

## **CURRICULUM**

### **B. Tech., Dual Degree, Honors & Minor Programmes in Aerospace Engineering, IIT Bombay (Applicable to Batches of 2016 and Onwards) (Last Update on 29<sup>th</sup> July, 2021)**

#### **1. Preamble**

The B. Tech. (and Dual Degree) programme of the department of aerospace engineering aim to provide generic engineering training, along with some specialism pertinent to aerospace engineering at undergraduate level as well as higher level training at Masters level. The programme is designed to achieve the above stated objectives, through a set of generic (or common) courses in basic sciences and general engineering, specific core courses in aerospace sciences and a basket of elective courses to provide next level of training for highly motivated and committed B. Tech. and Dual Degree students. The programme, though fairly structured, has sufficient flexibility for the students to explore the discipline as per individual interests and requirements.

Sections below provide the details of the curriculum, including its semester-wise structure, elective sets and detailed course contents.

#### **2. Programme Structure & Credit Requirements**

The prescribed B. Tech. programme in Aerospace Engineering consists of 271 credits. The option of B. Tech. Honors programme is also available by taking an additional 24 credits. Students from other departments can take the Minor programme that consists of a set of five courses (30 credits) composed of two blocks: one having a compulsory course and another having an option to choose any four courses from two baskets, one for autumn and the other for spring semester. The Dual Degree programme requires students to take the prescribed B. Tech. programme as well as the Honors programme, and in addition 96 credits of the Master's degree requirement, met through 24 course credits and 72 project credits divided into two stages of 36 credits each. The semester-wise breakdown of the credits for the B. Tech. and Dual Degree programmes are given in Table I, along with the Honors requirements. The first three years of the B. Tech. and Dual Degree programmes are common. However, the initiation of the Honors programme starting with the sixth semester is optional for students in the B. Tech. programme but mandatory for those in the Dual Degree programme.

#### **3. Departmental Options (in Prescribed Programme)**

##### **Department Electives**

Students are required to take five elective courses from the list of undergraduate elective courses offered by the Aerospace Department as listed in Table II; this is in addition to the two required institute electives. Students may also take postgraduate courses offered by the Aerospace Department listed in Table III to fulfill part or whole of this requirement. However, this is subject to the students satisfying the general eligibility criteria (such as CPI requirements) laid down by the Senate, and other additional criteria, if any, related to prerequisites or background requirements imposed by the DUGC. Additional relevant electives offered by other departments are listed in Table IV. Students

should consult faculty advisors/course instructors of PG courses listed in Table III/IV before registering for these courses.

### **Supervised Learning**

Students can optionally substitute up to a maximum of two department electives by taking up to two units of Supervised Learning (AE219 & AE419). In this case, each unit has to be registered for as any other course, and is required to be performed under the supervision of a guide from the department, over the duration of a semester. In cases where a student takes two units of supervised learning, they must be in different semesters, and may or may not be under the same supervisor. Even when performed under the same supervisor, they may or may not be in continuation. In other words, the two units are to be viewed as operationally independent.

Further, each unit may involve a literature survey (seminar), design/ development/ fabrication/ testing of equipment/ prototype, design project, research project, design/ development of algorithms/ software, collection/ analysis of experimental data using sophisticated equipment/ methods, or design of an experiment, and is expected to require 6-8 hours of effort per week.

Norms for registration and evaluation for both units of supervised learning will be specified by the supervisor. The availability of supervised learning units depends upon offerings by individual faculty members in their areas of interest. Faculty members may prescribe/ expect additional abilities such as skill sets (mathematical/ programming etc.) and/or demonstrated interest/ motivation from students, in conjunction with the eligibility norms, depending upon the type and area of work involved in each of the supervised learning units.

## **4. Honors Programme in Aerospace Engineering**

To obtain Honors in Aerospace Engineering, a student has to earn 24 credits in addition to the 271 credits for the prescribed B. Tech. programme. A student may obtain these 24 additional credits by choosing from the following options in any combination of his/her choice.

### **a) B. Tech. Project (BTP):**

A student may obtain 18 credits by choosing to do a B. Tech. Project (BTP) in two stages: Stage-I (6 credits) and Stage-II (12 credits). Partial consideration of these credits (e.g., only Stage-I) towards fulfilling the credit requirement for the Honors programme will not be permitted.

These two stages should be completed in two different and consecutive semesters of the III and IV years of the B. Tech. programme under the supervision of faculty member(s) from the department, subject to availability of topics/supervisors. Faculty members from other departments may be co-opted as co-guides with the consent of the department guide.

Further, a student expecting to obtain 18 credits in the form of B. Tech. Project should demonstrate an academic rigor equivalent to, or greater than, that required to earn 18 credits through department electives. Stages I and II are expected to involve 6-8 and 13-15 hours of effort, respectively, per week, and should together represent a unified body of work performed under the supervision of the same guide(s). Stage II of the BTP will be

available only upon successful completion of Stage I and only if continuation is permitted by the guide(s) depending upon the quality of work in the I stage.

In case continuation is not permitted due to inadequate quality as per requirements set by the guide(s), but the Stage I examination panel finds the work of passable grade, the student will earn the credit for BTP-I but will have to take exit from BTP. However, credits due to BTP Stage I alone cannot be counted towards the Honors credit fulfillment in the absence of Stage II completion.

**b) Electives:**

A student may fulfill whole or part of the 24-credit Honors requirement by choosing courses from the lists of departmental UG elective courses (Table II), departmental PG electives (Table III), and/or non-departmental courses (Table IV). Availability of the courses from the latter two lists is subject to the student satisfying the applicable minimum CPI and prerequisites criteria. Students should consult faculty advisors/course instructors of the PG courses before registering.

Possible options open to students for fulfilling the Honors requirements are charted at the end of Table I.

**5. Minor in Aerospace Engineering**

A student of the B. Tech. degree offered by departments other than the Aerospace Engineering Department may obtain a minor in Aerospace Engineering by earning 30 credits through a set of five courses as described below.

The minor programme starts from the third semester (2<sup>nd</sup> year Autumn Semester) onwards, with one course in each semester. Among the courses designated as the minor basket for Aerospace Engineering, Introduction to Aerospace Engineering (AE 153) is a compulsory course prescribed in the third semester. It is mandatory that the students complete the compulsory minor course AE 153 before taking up optional minor courses from the minor basket.

At the beginning of every semester, the department will declare the minor courses available for registration towards the Minor in Aerospace Engineering. The minor courses, other than AE 153, need not necessarily be offered in slot 5. With the partial removal of the slot-5 constraint, a large list of courses will be available for minor courses, which can be easily taken up depending on the suitability of the students opting for minors. Those students who complete the required number of courses from the minor basket, which includes AE 153 and four other courses from the approved list, can apply for retagging such courses as minor courses. The department will help the deserving students in this process.

Note that some of the courses in the minor basket may have prerequisite requirements and should be taken in consultation with the Minor Coordinator of the Department of Aerospace Engineering.

**6. Dual Degree Programme**

To obtain a dual degree in Aerospace Engineering, a student has to complete a total of 391 credits as per the breakup given below.

- (i) 271 credits towards the basic B. Tech. degree as prescribed in Table I, including the departmental options as described in Sec. 2.
- (ii) 24 credits as part of the compulsory Honors requirement as prescribed in Table I, by exercising options as described in Sec.3. The additional provision is that the student must have started the Honors programme latest by semester VI.
- (iii) 24 credits of postgraduate courses as specified below
  - a) At least three courses from the list of postgraduate courses offered by the Aerospace Department given in Table III, and
  - b) Not more than one course from the non-departmental postgraduate courses listed in Table IV, which may be updated with Senate approval from time to time.
  - c) Possible options open to students for fulfilling this requirement are charted at the end of Table I.
- (iv) 72 credits of M. Tech. dissertation work supervised by a faculty member of the Aerospace Department. Faculty members from other departments may be co-opted as co-supervisors with the consent of the department supervisor.

The semester-wise courses are described in the tables given subsequently. The electives' lists (Tables II, III and IV) and detailed course contents appear in separate documents.

**Table I – Semester-wise Schedule of Courses - B. Tech., Honors, Minor and Dual Degree Programmes in Aerospace Engineering**

<i><b>AEROSPACE ENGINEERING</b></i>											
<i><b>Table I – Course Curriculum for B. Tech., Honors, Minor and Dual Degree Programmes</b></i>											
<b>Semester I</b>						<b>Semester II</b>					
Course Code	Course Name	Credit Structure				Course Code	Course Name	Credit Structure			
		L	T	P	C			L	T	P	C
PH 107	Quantum Physics and Application	2	1	0	6	PH 108	Basics of Electricity and Magnetism	2	1	0	6
MA 105	Calculus	3	1	0	8	MA 108	Differential Equations	2	0	0	4
CH 105	Organic/Inorganic Chemistry	2	0	0	4	MA 106	Linear Algebra	2	0	0	4
CH 107	Physical Chemistry	2	0	0	4	CS 101	Computer Programming and Utilization	2	0	2	6
BB 101	Biology	2	0	2	6	AE 102	Data Analysis and Interpretation	3	0	0	6
ME 113	Workshop Practice	0	0	4	4	AE 152	Introduction to Aerospace Engineering	3	0	0	6
CH 117	Chemistry Lab	0	0	3	3	ME 119	Engineering Graphics and Drawing	0	1	3	5
						PH 117	Physics Lab	0	0	3	3
NC 101/ NO 101/ NS 101	National Cadet Corps (NCC)/ National Sports Organization (NSO)/ National Service Scheme (NSS)	0	0	0	P/NP	NC 102/ NO 102/ NS 102	National Cadet Corps (NCC)/ National Sports Organization (NSO)/ National Service Scheme (NSS)	0	0	0	P/NP
	<b>Total</b>				<b>35</b>		<b>Total</b>				<b>40</b>

Note: In the first-year curriculum, some courses may be interchanged between the two semesters due to operational reasons and the actual distribution will depend upon the timetable and the division allotted. The above distribution is indicative and the online registration system will show the actual distribution for each batch.

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**Table I – Course Curriculum for B. Tech., Honors, Minor and Dual Degree Programmes**

Semester III						Semester IV					
Course Code	Course Name	Credit Structure				Course Code	Course Name	Credit Structure			
		L	T	P	C			L	T	P	C
MA 207	Differential Equations II	3	1	0	4	MA 214	Introduction to Numerical Analysis	3	1	0	8
AE 223	Thermodynamics and Propulsion	3	0	0	6	AE 234	Aircraft Propulsion	3	0	0	6
AE 225	Incompressible Fluid Mechanics	3	0	0	6	AE 236	Compressible Fluid Mechanics	3	0	0	6
AE 227	Solid Mechanics	3	0	0	6	AE 238	Aerospace Structural Mechanics	3	0	0	6
HS 101	Economics	3	0	0	6	AE 240	Spaceflight Mechanics	3	0	0	6
EE 101	Introduction to Electrical and Electronics Circuits	3	0	1	8	AE 242	Aerospace Measurements Laboratory	2	0	2	6
	<b>Total</b>				<b>36</b>		<b>Total</b>				<b>38</b>
COURSES FOR MINOR REQUIREMENT						COURSES FOR MINOR REQUIREMENT <sup>+</sup>					
AE 153	Introduction to Aerospace Engineering	3	0	0	6		Max credit towards Minor				6

<sup>+</sup>To be chosen from the Minor basket available at the beginning of the semester

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**Table I – Course Curriculum for B. Tech., Honors, Minor and Dual Degree Programmes**

Semester V						Semester VI					
Course Code	Course Name	Credit Structure				Course Code	Course Name	Credit Structure			
		L	T	P	C			L	T	P	C
AE 330	Aerospace Propulsion	3	0	0	6	AE 305	Flight Mechanics	3	0	0	6
AE 308	Control Theory	3	0	0	6	AE 332	Aircraft Design	3	0	0	6
AE 326	Vibrations and Structural Dynamics	3	0	0	6	AE 312	Aerodynamics Laboratory	1	0	3	5
AE 333	Aerodynamics	3	0	0	6	AE 316	Aircraft Propulsion Laboratory	1	0	3	5
AE 314	Aircraft Structures Laboratory	1	0	3	5	AE 427	Control Systems Laboratory	1	0	3	5
HS 301/ HS 303/ HS 305/ HS 307	Philosophy/ Psychology/ Literature/ Sociology	3	0	0	6	AE 219	Department Elective/ Supervised Learning - I	3	0	0	6
	<b>Total</b>				<b>35</b>		<b>Total</b>				<b>33</b>
COURSES FOR HONORS REQUIREMENT <sup>¶</sup>						COURSES FOR HONORS REQUIREMENT <sup>¶</sup>					
	Honors Elective <sup>§</sup>				<b>6</b>		Honors Elective(s) <sup>§</sup>				<b>6/12</b>
AE 493	BTP-I <sup>§§</sup>				<b>6</b>	AE 493/ AE 494	BTP-I <sup>§§</sup> / BTP-II <sup>§§</sup>				<b>6/ 12</b>
	Max credit towards Honors				<b>6</b>		Max credit towards Honors				<b>12</b>
COURSES FOR MINOR REQUIREMENT <sup>+</sup>						COURSES FOR MINOR REQUIREMENT <sup>+</sup>					
	Max credit towards Minor				<b>6</b>		Max credit towards Minor				<b>6</b>

<sup>§</sup>Supervised Learning cannot be counted towards fulfilling Honors requirement

<sup>§§</sup>BTP-I cannot be counted towards fulfilling Honors requirement in the event of failing to successfully complete BTP-II

<sup>¶</sup>Students in the Dual Degree programme must start the Honors programme latest by semester VI

<sup>+</sup>To be chosen from Minor basket available at the beginning of respective semester

**AEROSPACE ENGINEERING**

**Table I – Course Curriculum for B. Tech., Honors, Minor and Dual Degree Programmes**

Semester VII						Semester VIII					
Course Code	Course Name	Credit Structure				Course Code	Course Name	Credit Structure			
		L	T	P	C			L	T	P	C
AE 407	Modelling and Simulation	3	0	0	6		Institute Elective I	3	0	0	6
AE 410	Navigation and Guidance	3	0	0	6		Institute Elective II	3	0	0	6
AE 219/ AE 419	Department Elective/ Supervised Learning -I/ Supervised Learning -II	3	0	0	6	AE 219/ AE 419	Department Elective/ Supervised Learning -I/ Supervised Learning -II	3	0	0	6
	Department Elective	3	0	0	6		Department Elective	3	0	0	6
ES 200	Environmental Studies: Science & Engg	1.5	0	0	3						
HS 200	Environmental Studies	1.5	0	0	3						
	<b>Total</b>				<b>30</b>		<b>Total</b>				<b>24</b>
COURSES FOR HONORS REQUIREMENT						COURSES FOR HONORS REQUIREMENT					
	Honors Elective(s) <sup>§</sup>				<b>6/12</b>		Honors Elective(s) <sup>§</sup>				<b>6/12</b>
AE 493/ AE 494	BTP-I <sup>§§</sup> / BTP-II <sup>§§</sup>				<b>6/ 12</b>	AE 494	BTP-II <sup>§§</sup>				<b>12</b>
	Max credit towards Honors				<b>12</b>		Max credit towards Honors				<b>12</b>
COURSES FOR MINOR REQUIREMENT <sup>+</sup>						COURSES FOR MINOR REQUIREMENT <sup>+</sup>					
	Max credit towards Minor				<b>6</b>		Max credit towards Minor				<b>6</b>
COURSES FOR MASTERS REQUIREMENT <sup>¶¶</sup>						COURSES FOR MASTERS REQUIREMENT <sup>¶¶</sup>					
	PG Elective 1				<b>6</b>		PG Elective(s) 1 and/or 2				<b>6/12</b>
	Max credit towards Masters				<b>6</b>		Max credit towards Masters				<b>12</b>

<sup>§</sup>Supervised Learning cannot be counted towards fulfilling Honors requirement

<sup>§§</sup>BTP-I cannot be counted towards fulfilling Honors requirement in the event of failing to successfully complete BTP-II

<sup>¶¶</sup>Dual Degree students must take two PG electives towards the Masters requirement in their 4<sup>th</sup> year, but both can be taken in semester VIII

<sup>+</sup>To be chosen from Minor basket available at the beginning of respective semester



**AEROSPACE ENGINEERING**

**Table I – Course Curriculum for B. Tech., Honors, Minor and Dual Degree Programmes**

Semester IX						Semester X					
Course Code	Course Name	Credit Structure				Course Code	Course Name	Credit Structure			
		L	T	P	C			L	T	P	C
COURSES FOR MASTERS REQUIREMENT						COURSES FOR MASTERS REQUIREMENT					
AE 593	Dual Degree Project - I				36	AE 594	Dual Degree Project - II				36
	PG Elective 3				6		PG Elective 4				6
	<b>Total</b>				<b>42</b>		<b>Total</b>				<b>42</b>

The two charts below detail the options open to students for fulfilling the Honors and Masters Requirements respectively:

**Possible Routes to Earn B. Tech. Honors\***

Option	BTP - I	BTP - II	Elective
1	Semester V	Semester VI	One in semester VII or VIII
2	Semester VI	Semester VII	One in semester V, VI or VIII
3	Semester VII	Semester VIII	One in semester V, VI or VII
4	–	–	One each in every semester from V <sup>th</sup> to VIII <sup>th</sup>
5	–	–	Two each in any two of semesters from V <sup>th</sup> to VIII <sup>th</sup>
6	–	–	One in semester V, one in any other semester from VI <sup>th</sup> to VIII <sup>th</sup> , and two in any remaining semester from VI <sup>th</sup> to VIII <sup>th</sup>
7	–	–	One in any two semesters from VI <sup>th</sup> to VIII <sup>th</sup> , and two in the other semester in this range

\* Students in the Dual Degree programme must start the Honors programme latest by semester VI

**Possible Number of PG Electives Towards Masters Requirement**

Option	Semester VII	Semester VIII	Semester IX	Semester X
1	1	1	1	1
2	0	2	1	1

## Document History

- 2021-07-29: Moved electives' lists and course contents to separate documents
- 2020-04-24: Total credits in DD program was not updated since AE 429 was removed. This is changed from 396 to 391 now
- 2019-05-14: Made applicable to 2016 batch onwards; Removed AE 429 as core from 7<sup>th</sup> semester and added it to Table II (as elective); Reduced credit requirement for that semester to 30; Reduced overall credit requirements to 271