will be four core courses that include a course on the Science and Technology of Solid State, two courses on nanomaterial's and nanotechnology and a Laboratory course aimed at giving hands-on experience on Advanced materials and nano systems (36 credits of DD core course).

Those students who opt for the Dual Degree program will do the courses from their 7th Semester as prescribed below.

S.No	Course No.	Course Name	L	T	E	P	O	C
Semester VII								
1	PH5011	*Core 1:* Science and Technology of Solid State	3	1	0	0	6	10
2	PH6022	*Core 2:* Introduction to Nanoscience	3	0	0	0	6	9
Total credits			**6**	**1**	**0**	**0**	**12**	**19**
Semester VIII								
1	*PH6011*	*Core 3: Nano materials and nanotechnology*	3	0	0	0	6	9
2	Elective 1	To be taken from the list of Electives mentioned	3	0	0	0	6	9
3	Elective 2	To be taken from the list of Electives mentioned	3	0	0	0	6	9
4	PH6015	*Core 4:* Advanced Materials and Nanotechnology Lab	0	0	0	6	2	8
Total Credits			**9**	**0**	**0**	**6**	**20**	**35**
Semester IX								
1	ID5190	Project-I (Summer)/Summer internship	0	0	0	0	25	25
2	Elective 3	To be taken from the list of Electives mentioned	3	0	0	0	6	9
3	Elective 4	To be taken from the list of Electives mentioned	3	0	0	0	6	9
3	ID5191	Project II (In the institute)	0	0	0	0	20	20
Total Credits			**6**	**0**	**0**	**0**	**57**	**63**
Semester X								
1	ID5192	Project III (in the Institute)	0	0	0	0	40	40
Total Credits			**0**	**0**	**0**	**0**	**40**	**40**

Total credits for the IDDD programme: 157

Core Courses								
1	PH5011	Science and Technology of Solid State	3	1	0	0	6	10
2	PH6022	Introduction to Nanoscience	3	0	0	0	6	9
3	PH6011	Nano materials and nanotechnology	3	0	0	0	6	9
4	PH6015	Advanced Materials and Nanotechnology Lab	0	0	0	6	2	8

List of Electives								
1	PH5310	Synthesis of Functional Materials	3	0	0	0	6	9
2	PH5320	Techniques of Physical measurements	3	0	0	0	6	9
3	PH5730	Methods of Computational Physics	3	0	0	0	6	9
4	PH5670	Physics and Technology of Thin Films	3	0	0	0	6	9
5	PH5690	Applied Magnetics	3	0	0	0	6	9
6	PH5600	Physics at Low Temperatures	3	0	0	0	6	9
7	PH5680	Superconductivity and applications	3	0	0	0	6	9
8	PH6013	Functional materials, Sensors and Transducers	3	0	0	0	6	9
9	PH5813	Principles of nanophotonics	3	0	0	0	6	9
10	PH5462	Magnetism in solids	3	0	0	0	6	9
11	PH6012	Semiconductor Physics and devices	3	0	0	0	6	9
12	PH5660	Non-linear Optical Processes & Devices	3	0	0	0	6	9
13	EE5347	Electronic and Photonic nanoscale devices	3	0	0	0	6	9
14	EE6500	Integrated Optoelectronics Devices and Circuits	3	1	0	0	6	10
15	ID6102	Principles and techniques of Transmission Electron Microscopy	3	0	0	0	6	9
16	ID5010	Advanced materials and processing	3	0	0	0	6	9
17	ID6050	Chemical Physics of Modern Technical Ceramics	3	0	0	0	6	9
18	MM5210	X-ray diffraction techniques	3	0	0	0	6	9
19	MM5680	Smart Materials	3	0	0	0	6	9
20	MM5700	Topics in nanomaterials	3	0	0	0	6	9
21	MM5017	Electronic materials devices and Fabrication	3	0	0	0	6	9
22	ME7023	Foundations of Computational Materials Modeling	3	0	0	0	6	9
23	CY6380	A Chemical Approach to Nanomaterials	3	0	0	0	6	9
24	CH5012	Modeling and Simulation of Particulate Processes	3	0	0	0	6	9
25	CH5021	Molecular Simulation of Soft Matter	3	0	0	0	6	9
26	CH5270	Polymers for Devices	3	0	0	0	6	9
27	CY6118	Experimental methods in chemistry	3	0	0	0	6	9
28	ID6030	Introduction to nano science and nanotechnology	3	0	0	0	6	9
29	EE5343	Solar Cell Device Physics and Materials Technology	3	0	0	0	6	9
30	EE5346	Introduction to plastic electronic	3	0	0	0	6	9
31	EE5340	MicroElectroMechanical Systems	3	0	0	0	6	9

32	EE5312	VLSI Technology	3	1	0	0	6	10
33	CH5190	Introduction to Macromolecules	3	0	0	0	6	9
34	MM5041	Medical Materials	3	0	0	0	6	9
35	MM5460	Physical Ceramics	3	0	0	0	6	9
36	AM5470	Analysis & Design of Smart Material Structure	3	0	0	0	6	9
37	AM6190	Cellular structures and mechanics	3	0	0	0	6	9
38	AM6512	Application of Molecular Dynamics	3	0	0	0	6	9

Potential recruiters

Based on the specialization the students opt for, they can be recruited by one of the private or public sector companies mentioned below. They will be perfectly suited to the research and product innovation wings of these companies.

1. Nissan
2. CUMI
3. Samsung
4. Honeywell
5. MRF
6. Saint Gobain
7. Titan
8. Aditya Birla Science and Technology Private Limited
9. IBM (R & D)
10. TATA Centre
11. SITAR, Bangalore
12. SAMEER, Chennai
13. APPLIED MATERIALS
14. DRDO, CSIR, ISRO, BHEL, DMRL, NML, NAL, ARCI, HAC