

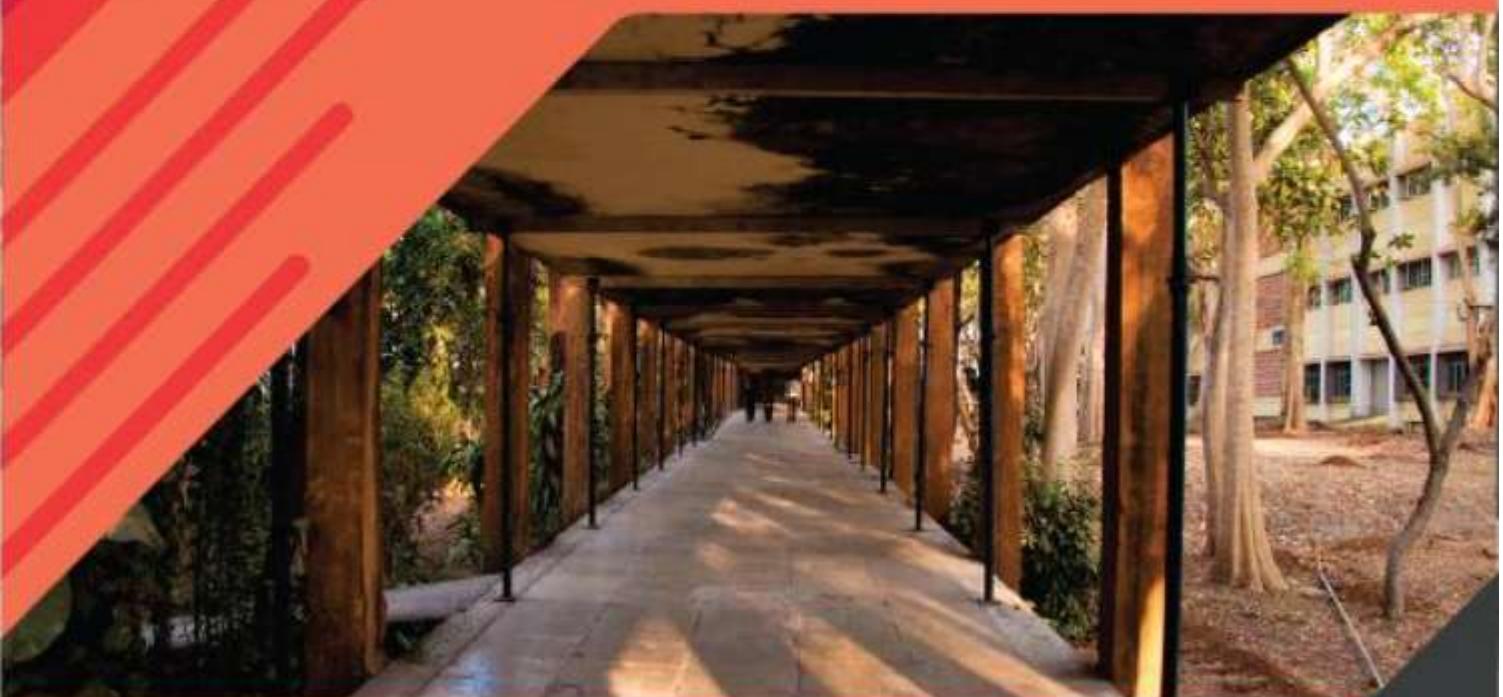


Student  
Support  
Services

# COURSE INFORMATION BOOKLET

A guide to courses at IIT-B

INDIAN  
INSTITUTE OF  
TECHNOLOGY, BOMBAY



UGAC



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# **DISCLAIMER**

The information written in the booklet is only a guideline to the students to help them with their choices in the courses they make and also in the various important features of the Institute academic system.

It may happen that the actual details of courses or rules mentioned in the booklet may face an amendment during the course of time. Please confirm the rules/details from relevant authorities before making any decisions.

The Undergraduate Academic Council members can be contacted for this purpose (details shared on the last page of the booklet).

# PREFACE

Dear Students,

As a vertical of UGAC, it is our duty to bring you the right kind of resources and provide you an intricately researched array of both old and new curricula that prevail in the institute. Course Information Booklet, a product of the same ideology, shall open doors in the field of academics for you and help you make a choice beyond your core curriculum.

This booklet includes information about various courses, like minors, electives etc, that you can choose from, after first year. We believe that since learning is a vital part of our lives as students, it is imperative that you opt for courses that will make the whole process of learning more affable. This booklet, therefore, strives to give you the exposure that you need before deciding on one particular course.

It also includes reviews from seniors, who have been in your shoes once and fared out well eventually. Personal experiences and individual ideologies behind taking a specific course also form a pivotal part of the booklet.

In today's world of cutting-edge competition, where no one expertise is enough, we believe that this booklet is a complete guide to unearthing the interdisciplinary field and following a passion you couldn't otherwise. We are open to suggestions and ideas from your side to improve this booklet.

Hope you have a nice time reading it!

**Priyanka Bagade**

**Institute Secretary of Academic Affairs**

**Head – Student Support Services (2020-2021)**

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Lastly we are indebted to all the readers of this booklet for their constant support and motivation, where any suggestions for further improvement of this booklet are welcome!

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# **1. REGISTRATION**

IIT Bombay follows a specialized credit-based semester system, therefore registration at the beginning of each semester (lookout for dates in the Academic Calendar) is mandatory for you till you complete your programme. Without registration, any academic activity (course/seminar/project etc.) that you undergo will not be counted towards the requirements of your degree.

## **1.1. COURSE ADJUSTMENT**

A student has the freedom of deletion/addition of one or more courses (after discussing and taking permission from the Fac-Ad) provided the total credits do not exceed the overload rule(discussed in Section 3) or fall below 18 credits by such adjustments. The last date for doing is about 1 week after the commencement of the semester.

## **1.2. DROPPING OF COURSES**

If a student finds his/her academic load too heavy, even after the date for course adjustment has passed, s/he may drop some courses out of the registered ones provided the minimum credit limit (18 credits) hold, after taking permission from the Fac-Ad. The last date for doing so is generally 20-30 days after the end of the mid-semester examination and is set in the academic calendar. Such dropping of courses results in a W grade in the transcript for that particular course

## **1.3. SEMESTER WISE REGISTRATION**

You can register for the courses you intend to take during a given semester on the basis of the programme for your discipline as given in your curriculum and as per the advice given by your Faculty Advisor. The Faculty Adviser is expected to discuss with the student his/her academic performance during the previous semester and then decide the number and nature of the courses for which s/he can register during the semester within the framework of the guidelines as approved by the Institute. You can check a particular semester's curriculum on ASC in Academic --> All about courses --> Curriculum section. **From third semester onwards, registration is dependent on the academic standing of the student.**

The online registration process involves filling up of an online Course Registration Form (CRF) stating the courses and project / seminar etc, that the student proposes to complete during that semester as per the prescribed curriculum. All students having outstanding dues to the institute or a hostel shall not be permitted to register online.

## **2. CATEGORY OF COURSES**

### **2.1. CORE COURSES**

Core courses are those courses which you have to do compulsorily for obtaining your degree. These courses count towards your final degree in all respects and count in your CPI (Cumulative Performance Index). These courses are **NOT** optional and have to be completed within the stipulated duration of your coursework (4 or 5 years). They give you a lot of exposure to your own departmental subjects and research; They also have an elective component, details regarding which are explained in the section on electives.

### **2.2. MINOR COURSES**

A Minor is an additional credential, a student will earn if he/ she does minimum 30 credits worth of additional learning in a discipline other than his/ her major discipline. Many academic units in the Institute offer minors in their disciplines and prescribe a specific set of courses and/ or other activities like projects for earning a minor in that discipline. Note that, courses equivalent in content to any of these specified courses from the same dept. can be taken as a minor course with the approval of the concerned HOD. After the completion of credits under the stipulated time period, a minor degree is awarded to the student. It is mentioned in the Degree Certificate "Bachelor of Technology in xxx with Minor in yyy." The fact will also be reflected in the transcript along with the list of courses taken.

Minor courses are allocated to students **only** through a pre-registration process before the start of every semester and the allocation for every minor course is done on the basis of CPI of the student as the seats are limited in every minor course. You can opt for as many courses of your choice during the process of pre - registration (in

a particular preference order). You will be allotted the minor course based on your CPI and preference order after the pre-registration window closes. The waitlist that is maintained for the minor courses (for students who have missed out on the course of their choice) is also sorted on the basis of the CPI of the students, **such that if any student who has got the minor course drops it during the process of registration, the next student in the waitlist would get the minor course**

Back loggers will not be allowed to take up minor courses until they clear them. Minor courses do not count in your core CPI.

**Note - The only way to get a minor is through the pre - registration window. It would not be possible to register for a minor on the main registration window.**

### **2.3. HONOUR COURSES**

Honour/ Honour is an additional credential a student will earn if he/ she opts for the extra 24 credits (in some cases, 30) needed for this in his/ her own discipline. The concerned department specifies the course requirements for earning the honours. An honour is like a specialisation in your own discipline.

Honour courses are either advanced level courses in your discipline or are courses designed to give you more exposure to different areas of your discipline. On successful accumulation of credits at the end of the programme, this will be mentioned in the Degree Certificate "Bachelor of Technology in xxx, with honours." The fact will also be reflected in the transcript, along with the list of courses, etc. taken. Dual Degree students have to do the honours courses by default. They are considered as their core courses. honour courses do not count in your CPI other than for dual degree students.

You can register for an honour and minor both together if you have a  $\text{CPI} > 8$  with no backlogs.

## **2.4. ELECTIVES**

Every programme (B.Tech/Dual degree/M.Tech/Int. M.Sc.) in IIT Bombay will have its own curriculum defined, which will define your core courses and the total credit requirement for the award of the degree. According to your curriculum your course completion may require doing courses of your own choice, wish and interest from:

**1) Dept. of Humanities and Social Sciences -**

All undergraduates are required to do a Humanities elective from HSS department in their third year and you have to choose this elective from the following set: HS 301 - Philosophy, HS 303 - Psychology, HS 307 - Sociology, and HS 305 - Reading Literature (based on the elective courses run in 2019-2020).

**2) Your own department- Department Elective**

As per your curriculum, you may be required to choose a few courses (Number varying across programmes) of higher-level (Say 4xx or 5xx) from your department across a pool of courses put forward by your department. **In some cases (varying across departments), you might be allowed to take up courses from other departments and tag them as a department elective.** It is best to check up with your departments regarding the same.

**3) A department other than yours- Institute Elective**

As per your curriculum, you may be required to choose a few courses (number varying across programmes) from a foreign department. Generally, you are free to choose any course out of your department as Institute electives. Departmental based restrictions may be there for a few courses. **1xx courses are generally not allowed to be taken as institute electives (except for some departments). For IDC courses, you can ask the HOD of your department if they will allow a particular IDC course to be tagged as institute elective.**

All these electives are a part of the core curriculum and will count in your CPI.

**NOTE:**

List of courses can be obtained on the department website.

HSS Course Codes are changed every year; thus search the course by its name; not by its code.

## **2.5. ADDITIONAL LEARNING COURSES**

According to the rule of maximum credit limit, one can take maximum credits based on his/her academic standing. To reiterate here is the rule

Category I - 54 credits

Category II, III, IV - 48 credits

Category V - 30 credits

Category VI (ARP) - 24 credits

**Exceeding any of the above is NOT admissible under any circumstances.**

If the rules are followed one can take some extra courses. Additional learning courses can be credited or audited. These ALC courses don't constitute the core CPI/SPI of a student. The tag of such a course can be changed during the retagging period which is explained later.

## **2.6. AUDIT COURSES**

*Audit courses refer to the courses for which they are no credits and the course you want to do simply for knowledge without having to think for the grade*

- Registrations are done along with main registrations.
- Restricted to a maximum of **two courses** in the entire period of the programme.
- Only students in category I and II are permitted to 'Audit' a course during regular semesters and summer term.
- The course will be mentioned in the transcript as 'Audit'
- The 'AU' grade would be awarded by the instructor if the attendance is satisfactory and additional requirements as set out by the instructor are met. If the attendance and performance is not satisfactory, the instructor will award a no grade.

## **2.7. SIT THROUGH**

If you are really interested in a particular course but are unable to register for the same due to some constraints (generally happens with popular minor courses). But

you are still willing to sit in that course just for knowledge, without any privilege for credits or mention in the transcript, then you can ask for the faculty in charge's permission to sit through that course. **There are no registrations for Sit-Through.**

<u>TYPE</u>	<u>MEANING</u>	<u>CPI</u>
<b>Minors</b>	30 credits worth of additional learning in a discipline other than your own major.	Separate minor CPI
<b>Honours Electives</b>	Total 24 credits (for B. Tech) worth of additional learning in your own discipline for an honours degree.	Separate honours CPI (for Btech)
<b>Institute Electives</b>	Extra course taken in any department other than your own given you fulfil the prerequisites.	Count towards major CPI
<b>HSS Electives</b>	HS3xx courses, Humanities and Social Sciences department.	Count towards your major CPI
<b>Department Electives</b>	Additional courses in your own department.	Count towards your major CPI
<b>Additional Learning Courses (ALCs)</b>	Any extra course, in any department, by your choice, taken up for extra learning.	Don't count towards your CPI
<b>Audit Courses</b>	Wanting just an exposure to a course - without obtaining a good grade - maximum of 2 audit courses in the entire period of study.	Don't count towards your CPI
<b>Sit through</b>	Sitting through a course only for exposure without registering for it	Don't count towards your CPI

**Note :-** All courses which count towards major CPI are compulsory to complete the minimum requirement for a degree.

### **3. WHY SHOULD I TAKE UP A MINOR?**

Minor courses allow you to officially explore a department other than your own while at the same time getting credit for it. It adds value to your major degree and can be a gateway to get opportunities in the field you have completed your minor in. Your minor degree can give you sufficient knowledge to enable you to take part in interdisciplinary research and even pursue your higher studies in such fields. Though a minor degree can be pursued simply out of genuine and deep interest in a particular department without any specific end goal in view, for the general majority, you should select it in such a way that it either suits your major degree in a research-oriented interdisciplinary manner or in a generic way to any engineer or scientist.

Before you select a minor, try to find what you are truly interested in. It is surely not easy for everyone to be crystal clear about this, but even a vague idea will help you enjoy the minor courses and truly enrich the experience. You can always sample courses from various departments to find this interest, but you lose the benefit of a minor degree in doing so.

You can select any minor course from any department but to draw the complete benefit out of it you should look for overlap between them and your discipline so that it supplements your learning. You should also look at how all the minor courses fit in with each other for a more holistic approach; some departments draw up a suggested schedule of when each minor course must be taken to reap the full benefits out of the curriculum. Minor courses don't count in your CPI, so you should select a minor based on your interest.

Listed on the next page is a suggested set of minor programs which may suit each branch. This matching is done by looking at how much overlap each discipline has with respect to other fields, so that the minor programs can support interdisciplinary learning of each student depending on his career plans. Use it only as a guide and not a binding set of rules; don't let it dissuade you from pursuing what really interests you:

**Note - This table is just to give you an idea about interdisciplinary research, some minors from the table may have been discontinued**

<b>Minor Programme</b>	<b>Suitable Branches</b>
<b>Biosciences and Bioengineering</b>	Chemistry, Engineering Physics, Chemical, Electrical, Metallurgical Engineering and Material Sciences, Energy
<b>Chemistry</b>	Engineering Physics, MEMS, Electrical, Chemical, Energy
<b>Chemical Engineering</b>	Chemistry, Mechanical, Electrical, Energy
<b>Centre of Studies in Resources Engineering (CSRE)</b>	Electrical, Computer Science, Engineering Physics
<b>Computer Science and Engineering</b>	Suits all!
<b>Electrical Engineering</b>	Engineering Physics, Chemistry, Chemical, Mechanical, MEMS, Energy, Aerospace, CSE
<b>Energy</b>	Mechanical, Chemical, Aerospace
<b>Entrepreneurship</b>	Suits all!
<b>Environmental Sciences and Engineering</b>	Chemistry, Chemical, Civil
<b>Industrial Design Centre</b>	Suits all!
<b>IEOR</b>	Suits all!
<b>Mathematics</b>	Suits all!
<b>Mechanical Engineering</b>	Civil, Electrical, Aerospace
<b>Management</b>	Suits all!
<b>Physics</b>	Chemistry, Chemical, Electrical, Mechanical, MEMS
<b>Statistics and Informatics</b>	Suits all!
<b>Systems and Control Engineering</b>	Engineering Physics, Electrical, Mechanical, Civil, Chemical, Aerospace

## **4. WHY SHOULD I TAKE UP HONOUR's?**

Honour courses are either advanced level courses in your department or are courses designed to give you more exposure to different areas in your department. They help you get deeper knowledge in your department to better prepare you for higher studies or to take a job in a certain specialized area so that you can compete with, say, an M.Tech who has specialized in the same area. You are likely to develop strong subject skills by completing an honour successfully and sincerely. Undergraduate classes introduce you to a wide breadth of topics and challenges, and an honours project enables you to explore one in much greater depth. honours research topics are varied and negotiable – if you are really interested in a topic and want to learn more about it, you'll be encouraged and supported.

From a potential employer's perspective, whatever your department, it appears laudable to have demonstrated ability in achieving a complex and demanding goal and having in-depth knowledge in your department. honour courses also help you if you want to pursue further studies or research in the future. The deeper understanding and chance to explore sub-domains assists in making an informed choice about the topic of future exploration. Also since you have more dedicated knowledge in your specialization, there are higher chances that your profile will get noticed by universities for their MS/PhD programs.

To complete the honour, 24 credits must be completed by tagging courses in your department as honour electives and they don't count in your CPI; a separate honours CPI is maintained. This means that taking some honour courses but not being able to complete the entire 24 credits does not harm you in any way; it, in any case, enables you to delve further into your department.

## **5. TAGGING RULES**

Every course that you do in the institute falls under one of the categories of courses as described in the section 1 and hence a tag is given to the course that you have done, in order to classify them. The tags of electives can be changed as per the rules that follow.

This facility allows students to do additional courses and finally make select courses count towards 'Core CPI' (the CPI of prescribed curriculum credits);

**Rules:** Re-tagging will be available to students **ONLY TWICE** in their entire program duration, first time before placements (Second Last Semester Starting) and second-time post curriculum completion (Last Semester). The courses that have been re-tagged during the opportunity given during the previous window will be debarred from the re-tagging process.

**NOTE:** From the year 2017 onwards, the tagging window for DD (Category I) Students will also be the same as the re-tagging window of their B.Tech counterparts (those who are graduating). For them (Category I DD students), the second window for re-tagging will be made available at the time of graduation. This has been done to ensure a fair process of selection for the institute medals.

For the rest of the categories' DD students, the first tagging window will be opened in the Autumn Semester before placements and the second one at the time of their graduation.

### **Tags of courses:**

- 1) Core Course- C
- 2) Department Elective - D
- 3) Institute Elective - I
- 4) Minor Course- M
- 5) Additional Learning Courses - T
- 6) Honours course - O

An approved change of tag will result in fresh calculation of SPI/ CPI from the semester. The tag change has been made effective due to the fact that additional learning course(s) do NOT constitute the core SPI/ CPI of a student.

Following is a table specifying the current rules about the changing of tags from one to another and the restrictions put on the same:

TAG CODE	TAG DESCRIPTION	CHANGEABLE INTO
T	Additional Learning	D,I,O,E
C	Core Course	Not Changeable
D	Department Elective	O,T,E
O	Honours Course	D,T,E
H	Humanities Elective	T
I	Institute Elective	T
M	Minor Course	I,T
E	Honours Elective	D,O,T

Note:

For any special requests i.e. a change, which cannot be implemented on the tagging interface, the student has to get an approval from HOD of the concerned department (other department in case of minors).

## **6. PREVIOUS YEAR MINOR CUTOFFS**

While last year's minor allocation (for spring semester) was done entirely on the basis of CPI (including the waitlist), we have compiled the CPI cutoffs for different minor courses from every department for the year 2019-20.

**Note - These cutoffs have been calculated with the resources available to us. We duly apologize in case of any discrepancy**

### **6.1. 2019-20 AUTUMN SEMESTER CUTOFFS**

<b>Course</b>	<b>Min. CPI</b>
AE 153	7.33
BB 405	8.13
BB 411	5.75
BB 503	7.79
BB 603	8.08
CS 228	9.23
CS 416	8.44
DE 407	8.27
DE 414	5.02
DE 415	6.91
EE 204	6.48
EE 210	6.22
EE 221	7.57
EN 301	5.51
ENT 201	7.67
ENT 204	8.93
ENT 207	5.59
ENT 209	4.71

<b>Course</b>	<b>Min. CPI</b>
HS 474	5.8
HS 490	5.77
IE 501	8.79
IE 503	8.64
IE 601	7.35
IE 603	7.71
IE 611	7.29
MA 403	8.94
MA 419	8.79
ME 201	5.74
ME 219	6.06
ME 338	6.32
MG 401	8.68
MG 403	8.66
MG 407	7.76
MM 201	4.94
MM 209	6.14
PH 251	6.82

ES 203	4.65
ES 303	5.91
ES 401	6.56
GNR 401	7.23
HS 213	5.3

PH 253	5.41
SC 301	7.23
SC 639	8.32
SI 402	8.7
SI 417	9.74

## 6.2. 2019-20 SPRING SEMESTER CUTOFFS

Courses	Min. CPI
AE 240	7.43
AE 305	5.98
AE 332	5.01
BB 400	7.41
BB 404	7.08
BB 610	9.12
CS 213	8.79
CS 347	8.2
CS 419	8.7
DE 403	5.16
DE 405	4.65
DE 408	4.32
DE 410	5.6
DE 413	5.22
DE 415	3.92
EE 207	5.77
EE 321	5.85
EE 325	5.76

Courses	Min. CPI
HS 457	6.69
HS 468	5.55
IE 502	8.47
IE 504	8.65
IE 613	8.12
IE 614	6.14
IE 616	8.96
IE 708	7.8
IE 709	6.57
MA 412	7.13
ME 209	5.55
ME 316	5.69
MG 402	7.82
MG 405	8.15
MG 406	8.22
PH 252	5.81
PH 352	7.11
PH 353	5.46

EN 410	4.93
ENT 205	6.53
ENT 206	5.39
ENT 208	5.02
ENT 210	6.48
ES 204	5.81
ES 458	6.95
GNR 402	6.25
GNR 410	6.24
HS 208	7.6
HS 448	5.38

SC 202	8.2
SC 602	7.05
SC 607	7.18
SC 618	8.57
SC 624	6.02
SC 630	5.78
SC 633	8.25
SC 635	7.33
SC 638	7.12
S1 422	9.47
S1 527	6.63

## **7. HSS ELECTIVE REVIEWS**

### **7.1. AYAN CHOUDHARY - PHILOSOPHY (HS 301)**

**What was your motivation behind taking this course?**

Motivation: Learning about different schools of thought, learning about how we think, about evolution of stuff and how theories are made.

I wanted to learn more about Indian philosophy. However, this course covered 75% western philosophy. Nevertheless, the psycho-philosophical concepts were dealt with in a nice way.

**Who was the instructor? What were her policies?**

The instructor was Prof. Amrita Banerjee. Attendance was manual (attendance sheet was circulated during the lecture). Electronic Devices were not allowed.

**What was taught in this course?**

The course started with defining philosophy and logical arguments like categorical imperatives, square of opposition, negation and premises.

The course was divided into different schools of thought. At the same time, many readings were also given to us in terms of research papers and old vedic stories.

The first major topic was Plato's apology of Socrates which was a reading that cleared the concepts of ignorance, epistemology, metaphysical analysis and argument by contradiction.

In addition to this, there was Hindu philosophy which included the chapter of Nachiketa and Yama. Western schools of thought included the Descartes philosophy of "cogito ergo sum".

Buddhist philosophy was greatly covered with the theory of "anattavada". Post midsem, the instructor covered all the recent western philosophy schools of Simon De Beauvior, Jean Paul Sartre and Judith Jarvis Thomson.

### **How were the evaluation components of this course?**

There were no quizzes. There was a midsem, an endsem and an Analytical Essay writing carrying 40, 40 and 10 percentage weightage respectively. The remaining 10% was allotted specifically for attendance. The exams were objective-based and of moderate difficulty.

### **Any general points you would like to mention?**

You can take this course if you want to know how we formulate things, make theories, read an analytical essay, learn about different schools of thoughts. There's philosophy included in almost every field be it at engineering or law.

Grading was a bell curve. The course becomes reading extensive after Midsem.

## **7.2. MRIGI MUNJAL - PSYCHOLOGY (HS 303)**

### **What was your motivation behind taking this course?**

I think I can vouch for the fact that you will definitely enjoy going through the course material. It was refreshing to go through the Psychology course material to take a break from the "math-ey" core courses during exam weeks.

### **Who was the instructor?**

I took HS303: Introduction to Psychology in Autumn 2019 under Prof. Rashmi Gupta.

### **What was taught in this course?**

The course content covered: Why study Psychology?, What is Psychology?, History of Psychology, Learning, Cognitive Neuroscience, Perception, Social perception, Attention, Emotion and Motivation Processes and Memory. The course structure was neatly distributed in these modules and the slides summarized everything there was to know from an exam point of view and no extra reading was expected from students. The content of the course was thoroughly engaging and you will get to know some cool terminologies and weird (and sometimes questionable) experiments and their results for your next nerdy conversation.

### **How were the evaluation components of this course?**

The exams were set by our instructor and a few instructors before her were entirely MCQs so you don't have to worry about writing long answers. That being said, the course was majorly fact-based and mostly checked your ability to retain and recall (there is a module in the course about this) what you read the day before the exam. An AA might not be that easy to come by because a huge proportion of the class performs well and it does not make sense for the instructor to award so many AAs. However, getting a decent grade in the course does not take a lot of effort as compared to a 6-credit core course in your department because the exams are MCQ-based and people usually get through by studying just a day before the actual test.

## **7.3. PRANAY REDDY - READING LITERATURE (HS 305)**

### **What was your motivation behind taking this course?**

I had taken Reading Literature (HS 305) as my HS elective in the third year. I had not known much about the course before registering; my only reasons for taking this course were because I heard it was "chill" and also because I liked reading. While my decision to take up this course was not exactly informed (read: literally tossed a coin to decide between psychology and literature :P), on the whole I really enjoyed the course a lot.

Through this review, I hope to address the questions that crop up regarding Reading Literature, and why you should (or should not) take up this course.

### **Who was the instructor? What were his/her policies?**

The course was split into two halves – the first half was taught by Prof Sudha Shastri and the second half was taught by Prof Paulomi Chakraborty. Attendance was not compulsory in the first half of the course. In the second half the professor planned to keep a surprise quiz on a Monday or Tuesday, thus forcing us to go to class on these days. Finally, however, there was no such surprise quiz.

### **What was taught in this course? How were the lectures?**

The course consisted of reading short stories, poems and plays, and analysing these works from a critical point of view. The critical analysis consisted of interpreting

important passages/stanzas, understanding the motivations behind the writing and analysing the literary devices that were used.

The content difficulty was similar to school level English. A wide variety of short stories were covered, ranging from rather enjoyable ones like Sherlock Holmes to more convoluted ones like the stories of Franz Kafka. The poems and plays were more classical, involving Shakespeare and other similar authors.

Both Prof Sudha and Prof Paulomi are good at teaching, and try to keep the class engaged throughout the lecture. They were also very receptive and flexible, and were more than willing to discuss any suggestions with respect to course content.

The only drawback in their teaching was their pace. Prof Sudha was fast and energetic, rapidly reading through passages and going through explanations, which at times made it difficult to keep up with her. Prof Paulomi, on the other hand, was slower, making it easier to keep up with her, but at times lectures could drag due to this.

#### **How were the evaluative components of the course?**

Each half of the semester had an equal weightage towards the final grade. The first half's evaluation was composed of 15% quiz + 35% final exam, and the second half's evaluation consisted of 10% quiz + 40% final exam.

The content of the first half was not asked in the second half of the course, thus the syllabus was not much. The questions were also not based on memorization, so the preparation time for quizzes and final exams was minimal. It could vary across people, but I found that approximately 2-3 hours of studying before the exam was sufficient.

The exam itself involved lots of writing. Although there were a few objective questions, the majority were subjective, requiring descriptive half page to one page answers. Most of these questions were directly from the discussions in class. The professors were unforgiving with respect to grammatical and spelling mistakes, deducting marks for such minor mistakes. Writing is an important part of the exams, and more or less decides the grade that a person got.

## **7.4. ADITYA KHANNA - SOCIOLOGY (HS 307)**

### **What is your motivation behind taking this course?**

This course is a beginner level course on Sociology and doesn't assume you have any knowledge of the subject. If you wish to understand the different types of theories, Understand ideologies of great philosophers, different types of democracies, historical changes that led to the modern world; then this might be the course for you, as in this course you will go through discussing the theories of many old as well as modern sociologists ranging from how nations are built to how caste prevailed in new Indian democracy because of the election system and many more.

### **Who was the instructor? What were his policies?**

Prof. Suryakant Waghmore.

There were 5 marks for having an attendance >90%. Roughly half of the batch got those 5 marks since the lectures are really interesting and the professor taught very well.

### **What was taught in this course?**

The course content by the professor varies by the division you are in. For our division we had the following sections.

- Sociological Imagination
- Sociology as Minimalist Science
- Sociology as Multiple-Paradigm Science
- Structural Functionalism
- Conflict Theory
- Symbolic Interactionism:
- Feminism
- Modernity through Marx
- Weber on Capitalism and Modernity
- Modernity through Durkheim
- Postmodernism, postcolonialism and Network Society
- Nationalism, State, Civil Society and Cosmopolitanism
- Sociology of Caste or Indian Sociology?
- India - Nationalism, State and Civil Society

### **How were the evaluative components of this course?**

The professor uploaded slides and additional learning materials that were very helpful, even if you had missed the classes. Most of the examination questions were from the slides. In the class, discussion varied from a wide variety of topics and the professor knew which topic would be of interest to us students and discussed such topics more frequently in the class.

- Midsem - 40 % ( 25 Marks MCQ and 15 mark Subjective Questions)
- Essay - 20 % ( In group of 3-4 students )
- Endsem - 35 % ( 33 MCQ and 2 marks subjective Questions)
- Attendance - 5 %

The exams were straightforward and easy to answer if you had gone through the slides. The Professor had given us sample subjective questions as well so as to get comfortable in writing long answers. Most of the MCQ's were repeated from previous year papers, so solving those are a must.

Usually the course is very easy if you attend all the classes. Going through the slides before the exam helps a lot too, since it covers almost all of the important areas. We also had to write an Essay of 3500 words about a sociological problem in groups of 3-4 involving case reviews and interviews of people.

## **8. MINOR REVIEWS**

### **8.1. ATHITHYAN PARAMASIVAN - BSBE**

#### **My Motivation:**

My inclination towards biology started off with BB 101, esp. with Prof. Sanjeeda Srivastava's portion. At the end of my first year, I meant to explore this field, which I felt would compliment my major in Chemistry quite well. The course content did seem a bit daunting at first, but after discussing with seniors, I decided to venture out.

#### **The Courses:**

Referring the BSBE department site for the minors offered in 2019-2020, we have the following :

Autumn Sem:

**BB 405** – Molecular Biology (6 Credits)

**BB 411** – Introduction to Molecular Cell Biology (6 Credits)

**BB 507** – Molecular Enzymology (6 Credits)

**BB 503** – Genetic Engineering (6 Credits)

**BB 603** – Physiology for Engineers (6 Credits)

**BB 605** – Genetics and Evolution of Biological Circuits (6 Credits)

Spring Sem:

**BB 400** – Molecular Biophysics (6 Credits)

**BB 404** – Metabolism and Bioenergetics (6 Credits)

**BB 610** – Biomedical Microsystems (6 Credits)

Out of the above, at the time of writing, I have attended BB 400, BB 404 and BB 405 at the time of writing, and I will mention my personal experiences.

### **BB 400 - Molecular Biophysics**

While taking up the course, you may be expecting some amount of mathematics and physics-based problem solving, but the actual course had almost nil math and almost nil 'mugging up' involved, and focussed on the biology and biological implications of biophysical processes. This does not usually run in Slot 5, it ran in Slot 2 in my year. The lectures would be sufficient for one's reference.

### **BB 404 – Metabolism and Bioenergetics**

Important information regarding the course is that the grading is absolute. It is a chemistry heavy course covering multiple reactions, pathways and mechanisms, that can seem overwhelming for inexperienced folk. The teaching style and the content made the course geared towards mugging up being a better option than understanding, as this course covers a lot of detailed information. It is a Slot 5 course.

### **BB 405 - Molecular Biology**

It is a discussion heavy class. The content covered requires one to refer to different sources. Each class is very informative and missing any can be hard to catch up without help. The examination is mugging averse and requires one to understand the ins and outs of the concepts clearly to do well. It runs in slot 5 and the grading is relatively strict. It covers in-depth the fundamentals of molecular biology and experimental techniques.

#### **Prerequisites:**

It helps that the Biosciences and Bioengineering (BSBE) minor had a low (if any) CPI threshold for entry. At the time of registering for my first minor courses (BB 400 and BB 404), I had a CPI of ~6.5 and I did not get waitlisted.

#### **Words of Wisdom:**

On that note, this minor can get the notion of being 'easy' due it's low/NIL CPI threshold, but, due to most of the minor offerings being MSc core courses, the competition would appear to be harder than usual (esp. if you are a sophomore) as almost half of the students would be well familiarized with the syllabus. However, this shouldn't be a deterrent as the grading schemes and examinations are largely fair for a student who has put in the due effort.

## **8.2. DIMPLE KOCHAR - CSE**

### **My Motivation:**

My main motivation to explore the CSE minor was to explore courses of another department (a break from EE rona) without affecting my CPI (yep, that's freshie rona!) coupled with curiosity to explore CSE. However, the learning and skills I picked up are very relevant and useful. Many have helped me with other projects in EE.

### **The Courses:**

2 to 4 courses run every semester in the minor slot. However, the offerings are known to get shuffled randomly. Due to this mismanagement, it is advised to get the courses done as early as you can to not miss out. Courses which ran in the last few semesters:

**CS 207** : Discrete Structures

**CS 213** : Data Structures and Algorithms

**CS 218** : Design and Analysis of Algorithms

**CS 224** : Computer Networks

**CS 228** : Logic for CS

**CS 347** : Operating Systems

**CS 416** : Computer and Network Security

**CS 419** : Machine Learning

Each of the courses listed above are 6 credit courses. 213 usually runs both semesters and is a prerequisite for most other courses, so one should start with DSA at the earliest.

For getting a minor degree in CSE, students must do **at least** 4 CSE M courses (specifically minor designated courses like those in the above list) and the fifth course can be any CSE elective course. A department elective can be credited as one of the five minor courses. Only 1 R&D project is allowed for minors. I have personally completed five 'M' courses.

- 1) **CS 213:** As the name suggests, the first half of the course is about different data structures. Second half of the course deals with algorithms for sorting, searching, finding the shortest path, etc

- 2) **CS 224:** This course deals mainly with internet architecture and its 5 layers: Application, Transport, Network, Link and Physical layer
- 3) **CS 347:** This course consists of concurrent processes and management including deadlock situations. It also includes memory, device and information management along with, of course, an overview of operating systems.
- 4) **CS 416:** This course begins with various cryptographic systems and protocols used earlier and now. It also discusses various vulnerabilities and attacks on TCP, DNS, ARP, etc. and DDoS attacks.
- 5) **CS 419:** This course basically provides a broad overview of ML and includes different topics in both supervised and unsupervised learning.

#### **Prerequisites:**

CSE minor attracts a lot of interest. So, it observes some of the highest CPI cutoffs, with the early courses (213/224) closing in 9.XXs. For the later courses, the cutoffs drop.

Most of the courses are good but you might not like some because of your own inclination towards those fields. This usually happens when you are forced to take that course because you have already completed the other offered courses or none other are offered or you end up with second choices due to CPI cut-offs. All the courses I did had their own set of coding assignments and projects. In all fairness, the CSE minor as a whole is not a super chill minor. Decent effort is expected to pull off high grades.

#### **Words of Wisdom:**

Advantage of the CS minor is that in today's world (ML ML!), it lets you crack good internships if you happen to understand the corresponding topic really well. In reality, I have observed that most of the students slack off and make the bare minimum effort to get the minor tag in their transcripts (guilty!) If you are genuinely interested in a deeper knowledge, you would have to make your own effort. The instructors I had were all really good and are there to help you.

## **8.3. PUSHAN BAL - ELECTRICAL**

### **Disclaimer:**

I am an ardent believer in the applications of basic knowledge of electronics in almost every discipline and this review may be biased a bit towards the good side. I will try my best to keep it neutral but certain inclinations are bound to happen. Take everything you see here with a pinch of salt ;)

### **The Courses:**

Out of the six available options, one has to complete five. All courses are worth six credits. The courses are:

- 1) **EE203** Electronic Devices
- 2) **EE204** Analog Electronics
- 3) **EE210** Signals and Systems
- 4) **EE221** Digital Electronics
- 5) **EE321** Power Electronics
- 6) **EE325** Probability and Random Processes

All the courses ensure that one gains certain skill sets that every engineer must have in his kitbag. Very versatile, students will find applications in almost every field of study they encounter.

### **My Motivation:**

I wanted to pursue postgraduate education after completing BTech here. One of the most important aspects of research is the analysis of data which is mostly electronically generated. A sound knowledge of electric circuits really helps one distinguish between actual data and the background noise. This is very important because I have seen many people misinterpreting something other than actual data as their results and having messed up. Designing measuring equipment is also a huge part of research since one may need to measure something specific for which there are no standard instruments available. A working knowledge of electronic circuits comes in really handy in these situations. This was my primary motivation to opt this minor. I have completed four courses till date and will finish the minor next semester. However, a word of caution, It is very important to select the order of courses to be

done very carefully. If chosen wrongly, one might feel that the minor is boring and may be inclined to drop it. Well, in that case he or she will be deprived of a very interesting experience.

#### **Pre-requisites:**

If one has paid reasonable attention to the electrical circuits part taught during JEE days, which you must have since you are here, it will be really easy to follow the courses. This is a type of minor in which the core concept is very short but is the heart of the matter. If one pays attention in class and gets that crucial concept, he/she does not need to study specifically for the minor. A few days before the exam is sufficient. If your CPI is around 7-7.5, you should get one of the six courses for sure though I can't guarantee that you will get one of your choices.

#### **Word of Wisdom:**

I have stressed this to everyone who cares to listen to me that a minor is not to be taken so that you might get shortlisted in so and so company. If you take a minor, it is your responsibility to attend each and every lecture. Make notes by yourself, attempt the assignments by yourself. Do not treat it like "yaar pass ho jayenge". I know most of you will but then think about this. You are investing 3 extra hours of your time per week learning this. You might as well make the best of it. You must be highly motivated to get up for a 9:30 am lecture on Wednesday and Friday even when your roomie doesn't have a minor and stays sleeping. If you think you are up to this, then and only then should you take a minor.

## **8.4. SIDDHAM JAIN - ENTREPRENEURSHIP**

#### **My Motivation:**

If you are fascinated by start-ups and plan to work on a venture of your own or if you want to get into the shoes of an entrepreneur and learn how businesses go about doing what they do, and what distinguishes an efficient system from the other, a minor in Entrepreneurship will be very insightful. Through various courses designed for effective learning, you learn the practical aspects of how a startup works - from looking for the right set of people for your team to idea creation to the final product prototype, essentially trying to mirror a real case venture from scratch. If you want to

brainstorm or pick up the smallest of details of your everyday life and think of various ways to add utilities to a process chain, this minor is for you. In most of the courses, there are no written exams and grading is based on pitch/presentation.

### **The Courses:**

I have done the following courses as a part of the minor :

#### **ENT 201 — *Introduction to Entrepreneurship* — 6 credits**

It is a foundation course. Like any basic course, it gives you an introduction to the subject - in this case, Entrepreneurship. Here, you form a team to work on ideas to get a flavor of an end to end business modelling.

#### **ENT 207 — *Business Fundamentals for Technopreneurs* — 3 credits**

This course is more towards the theoretical side and covers various business operations with a special focus on the financial management of your startup.

#### **ENT 210 — *Marketing for Entrepreneurs* — 3 credits**

In this course, you work on your market research and customer acquisition skills. You also talk to potential customers to gain business insights.

#### **ENT 209 — *Managing Technological Innovation* — 3 credits**

This course covers aspects of prototyping and innovating your product.

#### **ENT 205 — *Intellectual Property for Entrepreneurs* — 3 credits**

This course covers the IP rights (copyrights, patents etc.) one needs to understand before starting off on an idea.

#### **ENT 204 — *Developing the Proof-of-Concept* — 6 credits**

In this lab course, you get hands-on experience on prototyping and designing your product.

#### **ENT 208 — *Technology Venture Creation***

It is a capstone course in which you are expected to create a complete business plan and build a minimum viable product. Field trips are organised by the faculty where you get to interact with potential customers. You should take this course only if you are really serious about entrepreneurship because the work expected is much more than 6 credits.

### **Words of Wisdom:**

Overall, my experience was a good one. There are no prerequisite or CPI requirements for the minor. The professors are very experienced and really helpful. You can contact them anytime and they'll always be ready to help you brainstorm and discuss your ideas

## **8.5. KINJAL SAXENA - ENGINEERING PHYSICS**

### **The Motivation:**

I chose physics minor because I was keen about doing research in quantum mechanics. The first thing to do was get some courses and perhaps a reading project with a professor. I did my third-year internship in Quantum Optics CERC group in University of Ottawa through Mitacs. If you're keen in pursuing research in physics, a minor degree on your resume won't harm. There are many ways to go about: some people might choose to focus more on projects and core physics courses (where you compete with EP students for grades); while other people would prefer a minor degree on resume with good grades (good grades in major physics courses are very important if you wish to pursue higher studies in physics), with projects (which along with your extra learning can aid your concepts). I would say, ultimately if you do not have enough understanding of physics, you cannot enjoy it or do good even in your projects, so no matter what, whether you choose to do minor or just take core physics courses as ALC, focus on building your concepts.

### **The Courses:**

The "**Introduction to Quantum Mechanics**" course is a single introductory course which covers Quantum I and Quantum II of EP department in brief. The "**Thermal and Statistical Physics**" course covers basic Thermodynamics pre-mid sem while Statistics post mid sem. Whereas, the "**Statistical Physics**" core EP course is much more involved from the beginning. The "**Classical Mechanics**" course is quite easy when compared to others. I personally did not find this minor course useful, as Classical Mechanics is the most important prerequisite for any other subsequent courses and without a strong foundation in classical mechanics you cannot understand the beauty of physics and will not be able to appreciate quantum mechanics later. So, I would prefer that if you are keener in just a superficial learning and a minor degree on paper with good grades, go with the minor courses, you can anyway learn the concepts if you keep following standard books or video lectures.

Otherwise, for a better learning and strong foundations, I would suggest to take some courses with the EP department as well.

**Prerequisite:**

Classical Mechanics, Introduction to Quantum Mechanics, Thermal and Statistical physics are the basic courses. There aren't very rigid pre-reqs in physics minor but these three courses do make the fundamentals of other advanced courses. There are no CPI requirements.

**Words of Wisdom:**

EP is a unique branch in which you can take some core courses with EP students and later tag them as minor. I would suggest if someone is willing to just explore physics as a subject and does not want to delve into much intricacies and maths behind it, the available minor courses do good. But if you are even a bit serious about the learning and wish to do some projects, etc., I would suggest doing Quantum Mechanics I, Statistical Physics, Classical Mechanics courses with the EP students. Doing so might have some clashes with your core courses but some of the courses run in two slots in my department (Mechanical Engineering), so it was not as much an issue. Though I did Classical Mechanics and Thermal and Statistical Physics from the minor courses.

## **8.6. PRADEEP HIMIRIKA - IDC**

**DISCLAIMER: My minor program is ongoing and I have completed 3 courses - DE214, DE215, DE304.**

**My Motivation:**

I chose design as my minor because I was good at fine arts(not a necessity). I also had POR aligned with this field. I had started designing with software like photoshop and illustrator. I thought of knowing more about the process and ideation behind a good design. Therefore I thought of exploring design studies. I had consulted seniors who were also pursuing courses and their response was positive before.

The minor program basically gives an overview specialization at IDC. There are 2 studio projects and 12 theory courses. You have to choose any 5 from them. Studio projects are basically made for the hand-on experience for the student. Unlike other

minors, you can take 2 courses in a semester- one theory course and another studio project. This is very helpful to complete the program soon compared to other minors.

For a studio project, students can approach professors and request to work on his/her own initiative or on the professor's ongoing project. Studio projects will run by some instruction based sessions that are smaller than lecture sessions. Theory courses are given a basic overview of the specifications. Attendance, of course, depends on the instructor.

#### **The Courses:**

I have done the following courses:-

**DE215**, 'Understanding Design'. This introductory course involves product design and visual communication.

**DE214**, 'Innovation by Design'. This course gives an overview of product design. Here I got to know the design principles, pitfalls, and processes involved in a final product. I got to know the design innovations by IDC IIT Bombay.

**DE304**, I have done a studio project under this course. This course is about the history and process of pottery making. It is very soothing to make teacups and Khulhad with your own hand.

#### **Prerequisites:**

There are no prerequisites for minor in design. Most of the courses are first come first serve basis. There is no CPI cutoff.

#### **Words of Wisdom:**

As most of the courses are fun and learning, I will suggest to all try at least a course. Courses so designed will surely give a different perspective towards everything you see around. As most minor courses can also be tagged as institute electives, you can tag them if you face any problem in the middle of your program.

## 8.7. ASHUTOSH NEHETE - IEOR

**Disclaimer:** At the time of writing this review, I have completed IE 501, IE 502, IE 504, and IE 603 courses.

### **My Motivation:**

One can view IEOR as a discipline that is an amalgamation of theory, modeling, application, and problem-solving/decision-making techniques for increasing the efficiency of systems-level engineering problems. It is a subfield of applied mathematics. You might want to consider this fantastic option if you like probability, statistics, mathematical formulation + optimization of real-world problems (like supply chain, scheduling, forecasting, transportation networks, infrastructure/service/ industrial/ social systems).

### **The Courses:**

The Industrial Engineering Operations Research [Minor](#) requires you to complete the three compulsory courses - IE 501 (Optimization Models), IE 502 (Probabilistic Models), and either one of IE 503 (Operations Analysis) or IE 504 (Service and Infrastructure Systems). These introductory level courses generally run in slot 5/6/10/11/12 and can be taken up in any order to start things off. Next, you need to complete 2 IE labeled electives (can include IE 503 or IE 504 as well, and excluding IE505, IE507, IE605, IE614, IE684). These are advised to be done after the compulsory courses (although not mandatory) since some of the electives have prerequisites. One can choose these two electives from a wide array of options suited to one's interest.

**IE 501** is perhaps the best course to kickstart the minor and get a feel for the department. It gives a flavor of modeling abundant linear convex optimization problems (including real-world intuitive examples) mathematically and the underlying solution methods behind it.

**IE 502** is about probability-based models and techniques used to understand the randomness associated with the systems; this is similar to the data analysis course and touches Markov chains.

**IE 504** familiarises the students with service and infrastructure systems, location and capacity planning, operations analysis in transportation systems, network models,

queuing, power systems, communication networks, etc. Detailed contents of the courses and credit structure can be found [here](#).

#### **Prerequisites:**

The courses have an upper limit of 20 for minor registrations, making it somewhat competitive, but there have been instances when professors had agreed for no upper reg limit.

#### **Words of Wisdom:**

The courses are intuitive, exciting, and relatively chill when it comes to devoting time. I would strongly suggest anyone attend the regular lectures properly as one can sail through the exams if done so. The courses' structure is similar to quizzes (generally two) + mid-sem + end-sem + assignments (if applicable in some cases), and they typically have decent grading stats.

## **8.8. SAMARDEEP SARNA - MANAGEMENT**

#### **My Motivation:**

The topics we learn during our course of BTech or DD are mostly on the technical side. However, industry and the businesses need to keep in mind a lot of other things which make a business viable. The management minor equips you with those skills and knowledge and these are vital basics that a person working on the technical side would also benefit knowing. I was curious about the functioning of businesses and the thought process behind industry functioning hence took it.

#### **The Courses:**

There are 6 courses available covering every aspect of a business and like all other minors, you take 5 courses to complete it. All run in slot 5. You can do the courses in any order and they have no prerequisites with the exception that **MG 406: strategic management** has a prerequisite of doing at least 1 other MG course (preferably MG 401 – Marketing Management or MG 403 – Basics of Accounting and Financial Management) before you are allowed to take it. The Management minor plays a vital role in understanding how businesses (not just non-core companies but all) function. It gives a basic taste of management to you if you ever plan to go for an MBA later.

**MG 401** – Marketing Management: Principles of Marketing (4 P's and 5 C's). Segmentation of customers, sales and demand forecasting. B2B marketing, social media marketing. Implementation of marketing strategies. Analysis of practical marketing problems. Discussion on famous marketing campaigns and marketing battles between competitors. Prof Arti Kalro makes the class very lively with lots of discussions and interactions and teaches very well.

**MG 402** – Human Resource Management: I did not take this course

**MG 403** – Basics of Accounting and Financial Management: Basic accounting, Learning to evaluate and understand financial statements (balance sheet, profit loss, cash flow), net present value of money, discounted cash flows, basics of finance, asset classes. This is a very useful course for everyone as it gives you skills of basic accounting and finance which are essential and you will never feel lost while reading any financial news!

**MG 405** – Project Management: Tools for project planning (Bar charts, CPM, LOB, and PERT). Gantt Charts, Project Budgeting, Planning and Scheduling, Resource Constraints and Allocation, Cost Estimates and Estimating Methods. This course is useful to understand how special or big projects get completed in companies.

**MG 406** – Operations Management: Practices in Operations Management and industrial optimisation practices, Supply Chain Design, Planning and Scheduling, Inventory Management, Continuous and Batch Processes, Shadow pricing, Linear and Integer Optimization using Excel. This course is a bit on the mathematical side so this would be pretty enjoyable and can be taken before the other ones if you aren't very comfortable with purely business end of things yet.

**MG 407** - Strategic Management: Concept of Corporate and Competitive Strategies, Mission and Vision, A wide number of strategies in every aspect of business, top-down and bottom-up approach, New Market Development, Diversification, Mergers & Acquisitions, Turnaround Strategies, Corporate Governance, Corporate Social Responsibility, Porter's 5 forces, Red ocean and blue ocean strategy. This course is sort of a big overview of what kind of thought process goes behind taking business decisions. Class participation is a vital component and prof Atanu takes attendance and participation seriously. As mentioned earlier, MG 406: strategic

management has a prerequisite of doing at least 1 other MG course (preferably MG 401 – Marketing Management or MG 403 – Basics of Accounting and Financial Management) before you are allowed to take it.

**Prerequisites:**

There are no prerequisites as such. Most courses start from the basics. MG 406: strategic management has a prerequisite of doing at least 1 other MG course (preferably MG 401 – Marketing Management or MG 403 – Basics of Accounting and Financial Management) before you are allowed to take it. The CPI cutoff usually hovers around 8.5, however, if you are really interested in a course you could talk to the prof and see if he can take you.

**Words of Wisdom:**

The courses are fairly easy and you could score an AB or more in most courses with some effort. Since most of our courses are on the technical end of things, the minor gives a breath of fresh air and helps you develop a more holistic idea of things since you would have an idea of the functioning of the company at the business and technical side.

## **8.9. MANU SRIVASTAVA - MATHS**

**My Motivation:**

Mathematics can be broadly categorized into Analysis, Algebra and Geometry. For the reader in a hurry, let me put the logistics first.

Minor offered by the Mathematics Department consists of four courses that aim to touch up a little on each of the three sub-categories. Real Analysis and Basic Algebra are the two courses offered in the Autumn Semester. These are also the courses which do not have any prerequisites. Complex Analysis and General Topology are the other two courses. These are offered in the minor slot of Spring semesters alternatively (only one of them runs in the minor slot in a given semester). Real Analysis is a prerequisite for both of these courses. Each of the 4 courses is worth 8 credits which usually amount to 3 hours of lectures and a 1-1.5 hour tutorial session in a week. As per rules, you have to compulsorily do all the four courses to complete a Math minor. But there have been cases when people, with permission from the

Math Department HOD, have done a Math course other than these four and retagged it as a Minor course, to complete the Minor. But such cases are not very common.

Now to a more relaxed reader, a Minor in Mathematics exposes you to skills and a way of thinking which is unique to the field of Mathematics alone. The courses not only provide you with tools valuable to several fields like Theoretical Physics and Computer Science but also train your mind to think abstractly, analytically, logically and deductively.

### **The Courses:**

The courses required for completing the minor are:-

- **MA 403 - Real Analysis**
- **MA 419 - Basic Algebra**
- **MA 406 - General Topology**
- **MA 412 - Complex Analysis**
- **MA 522 - Fourier Analysis and Application**

About the courses, I will not describe the contents of each in detail (can be found on ASC), but just touch upon a little. It is a common practice to start the Math minor journey with Real Analysis. The course begins from MA 105 and sets up the tempo for the rest of the Minor. Basic Algebra contains point group theory and ring theory. Complex Analysis generalizes what is done in Real Analysis to complex variables, opening up several novel features. In General Topology, you study things in much more abstractness. It is almost beautiful, when during the topology course; you realize that Real and Complex Analysis are just special cases of a much more general framework.

### **Prerequisites:**

The CPI requirement for a Math minor course is usually in excess of 9. But most professors, if requested, allow enthusiastic students to credit the course, no matter what CPI.

### **Words of Wisdom:**

Math minor courses are in no way to be taken lightly. They will probably be four of the toughest courses you will go through in your stay at IITB. You will have to invest time. The importance of not missing classes cannot be overstated. But at the end,

you will have gained a lot, a perspective to look at things in much more generality and abstraction.

To summarize, Math Minor will surely not be a very easy and comfortable journey, and therefore will definitely be an interesting one.

## 8.10. SAHIL SHAH - STATISTICS

### **My Motivation:**

I chose the Statistics minor because I thought I was interested in Probability and related topics during JEE, and thought that it would complement my major of Computer Science well. There was a course on Derivative Pricing that caught my eye since I was somewhat interested in Finance as well. One should choose this minor if one is interested in understanding the theoretical fundamentals of statistics.

### **The Courses:**

There are 3, 8-credit courses and 2, 6-credit courses. To complete the minor all of the former courses need to be taken and any one of the latter and hence, there is limited flexibility. The webpage on the Mathematics Department's site provides all relevant details.

Here is an overview of the 3 compulsory 8 credit courses:

**SI 407 Probability Theory** sets up the theoretical framework needed for future courses.

**SI 402 Statistical Inference** deals with estimation, comparing and testing hypotheses which can have practical applications (though they are not discussed in the course).

**SI 422 Regression Analysis** covers comparing and analyzing simple and multivariate regression models and has a programming lab

The other 2 courses are 6 credits each and one needs to take only one of the following:

**SI 527 Introduction to Derivative Pricing** develops the concepts of futures and options derivatives and covers some basic financial modelling.

**SI 404 Applied Stochastic Processes** (haven't taken the course)

#### **Prerequisites:**

There is usually a stringent CPI requirement for the introductory course. The requirements in the future courses are relaxed since SI 417 is a prerequisite for all of them.

#### **Words of Wisdom:**

There is no logistical issue since all courses are run only in the designated Minor slot. One must, however, plan in advance since some courses run only once in 4 semesters and since all courses run in Slot 5, one cannot take multiple courses in one semester. Courses are fairly light and generally do not have continuous or in-class grading.

Be willing to get up in the morning since attendance is enforced in most courses and DX grades have been awarded in the past!

The courses were much more theoretical than I had expected, with little focus on practical applications and only one course has a programming component. This minor provides a good introduction to the world of theoretical statistics but do not head into it expecting to tackle recent real-world problems. I would recommend making good use of the adjustment window to judge your interest.

## **8.11. ANANT JOSHI - SYSTEMS & CONTROL**

This article portrays my perspective of the systems and control engineering (Syscon) minor, what I took away from it and how it helped me. I have tried to be as inclusive of various other viewpoints as possible, but it will naturally be inclined towards my way of thinking and reflect my personal biases.

#### **About the field**

Systems and control engineering finds its application in a variety of fields like robotics, aerospace, finance, chemical industries, to name a few. A control system is a system whose behaviour can be influenced by an external input termed the control. There are two main areas of study in control engineering. The first, popularly termed dynamical systems theory, involves studying the physics and the mathematical structure of these systems. The second, control theory, looks at synthesizing input signals which would effectuate desirable behaviour from the system, whilst

respecting the structure of the system and any constraints imposed by it. Particular emphasis is laid on making such systems autonomous.

These principles are applied to diverse places, like guidance, navigation and control of aircraft, spacecraft and missiles; design and control of robotic arms; control of chemical reactors, manufacturing processes and operations research, control of electrical circuits and even in biology. They are used to study phenomena in physics, both classical and quantum physics.

I will divide the graduate-level courses into two rough divisions: those of a more theoretical nature and those that are application-oriented. The former would be mathematically advanced and rigorous with only a few classic examples being demonstrated while the latter would focus on solving many examples of specific problems using a certain set of control design techniques.

### **My Motivation:**

Through technical events like line follower and ITSP, I developed an interest in robotics in my first year, and I have been comfortable with mathematics well before coming to IIT Bombay. These factors led me to choose this minor as my first choice. I was undoubtedly a little sceptical of whether I would be able to handle the level of mathematical rigour and difficulty that this minor would pose, but the difficulty I actually ended up facing was much lesser than what I'd imagined. And in addition, I also discovered<sup>1</sup> that I enjoy and appreciate the rigour and precision.

### **The Courses:<sup>2</sup>**

#### Grading

Grading in most courses is reasonable and if one is regular in attending classes and keeping pace with the course, one will definitely secure a good grade. 80% of the exams are generally based on classroom teaching. Professors are generally more interested in learning and are lenient and reasonable when it comes to exams if the students show genuine interest in the course.

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<sup>1</sup> through the first minor course SC 201, and an additional learning course CS 709 Convex Optimisation

<sup>2</sup> My review is based on the course content from when I took the course which may or may not have changed the next time the course runs. The semester when I took the course is given after the name of the course. The instructor who took the course during that semester can be seen from ASC.

### **SC 201 Mathematical Structures for Systems and Control (2016-17 Autumn)<sup>3</sup>**

This course recalls concepts from the MA 1xx courses and covers elementary real analysis, which is a step forward. These concepts are a prerequisite to thoroughly understand most of control theory (and all the courses reviewed here). Similar to the MA 1xx courses, it is fairly rigorous, and consequently can get dry.

### **SC 202 Signals and Feedback Systems (2016-17 Spring)**

This course was run in two parts. It introduces classical control theory. The first part showed us Laplace, Fourier and Z transforms, which are techniques to analyse the behaviour of control systems. It was taught very rigorously and mathematically. The second part covers the design of controllers using these techniques. This is on the application oriented end of the spectrum where one looks at numerous examples of problems and how to tackle them using said techniques.<sup>4</sup>

### **SC 301 Linear and Non-Linear Systems (2017-18 Autumn)**

This course introduces two basic building blocks in modern control theory. The first part covered the theory of linear state-space systems. Stability, controllability and observability, and finally a few control design techniques were taught. This part was application oriented. In the second part, material from the analysis of non-linear systems including equilibria and stability was covered, and finished with feedback linearization which is a control design technique for nonlinear systems. The second part had more of a theoretical nature.

### **SC 625 Systems Theory (2018-19 Autumn)**

This course is a mix of SC 201 and SC 301 meant for first year M.Tech. students to pick up fundamentals. It covers vector spaces (similar to MA 106) and linear systems theory (similar to the first part of SC 301). It has a theoretical nature throughout.

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<sup>3</sup> This course has now been replaced with SC 639 which is reviewed later in the article

<sup>4</sup> I personally faced difficulty adjusting to the sudden change from rigorous theory to application. ME 311 helped to bridge that gap since the professor covered a simpler version of the theory which was enough to connect to the application he showed

### **SC 639 Mathematical Structures for Control (2019-20 Autumn)<sup>5</sup>**

This course serves to act as a replacement for SC 201. It covers the basics of vector spaces, elementary real analysis and multivariable calculus from a mathematical viewpoint. Since the course content is more than that of SC 201, it will take more effort than SC 201 to keep pace with. However, diligent effort will definitely see a student through.

### **SC 617 Adaptive Control (2017-18 Spring)**

This course is of an applied nature, covering a widely used technique in nonlinear control design called adaptive control. Adaptive control deals with systems which have parametric uncertainty and offers a method to deal with them. We covered certainty equivalence adaptive control, adaptive control for spacecraft, adaptive backstepping to name a few topics.

### **SC 629 Probability and Random Processes (2018-19 Autumn)**

This course covers probability theory from a mathematical viewpoint. It begins with random variables, studies in particular the Gaussian random variable and a few applications related to it. Then it proceeds to Kalman filtering. It ends with Markov chains. It is supposed to be an introductory course for M.Tech. students.

### **SC 643 Stochastic and Networked Control (2019-20 Autumn)**

This course is application oriented, covers two large paradigms in control theory called stochastic control and networked control. It is recommended to complete SC 629 before taking this course, though it isn't a formal prerequisite. Stochastic control deals with systems that are uncertain in a stochastic sense (i.e. systems which are affected by random variables) and offers techniques to control them in the mean sense. Networked control refers to systems that are interconnected with each block having its own characteristics, and exploring how they behave in the presence of stochastic signals. We covered LQG control, Kalman filtering, Markov processes and communication over random channels.

### **SC 633 Geometric and Analytic Aspects of Optimal Control (2018-19 Spring)**

This is a theoretical course which explores a paradigm called optimal control. It begins with the basics of optimisation, and then introduces optimal control problems. The Pontryagin Maximum Principle, a popular method to tackle optimal control

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<sup>5</sup> I was a TA for this course, not a student

problems is studied in great detail. The course ends with a study of the classic LQR problem. The course focuses on the proofs behind the control techniques presented and requires significant effort to keep pace with, since the theory is deep.

#### **SC 618 Analytical and Geometric Dynamics (2018-19 Spring)**

This is a theoretical course which introduces the student to formal mathematical treatment of mechanics. It starts with mechanics of particles, then introduces Lagrangian and Hamiltonian mechanics. It proceeds to study manifolds and Lie groups, which are mathematical structures essential to the formal study of mechanics, since they form the configuration spaces of numerous physical systems. Finally, it treats mechanics on manifolds.

#### **SC 624 Differential Geometric Methods in Control (2017-18 Spring)**

This is a theoretical course which looks at control of systems that evolve on smooth manifolds. It begins with an introduction of smooth manifolds, and the concepts that are essential to studying controller design. Then it builds on to control systems and control techniques that are specifically developed for such systems.

#### **CL 653 State Estimation<sup>6</sup> (2017-18 Autumn)**

This course treats a topic which is central to control theory - Kalman filtering. Kalman filtering has wide applications in a lot of engineering fields. This is more of an applied course, with a short theoretical part, and the instructor makes sure to treat the theoretical with sufficient care by keeping it precise but without making it too difficult to understand. It introduces many techniques in linear system observer design, including the Kalman filter, and then touches upon some popular extensions of these techniques like the extended Kalman filter, unscented Kalman filter to non-linear systems. All the techniques that are taught are illustrated through many examples, and a separate tutorial is held in which MATLAB coding is practised. There are tests on implementing the filters on MATLAB and a course project which requires implementation on MATLAB as well.

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<sup>6</sup> This course is not a part of the minor programme as per the syscon website, but has been included here since it covers topics central to control theory.

### **CL 686 Advanced Process Control (2018-19 Spring)**

This course introduces a variety of basic control techniques that are commonly used. It teaches the theoretical backing behind each one of them with sufficient care but keeps it easy to understand, and at the same time illustrates their application in multiple examples. It has a tutorial dedicated to MATLAB coding and multiple course projects which require the application of the theory that was learnt.

#### **Prerequisites:**

The CPI cap is generally not very high (if at all it exists) and since due to its mathematical nature, only those who are keen about the minor apply for it (which is **strongly advisable** to do as well), registration goes through smoothly.

#### **Words of Wisdom:**

The minor programme aspires to give students an introduction to the field of control theory and dynamical systems. Students are required to complete five courses of six credits each (a total of thirty credits). The first three courses<sup>7</sup> are compulsory, and the other two can be chosen from a prescribed list of graduate-level courses.

Almost all the courses are **primarily mathematical** in nature. I think if one is comfortable with MA 105 and MA 106, one can definitely cope with the first three compulsory courses, and also with quite a few of the application-oriented graduate-level courses. The courses will either focus on the mathematical models and structure of control systems or techniques which are useful in controller design. There are only a handful of courses in which one gets to work with hardware, and they might or might not be open to everyone. It is not necessary for one to have a deep appreciation and excitement for hard core mathematics (it certainly helps to have it), but one **must be willing to handle fairly rigorous engineering mathematics**.

#### **Acknowledgements**

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<sup>7</sup> description included in a previous section of this article

# 9. SUPERVISED LEARNING PROJECT (SLP) REVIEWS

Supervised Learning Project (SLP), also known as RnD in some departments, is a project-based course - generally for 6 credits, where a student can work for one entire semester on a project under a professor. It is not always necessary to do a project under a professor in your department. The professor you chose can be from a different department, but it is subject to rules/ conditions laid down by your department. In order to give you a better idea about this, we have included reviews from experienced seniors, who have done this course.

## **9.1. AMAN SHARMA**

*An Engineering Physics student who did his SLP in BSBE dept*

**What was your motivation to take up an SLP?**

I always had in mind to pursue research plus SLP was a good way to earn credits for my honours. SLP gives a good chance to try out research and see if you'll enjoy it, or maybe make a foray into a new field.

**How did you decide which prof to take a project under? And how did you decide on the topic itself?**

My initial interest in the topic grew out of a lecture I attended at the Chemical Engineering symposium. I approached a professor in my department whose work resembles most closely to my topic of interest. While talking with him, he redirected me to my guide in a different department. So I feel it's important to talk to as many people as you can before fixing on your guide.

**What was your experience like taking up the project?**

The experience overall was a good one. Depending on your topic and your prior experience with the material, you'll most likely have to do a whole lot of reading. Depending on the semester you take it in (mine was the 5th semester), one might

have to cover a lot of basics before working, and a lot of people present this extensive literature survey as their project itself.

If your project is more collaborative it can give you a good insight into how research groups and labs go about their work and give an experience for the work environment one might have in research. Interactions with other masters and doctoral students are a great learning experience, and a good rapport with your guide can be very fruitful. Your guide can help you with your internship, and later your graduate school applications(if that's something you choose).

**How much effort did you have to put in compared to other courses? And approximately, how many hours per week did it require?**

I used to work at least 4 days in the week, around 6-7 hours. Depending on your familiarity with the topic and project, you might have to vary the times. Especially, experimental work requires certain discipline as well as flexibility in your schedule.

By the end though, one might have to in a little more effort to have a decent presentation and work report.

**What are the pros and cons of taking up an SLP? Any suggestions for those wanting to take an SLP up?**

Obvious pros for an SLP are relatively better grading with what I felt lower efforts, plus you can choose your topic of interest and focus on what kind of work you want to do. You might get a chance to explore something offbeat, and it's definitely a great channel for your creativity and curiosity. You'll get to meet different people and wider perspectives. The experience to present your work is something one should consider.

As for cons, there's a definite dedication requirement. Plus if something substantial isn't gotten out of it, one might regret the time and effort put. It's really important to have a guide who actually cares and is understanding. Misguided projects can be frustrating, and drain your time which you could've used to take another course if nothing else.

**Could you talk about what you did for your project? What is the brief outline for this project (if you had reports/presentations etc.)?**

My project focused on the organization of DNA in the nucleus of a cell, I had to start from the very basics of Statistical Mechanics since I still hadn't taken the course going on to study certain repair mechanisms and replicated some computational results. You'll have to prepare a report by the semester end and a presentation, on which you'll be evaluated.

**How did SLP help you to further decide your research work? Did you continue research in that field, or take something else up?**

SLP definitely helped me decide to stick to biophysics, it provided a good introduction. So on working in other fields I could gauge my interest and pick with what I wanted to go ahead. I did go on to do my BTP in biophysics as well although it was on a different scale and focus altogether.

## **9.2. KUMAR ASHUTOSH**

***An Electrical Engineering (Dual) student who did his SLP in EE dept***

**What was your motivation to take up an SLP?**

I am a fourth-year dual degree student. As a part of our curriculum, we are supposed to decide our guide for our master's project. In order to facilitate this decision, we are supposed to do a six-credit course (EE 451-Supervised Research Exposition). In addition, there is a possibility of taking a six credits project course - EE 692 Research and Development Project. I took both these courses under two different professors of EE to gauge my interest and decide a guide for my master's research work.

**How did you decide which prof to take a project under? And how did you decide on the topic itself?**

The choice of the professor was largely dictated by my previous interest in that particular research field. As part of some other computer science course, I had learned the basics of the Multi-Armed Bandit problem and various algorithms in solving such problems. The research area of the concerned professor happened to

intersect with my interests and hence I contacted him with my prior knowledge and the broad area I would like to work on. Fortunately, the professor had a similar research problem in his mind.

**What was your experience like taking up the project?**

It was really good and fruitful. I learned so many new things. The most important of them being research aptitude. Working on a new idea requires an extensive literature review and an understanding of the background knowledge.

**How much effort did you have to put in compared to other courses? And approximately, how many hours per week did it require?**

Since I was interested in the work, I did put in more efforts compared to other courses. I devoted at least 10-12 hours per week which is more than the expected duration of six hours per week.

**What are the pros and cons of taking up an SLP? Any suggestions for those wanting to take this up in the future?**

Pros:

1. You learn a lot. Which majorly includes how to do proper research work.
2. You get to know the research being done in the department.
3. Get to know more about how profs work and how they expect.

The only con I can think of is wasting too much time trying to achieve something really difficult. In this scenario, it is best to seek help from the project guide.

**Could you talk about what you did for your project? What is the brief outline for this project (if you had reports/presentations etc.)?**

Multi-Armed Bandits are very standard online learning algorithms. They assume the knowledge of underlying probability distribution - for example, sub-Gaussian, Uniform, etc. There does not exist any standard robust MAB algorithm which takes into account the uncertainty in the knowledge of arm distributions. In my work, I attempted to propose statistically robust algorithms with provable upper bounds. The proposed upper bounds touch the lower bounds and hence our proposed algorithm is an optimal solution up to a scaling factor.

The work, in the form of a potential research paper, is available here: (<http://arxiv.org/abs/2006.12038>).

**How did SLP help you to further decide your research work? Did you continue research in that field, or take something else up?**

I did not continue research in the same field but instead took up something else. It really helped me in developing research temperament. In addition, I also interacted with my professor a lot and that helped me perceive things more logically.

# **10. UNCONVENTIONAL COURSES**

IIT Bombay has a plethora of courses providing opportunities for students to grow in different fields. These courses need not necessarily be from departments offering UG Programs. Centers like CTARA, Policy Studies (PS) etc. also offer courses for UG students. Therefore, to give you a more brief idea about these courses, we have compiled reviews from Undergraduate students who have done courses from GNR (Geoinformatics and Natural Resources Engineering), PS (Policy studies) and CTARA (Centre for Technology Alternatives for Rural Areas).

## **10.1. SAKSHEE PIMPALE - GNR652 (Machine Learning in Remote Sensing)**

**How did you find out about this course, and what led you to take this course?**

I came to know about the course through discussions with friends about extra courses. This was the only ML course offered that semester, the syllabus looked appealing, the course project component, and the fact that many of my friends were also opting for it led me to take this course.

**Could you briefly explain the curriculum of this course?**

Quite a lot of topics are introduced in this course ranging from supervised learning, unsupervised learning to semi-supervised learning to the introduction of Deep Learning. Supervised learning is touched upon with more rigour.

1. Probabilistic Machine Learning
2. Linear Regression, Logistic Regression, Ridge Regression
3. Decision Trees
4. Support Vector Machines
5. PAC Learning
6. Maximum Likelihood Estimation, MAP Estimation
7. VC Dimension
8. Clustering - K-means, Graph-cut using spectral clustering, Mean-shift
9. Dimensionality reduction - PCA, Kernel PCA
10. Learning to rank - SVM based, triplet loss, siamese loss

11. Neural network - back-propagation derivation, multi-layer perceptron, auto-encoder (sparse, denoising, contractive), different layers of CNN (Conv, pooling, non-linearity, dropout, batch-norm)
12. Semi-supervised learning - active learning, transductive SVM

**How is the rigour of this course compared to your other courses, and how many hours of effort did you put in each week? What do you have to do as a part of this course (reports/assignments/presentations etc.)?**

This course had three assignments, a paper review and a course project. The weightage was as follows:

1. Midsem - 25 %
2. Endsem - 40%
3. Course Project - 20%
4. 3 Assignments (+1 paper Review) - 15%

The assignments are doable and almost everyone receives good marks. Project is a good learning experience where we need to implement a paper or in some cases get a new project idea of our own. The presentation and viva for the course project were scheduled after the endsem which gave us enough time.

Regarding the difficulty, it is moderate and I had put in 6 hours of self-study per week similar to other moderate level subjects. A lot of topics are covered and it certainly helps knowing and revising the basics of Machine Learning like the Andrew Ng course at the onset of the course.

**What were the pros/cons of this course? Any suggestions for people wanting to take this course?**

The pros of the course include-

1. The professor is very chill and approachable and helps with resources for assignments and self-learning. Sometimes good hints are provided to help with the assignments.
2. Assignments are allowed to be done in any language. It gets easy with Matlab if you don't have the time. But working in Python could have a learning curve but it isn't that difficult and worth the effort.

3. The exams require conceptual understanding and some questions are simply mathematical regarding the algorithms or techniques e.g. build a decision tree given the data, do the dimensionality reduction given the data, etc.
4. Grading is moderate

Cons:

1. If you are extremely new to ML, some self-study is required.
2. The professor doesn't go too deep into the working of a particular topic but covers a wide range of topics.
3. Slides may not be very informative and we are required to refer to YouTube videos and online links and references by the professor at the time of exams.

**How did this course help you?/ How is this course relevant for your career?**

The course has been very relevant to me. It gave me a thorough familiarisation and kickstart into Machine Learning. The assignments weren't too comprehensive of all the topics covered but did cover the important concepts. So this helped me get started with Programming Machine Learning Algorithms. I later did research projects in this field which strengthened my python programming skills and set my thought process about approaching problems in the ML way. The paper review component taught about the importance of island benefits of reading research papers. The exams brought clarity of concepts. This also helped set my stage for the following course GNR 638 which gave great insight with a lot of hands-on learning.

## **10.2. MADHAV GUPTA - PS 301 (Policy Related Supervised Learning)**

**How did you find out about this course, and what led you to take this course?**

It was advertised through students' notices by CPS. It was a first of its kind offering. It was a half-semester course. I wanted to delve deeper into the policy work, understand the work of public policy consultants, and how big projects work which require a multi lensed approach.

**Could you briefly explain the curriculum of this course?**

PS 301 is PRSL [Policy related supervised learning]. It is quite similar to TDSL. It does not have any fixed curriculum. I felt that the main aim of the course and learning

objective is to interact with the outside world directly and formulate solutions. It can be a policy report/recommendation or an analytical understanding of the course.

One can check out more here - <https://www.cps.iitb.ac.in/prsl/>

**How is the rigour of this course compared to your other courses, and how many hours of effort did you put in each week?**

It is the usual rigour as a project course. It will all depend on you and your guide. What is that you are expecting from the course and the guide is expecting from the course. My guide clearly told me that I need to put in 2 afternoon's work per week. Which is around 6-8 hours. A lot of my time went into reading the NPE and other documents that referred to the NPE/relevant to education. I personally feel that the half-semester was less to do with my topic of NPE.

**What were the pros/cons of this course? Any suggestions for people wanting to take this course?**

Pros of the course-

1. Not a theory course, actually a project course with possible hands-on experience.
2. Work at your own pace for the course project,

Cons -

1. Might require a lot of time to work on than the usual theory course. It depends on you and your guide of course, but I didn't use any kind of analytical/quantitative framework. My report was very qualitative and more along the lines of an opinion piece.

Whatever it is, you will require constant effort for a good grade and a tangible outcome.

**How did this course help you?/ How is this course relevant to your career?**

The course was really enriching in terms of Education practices, policies. I got to understand how are national-level policies really made, who are they made by, what is the reasoning behind deploying something. How are policies different from implementation. I also felt the project to be very multi lensed, whenever designing

any public policy/vision document, people with different interests are required to come together to contribute and make an all-encompassing policy benefiting all.

Relevant to the career? I am not sure as of now if I want to pursue a career in policy or not, but it gave me a clearer understanding of different bifurcation of jobs. This was out of the context of the project work that I was doing but I was able to understand slightly the varying level of capacities that I can be engaged to work for the betterment of the policies in India.

**Just some general suggestions-**

1. Pick up the project extremely carefully
2. Start early on your project - define the problem statement as soon as possible.  
Make a template report and start populating it. It has a lot of inertia to overcome, hence it is advisable that you populate your report as soon as possible.
3. Fix office timings/weekly meetings with your guide - This way the pressure to be regular and working will be maintained.

### **10.3. AYUSHI PANGHAL - PS 301 (Policy Related Supervised Learning)**

**How did you find out about this course, and what led you to take this course?**

I got to know about it through an email from CPS mentioning the Supervised Learning course under the policy umbrella (PRSL: Policy Related Supervised Learning). Since the course provided an opportunity to work on half-semester long policy-related live projects, it offered an excellent opportunity to students who wish to apply themselves as policy analysts, social scientists, or consultants in this exciting area of Policy development. I had previously worked in the impact sector through various platforms and I wanted to explore the Policy development space - so this was the right fit for me.

They had also mentioned that the projects would involve direct interaction with the larger society and require the formulation of solutions that could be in the form of policy recommendations based on an analytical understanding of a research topic. Among the broad list of topics they were offering, I decided to pursue NEP (National Education Policy) as I had previously enjoyed working with an impact consulting firm in this sector.

**Could you briefly explain the curriculum of this course?**

Eligibility Criteria: PS 301 course was open to undergraduate students (in their third year and beyond) of all departments. Applicants had to write a note (500 words) describing their motivation to take up this course and the topic(s) of mutual interest to the supervisor. Since registrations were limited, students were selected by their demonstrated interest and preparation.

Once selected, we could meet our guide to discuss the scope of the project. After we mutually agreed to go ahead with the project, we filled the registration form and got it signed from both the faculty adviser and the PRSL course coordinator before the deadline.

PS 301: 03 credits (UG, half-semester)

The outcome of the study should have content that is of interest to the stakeholders. The course largely involved the gathering of data, fieldwork (if required), study, and analysis. Stakeholder participation was essential.

The deliverables required for the project were very specifically fleshed out. These were:

1. Objective and Methodology document at the beginning of the work (by end of the first week)
2. Final report and presentation

Grades were based on these deliverables and the final presentation (the success of the PRSL (course and grade) depended on the following: ownership of the topic under study, commitment and initiative, eagerness to go on field visits, proper documentation and analysis, and an eagerness to understand the interface between policy and real problems). It was expected that the external stakeholders be invited for the final presentation.

**How is the rigour of this course compared to your other courses, and how many hours of effort did you put in each week?**

It was recommended that the students set up a fixed weekly meeting time with their guide to discuss the progress of their work. Hence, I used to meet my guide for an hour every week for approximately 6 weeks.

Apart from this, I had to invest around 2-3 hours every week to read and analyze the policy draft. I invested 2-3 days in fieldwork by doing a survey for the project and analyzing it in the context of the policy. Finally, the report and presentation took a lot of consistent effort and time for a week.

Although in the course guidelines it was mentioned that the 3 credit registration required to have 2-3 days of fieldwork and 25 hours of desk work, the efforts required significantly exceeded the mentioned durations. As compared to any other course that I was pursuing in that half-semester, PRSL required most efforts owing to the multiple deadlines in a short duration of time.

**What were the pros/cons of this course? Any suggestions for people wanting to take this course?**

Pros: Opportunity to understand the policy development space by working on live projects, skill development (managing stakeholders, ownership, analyzing the impact of a particular policy - understanding the interface between policy and real problems, fieldwork - understanding the on-ground reality, supervised learning, thought-provoking discussions with the guide)

Cons: Half-semester course (multiple deadlines in a short duration, limits learning opportunities, more focussed on deliverables than the learning outcomes, broader scope of projects - incoherent with the timelines)

**How did this course help you?/ How is this course relevant for your career?**

The course offers an excellent opportunity for beginners who wish to apply themselves as policy analysts, social scientists, or consultants in the area of Policy development. I will soon be working as an associate with BCG and impact space remains high on priority for me - so in the near future or sometime later, the skillsets I have developed through this course would certainly help me in my career.

## **10.4. NIKHIL RODEKAR - PS 301 (Policy Related Supervised Learning)**

**How did you find out about this course, and what led you to take this course?**

I found out about the course through the mail sent by the relevant authorities. I have always been inclined towards primary education and policymaking in the area hence it was no surprise for me that I wanted to take this course.

**Could you briefly explain the curriculum of this course?**

In our group, we analyzed the primary education section of the Draft National Education Policy (DNEP) of 2019. Throughout the course, we went through various sections of the said policy and thought about possible reasons behind the proposals in the policy. Furthermore, we were required to examine the current situation and make our own suggestions and then see those in light of the policy. To state simply, the curriculum was just analyzing a part of the DNEP (Draft National Education Policy) 2019.

**How is the rigour of this course compared to your other courses, and how many hours of effort did you put in each week?**

It was fairly lax. I had to put in not more than 4 hours a week which was okay. Towards the end, though we did put in some extra hours to make a report but that I guess that is a given!

**What were the pros/cons of this course? Any suggestions for people wanting to take this course?**

The pros were that students are getting exposed to a world outside technology in a way that makes them socially conscious in the true sense. It also makes them look at how decisions that affect their lives are made (I am primarily talking about my project and I have no idea about others' projects)

A con of this course would probably be that as of now, there's not a whole lot of students to work with.

**How did this course help you?/ How is this course relevant to your career?**

It helped me to look into the meticulous nature of our policymaking that usually goes overlooked. I think it might in general help any individual to look into the details of things, seek consultation from experts and make an informed decision that affects a

large mass with responsibility. Personally, it has helped me to go deeper and enquire about things that I would have otherwise taken to be fairly obvious.

## **10.5. KUSHAGRA KACHOLIA - TD 390, TD 490 & TD 491 (CTARA Courses)**

### **How did you find out about this course, and what led you to take this course?**

Having clearly made up my mind right in the first semester to not put my hands in anything even remotely related to Core Mechanical, I found myself trapped in the guilt of potentially passing out of IIT without taking up even a single project. While browsing through the list of courses that could be taken up as institute electives, I came across TD390, which according to me is as close to a "Non-Core" project as one can find in insti. It promised to help develop a wide variety of interpersonal skills, while simultaneously allowing to have an unbeatable on-ground experience in the rural areas of Maharashtra.

### **Could you briefly explain the curriculum of this course?**

TD 390 is a study, i.e., a report of a field situation to people in IIT. TD 490 is an analysis in addition to the study and must be shared with the stakeholders. The outcome of the study must have content which is of interest to the stakeholders. The TD 390/TD 490 will largely involve gathering of data, field work, study and analysis. TD 491 has a design component, i.e., a solution to a "development situation". Again, stakeholder participation is essential. All three courses require a significant amount of field work.

The deliverables required for the project are:

- 1) Objective and Methodology document at the beginning of the work
- 2) Final report
- 3) Copy of the presentation

Grades will be based on these deliverables and the final presentation. For TD 490 and TD 491, it is expected that the external stakeholders be invited for the final presentation.

**How is the rigor of this course compared to your other courses, and how many hours of effort did you put in each week?**

A 6 credit registration 4-5 days of field work and 50 hours of deskwork. A 12 credit registration needs double of the above amounts. If 2 or more students work together on a project, then the total number of hours expected to be put into the project would multiply by the same factor.

**What were the pros/cons of this course? Any suggestions for people wanting to take this course?**

One should be careful to not get too excited by the grading statistics of the course (which is quite good by the way) as a decent grade is only guaranteed if the project is completed on time and all the goals have been achieved successfully. Also, try avoiding taking projects involving visits in open areas in the Autumn semester as the weather can be a brutal force to encounter. Choose your team-mates wisely as there might be a phase where you'd feel like giving up and would require some support and encouragement.

**How did this course help you?/ How is this course relevant for your career?**

The projects can help you secure an internship or two (at least in my case they did :P), as well as help you while filling your higher studies applications as it involves some amount of social work, but only if done properly and with complete dedication. These courses can turn out to be one hell of an experience and I would recommend all the enthusiastic people to give it a go.

# **11. IR LANGUAGE COURSE REVIEWS**

IR language courses are the courses that are offered by the institute for the benefit of students as well as staff of IIT Bombay. These courses are offered in many languages like Japanese, French, Italian, German etc. The following reviews of four languages i.e Japanese, Chinese, German and French will help in providing a better exposure to the course and deciding which language to take up.

## **11.1. MAITREYA SAHOO - MANDARIN COURSE**

**Give us a brief introduction about the language and how it is different from Hindi and English -**

Chinese language has a wide range of variants and dialects which are spoken apart from China, in countries like Taiwan, Malaysia, Singapore, etc. This would give me an opportunity to visit these countries for internships, understand their culture, tradition and lifestyle. It was a new language to learn, different from communicative languages that we know (Hindi, English and regional languages) and it was a good learning experience for me.

**Why did you decide to study the language? Why should others take up the course?**

I have come across a lot of institutes and learning centres that provide courses on foreign languages like French, German, Spanish, Japanese, and a few others. But Chinese being offered as a course was a great opportunity to learn something different. I would suggest others, who would be having chances of visiting China or other south-east Asian countries to take up this course as it would help to enable hassle-free communication with people of these countries.

**Tell us about the course load and your class schedule for the same (the books used also).**

I had taken the Mandarin language basic course. This course is of one-year duration divided in two modules, one for each semester. The classes were held every Monday and Thursday in two time slots i.e., 5-7pm and 7-9pm. I had opted for the second slot.

The course was very well structured and complete in all aspects-understanding, speaking, writing, reading and listening- all done sequentially. Starting from basic introduction about ourselves in Mandarin to study of basic tones, numbers, date and time system, directions, objects used in everyday life, dialogues and characters in writing, everything was taught. We also had other activities like skits, assignments and tests- that are helpful for a beginner to understand its essentials.

The interesting aspects of this course were learning cuisines and dining etiquettes through a dinner at a Chinese restaurant, visiting a culture shop to see their artworks, watching Mandarin movies and shows, and a lot more. We enjoyed these practical aspects very much. We were also provided with some course materials for self-study like dialogue and picture books, TOCFL study materials, etc.

**How to register for the course?**

Registration for this course starts at the beginning of an academic year. An online application form is floated by the Dean IR office. Students get selected for language courses depending on the availability of seats for a course.

**Tell us about your course instructor -**

Our course instructor was very jovial and energetic. She was passionate about us learning Chinese and sometimes she even changed her teaching strategy based on our feedback and understanding. She also had a lot of enthusiasm in explaining daily, routine affairs in China, their education system, societies, artforms and how well it's similar to that of ours. During our visits to culture shops and restaurants, she gave us practical examples and demonstrations of conversing, dining and appreciating. Of course, she took a keen interest in making us learn a new language.

**Are there any myths about the language or the course in general that you'd like to discuss?**

A lot of people find Chinese to be a difficult language to learn when it comes to memorizing a new set of tones and characters. But I would say that Chinese language itself has a lot of variants, among which, only Mandarin is taught here. And it's quite easy to understand this variant. In fact, one can learn it well if he/she gets to know some basic rules followed in this language.

**What are the take away points from your experience that you would want to suggest to others who are willing to study the same course?**

Take the course as a recreation and it will be enjoyable learning it. Spend some time revising and conversing and you can be fluent in understanding and expressing. Lastly, make some time reading Chinese short texts, watching movies and shows that can brush up your learning. Enjoy the course!

## **11.2. NAKUL RANDAD- GERMAN REVIEW**

**Give us a brief introduction to the language and how it is different from Hindi and English-**

One of the major languages of the world, German is a native language to almost 100 million people worldwide and the most widely spoken native language in the European Union. As far as the script is concerned, German is similar to English with a few extra alphabets but the grammar is way more difficult. I found the German grammar closely related to Sanskrit (just a fun fact). Few words sound similar to their English counterpart but some, totally contrasting.

**Why did you decide to study the language? Why should others take up the course?**

I always had a wish to learn some popular foreign language (not widely spoken in India). The options I had were few as languages like Japanese and Chinese had a different script, so became out of my scope. Also, I had done some basic courses in French and German during my schooling and found them fascinating. The other pros German has are: a very rich literature and culture, many scientific publications, good quality movies & music and increased job opportunities (when proficient). You can take this course even if you have the slightest desire/enthusiasm to get acquainted with a good language and also as an escape to academics for a while ;)

**Tell us about the course load and your class schedule for the same (the books used also).**

The course is pretty chill and mediocre paced(exams as well). I did not have any excess load with the homework provided as they were just 10 to 15 minutes long. I used to attend evening 7-9 class twice a week which I enjoyed thoroughly after day-long lectures and lab sessions. All the books were provided by the instructor which were more than sufficient for the course.

**How to register for the course?**

I received an email from the Dean IR office on GPO which was followed by a test to register for the course.

**Tell us about your course instructor -**

The course instructor was very lively and enthusiastic and enjoyed teaching us the language. She used to converse with all of us in the class to build the vocabulary, share fun facts, play German songs once in a while and sometimes arrange movie screenings as well. She did not rush in any part of the course and clarified all our grammar-related doubts. In fact, by the end of the course, I developed a taste for German music.

**Are there any myths about the language or the course in general that you'd like to discuss?**

The myth I encountered often is: German is a hard language to learn. As a matter of fact, any language is going to be difficult to learn from scratch. Standardization has been done to simplify the rules of a language. It helps to make spelling more uniform and predictable and grammar subtle. Though I agree, I found the grammar more difficult than English.

**What are the takeaway points from your experience that you would want to suggest to others who are willing to study the same course?**

As I mentioned earlier, the language course is a good escape to academics. I found the course interesting as it enabled me to get to know German culture better. It is not a time demanding course and adds a lot of value to the learner. The instructor is very cooperative with other academic commitments as well so I never felt loaded with the course. In the end, I strongly recommend this course as the overall experience I had was positive.

### **11.3. RISHAV RANJAN - FRENCH COURSE**

**Give us a brief introduction about the language and how it is different from Hindi and English -**

The words are hard to pronounce, unlike English where the words are pronounced more or less the same way we read it. Pronouncing and learning plays a crucial part which makes it a little bit tough.

**Why did you decide to study the language? Why should others take up the course?**

We get to learn a new language. Further, It opens options for us such as securing Interns or SemEx or opting for higher studies to Universities in France as some of the Universities prefer students with proficiency in basic French language. It also provides us the leverage of applying for job opportunities in France in future.

**How was the course load?**

The course load is minimal. Most of the learning happens in the class. Regarding the assignments, sometimes we are given some sentences in English to translate and pronounce in French and send him the audio clip which hardly takes time. Sometimes he asks us to see a particular movie or video in French with English subtitles so that we can relate to and practice what we are learning in class.

**What are the class timings? Is the course certificate based or credit based?**

Class happens two times a day from 7pm-9pm. There are two batches for the same. One batch has classes on Monday and Thursday and the other batch has classes on Tuesday and Friday. Students can opt for any one batch as per his other academic commitments of the semester. The course is certificate based. We are awarded a certificate if we complete more than 50 hrs of classes per sem and pass a test at the end of each sem.

**How to register for this course?**

The courses are offered by the International Relations office of IIT Bombay at the start of each academic year. We need to register for the course for a whole year. Since the seats are limited, the students have to pass a screening test whose syllabus and notes are provided well before.

**Tell us about your course instructor -**

Our instructor Nicolas Mace, was the jolliest person I have seen in IIT. He greets every student and remembers each student's name. He roams around the whole class when he teaches and makes sure every student is learning and pronouncing words correctly and helps him/her in their weak areas as much as he can. His friendly and positive attitude kept us going. His teaching techniques are quite intuitive. He shows us French movies with English subs to strengthen our vocabulary sometimes. He gives insights about the opportunities in France too.

#### **11.4. SAI ANIRUDH - JAPANESE COURSE**

**Give us a brief introduction about the language and how it is different from Hindi and English -**

Japanese is said to be a rather difficult language to obtain proficiency in, especially for native English speakers. However, in aspects such as pronunciation and sentence structure, it is very similar to many Indian languages, including Hindi. The average Indian may find it easy to learn a decent level of spoken Japanese. However, it may take several years to become proficient in its vocabulary and the accompanying script, which consists of a huge number of ideographs (known as Kanji).

**Why did you decide to study the language? Why should others take up the course?**

I find Japanese culture to be very intriguing and respectable, and I believe learning the language is the best way to learn more about it. Many of us may already be exposed to their culture owing to their strong presence in popular culture, through Manga and Anime.

You should take this course if you want to be able to hold a basic conversation in the language, or want to spend time learning more about the culture in a formal manner, or simply want to add the language to your skillset. But don't expect to be a master of the language by the end of the year.

Also, having completed ~100 hours of learning with this course, with a little extra preparation you should be ready to appear for the N5 level of the Japanese Language Proficiency Test (JLPT), which is the first of five levels.

**Tell us about the course load and your class schedule for the same (the books used as well) -**

There are two classes per week, each 2 hours long. They happened on Mondays and Thursdays in two batches, 5-7PM and 7-9PM. Aside from classroom hours, any load you take is purely voluntary study. There was no strict evaluation as such, just a test at the end of each term. This test was fairly straightforward if you paid some attention during classes. A total of 50% attendance in each term is necessary to be eligible to receive a certificate for having attended the course. The reference book is provided by the IR Office as part of the course, and is called 'Minna No Nihongo' (Japanese For Everyone), and is a very popular book for beginner level Japanese.

**How to register for the course?**

There is a form circulated by the IR Office right before the start of the Autumn semester. Registration and batch allotment happen after screening as there are supposedly a large number of applicants.

**Tell us about your course instructor -**

Our instructor, Mr. Chiaki Sunauchi, is from Japan and is a humble and sincere man. He is quite interested in students' learning, and incorporates many activities in his classes to give different tastes of Japanese culture. These included brush painting, postcard making, Origami, a Kendo (type of martial arts) demonstration, and occasional Japanese movie binge watches. Apart from teaching lessons from the book, he also spends time talking about relevant news from Japan, festivals and events, and brings show-and-tell objects to pass around class. He is also very lenient in terms of student punctuality. The only difficulty we faced was the language barrier, as he is not very proficient in English. So at times it took effort to communicate with him.

**What are the take away points from your experience that you would want to suggest to others who are willing to study the same course?**

A lot of people seem to lose interest/ no longer have time to attend classes mid way. But the course has a lot of learning to offer. If one makes a little effort to stay attentive in class, things will make sense and you can learn a lot rapidly over the year. Occasional review would help keep in touch with the vast vocabulary as well. And make sure to keep track of events and activities that the instructor has planned, as they give a great perspective to the culture, apart from being entertaining, of course.

# **12. COURSE LADDER**

## **12.1. ABHINAV JAIN - ANALYTICS**

**When did you decide to explore the Analytics field? And what got you interested in that field?**

I decided to explore the field of analytics at the end of my first year. As a student of Aerospace engineering in my freshmen year, I came across data analysis, visualizations, and python programming as a part of my introductory course AE102. The course is very popular among freshmen and sophomores for being hands-on and creative in coursework. However, I truly took steps in the field in my second year when I got back to python programming as part of other courses in my third and fourth semester. Especially in my solid mechanical lab, where we worked on improving one of the experiments and worked intensively to improve the quality of results. From that time it was no turning back!

**What were the courses and clubs/programs you took from insti that supplemented your learning towards that field, and how much did they contribute towards your learning?**

Starting from my department introductory course AE102 (Data Analysis and Interpretation), I also took courses from different departments related to data analysis and machine learning. Some of them include ME781 (Engineering Data Mining and Applications), ME773 (Reliability Modelling and Analysis for Engineering Systems), IE614 (Linear Systems), IE502 (Probabilistic Models), and IE643 (Deep Learning - Theory and Practice).

Apart from courses, I also undertook independent projects that included data analysis and took part in events like Inter IIT Tech Meet and other events in the institute that contributed towards my learning.

**Did you explore that field through other sources (non-insti courses) as well? If yes, what were they?**

I have done two internships in the field where I got to learn a lot of techniques and technologies that are relevant to industries. Topics like regular expressions, SQL, text processing, and using remote management software like Putty are not something

that can be learned in the institute easily. Hence, the internships turned out to be of great help.

**Would it be beneficial to explore this field alone or with like-minded people?**

While I did explore the field on my own, I did get to learn a lot from my peers who worked in the same field. I did not work with them but we had discussions on various topics and their knowledge benefitted me in my journey of data science. Therefore my recommendation would choose your own path for learning as everyone faces different circumstances, but engaging in some community (online or offline) certainly helps in learning.

**Anything you would like to suggest to someone who's interested in learning and going deep in this field (or any field in general)?**

Always keep yourself updated. This is really important especially in a field like data science where new things are being done almost every day. It may not seem so, but even reading an article related to your field every alternate day or two can sometimes turn out to be useful in interviews or applications.

## **12.2. SARTHAK CONSUL - ARTIFICIAL INTELLIGENCE**

**When did you decide that you want to explore AI? And what got you interested in that field?**

My journey began, like most, with the Coursera ML course. I was recommended this by my brother while I was bored during the winter vacations after my 3rd sem. After finding the Coursera lectures too simplified, I went on to watch Prof. Andrew Ng's CS229 lectures on YouTube and was hooked by the mathematics. The elegant mathematics, coupled by the countless possible applications, is what kept me pursuing the field. I then proceeded to do multiple online courses to learn as much as possible before I approached Prof. Amit Sethi for a project for the summer holidays. It was after this internship that I fully committed to pursuing AI and started taking electives to deepen my knowledge base.

**What were the courses and clubs/programs you took from Insti that supplemented your learning towards AI, and how did they contribute towards your learning?**

- Non 'AI courses' that cover the mathematical concepts behind ML algorithms -

1. EE223 - The basic Probability theory course which is necessary to understand the foundational math of ML
  2. EE325 - Probability and Random Processes - The follow-up course to EE223, random processes are an important concept to understand, especially for computational simulation which is needed in RL
  3. EE636 - Matrix Computations – Speed Up in computations using matrix operations is the main reason that modern deep learning approaches are feasible and thus so famous. This course focuses on the theory behind such computations. The knowledge gained proves useful when trying to understand what goes on under the hood during the computation. While it is not a necessary course, it is certainly useful.
  4. EE659 - A First Course in Optimization - A very heavy course that covers the theory of optimization. It provides the tools to understand the advanced math behind modern ML algorithms
- 'AI courses' -
    1. CS419M Introduction to ML - Teaches the foundations of ML, covers the basic supervised learning algos and the working of NNs
    2. CS747 - Foundations of Intelligent and Learning Agents - An excellent course that covers the bandit algorithms and the basics of Reinforcement Learning
    3. CS748 - Advances in Intelligent and Learning Agents - A follow-up course of CS 747 that covers the modern approaches taken to train an agent using Reinforcement Learning
    4. EE737 - Introduction to Stochastic Control - This course focuses on theoretically proving the performance bounds of bandit algorithms.
    5. CS753 - Automatic Speech Recognition - Covers the various algorithms devised for temporal data. Useful if interested in NLP/ASR
    6. EE782 - Advanced Topics in Machine Learning - An excellent course that covers the various advances in Deep Learning.
  - Other Courses that supplemented my forays into ML -
    1. CS663 Fundamentals of Digital Image Processing - While this is not an AI course, it is a useful course to take, especially since a lot of AI is focussed on learning from visual data.

- EE702 Computer Vision - Covered the mathematical formulation of vision problems and the various non-ML approaches to obtain depth from 2D Images. Note: CS763 covers the DL approaches in obtaining depth estimates.
  - CS754 Advanced Image Processing - Focuses on Compressed Sensing. While most of the course tackles non-ML approaches, the course does spend time on DL approaches to Compressed Sensing.
- Clubs/Programs -

I spent the summer after Sem 4 interning under the guidance of Prof. Amit Sethi where I gained experience in leveraging deep learning on medical data for practical applications. I continued working with his MeDAL lab throughout my third year.

The WnCC/ Electronics Club routinely hosts talks wherein students share their research experience. I attended a few of them which I found were informative and allowed me to learn about topics in AI that I had previously not explored.

**Did you explore AI through other sources (non-insti courses) as well? If yes, what were they?**

- Prof Andrew Ng's CS229 Online lectures on YouTube (Stanford) - Similar content to CS419M. A more mathematically rigorous treatment of ML than his Coursera course
- Prof Andrew Ng's Machine Learning course on Coursera - Topics are a watered-down version of Prof. Andre Ng's CS229 lectures so I only did the assignments for exposure to machine learning on MATLAB. MATLAB is not commonly used by the ML community and so not really worth it.
- Prof. Geoffrey Hinton's Neural Networks for Machine Learning course on Coursera - Covered the various Artificial Neural Networks such as Perceptron Network, Hopfield Nets, Restricted Boltzmann Machines, and the modern deep Neural Networks. Gives experience in Python coding for AI. While most of the topics aren't as relevant in modern research, you'll learn about the various precursors to modern Neural Networks with Prof Hinton's expert commentary. This is also the citable source to the famous RMSProp learning rule that is still in use till this date. Not an essential course to do, but it is informative. EE782 will cover some topics such as Boltzmann Machines

4. Prof. Fei Fei Li's CS231n Online Lectures on YouTube (Stanford) – I did this course before my internship with Prof. Amit Sethi. It focusses on CNNs and deep learning on visual data. This material is covered in EE782.
5. Dr David Silver's Reinforcement Learning Online Lectures on YouTube (DeepMind) – Excellent video lectures but CS747 will cover the topics in this 10-part video series.
6. Various blog posts on an assortment of topics

#### **How beneficial would it be to explore this field with like-minded people?**

Finding people with similar interests is undoubtedly better when exploring a field. My advice is don't wait for a group to begin your exploration - with ML being such a hot topic, the internet is full of great material to facilitate your exploration by oneself. Instead, connect with people while you're exploring. Connecting with people of similar interests will allow you to learn about different ideas or topics that they're familiar with and also gives you the opportunity to condense and explain your learnings with others (which is an important aspect in research and a mark of true understanding).

I personally learnt a lot when I interacted with the PhD and Masters students working in the MeDAL lab and the VIP lab in the EE department. Their advice, coupled with the experiences shared by my friends, has shaped my journey in AI.

#### **Anything you would like to suggest to someone who's interested in learning and going deep in AI/ML?**

With AI being such a hot buzzword right now, it's important to gauge for oneself if the field is your calling. Don't simply jump blindly into the bandwagon. First, seriously read up about the field – the internet is your friend here, with plenty of introductory courses and books to get a clear picture of the field. Focus on introductory level material at this stage, the deeper technical details can be covered once you've established an interest. Listening to the experiences of seniors is another source of information you should exploit. IITB has a great pool of faculty working on the various subdomains of AI. After doing the required background research and figuring out which subdomain you'd like to explore, you should approach a relevant professor for guidance. Working on a project with them during the vacations (especially the winters and the 2nd year summers) is a great way to delve into the field. While some may decide to focus solely on AI, there is an increasing demand for leveraging AI to

problems in the core engineering. I highly recommend this as it has a lot of potential and is a great way of utilising your engineering background in a new exciting manner.

### **12.3. ANMOL GUPTA - CONSULTING**

**When did you decide that you want to explore the consulting field? And what got you interested in that field?**

I wanted to use my undergrad to explore various fields properly, so I tried a univ intern in my second year summers, and a corporate technical intern in third year summer. I had read about Consulting from my seniors' accounts, and therefore felt like I had to experience it once. So , in my fifth semester itself, I got into ShARE - which perhaps came closest to the field of consulting for me at that time. It was then when I started participating in case study competitions, and really enjoyed working on the problems then. So, that furthered my interest in the field.

**What were the courses and clubs/programs you took from insti that supplemented your learning towards that field, and how much did they contribute towards your learning?**

I attended a few sessions by Consult Club for placement preparation, and there was also this Global Governance Initiative Masterclass on Public Policy Consulting that I attended, which gave me quite some insights into the public sector side of consulting and the challenges involved there.

**Did you explore that field through other sources (non-insti courses) as well? If yes, what were they?**

It was majorly the case competitions that helped me learn more about the field in some sense. Those are arguably the best non-insti resources because you get to really experience how to systematically solve a business problem and present the solution in a refined manner.

**How beneficial would it be to explore this field with like-minded people?**

I think as with most learning experiences, this is better done with people of similar interests, because you get to exchange resources, have discussions, and participate in sessions/competitions together.

**Anything you would like to suggest to someone who's interested in learning and going deep in this field?**

Frankly, there isn't really a plethora of opportunities available in undergrad for consulting, if you remove the professional roles - viz. internships. There are of course a few student-organisations that are trying to fill that gap, and one can try to enroll in them to understand the field better. Apart from those, it's primarily the case study competitions that can really help one explore the field properly. Try choosing a few good ones instead of attempting every single one out there. Also, try teaming up with seniors who have some experience in case studies, for you'll be able to observe and understand their way of approaching and analysing the problem very well in this manner.

## **12.4. ADIT DAFTARY - FINANCE**

**When did you decide that you want to explore finance? And what got you interested in that field?**

I had always wanted to explore Finance right from my first year and like many people, even I was baffled about where to start from.

**What were the courses and clubs/programs you took from insti that supplemented your learning towards that field, and how much did they contribute towards your learning?**

As a starter, I had taken up MG403 (*Basics of Accounting and Financial Management*) as an Elective in my sophomore year. In hindsight, the course had really good content and I had taken it prematurely with no understanding whatsoever. I didn't learn much theory wise, but the course strong footed my decision of exploring Finance full-fledged.

Next, I took up a course offered on Equity Portfolio Management via our own Finance Club. It gave me a good headstart and decent guidance on how to get started with things. As vast as finance is, I believe, the majority of one's learning is going to be self-taught. I have picked up keywords and just Googled them most of the time. Investopedia has been a good companion throughout.

**Did you explore that field through other sources (non-insti courses) as well? If yes, what were they?**

During the summers (after completing 2nd year), I leveraged my internship experience at IIFL Markets to gain a lot of knowledge in a span of 2 months. Other than my internship, I did 4 extra courses on Udemy and read several books on finance during the summers. I used to day trade (this is discretionary stuff) to get a knack of the markets. I followed Technical indicators and Price charts day in and day out. I completed YTC Price Action Strategies complete set of 6 books by the end of Summers. I used all my knowledge gained and bagged an internship at Barclays Investment Bank during my 3rd year.

**How beneficial would it be to explore this field with like-minded people?**

I would recommend exploring this field with people having similar interests. It enables better exchange of information (be it theory or current trends in the industry) among each other.

**Anything you would like to suggest to someone who's interested in learning and going deep in the finance field?**

I believe in Paralysis by Analysis. Catch hold of people who are successful in that field. Saves your time. I remember connecting with working professionals on LinkedIn just to know the work prospects in Finance. I used to sit and talk with different employees during my lunch breaks at my internship. Be it about theory or about the industry, I was unafraid of asking the silliest of questions to people. What might take hours of Googling can simply take 10 minutes if explained by someone. In the end, it's up to you of how you assimilate all the information, but be rest assured that the journey will always be beautiful like mine has been.

For more info regarding Adit's experience in Finance, refer to the following link:

<https://medium.com/@adit25daftary/faqs-on-finance-327188297596>

For more info regarding Adit's experience on his application for the Barclays' internship, refer to:

<https://medium.com/age-of-awareness/the-interview-1-2-89bb43acb60>

## **13. EQUIVALENT COURSES FOR CLEARING BACKLOG**

For the purpose of clearing backlog, a list of equivalent courses which can be done has been given below:

**It is to be noted that these courses are not equivalent by default but due to the similarity in the course structure, they have been allowed to be taken in lieu of the corresponding backlog courses subject to approval from the competent department authority. Approval needs to be taken from the DUGC for tagging two courses as equivalent that are not given in this list.**

<b>Backlog</b>	<b>Equivalent Course</b>
ME 346- Heat Transfer II	CL 246- Heat Transfer
MM 152- Materials & technology	CL 346- Material Science
CE 201- Solid Mechanics	CL 231- Solid Mechanics
CE 201- Solid Mechanics	ME 201- Solid Mechanics
CE 205- Fluid Mechanics	ME 203- Fluid Mechanics
CE 221-Solid Mechanics	ME 201- Solid Mechanics
AE 460-Heat Transfer - Aerospace Applications	ME 346, Heat Transfer II
AE 102-Data Analysis and Interpretation	MM 217-Data Analysis and Interpretation
CL 202-Introduction to Data Analysis	EP 219-Data Analysis and Interpretation
AE 102-Data Analysis and Interpretation	ME 102-Data Analysis and Interpretation
AE 209-Solid Mechanics	ME 201-Solid Mechanics
AE 102-Data Analysis and Interpretation	CS 215-Data Analysis and Interpretation
EN 206-Power Electronics and Machine	EE 222-Electrical Machines and Power Electronics
AE 308-Control Theory	EE 302-Control Systems
ME 346-Heat Transfer II	AE 460-Heat Transfer - Aerospace Applications
MM 203-Mechanics of Materials	EN 211-Mechanics of Materials
EN 201-Basic Electrical Engineering	EE 111-Introduction to Electrical Systems
MA 214-Introduction to Numerical Analysis	CL 244-Introduction to Numerical Analysis

## **14. FAQs**

**Q. If I get an FR Grade in a minor course do I need to repeat the course? And will it reflect in my final transcript?**

*A. No, you do not need to repeat the course. However, an 'FR' grade will reflect in the course under the additional courses done.*

**Q. What is the difference between an ALC, Audit course, and sitting through a course?**

*A. ALCs do not count towards your CPI but are involved in tagging - Tag it later as an elective and the grade you get then counts in your cpi. When you audit a course, you do it without obtaining a grade - you get 'AU' - which does not carry grade points. Formal registration is required for both these, and they appear on your transcript, while for sitting through a course - you don't need to register for it, nor does it appear on your transcript.*

**Q. If one gets an FR in Elective HS \*xxx\*. Does he need to repeat the same choice or can he do Elective HS\*yyy\* in its place?**

*A. He can take \*yyy\* as his HSS elective by changing the tag of HS\*xxx\* to additional learning and registering for \*yyy\* in the next semester as HSS-Elective.*

**Q. What about the credits when one does some honour courses but they're not enough for an honours degree?**

*A. If one has done some of the honour courses but not enough to acquire an honours degree, then those courses would be counted in Additional learning Courses, some departments allow to tag these as Department electives/other electives as well*

**Q. What if I take up a course of any other random subject but I don't want to get a minor will that course show up anywhere while passing out?**

*A. The grade that you obtained in the course will show up in the transcript. All the courses taken up as a minor are converted to Additional Learning unless you have completed 30 prescribed credits of minor in a particular department.*

**Q. Would the courses I had taken an S in be counted towards my CPI?**

*A. S grade is just a placeholder grade. For that particular course (where you took an S grade) to be counted in your CPI, you will have to give a re-exam and take a letter grade in it. Otherwise it gets converted to PP (in this case the credits get counted towards credit completion) and is no longer counted in your CPI*

**Q. I had taken an S grade in one of the courses, whose tag I want to change later. Would it be possible?**

*A. Yes, it would be possible to change the tag for the course where you have taken an S grade in accordance with the rules mentioned in the retagging section above*

## 15. SOME USEFUL NOTES

- If you have successfully done the pre-registration of a course (Minors/ HSS Electives), then at the time of registration the allotted pre-registered course comes under the heading “Pre Registered Courses” on your asc interface, and you need not register for the course again under any other heading say Institute elective, Non-Credit Course, Additional course etc.
- Course not listed - If you get a message on the interface saying that the course is not running this semester even though it is, please check the division ('M', 'S1', etc.) in the list of running courses and enter the correct division on the interface while registering for it.
- Entering the division as 'M' will not change your tag to a minor (All about courses → Running Courses) e.g. CE 310 - M, MM 474 - M, CS 101 - D1/D2/D3/D4, etc.
- Prerequisites pains - If there are errors, please send a mail to [asc.help@iitb.ac.in](mailto:asc.help@iitb.ac.in) with a screenshot using your **LDAP ID** only, if the grade for the prerequisite course is not out or if you want to take a course without clearing the prerequisite, please get permission from the **course instructor**.
- If your category has been mentioned wrongly on ASC then you need to mail [asc.help@iitb.ac.in](mailto:asc.help@iitb.ac.in) to get the issue resolved.

# 16. REACHING THE ACADEMIC COUNCIL

The UGAC, IIT Bombay, or the Undergraduate Academic Council of IIT Bombay, is a student body dedicated to improving the academic system and culture of the institute by working on various policies and conducting sessions to disseminate information. It has 6 primary pillars on which it functions :

- 1. Student Support Services:** SSS mainly takes care of the basic requirements of the students like tutorials, registration, personality development, Language and Communication skills, faculty-student relations, learning issues etc.
- 2. Career Cell:** The career cell aims at equipping the students with all the required information and insights into every single career opportunity coming its way and provides an impartial, fair account of every possible detail about various careers and job profiles
- 3. EnPoWER:** Engineering oriented Promotion of Work Experience and Research, EnPoWER aims at the promotion of research among the undergraduate students of IIT Bombay and also encourages them to use their skills to tackle problems faced by the industry.
- 4. Finance Club:** The Finance Club conducts a large number of sessions and competitions on various topics related to finance.
- 5. Consult Club:** The Consult Club conducts sessions and workshops to help students gain an understanding of consulting and its nuances
- 6. Analytics Club:** The Analytics Club organised sessions of various kinds that teach students various skills and software related to analytics and their applications
- 7. International Relations:** The international Relations coordinates international activities of IIT Bombay including semester exchange, scholarships and international programs.

The Academic Council strives to help the students and is always available in any kind of problem. Feel free to contact anytime. You can reach the Council through :

1. **UGAC website** - All the information regarding the Academic Council is available on its website, <https://gymkhana.iitb.ac.in/~ugacademics/>
2. **Facebook pages & group** - One can ask any query and clear any doubt/confusion they have and also post anonymously or message directly.

The FB pages/groups of various verticals of the council are:

- Student Support Services –<https://www.facebook.com/sss.iitb/> AND [https://www.facebook.com/groups/409276826167955/?ref=br\\_rs](https://www.facebook.com/groups/409276826167955/?ref=br_rs)
  - Career Cell – <https://www.facebook.com/careercell.iitb/>
  - EnPoWER – <https://www.facebook.com/enpoweriitb/>
  - Finance Club – <https://www.facebook.com/groups/finclubiitb/>
  - Consult Club – <https://www.facebook.com/consultclubiitb/>
  - Analytics Club -<https://www.facebook.com/groups/AnalyticsClubIITB/>
  - International Relations Office – <https://www.facebook.com/IR.IITB/>
  - In addition to these pages, the link to the main UGAC page is <https://www.facebook.com/iitb.ugacads>
3. **Email ID** - For any of your problems and doubts to you can also send an e-mail to [gsecaaug@iitb.ac.in](mailto:gsecaaug@iitb.ac.in) or [sss.iitb@gmail.com](mailto:sss.iitb@gmail.com)

# **17. CONTACT INFORMATION**

In case of any queries please feel free to contact the UG academic council members, their contact details are as follows:

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