STUDENT INFORMATION HANDBOOK

AND

SCHEME OF INSTRUCTIONS

UNDERGRADUATE PROGRAMS

ACADEMIC YEAR: 2024-25

INDEX

CHAPTER 1

FOUR-YEAR BACHELOR OF SCIENCE (RESEARCH)

1.1 BASIC STRUCTURE

The Four-Year Bachelor of Science (Research) Program is organized into eight semesters. The following Major disciplines are available in the Bachelor of Science (Research) Program.

- Biology
- Chemistry
- Earth and Environmental Sciences
- Materials
- Mathematics
- Physics

A student is required to take a specified number of core courses in the 1st three semesters. At the end of the 3rd semester, each student will be assigned a Major discipline (from the list above) based on her/his preferences and CGPA. While a student specializes in a Major discipline, she/he can also broaden her/his knowledge and skills by taking courses in other disciplines. Students who take a sufficient number of courses in a discipline other than the chosen Major will qualify for a Minor in that discipline.

1.2 FACULTY ADVISOR

In the 1st three semesters, the Dean and the Associate Deans will be advising the students. Each student will be assigned a Faculty Advisor (Major Discipline Coordinator) at the beginning of the 4th semester. The Faculty Advisor may be consulted about all matters (academic as well as non-academic) that may be of concern to the student. The Faculty Advisors will do their best to promote the development and growth of the students in their scientific career.

1.3 REGISTRATION OF COURSES AND COURSE LOAD

1.3.1 UNTIL BATCH 2021

Table 1.1: Details on course registration and credit limits till 2021 Batch

Semester	Criteria	Credits
1st and 2nd	Student needs to register fix number of credits	17 in each semester
3rd	Student needs to register fix number of credits	18
4th to 8th	CGPA < 8	Min.: 16 and Max.: 19
4th to 8th	CGPA ≥ 8	Min.: 16 and Max.: 23
4th to 8th	Preceding term TGPA ≥ 8	Min.: 16 and Max.: 23

1.3.2 BATCH 2022 ONWARDS

Table 1.2: Details on course registration and credit limits Batch 2022 onwards

Semester	Criteria	Credits
1st	Student needs to register for a fixed number of credits	18
2nd	No CGPA and TGPA requirements	Min.: 17 and Max.: 21
3rd	No CGPA and TGPA requirements	Min.: 17 and Max.: 21
4th	CGPA < 8	Min.: 15 and Max.: 17
	CGPA ≥ 8	Min.: 15 and Max.: 21
5th to 8th	CGPA < 8 or Preceding term TGPA < 8	Min.: 16 and Max.: 18
	CGPA ≥ 8 or Preceding term TGPA ≥ 8	Min.: 16 and Max.: 21

1.3.3 DETAILED BREAKUP OF COURSES FROM 1st TO 3rd SEMESTERS

Table 1.3: Detailed Breakup of Courses for Semester 1

SEMESTER I			
Course Type	**Course Code**	**Course**	**Credits**
Humanities (Mandatory)	UH 101	Ways of Knowing	2:0
Basic Courses (Mandatory)	UMA 101	Analysis and Linear Algebra I	4:0
	UBL 101	Introductory Biology I	3:1
	UCY 101	Introductory Chemistry I	3:1
	UPH 101	Introductory Physics I	3:1
Total Credits			**18**

Table 1.4: Detailed Breakup of Courses for Semester 2

SEMESTER II			
Course Type	**Course Code**	**Course**	**Credits**
Humanities (Mandatory)	UH 102	Ways of Seeing	2:0
Engineering (Mandatory)	UENG 103	Introduction to Earth and its Environment	3:0
Basic Courses *Choose any Three out of Four courses*	UBL 102	Introductory Biology II	3:1
	UCY 102	Introductory Chemistry II	3:1
	UMA 102	Analysis and Linear Algebra II	4:0
	UPH 102	Introductory Physics II	3:1
Optional Elective	UE 102	Electronics	3:1
Total Credits (Min. - Max.)			**17-21**

Table 1.5: Detailed Breakup of Courses for Semester 3

SEMESTER III			
Course Type	**Course Code**	**Course**	**Credits**
Humanities (Mandatory)	UH 201	Ways of Doing: Mapping Science-Society Relationship	2:0
Engineering (Mandatory)	UENG 201	Introduction to Material Science	3:0
Basic Courses *Choose any three out of Four courses*	UBL 201	Introductory Biology III	3:1
	UCY 201	Introductory Chemistry III	3:1
	UMA 201	Probability and Statistics	4:0
	UPH 201	Introductory Physics III	3:1
Optional Elective	UENG 101	Algorithms and Programming	3:1
Total Credits (Min. - Max.)			**17-21**

1.4 CHOOSING MAJOR AND MINOR: BATCH 2022 ONWARDS

1.4.1 MAJOR DISCIPLINE

A. A student is required to select a Major discipline before the commencement of the 4th semester. The Major disciplines offered in the Four-Year Bachelor of Science (Research) Program are listed below, along with the eligibility criteria.

Table 1.6: Majors and eligibility criteria

Sl. No.	Major	Criteria for being eligible to apply for Major Discipline
1	Biology	A student must have passed Biology Basic Core Courses by the end of the 3rd semester.
2	Chemistry	A student must have passed Chemistry Basic Core Courses by the end of the 3rd semester.
3	Earth and Environmental Sciences	All students are eligible to apply
4	Materials	All students are eligible to apply
5	Mathematics*	A student must have passed Mathematics Basic Core Courses by the end of the 3rd semester.
6	Physics	A student must have passed Physics Basic Core Courses by the end of the 3rd semester.

*Note: *A minimum of two 'B' and one 'C' grades are required in the mathematics courses in the 1st three semesters.*

B. A few examples explaining the eligibility criteria are given below.

Example 1: Student drops Physics in Semesters 2 & 3
In this case, the student is no longer eligible for a Physics Major but can choose from any other five Major disciplines (Biology, Chemistry, Mathematics, Earth & Environmental Science, Materials).

Example 2: Student drops Physics in Semester 2 and Chemistry in Semester 3
In this case, the student is ineligible for Physics and Chemistry Majors but can choose from any of the four other Major disciplines (Biology, Mathematics, Earth & Environmental Science, Materials)

C. A student can choose up to three disciplines (provided the conditions laid down in table 1.6 are met) for a Major in the order of preference while applying for specialization in the SLCM. The student will be assigned one of these disciplines as a Major on Dean UG's approval.

1.4.2 MINOR DISCIPLINE

A. Students are not required to choose a Minor discipline, as it is optional. If a student decides to opt for a Minor, they can do so before the commencement of the 4th semester and until the start of the 7th semester. The list of available Minor disciplines for the Four-Year Bachelor of Science (Research) Program and eligibility criteria are provided below for reference.

Table 1.7: Minors and Eligibility criteria

Sl. No.	Minor	Criteria for being eligible to apply for Minor Discipline
1	Biology	A student must have completed the Biology Basic Core courses by the end of 6th Semester.
2	Chemistry	A student must have completed the Chemistry Basic Core courses by the end of 6th Semester.
3	Earth and Environmental Science	All students are eligible to apply.
4	Materials	All students are eligible to apply.
5	Mathematics	A student must have completed the Mathematics Basic Core courses by the end of 6th Semester.
6	Physics	A student must have completed the Physics Basic Core courses by the end of 6th Semester.
7	Bioengineering	All students are eligible to apply.
8	Quantum Technologies	All students are eligible to apply.

B. A student can choose up to three disciplines for a Minor in the order of preference while applying for specialization in the SLCM. The student will be assigned one of these disciplines as a Minor on Dean UG's approval.

1.5 PROJECTS

1.5.1 Project work could be initiated at the end of the 6th semester. **Each student must register for the Project at the beginning of the 8th semester.** The project is carried out under the supervision of a Project Advisor chosen based on the student's interests. The Project Advisor will also serve as the Faculty Advisor from this stage. The minimum pass grade is "D".

1.5.2 Major wise Project credit details are given below:

Table 1.8: Project credit details

DISCIPLINE	PROJECT CREDITS	
	Until Batch 2021	Batch 2022 onwards
Biology	16	16
Chemistry	14	12
Earth & Environmental Sciences	16	15
Materials	13	13
Mathematics	13	13
Physics	16	15

1.5.3 Extension of Projects: If there is a need for an extension of the project, prior approval from Dean UG must be obtained on or before April 15 of the Academic Year. In such cases, an application forwarded by the project advisor and the subject coordinator is to be submitted. Then, the student must register for the summer term, and the best grade that can be obtained will be a 'B' grade.

1.5.4 Internship/Project work to be undertaken in a laboratory/institute outside the institute has to be proposed by the primary project advisor at IISc in the form of an application to the Dean with details of the work to be carried out by the student. A period not exceeding one semester may be permitted based on the application. No exemptions will be given for compulsory courses during the period of absence. Project Credits must be registered before leaving for internship in the 8th Semester.

1.6 DEGREE AWARD REQUIREMENT

A. Normally, students have to complete the Bachelor of Science (Research) program in 8 terms. However, in special circumstances, a student may be permitted an extension, so as to complete all requirements for the degree within a maximum of 12 terms. Further, the core courses need to be cleared within a maximum of 6 terms. Summer terms are not counted for this purpose.

B. The computation of the final CGPA is done only if the student clears all courses successfully within the period specified.

C. A student must complete the specified course requirements of 131 credits of the relevant degree program with a minimum CGPA of 5.0.

Table 1.9: Degree Award Requirement Until Batch 2021

Degree Award Requirement Until Batch 2021						
Basic Course	**Engineering**	**Humanities**	**Major and Project**	**Minor (Optional)**	**Electives (Assortment Courses)**	**Total**
36	19	9	52	15	0-15	131
				15*		

NOTE:

1. **Students not opting for a minor should fulfil 15 credits of assortment courses.*
2. *To be eligible for a minor, a student should fulfil 15 credits from the minor pool.*
3. *Excess credit(s) from any pool will be counted towards assortment credits.*

Table 1.10: Degree Award Requirement Batch 2022 onwards

Degree Award Requirement Batch 2022 onwards						
Basic Course (Sem 1-3)	**Engineering (Sem 2-3)**	**Humanities (Sem 1-6)**	**Major and Project**	**Minor (Optional)**	**Electives (Assortment Courses)**	**Total**
40	6	9	51	15	10-25	131
				25*		

NOTE:

1. **Students not opting for a minor should fulfil 25 credits of assortment courses.*
2. *To be eligible for a minor, a student should fulfil 15 credits from the minor pool.*
3. *Excess credit(s) from any pool will be counted towards assortment credits.*

1.7 CLASSIFICATION OF AWARDS

Successful completion of the course can carry any one of the following awards: First Class with Distinction and First Class. The CGPA requirements for each award are given below:

Table 1.11: Classification of Awards

CGPA	Award
8.5 and above	First Class with Distinction
6.0 to 8.4	First Class

1.8 MEDALS

1.8.1 A list of medals awarded in the Four-Year Bachelor of Science (Research) program is given below.

Table 1.12: Medals

Discipline	Name of the Medal
Biology	Kothrapalli Satyanarayana and Vimaladevi Medal
Chemistry	Rajarshi Bhattacharya Memorial Medal
Earth and Environmental Sciences	Institute Medal
Materials	Sitaram Jindal Foundation Medal
Mathematics	Rohan Medal
Physics	Prof. R. Srinivasan Gold Medal

1.8.2 Norms for recommending a student for the Medals in a Four-Year Bachelor of Science (Research) Program

a. Students who have fulfilled all degree requirements by the end of the 8th semester are eligible to be considered.
b. There must be at least five eligible candidates in the Major discipline to be considered. If there are less than five eligible candidates, they can be considered in the following year, along with the eligible candidates of that year.
c. When less than five candidates are eligible, and an exceptionally good candidate (CGPA ≥ 9.5) is present, the Dean may recommend the candidate with full justification to the Medals committee for consideration.
d. The nominated candidate must have:
    i. a CGPA ≥ 8.5.
    ii. secured highest CGPA among all the eligible candidates.
    iii. secured a minimum of an ‘A’ grade in the project work.
e. The Dean should recommend only one candidate for each medal; sharing a medal by two students is not permitted. In case of a tie in CGPA, the tie may be resolved by using parameters such as the number of ‘A+’ grades obtained, number of ‘A’ grades obtained, publications by the student during the course program, etc.

CHAPTER 2

MASTER OF SCIENCE

2.1 BASIC STRUCTURE

Undergraduate students who fulfil the requirements towards the Bachelor of Science (Research) degree at the end of the 4th year have an option to continue for a 5th year to register for a Master of Science degree. The 5th year is organized in two semesters. Students are required to take a specified number of courses as outlined in table 2.1 and complete a research project in their Major discipline. A project report has to be submitted which will be evaluated and graded. All other guidelines as laid out for the Bachelor of Science (Research) program will be applicable for the Master of Science program as well.

2.2 MAJOR DISCIPLINE REQUIREMENTS

Table 2.1: Major Discipline Requirements for Master of Science Program

DISCIPLINE	COURSE CREDITS	PROJECT CREDITS
BIOLOGY	12	20
CHEMISTRY	12	20
EARTH & ENVIRONMENTAL SCIENCES	12	20
MATERIALS	12	20
MATHEMATICS	30	-
PHYSICS	12	20

**Please refer to Section 2.4 for course/project details*

2.3 CREDIT CARRYOVER

Credits fulfilled over and above 131 in the Bachelor's degree could be considered towards Master's degree provided the following conditions are met:

A. A maximum of 12 credits completed over and above 131 in the Bachelor's degree and belonging to the subject area of the student's Major discipline could be considered towards the Master's degree.
B. If the 12 credits taken in excess of the required 131 in the Bachelor of Science (Research) program are those of mandatory course credits required to be fulfilled in the Master's program, then the student will only have to fulfill project credits in the 5th year.
C. If the excess 12 credits (fulfilled in the Bachelor's program) do not include any compulsory courses (as prescribed by the respective discipline for the Master' degree program) then the student is required to fulfill the compulsory course credits in the 5th year.
D. No exemptions will be given for compulsory courses.

2.4 MANDATORY COURSE REQUIREMENTS: (BATCH 2020 ONWARDS)

A. BIOLOGY

Any 12 credits from the Biology division **[**(i.e. Biochemistry (BC), Centre for Ecological Sciences (CES), Centre for Neurological Sciences (CNS), Microbiology and Cell Biology (MCB), Molecular Biophysics Unit (MBU), Developmental Biology and Genetics (DBG), Courses offered by integrated Ph.D. by Biological Science Division (course codes starting with DB)**]**, and from Department of Bioengineering (BE).

- UB 500 (0:20): Master's Project

B. CHEMISTRY

Minimum of 6 credits (200 or 300 level) from within the Chemical Sciences Division **[**i.e. Inorganic and Physical Chemistry (IPC), Organic Chemistry (OC), Solid State and Structural Chemistry Unit (SSCU), Materials Research Centre (MRC), Chemical Division Courses offered for Integrated Ph.D. students (course codes starting with CD) & Courses offered for M.Sc. Chemical Sciences Program (course codes starting with CY)**]** and 6 credits (200 or 300 level) from any division OR all 12 credits (200 or 300 level) from within the Chemical Sciences Division.

- UC 500 (0:20): Master's Project

C. EARTH AND ENVIRONMENTAL SCIENCES

Any 4 courses (12 credits) from Departments/Centre participating i.e.; Civil engineering (CiE), Centre for Atmospheric and Oceanic Sciences (CAOS), Centre for Earth Sciences (CEaS), Centre for Sustainable Technologies (CST) in the E&ES program or equivalent courses as per students' handbook after a discussion with the EES coordinators and 20 credits from the Project with the Masters' thesis advisor.

- UES 500 (0:20): Master's Project

D. MATERIALS

The choice of 4 courses (12 credits) should be as follows:

1. **Core courses*:**
   - MT 202 (3:0): Thermodynamics and Kinetics
   - MT 204 (3:0): Structure and Properties of Materials
2. **Any one out of the following soft-core courses:**
   - MT 209 (3:0): Defects in Materials
   - MT 205 (3:0): Structural Characterization of Materials
   - MT 206 (3:0): Texture and Grain Boundary Engineering
   - MT 213 (3:0): Electronic Properties of Materials
   - MT 217 (3:0): Computational Mathematics for Materials Engineers
   - MT 220 (3:0): Microstructural Engineering of Structural Materials
   - MT 240 (3:0): Principles of electrochemistry and corrosion
   - MT 253 (3:0): Mechanical Behavior of Materials
   - MT 260 (3:0): Polymer Science and Engineering

- MT 307 (3:0): Materials in Extreme Environments
- NE 316 (3:0): Advanced Electro Microscopy

3. Any one PG-level course offered in Materials Engineering or Materials Research Centre

**Those who have already taken MT 202 and/ or MT 204 in their Bachelor's program, can fulfill the core credit requirements from the above list of soft core courses (refer point 2).*

- UMT 500 (0:20): Project: MATERIALS

E. MATHEMATICS

1. **Following mandatory courses to be fulfilled:**
   - MA 213 (3:1): Algebra II
   - MA 222 (3:1): Analysis II
   - MA 389A (1:0): Seminar on topics in Mathematics I
   - MA 389B (1:0): Seminar on topics in Mathematics II
2. **Soft core courses requirement: Any 3 courses from the list below**
   - MA 220 (3:0): Representation Theory of Finite Groups
   - MA 223 (3:0): Functional Analysis
   - MA 232 (3:0): Introduction to Algebraic Topology
   - MA 235 (3:0): Introduction to Differentiable Manifolds
   - MA 242 (3:0): Partial Differential Equations
   - MA 262 (3:0): Introduction to Stochastic Processes
   - MA 312 (3:0): Commutative Algebra
   - MA 313 (3:0): Algebraic Number Theory
   - MA 321 (3:0): Analysis III
   - MA 361 (3:0): Probability Theory
3. The remaining 21 credits could be comprised of the following Master's **projects A & B** and courses offered by any department or a combination thereof.

   Optional Reading Projects:
   UM 501 (0:6): Master's Project A (Aug term)
   UM 502 (0:6): Master's Project B (Jan term)

F. PHYSICS

Following mandatory courses to be fulfilled:

- PH 206 (3:0): Electromagnetic Theory
- PH 208 (3:0): Condensed Matter Physics -1 **OR**
  IN 232 (3:0): Concepts in Solid State Physics
- PH/HE 215 (3:0): Nuclear and Particle Physics
- PH 217 (3:0): Fundamentals of Astrophysics

NOTES:

- The students have to complete 12-Credit blackboard courses during the 5th Year.
- In case none of the above-mentioned mandatory courses are completed by the student during the 1st Four-Years (Bachelor of Science), they have to credit all of them in the 5th year.
- In case the student has already completed all of the above-mentioned mandatory courses during 1st Four-Years (Bachelor of Science), to fulfil the 12-credit requirement, they can take any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor and the UG coordinator.

- In case the student has completed part of the above-mentioned mandatory courses during the 1st Four-Years (Bachelor of Science), they have to complete the remaining mandatory courses and to fulfill the 12-credit requirement, any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor and UG coordinator.

    - **UP 500 (0:20): Project: PHYSICS**

This is a 20-credit project course of six months duration and is compulsory for the completion of the MSc course. The student can choose any faculty of his or her choice from any of the three departments: Physics, Centre for High Energy Physics (CHEP), Instrumentation and Applied Physics (IAP) with mutual consent and take up an advanced topic of research either in the experimental or theoretical stream. At the end of the term, the student will submit a soft copy of the report to the coordinator. The viva-voce examination will be conducted with two examiners and evaluated accordingly.

2.5 CLASSIFICATION OF AWARD

Table 2.2: Classification of Award

CGPA	Award
8.5 and above	First Class with Distinction

CHAPTER 3

BACHELOR OF TECHNOLOGY (MATHEMATICS AND COMPUTING)

3.1 BASIC STRUCTURE

The Bachelor of Technology (Mathematics and Computing) Program is a Four-Year program, organized into 8 semesters. Students need to complete 128 credits as specified in the table and sections below.

Table 3.1: Summary of Credit requirements

Course Category	Core	Breadth Soft Core	Humanities	Soft Core		ISP-I /ISP-II /Project /Electives	Total
				Math	Computing		
Minimum Credit Requirement	49	14	9	21		35	128
				6	6		

3.2 OVERVIEW OF COURSE REQUIREMENTS

A. **CORE:**

- **Mathematics:** Analysis and Linear Algebra I, II, Probability and Statistics, Basic Analysis, Introduction to Algebraic Structures.
- **Computing:** Algorithms and Programming, Introduction to Electronics and Electrical Engineering, Introduction to Computer Systems, Discrete Mathematics, Data Structures and Algorithms, Automata Theory and Computability, Introduction to Numerical Methods and, Introduction to Artificial Intelligence & Machine Learning.

B. **BREADTH SOFT CORE**

14 credits from a selection of Physics, Chemistry, Biology, Material Science, Earth and Environmental Science subjects.

The list of core and breadth soft core courses and their semester wise break-up can be found in the scheme of instructions (SoI).

C. **SOFT CORE**

The soft core consists of the Mathematics and Computing streams. Students have to take at least 6 credits in each stream. Students have to take at least 21 credits from the list of soft-core courses. Courses from the list of soft-core courses can also be taken as electives. The list of courses in each stream is specified in the Scheme of Instructions (SoI).

D. **PROJECTS**

ISP stands for Independent Study Project. ISP-I (semester 7), ISP-II (semester 8) carries 6 credits each. Project refers to Research or Industry Project and carries 12 credits. Detailed rules governing projects are specified in Section 3.6.

E. **ELECTIVES**

Elective credits can be fulfilled by passing any course offered across the institute. Some useful elective courses are also provided under the category of suggested electives in the SoI.

F. **STUDY TRACKS**

The program structure encourages interested students to pursue a study track should they wish to do so. Here is an indicative list of study tracks (The corresponding courses in each study track can be found in the SoI); Mathematics, Artificial Intelligence & Machine Learning, Computational Science, Theoretical Computer Science, Quantum Computing, Computational Biology, Signal Processing, Mathematical Finance.

3.3 SEMESTER WISE COURSE STRUCTURE

Table 3.2: Course Structure for Semester I

SEMESTER I			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 101	Ways of Knowing	2:0
	UENG 101	Algorithms and Programming	3:1
	UMA 101	Analysis and Linear Algebra I	4:0
Breadth Soft Core *Choose any **TWO** out of the three courses*	UBL 101	Introductory Biology I	3:1
	UCY 101	Introductory Chemistry I	3:1
	UPH 101	Introductory Physics I	3:1
Total Load			**18**

Table 3.3: Course Structure for Semester II

SEMESTER II			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 102	Ways of Seeing	2:0
	UENG 102	Electrical and Electronics Engineering	3:1
	UMA 102	Analysis and Linear Algebra II	4:0
	UMC 102	Computer Systems	3:0
	UMC 103	Discreet Mathematics	2:0
Breadth Soft Core *Choose any **ONE** out of the four courses*	UBL 102	Introductory Biology II	3:1
	UCY 102	Introductory Chemistry II	3:1
	UPH 102	Introductory Physics II (Elec-Mag-Optics)	3:1
	UENG 103	Introduction to Earth and its Environment	3:0
Total Load			**18-19**
Reduced load (drop any one course other than UMA 102, UMC 102, UMC 103)			**14-17**

Table 3.4: Course Structure for Semester III

SEMESTER III			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 201	Ways of Doing	2:0
	UMA 201	Probability and Statistics	4:0
	UMC 201	Data Structures & Algorithms	3:1
	UMC 202	Numerical Methods	3:1
Breadth Soft Core *Choose any ONE out of the Four*	UBL 201	Introductory Biology III	3:1
	UCY 201	Introductory Chemistry III	3:1
	UPH 201	Introductory Physics III	3:1
	UENG 201	Materials Science	3:0
Total Load			**17-18**
Reduced Load *(Drop UH 201 or the Breadth Soft Core)*			**14-16**

Table 3.5: Course Structure for Semester IV

SEMESTER IV			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 203	Mapping India Through Folk Arts	1:0
	UM 204	Analysis	3:1
	UM 205	Algebraic Structures	3:1
	UMC 203	Introduction to Artificial Intelligence and Machine Learning	3:1
	UMC 205	Automata and Computability	3:1
Total Load			**17**
Reduced Load *(drop one out of the above core courses)*			**13-16**
Enhanced Load			**17-21**

Table 3.6: Course Structure for Semester V

SEMESTER V			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 301	Journalism for Scientists	1:0
Soft Core/Elective			16
Total Load			**17**
Normal Load			**17-19**
Enhanced Load			**17-21**

Table 3.7: Course Structure for Semester VI

SEMESTER VI			
Course Type	**Course Code**	**Course**	**Credits**
Core Courses	UH 302	Introduction to Governance	1:0
Soft Core/Elective			16
Total Load			**17**
Normal Load			**17-19**
Enhanced Load			**17-21**

Table 3.8: Course Structure for Semester VII

SEMESTER VII	
Course/Course Type	**Credits**
UMC 401 ISP I (0:6)/Soft Core/Electives	6
Soft Core/Electives	6
Total Load	**12**
Normal Load	**12-16**
Enhanced Load	**12-21**

Table 3.9: Course Structure for Semester VIII

SEMESTER VIII			
Course Type	**Course Code**	**Course**	**Credits**
Any **ONE** of the Two	UMC 402 ISP II (0:6) /Soft Core/ Electives (6) + Soft Core/Electives (6)		12
	UMC 403 Project		0:12
Total Load			**12**
Normal Load			**12-16**
Enhanced Load			**12-21**

Note:

1. For reduced, normal and enhanced load criteria, refer to section 3.5
2. Detailed rules governing projects are specified in section 3.6

3.4 FACULTY ADVISOR

Each student will be assigned a Faculty Advisor at the beginning of the first semester. The Faculty Advisor may be consulted about all matters (academic as well as non-academic) that may be of concern to the student. Faculty advisors will do their best to promote the development and growth of the students during the program.

3.5 REGISTRATION FOR COURSES AND COURSE LOAD

A. Registration for courses will be done in consultation with the Faculty Advisor.

B. All students must complete a total of at least 128 credits comprising courses and other components like projects, as specified in Tables 3.2 to 3.9. The course load for the 1st three semesters is fixed. Each subsequent semester has a "Normal", "Reduced" and "Enhanced" course load, as specified in Table 3.2 to 3.9. Based on their CGPA and previous-term TGPA, students must register for an appropriate course load as specified in Table 3.10 below. Any deviation from the recommended load will be allowed only with the permission of the Dean.

Table 3.10: Recommended Course Load

Criteria	Course Load
CGPA ≤ 6.0 AND Prev-TGPA ≤ 5.5	Reduced in Semester II to IV, Normal in Semester V to VIII
6.0 < CGPA < 8.0 OR 5.5 < Prev-TGPA < 8.0	Normal in Semester II to VIII
CGPA ≥ 8.0 AND Prev-TGPA ≥ 8.0	Normal in Semester II and III, Enhanced in Semester IV to VIII

3.6 PROJECT

A. Students can choose to undertake an independent study/research experience/industry project (denoted 'ISP' in the course table) worth 6 credits in their 7th semester, followed by either an ISP for 6 credits or a research/industry project worth 12 credits in their 8th semester. Alternatively, students can choose to earn the credits for one or more of these components from courses. The choice of ISP/project/electives must satisfy the following criteria:

1. The topic of an ISP/Project can be broadly in applications of Math or EECS, possibly with faculty in other departments.
2. Each ISP/Project needs a faculty advisor from the institute, even if the ISP/Project is done outside the institute.
3. Students who have not opted for ISP-I are eligible for the 12 credit Project provided they have a CGPA of 7.0 or above at the end of Semester 7.
4. Students who have opted for ISP-I are eligible for ISP-II provided they do not have a C grade or lower in ISP-I.
5. Students who have opted for ISP-I are eligible for the 12 credit Project provided they do not have a B grade or lower in ISP-I.
6. For ISP/Project outside the Institute:
   i. At most *one* of ISP-I, ISP-II, or Project can be done outside the institute (academia or industry).
   ii. Students doing ISP-I in Sem 7 outside the institute must satisfy the following criteria:
      - They must have a CGPA of at least 7.0 upto and including Semester 6.
      - They must have completed at least 3 of the 6 credits needed for Semester 7. Remaining may be completed in Semester 8.
      - They must have completed all soft-core requirements before Semester 7.
   iii. Students doing ISP-II / Project in Semester 8 outside, must have completed all other credit requirements earlier.

Students who choose to do an ISP/Project component must obtain the consent of a faculty member who is willing to act as a Project Advisor. If the student chooses to do a project, the Project Advisor becomes the student's Faculty Advisor from that point.

B. Minimum Project Pass Grade: The minimum pass grade is D. Should there be a need for extension of the project, prior approval from the Dean needs to be obtained before the end of the 8th semester. In such cases, an application forwarded by the project advisor and the subject coordinator is to be submitted. The student must then register for the summer term and the maximum grade that can be obtained for project will be a B grade.

C. Internship to be undertaken in a laboratory/institute outside the institute in connection with the project, has to be proposed by the primary project advisor at IISc in the form of an application to the Dean with details of the work to be carried out by the student. A period not exceeding one semester may be permitted based on the application. A specific recommendation by the primary project advisor at IISc has to be made. No exemptions will be given for compulsory courses during the period of absence. Project credits will have to be registered for that semester before leaving for internship.

3.7 CLASSIFICATION OF AWARDS

Successful completion of the course can carry any one of the following awards: First Class with Distinction and First Class. The CGPA requirements for each award are given below:

Table 3.11: Classification of Awards

CGPA	Award
8.5 and above	First Class with Distinction
6.0 to 8.4	First Class

CHAPTER 4

MASTER OF TECHNOLOGY (MATHEMATICS AND COMPUTING)

4.1 Students have the option to continue for their 5th year to obtain an M Tech degree in Mathematics and Computing. To be eligible to exercise this option, students must:

a) have completed all the requirements of the B Tech Mathematics and Computing degree at the end of their 8th semester; and

b) have a CGPA of 7.0 or more at the end of their 8th semester.

4.2 To obtain an M Tech degree, students need to complete 32 credits with the following breakup:

- 13 credits of courses in the 9th and 10th semesters.
- A project of 19 credits in the 9th and 10th semesters.

4.3 Students are required to have completed a minimum of 10 credits of courses from the Mathematics Soft Core Pool and 10 credits of courses from the Computing Soft Core Pool, across the 10 semesters of the B Tech/M Tech program.

4.4 CREDIT CARRYOVER

A maximum of 12 credits worth of courses fulfilled over and above the requirements of the B Tech program, can be considered towards fulfillment of the 13 course credits in Semesters 9 and 10.

4.5 CLASSIFICATION OF AWARD

Table 4.1: Classification of Award

CGPA	Award
8.5 and above	First Class with Distinction

CHAPTER 5

COURSE REGISTRATION, GRADING SYSTEM, CONTINUATION, CANCELLATION AND REINSTATEMENT OF REGISTRATION

5.1 COURSE REGISTRATION

A. Course registration should be done on the SAP portal within the prescribed dates.

B. Each student registers for a set of courses in the 1st three semesters under the guidance of the Dean and the Associate Deans. From the 4th semester onwards, the students register for courses under the guidance of the Faculty Advisor assigned to them.

5.2 DROPPING OF COURSE

A. Students can drop the courses as per the timelines mentioned in the academic calendar in SAP. The options for dropping a course are as follows:
   - Course dropping without mention in the transcript.
   - Course dropping with mention in the transcript.

B. Dropping the courses requires the approval of the course instructor and Faculty adviser/Dean UG. Dropping of a course is permitted only if the total number of credits does not fall below the minimum stipulated.

C. It is advised that the student informs the course instructor if the course is being dropped.

D. If a course is dropped during the 'course drop without mention' period (as mentioned in the Academic Calendar), the dropped course will not be listed in the final transcript. If a course is dropped during the 'course drop with mention' period, the dropped course will be included in the transcript with a 'W' (Withdrawn).

E. A student may register again for the course that they dropped in an earlier term.

5.3 GRADING SYSTEM

A. The 10-point system of grading has been adopted in the Institute from the academic year 2016-2017.

B. The instructor decides the grading pattern at the beginning of the semester. Only the grades are recorded in the transcripts. The letter grades and the corresponding grade points are provided in Table 5.1. All grades except the 'F' grade are passing grades.

C. The Grade Point Average (GPA) is a measure of overall performance. The Term GPA (TGPA) is based on the grades of the current term, while the Cumulative GPA (CGPA) is based on the grades of all courses taken in the program. The grade points accrued for each course is the product of the number of credits and the grade point value corresponding to the grade obtained in it.

D. For instance, for a 3-credit course, if a student gets a B grade (which carries a grade point value of 7), then the accrual of the total grade points is equal to 3 x 7 = 21. The TGPA is obtained by adding the grade points accrued by all the courses taken in the current term divided by the total number of credits in the term. The CGPA is calculated similarly, the only

difference being that one considers the grade points accrued for all the courses taken in the program. The TGPA and CGPA are rounded off to the 1st decimal place.

Table 5.1: Grades and Grade Point Values

Grade	A+	A	B+	B	C	D	F
Grade Point Value	10	9	8	7	6	5	0

5.4 TERMINAL EXAMINATION

Terminal examinations are held during the last fortnight of each semester and during the last week of the Summer Term. The Timetable will be notified in advance. The graded answer scripts of the terminal examination will be made available to the students on a specified date within one week from the date of the terminal examination. Requests for changes in the grading of the terminal examination papers can be made only when the graded papers are shown to the students.

A. Attendance of the terminal examination is compulsory. If a student does not attend the examination, she/he shall be considered as having obtained zero marks in it and will get an F grade. Absence on medical grounds, certified by the Chief Medical Officer of the Institute, may be condoned, and the student may be permitted to take substitute examination(s) within a prescribed period (Refer Para. 5.5 (C)). **In such a case**, **student needs to apply for a medical leave on SLCM within seven days of recovery from an illness.** At the time of applying for medical leave on the SAP portal, supporting documents (medical certificate) issued by the Health Centre must be uploaded on the portal.

5.5 HANDLING OF 'F' AND 'X' GRADES

A. 'F' Grade

- 'F' is a failing grade. The student should clear the 'F' grade course either by repeating the same course or by taking a substitute course (in case of an elective), in consultation with the Major discipline coordinators.
- Only one chance is provided to the student to clear the 'F' grade. If, upon repeating the course (or in the substitute course), the student gets an 'F' grade again, the studentship will be terminated.
- If the 'F' grade is obtained in a core course, the same course must be repeated. For an elective/softcore course, the substitute course can be any other elective/softcore course.
- Such repetition of courses is permitted only to clear 'F' grades. Students are not permitted to retake courses in which they have obtained any other grades.
- Until an 'F' grade is cleared, it will be used for the computation of the TGPA and the CGPA. Subsequently, it will be omitted from the TGPA computation of the term in which the 'F' grade is cleared, and the grade from the repeated or the substitute course will be replaced in the CGPA computation.
- If a student has completed all the minimum course credit requirements for the award of a degree and obtains an 'F' grade in any additional courses, the student is not required to clear such 'F' Grades.

B. Make-Up Examinations

- Make-up examinations are conducted in the summer term of the academic year for the courses (those with 'U' course code) that have been offered in the same academic year. Make-up examinations will only be conducted for the theory courses.
- If the 'F' grade is obtained in a core course, it may be cleared either by taking a make-up examination in the same course in the summer term of the same academic year or by repeating the same course in a subsequent semester.
- If a student clears an F grade by taking a make-up examination, the highest grade she/ he can get in that course is 'C'. A student who fails the make-up examination should repeat or substitute the course as applicable.
- If the student wishes to take up a make-up examination, course registration in the SAP portal is mandatory.
- A student who has credited a non-UG/departmental course either as electives or as part of the mandatory requirements towards their degree program in the 7^{th} or 8^{th} semesters (final year) and has got 'F' grades in such courses may also be allowed to take makeup exam subjected to following conditions.
  - If the DCC (of the department in which the course is offered) recommends, the student will be permitted to clear the 'F' grade in the 7^{th} or 8^{th} Semester through a make-up exam.
  - Consideration for make-up exams will be given to only students with a maximum of two 'F' active grades. A maximum grade of 'D' will be allowed in the make-up exam in such instances.
  - If the student has more than two 'F' grades, this (make-up exams) will not be applicable.
- The above provision of make-up exams for students who have taken non-UG/departmental courses as electives is also applicable to the Master of Science Students.

C. 'X' Grade

- 'X' grades are awarded to those students who cannot attend the sessional or final examination due to medical reasons. Such Students should submit a medical certificate to this effect, certified by the CMO of the Institute, failing which an 'F' grade shall be awarded. To award an 'X' grade the course instructor needs to provide a justification based on the medical certificate submitted by the student. The 'X' grade should be cleared within a specified timeframe within the completion of the final assessment. The upper bound for taking the final assessment is suggested to be June 30 of the next calendar year for the August term courses and November 30 of the same calendar year for the January term courses. If the exam is taken within this period, then the 'X' grade will be replaced by the appropriate grade. Otherwise, the 'X' grade will lapse and be converted to an 'F' grade at the end of this timeframe unless there is any further certified medical reason.
- Once the course instructor conducts the retest of the student, he/she needs to request a grade change in the SLCM within the timelines mentioned above. It may be noted that based on the student's performance in the exam, he/she may be awarded any letter grade like a regular exam.

5.6 SCRUTINY OF ANSWER SCRIPTS

A student is entitled to go through their corrected answer scripts with respect to the courses offered during the August-December term before 14th January of the next calendar year, and similarly for the courses offered during the January-April term, the student may go through their corrected answer scripts before 25th May. If a change in the grade is warranted as a consequence of the scrutiny by the student, it should be done by the course instructor and approved by the SCC/UGSCC in the SLCM within two weeks of the above-mentioned dates.

5.7 CANCELLATION OF REGISTRATION

Not fulfilling any of the above criteria will lead to cancellation of registration.

A. The student should not have obtained more than four F grades at any given time during the period of studentship. If a 5th F grade is obtained without clearing the four existing F grades, she/he shall leave the Institute.
B. In the 1st term, the TGPA should not be below 4.5 and in subsequent terms, the CGPA should not go below 5.0.
C. Student should not get an F grade in the repeated course or in the specified substitute course.
D. Normally, students have to complete the Bachelor of Science (Research) program in eight semesters (i.e., 4 Years). Summer terms are not counted for this purpose. However, in special circumstances, a student may be permitted an extension to complete all requirements for the degree within a maximum of twelve semesters (i.e., 6 Years). If a student fails to meet this condition, he/she has to leave the institute.

5.8 TIME SPAN FOR DEGREE

The minimum and the maximum time span for completing the degree award requirement for a program is given below:

Table 5.2

Program	**Minimum/Normal Duration**	**Maximum Duration**
Four-Year Bachelor of Science (Research)	4 Years	6 Years
Master of Science (In continuation of Bachelor of Science (Research) degree)	5 Years (4+1)	6 Years
Bachelor of Technology (Mathematics & Computing)	4 Years	6 Years
Master of Technology (M Tech) (In continuation of B Tech degree)	5 Years (4+1)	6 Years

Note:

- B.S. (Research) /B.Tech. students belonging to SC/ST categories could be given the option to either complete the program in four years or choose a slow track where they could complete the course within five years and still be eligible for continuation for the MS/M.Tech. in the 6th year.
- For other students, if they fulfil the requirements of the Bachelor of Science (Research) Degree/BTech by 31st July of the academic year in which they complete four years, they will be eligible to continue for the Master of Science/Master of Technology in the 5th year.
- Master of Science/MTech degree must be completed within a maximum period of two years from the time of enrolling for the Master's degree.
- In exceptional circumstances, the Director may grant a further extension of one more year based on the recommendation of UGSCC.

5.9 REINSTATEMENT OF REGISTRATION

A. If the students' registration is cancelled from the program, he/she may appeal for reinstatement of registration within seven days from the receipt of intimation of registration cancellation.

B. The competent authorities for reinstatement of student registration is placed below:

Table 5.3

Cancellation of Registration	**Competent Authority for Reinstatement of Registration**
1st time	Dean UG
2nd time	Director; based on recommendation of Dean, UG
*3rd time onwards until the maximum tenure permitted@ for the program.	Director; based on the recommendation of the UGSCC

*Reinstatement may be done by the Director on a case-to-case basis depending on the merit and the UGSCC recommendation.

@ In case students taking a break in studies due to medical/extraordinary circumstances, reinstatement beyond the maximum tenure to be decided by the Director on the recommendation of the UGSCC

5.10 FINANCIAL SUPPORT FOR INTERNATIONAL CONFERENCES

Requests for partial financial support to attend and present papers at international conferences could be made by students in the 4th year (Bachelor's program) or in the 5th year (Master's program)

The following conditions should be met in order to apply.

- CGPA should be 7.0 or more in Bachelor's or Master's program.
- Student seeking financial support should be the first author of the paper to be presented in the conference.
- A specific recommendation by the research advisor should be submitted.
- Conference should have been scheduled before 30th April of that particular year.

CHAPTER 6

FEE STRUCTURE AND OTHER CHARGES

6.1 BACHELOR OF SCIENCE (RESEARCH)

Tuition and Other Annual Fees

Table 6.1

Particulars		**General/OBC/EWS (in ₹/INR)**	**SC/ST (in ₹/INR)**
Tuition Fee		10,000	Fully waived
Gymkhana Fee		1,200	1,200
Other Academic Fees		3,700	3,700
Students Emergency Fund		300	300
Medical Insurance Premium*		3,292	3,292
TOTAL		18,492	8,492
INSTALLMENT PAYMENT	Installment I	35%	
	Installment II	35%	
	Installment III	30%	

*Medical Insurance premium is variable

6.2 BACHELOR OF TECHNOLOGY (MATHEMATICS AND COMPUTING)

Tuition and Other Annual Fees

Table 6.2

Particulars		**Gen/OBC/EWS Category (in ₹/INR)**	**SC/ST Category (in ₹/INR)**
Tuition Fee		2,00,000	Fully Waived
Gymkhana Fee		1,200	1,200
Other Academic Fees		3,700	3,700
Students Emergency Fund		300	300
Medical Insurance Premium *		3,292	3,292
TOTAL		2,08,492	8,492
INSTALLMENT PAYMENT	Installment I	35%	
	Installment II	35%	
	Installment III	30%	

*Medical Insurance premium is variable

6.3 DUE DATES

Table 6.3

For students who joined in August	
Period	**Due Date**
I Installment (August – October)	16th August
II Installment (November – December)	15th November
III Installment (January – July)	16th January

NOTE:

1. *Students who are in receipt of scholarship/fellowships the I, II, III installment fees will be deducted from their scholarship/fellowship payable in the month of August, November, and January, respectively.*
2. *Students who are not in receipt of scholarship/fellowship and those who are under Direct Beneficiary Transfer (DBT) scheme have to pay the fees as per the due dates given in the Table above. However, if the due date falls on a holiday, fees must be paid on the next working day (late fee will not be levied). Those students who do not pay the fees by the due dates, a fine of ₹ 20/- per week will be levied.*

6.4 REFUNDABLE DEPOSITS

Table 6.4

Deposits	**Amount (in ₹/INR)**
Hostel	20,000
Hostel (for Married apartment)	20,000
Statutory	7,500
Library	7,500

6.5 HOSTEL CHARGES

A. Single Room charges per student per month

Table 6.5

Students admitted to	**General (in ₹/INR)**	**SC/STs (in ₹/INR)**
Bachelor of Science (Research)	400	200

B. Double Room charges per student per month

Table 6.6

Students admitted to	**General (in ₹/INR)**	**SC/STs (in ₹/INR)**
Bachelor of Science (Research)	200	100

C. Married Apartment charges per month

Table 6.7

Type of Apartment		General (in ₹/INR)	SC/STs (in ₹/INR)
Bhaskara		1,800	1,800
Kapila		1,800	1,800
Kaveri		2,250	2,250
Ramanujam		2,250	2,250
Aryabhata	Double Room	2,250	2250
	Single Room	1,350	1,350

D. Other charges

Table 6.8

Particulars	For single room, double room (in ₹/INR)	For married apartment (in ₹/INR)
Establishment charges	200	200
Amenities charges	200	200
Electricity & water charges	200	200
Mess Amenities charges	1000	1000

6.6 PENALTIES

6.6.1 If a student fails to pay tuition and other fees by the due date, any one or more of the following penalties will be levied:

a) Overdue charges of Rs. 20/- per week or part thereof
b) Stoppage of scholarship and/or loss of attendance for the period of non-payment.
c) Withdrawal of permission to take the examinations or to continue research and cancellation of registration.

6.6.2 If the last date of payment is a holiday, the fees can be paid without penalty on the next working day.

CHAPTER 7

SCHOLARSHIPS AND FELLOWSHIPS

The details of scholarships and fellowships available to the UG program students are as follows.

7.1 DETAILS OF SCHOLARSHIPS/FELLOWSHIPS

For Four - Year Bachelor of Science (Research) program:

Table 7.1

Scholarship/Fellowship Name	Details
KVPY (Up to Batch 2022)	**For 1st to 3rd year** Monthly Scholarship - Rs. 5,000 Summer project Grant per annum- Rs. 20,000 **For 4th and 5th year** Monthly Scholarship - Rs. 7,000 Summer project Grant per annum - Rs. 28,000 (for other details, refer to the official website: https://www.online-inspire.gov.in/)
INSPIRE (SHE)	Monthly Scholarship - Rs. 5000 Mentorship Grant per annum - Rs. 20,000 (for other details, refer to the official website: https://www.online-inspire.gov.in/)
IISc Promotional Scheme (IIScP)	Monthly Scholarship - Rs. 5000 1st to 4th year 5th year for student continuing for Masters

In addition to the scholarships mentioned above, below are some private fellowships for UG Students.

Table 7.2

Private Scholarship/Fellowship Name	Program
Dr. Priyadarshini Panda UG Fellowship	Four - Year Bachelor of Science (Research)
IISC- Class of 1998 ME(Int) Fellowship	
IISc-AANA Midwest Chapter Fellowship for Women in Science	
Mallika Fellowship for Women Students	
Pratibodh Foundation	Four - Year Bachelor of Science (Research)
Prof. J. Nagaraju Memorial Fellowship for Women	
Smt. Jayalakshmi Late Sri K.T. Venkataramchar Women Fellowship	
Vasant Natarajan UG Fellowships	

Deep Asher Fellowship	Four – Year B. Tech (Mathematics & Computing)
Dibakar Das Memorial Fellowship	
Dr. Kolar and Mrs. Girija Kodandapani Scholarships	
Jay Pullur Memorial B.Tech Fellowship	
Kotak UG B.Tech Fellowship	
Square Point Foundation Fellowships	
The Kunal Roy and Neelam Roy B.Tech. Fellowships	

7.2 ASSIGNMENT OF SCHOLARSHIP/ FELLOWSHIP

A. Initially, for 1st year students, a Scholarship/fellowship will be assigned by the UG Office based on eligibility.

B. The scholarship for the students admitted under 'provision' status will be processed only after admission is confirmed. Hence, the students must upload the required certificates /documents online in the Applicant's Interface and produce them at the UG Office to regularize admission on or before 31st October of the admission year.

7.3 PAYMENT OF SCHOLARSHIP/FELLOWSHIP

A. The students assigned with KVPY or INSPIRE (SHE) will get the scholarship payment directly credited to their bank account by the Department of Science and Technology (DST) in Direct Beneficiary Transfer (DBT) Mode, subjected to fulfilling renewal of scholarship criteria. To renew the scholarship, students should follow the instructions given by the scholarship agency.

B. The students who are assigned with the IIScP Scheme or other private fellowships/scholarships will have to raise scholarship payment requests for each month from the 6th to 15th. For more details refer to the SAP SLCM UG Student Manual.

C. If a student undertakes project work/Internship outside the Institute during these periods, payment will be made on production of a certificate of attendance and satisfactory progress in the training along with the declaration that they have not received any other emoluments during any part of this period. If the student has received any emolument during the project work/ Internship, no scholarship will be paid.

7.4 RENEWAL OF SCHOLARSHIP/FELLOWSHIP

A. The renewal of the scholarship/Fellowship is subject to the eligibility criteria as follows:

Table 7.3

Scholarship/Fellowship Name	Eligibility criteria for renewal
KVPY	i) No Active 'F' or 'X' grade. ii) Previous year GPA >=6. iii) For SC/ST category students, Previous year GPA >=5. For more details, follow the instructions provided on the fellowship agency website.
INSPIRE (SHE)	i) No Active 'F' or 'X' grade. ii) Previous year GPA >=7. For more details, follow the instructions provided on the fellowship agency website.
IIScP Scheme or other private fellowships/scholarships	i) No Active 'F' or 'X' grade. ii) Previous year GPA >=6.

B. If the student has an active 'X' grade(s), his/her scholarship renewal will be on hold until it becomes any other valid grade than 'F' within the stipulated time. If the grade is changed into 'F', then he/she is not eligible for scholarship renewal.

C. KVPY Scholarship: The students are directed to follow the renewal procedures as mentioned in the guidelines provided on the official website until the completion of the course.

D. INSPIRE (SHE): (i) The students who are recommended through the Institute mode will be contacted by the UG Office for a renewal process. (ii) The students who applied and got shortlisted through individual mode are directed to follow the renewal procedures as mentioned in the guidelines provided on the official website until the completion of the course.

E. IIScP Scheme or other private scholarship/fellowship: The students need to raise the renewal of scholarship/fellowship request via SAP for each academic year from the 2nd year onwards, preferably during the 1st week of August, subject to fulfilling the eligibility criteria mentioned above.

CHAPTER 8

ATTENDANCE AND LEAVE RULES

8.2 ATTENDANCE

A. Students are required to attend lectures and other academic activities. Attendance in all classes (lectures, tutorials, laboratories, etc.) must be at least 80% of the total number of classes. Students with less than 80% attendance in a course at the time of the mid-term examination will not be allowed to take the examination. A student will be debarred from appearing in the terminal examination of a course if her/his attendance in the course for the semester falls below 80%. A shortage of attendance may be condoned by the Dean only in exceptional circumstances.

B. Condonation of attendance: The 80% mandatory attendance may be condoned for medical issues, in which case, proper supporting documents (medical certificate issued by the CMO, Health Centre, IISc) need to be furnished at the time of applying for medical leave of absence on the SAP. In such instances, the attendance requirement will be condoned for the days of medical leave.

C. **Application for medical leave of absence must be made on the SLCM portal within seven days of recovery from an illness.** At the time of applying for medical leave on the SAP portal, supporting documents (medical certificate) issued by the Health Centre must be uploaded on the portal

8.3 LEAVE RULES

A student is eligible for the following leaves:

A. Leave on personal grounds: 30 days in a year. Leave of absence on personal grounds will not be condoned for attendance purposes.

B. Leave on medical grounds: Up to 30 days a year with a scholarship for extended sickness normally requiring hospitalization. A Medical Certificate and a subsequent Fitness Certificate from the CMO of the Institute are required for resumption of studies.

C. Women students are permitted to avail maternity leave as per the prevailing GoI regulations - currently 26 weeks per child for a maximum of 2 children.

D. A combination of different types of leave is normally not permitted.

E. Absence for a period not exceeding two weeks in a semester due to unavoidable reasons for which prior application could not be made may be condoned by the Dean of Undergraduate Studies provided she/he is satisfied with the explanation.

F. No carry-over of leave is permitted.

G. With regard to leave, the year is reckoned from the date of commencement of the 1st term, irrespective of the date of joining.

H. Leave availed more than the permissible limit will be treated as leave without scholarship.

I. Students permitted to attend approved conferences may be considered on duty with/without scholarship subject to stipend received.

J. All students are entitled to take leave for the full summer term. Students are not required to apply for leave during term break (Summer Term). However, permission needs to be sought in case of attending an internship during this period.

K. Cancellation of the approved leaves (in case of a change of plan) may be sought through SAP mentioning reason for cancellation.

8.4 BREAK IN STUDIES

A. Students may be permitted a break in studies only on medical grounds for a maximum period of one year. Students should apply on SAP as soon as the problem manifests for consideration by the UGSCC. Break in studies in other pressing cases may also be granted under exceptional circumstances with the approval of the Director following a favorable recommendation of UGSCC.
B. The request must be accompanied by a certificate from the Chief Medical Officer (CMO) of the Institute. It should be forwarded through the Subject Coordinator/PCC chair and the Dean UG.
C. Resumption of studies requires a fitness certificate from the CMO of the Institute.
D. The student must pay tuition and all other fees even during the break period to maintain studentship.
E. For Break in studies on medical grounds, scholarship will be paid for a maximum period of one month and the rest of the leave period will be without any scholarship.
F. To maintain the studentship status, the student should pay tuition and all other fees even during the break period.

CHAPTER 9

DISCONTINUATION OF STUDIES

9.1 Students who wish to discontinue their studies due to personal reasons, or who secure a job opportunity must initiate a request on SAP attaching a request letter justifying the reason for discontinuation recommended by subject coordinator/PCC Chair and Dean, UG before leaving the Institute.

9.2 Student must apply for No Dues through SAP portal and initiate discontinuation request on SAP once No Dues process is completed from all the respective departments/units/sections.

9.3 A request for a refund of statutory deposits should be made with the Finance and Accounts section.

9.4 After 15 days from leaving the Institute, the Finance and Accounts may be contacted for the refund status on telephone no: 080-22932570.

CHAPTER 10

STUDENTS' ASSISTANCE PROGRAM

10.1 STUDENTS' AID FUND

A. Each student shall contribute at least Rs. 50 per annum towards Students' Aid Fund. Donations are also received from other sources.

B. The Fund is administered by a committee constituted by the Director. This Committee prescribes operational rules for sanction of assistance from time to time.

C. Assistance in the form of loans from the fund is available to poor students to meet:
   - tuition fees
   - purchase of books, instruments and stationery necessary for the course or research program
   - other expenses connected with their work and for their maintenance at the Institute as may be approved by the Committee.
   - hostel, dining hall, medical expenses, etc.

D. No payment shall be made as scholarships or prizes to students from this fund.

E. This assistance in the form of loans will be as reimbursement of expenditure incurred. The amount will be recovered in equal instalments. The number of instalments will be decided at the time of sanctioning the loan.

F. Requests for assistance should be made to the Academic Section in the prescribed form.

G. Financial Assistance for medical care: Students can get limited assistance to meet the cost of expenditure incurred in the case of hospitalization from the Students' Medical Care Fund, formed out of contributions made by the students and a matching grant made by the Institute.

10.2 FINANCIAL ASSISTANCE FOR MEDICAL CARE

A. Students can get limited assistance to meet the cost of expenditure incurred in case of hospitalization, from the Students' Medical Care Fund, formed out of contributions made by the students and a matching grant made by the institute

B. Medical Insurance: Students are required to sign up for the mandatory Group Medical Insurance.

CHAPTER 11

AdSER, SLCM and SOLMAN

11.1 ADSER (ADMINISTRATIVE SERVICE REQUEST)

A. AdSeR is a portal developed in-house primarily for students, faculty, and administrative employees to raise service requests pertaining to administrative functions.

B. AdSeR is an online system that facilitates employees and students to raise service requests/queries to various administrative units. (Academic Section, Finance and Accounts, etc.) The service requests are automatically forwarded to the respective admin officer for review and resolution. The service request can also be delegated by the admin officer to any other employees dealing with the subject matter. The system tracks various stages of service requests and notifies the initiator and the admin officers about the progress.

C. The URL to access AdSeR portal is: https://adser.iisc.ac.in/

D. Users can login to the AdSeR portal using their IISc e-mail id and password. The portal access is restricted within the IISc network and VPN.

E. **Students should raise all queries and service requests on AdSeR portal** and avoid making personal visits, e-mail communication and telephone calls to administrative units unless absolutely necessary.

11.2 STUDENT LIFE CYCLE MANAGEMENT (SLCM)

A. From the year 2021, IISc has implemented the digital platform SAP for almost all its academic and financial activities. Currently most of the academic and financial activities related to students are being (or already) migrated to SAP. What follows is a brief overview of SAP. Complete details of SAP, related to student activities, are available at https://digits.iisc.ac.in

B. At the time of Registration, a student will be assigned a SAP number and the students should familiarize themselves with the essential features of SAP. On being assigned a SAP number, the student should:

- Provide contact details – address, telephone number, email etc. – of a person to be contacted in case of emergency.
- Provide bank account details for scholarship related transactions.

C. Application of leave, scholarship etc. are to be done on SAP.

D. The student is responsible for payment of tuition and other fees on time. In case the tuition fee is remitted from external funding agencies, it is the responsibility of the student to ensure that tuition and other fees are deposited on time.

E. The courses credited by a student and the grades obtained are maintained in SAP. It is advisable to check the accuracy of the data and contact Academic section (through AdSeR portal) in case of any issues to avoid errors in the transcripts generated though SAP.

F. SOP for various student-related activities in SLCM is available on the DIGITS website (www.digits.iisc.ac.in) under SAP S/4 HANA section.

11.3 SOLMAN (SAP Solution Manager)

A. Student can raise their complaints related to SAP processes using the URL: **solman.iisc.ac.in**

B. Please refer to the user guide with the following link: **SAP Complaint and Service Request Management (Solution Manager) for IISc Users**

CHAPTER 12

DISCIPLINE, CODE OF ETHICS, CONDUCT RULES AND ACADEMIC INTEGRITY

12.1 Students are expected to dress and conduct themselves in a professional manner.

12.2 All forms of ragging are prohibited. If any incident of ragging comes to the notice of the authorities, the student will be given the opportunity to explain. If the explanation is not found satisfactory, the authorities can expel the student from the Institute.

12.3 Students are expected to conduct themselves in a manner that provides a safe working environment for women. Sexual harassment of any kind is unacceptable and will attract disciplinary action. Further details can be obtained from the website http://iisc.ac.in/icash/

12.4 At the time of admission, each student must sign a statement accepting the code of ethics and conduct, and giving an undertaking that:

- The student will complete their studies in the Institute.
- If the student is forced to discontinue studies for any legitimate reasons, it will be done only with permission of the Deans.

12.5 If a student commits a breach of the code of conduct, student will be asked to leave the Institute and will not be eligible for the following:

- Re-admission for a period of three years
- Issuing transcripts or certificates for the courses studied or work carried out.

12.6 On account of misconduct or unsatisfactory work, the Deans may withdraw the scholarship at any time and/or decide that the scholarship has to be refunded from the date of the last award.

12.7 In various phases, one is faced with issues of integrity and conflict of interest. Behaviour of all students and research workers (including faculty) at the Institute must be in conformance with the Academic Integrity policy.

12.8 PRIVILEGES AND RESPONSIBILITIES

12.8.1 All students are bound by the rules and regulations of the Institute.

12.8.2 Full Time Students: During the tenure of their studentship, full-time students are eligible for the following:

- Residence in the Hostel, subject to availability.
- Membership of the Gymkhana.
- Participation in the activities of the Students' Council
- Participation in the Students' Assistance Program
- Assistance from the Students' Aid Fund (SAF)
- Leave privileges
- Limited assistance from the Special Medical Care Scheme

12.8.3 Foreign Nationals

- Foreign Nationals are eligible for hostel accommodation (subject to availability) and membership of the Gymkhana.
- They need prior permission from the Dean to go out of India on vacation/ leave.

12.9 WHAT CONSTITUTES MISCONDUCT?

The Institute believes in promoting an environment that ensures safety to all and promotes academic efficiency by enforcing behavioral standards. These standards include upholding of academic integrity and respecting all persons, their rights and property etc., Prohibited conduct includes, but is not limited to the following:

12.9.1 Alcohol and Substance Abuse

i. Consumption, manufacture, sale, possession, and distribution of alcohol is prohibited on campus. Any student found guilty of behaving irresponsibly under the influence of alcohol will be penalized. A first-time offender will be charged a fine of Rs 10,000/- and asked to submit a written commitment that they will not repeat the offence. A second- time offender will be fined Rs 25,000/- and the offence will also be reflected in the student records. A third-time offence will attract a more severe penalty, including rustication from the Institute.

ii. Students found guilty of engaging in any unlawful possession, use, distribution or manufacture of controlled substances or illegal drugs, or their raw materials will be referred to the state police. Once found guilty the student will be suspended and could also be dismissed.

12.9.2 Ragging

The Institute has a coherent and effective anti-ragging policy in place which is based on the UGC Regulation on Curbing the Menace of Ragging in Higher Educational Institutions, 2009 [hereinafter referred to as the 'UGC Regulations']. The UGC Regulations have been framed as per the directions issued by the Honorable Supreme Court of India to prevent and prohibit ragging in all Indian Educational Institutions and Colleges.

A. Ragging constitutes one or more of the following acts:

i. any conduct by a student or students hurting, teasing, or being rude to others.
ii. rowdy or undisciplined activities which causes or is likely to cause annoyance, hardship, physical or psychological harm or raise fear or apprehension thereof in any other student.
iii. asking a student to do an act which makes them uncomfortable, and which has the effect of causing or generating a sense of shame, torment or embarrassment, affecting the physique or psyche of such a student,
iv. any act that prevents, disrupts or disturbs the regular academic activity of any student.
v. exploiting other students to complete academic tasks assigned to them,
vi. any act of financial extortion or forceful expenditure burden put on a student by other students,
vii. any act of physical abuse including sexual abuse, stripping, indulging in obscene, lewd acts including but not limited to gestures, causing bodily harm or any other danger to the health of a student,
viii. any act or abuse either orally or in writing including by spoken words, emails, post, public insults which would also include deriving perverted pleasure, the

vicarious or sadistic thrill from actively or passively participating in the discomfiture to any other student.

ix. any act that affects the mental health and self-confidence of any other student with or without an intent to derive sadistic pleasure.

B. Anti-Ragging Committee

The Anti-Ragging Committee, as constituted by the Director and headed by students' affairs advisors, shall examine all complaints of anti-ragging and come up with recommendations based on the nature of the incident. The committee can have the Deans, Student Counselors, Faculty Advisors, and the Chairperson of the concerned Department as its members as decided by the Competent Authority from time to time. The Committee, however, should have a diverse mix of membership in terms of levels and gender.

C. Anti-Ragging Squad

To assist students, the Institute has also constituted a body called the Anti-Ragging Squad, which consists of various members of the campus community. The Squad shall keep a tab on ragging incidents taking place in the community and undertake patrolling functions. Students may note that the Squad is active and alert at all times and are empowered to inspect places of potential ragging, and also make surprise raids in hostels and other hotspots in the Institute. The Squad can also investigate incidents of ragging and make recommendations to the Anti-Ragging Committee.

D. Penalties

On receipt of any recommendation from the Anti-Ragging Squad or on receipt of any information concerning any reported incident of ragging, the Head of the Institution shall also immediately determine if a case under the criminal laws have been made out and if so, then either on his own or through a member of the anti-ragging committee authorized by him on his behalf proceed to file a First Information Report (FIR) within twenty four hours of receipt of such recommendation with the police or local authorities including those of abetment to ragging, criminal conspiracy to rag, unlawful assembly and other offences as enumerated in Para 12.9 and Para 12.11 of the Regulation.

The Institute shall also continue with its own enquiry initiated and any remedial action shall be initiated and completed immediately and no later than 7 days of reported occurrence of the incident of ragging. A student found guilty by the committee will attract one or more of the following penalties, as imposed by the Anti-Ragging Committee:

i. Suspension from attending classes and academic privileges;
ii. Withholding/withdrawing scholarship/fellowship and other benefits;
iii. Debarring from appearing in any test/examination or other evaluation processes;
iv. Withholding results;
v. Debarring from undertaking any collaborative work or attending national or international conferences/symposia/meeting to present their research work;
vi. Suspension/expulsion from the hostels and mess;

vii. Cancellation of admission;
viii. Expulsion from the institution and consequent debarring from admission to any other institution for a specified period;
ix. When the persons committing or abetting the act of ragging are not identified, the institute shall resort to collective punishment;
x. If need be, in view of the intensity of the act of ragging committed, a First Information Report (FIR) shall be filed by the Institute with the local police authorities.

The Anti-Ragging Committee of the Institute shall take an appropriate decision, including the imposition of punishment, depending on the facts and the nature and gravity of the incident.

An Appeal against any of the orders of punishment enumerated above can be submitted to the Director of the Institute.

12.10 SEXUAL HARASSMENT

Students should note that sexual misconduct or harassment encompasses a range of behaviour, including but not limited to, sexual assault, unwanted physical contact, persistent unwelcome comments, sending e-mails, messages on social media or pictures that are insulting or degrading. Sexual harassment amounts to a serious misconduct and will be dealt with as per the Indian Institute of Science Policy on Prevention and Prohibition of Sexual Harassment at Workplace, 2017 and the Indian Institute of Science Rules for Internal Committee, 2017. All cases will be referred to the 'Internal Committee Against Sexual Harassment' (ICASH) of IISc. ICASH will determine, based on the circumstances of each case, whether the actions brought to its notice constitutes a violation of the sexual autonomy and dignity of the recipient of the action.

12.11 OTHER MISCONDUCTS

A. Storing, possessing or using real or replica firearms or other weapons, explosives (including fireworks), ammunition, drugs, or toxic or otherwise dangerous materials on Institute premises.
B. Stealing, misusing, destroying, defacing or damaging Institute property or property belonging to someone else.
C. Any act of discrimination (physical or verbal conduct) based on an individual's gender, caste, race, religion or religious beliefs, skin colour, region, language, sexual orientation, marital or family status, physical or mental disability etc.
D. Unauthorized use of any Institute facilities, equipment, services or computers. Theft or abuse of the Institute computers and other electronic resources such as computer and electronic communications facilities, systems, and services which includes unauthorized entry, use, tampering of Institute property or facilities, the private residence of staff/professors, offices, classrooms, computers networks, and other restricted facilities.
E. Making false accusations against any member of the Institute.
F. Not producing the identity card issued by the Institute or refusing to produce it on demand by campus security.

G. Physical assault, threats of violence, which includes any disruptive activity in a classroom or in an event sponsored by the Institute. Any conduct which has a negative impact or constitutes a nuisance on and off campus.

H. Organising meetings and processions without permission from the Institute.

I. Accepting membership of religious or terrorist groups banned by the Institute/Government of India.

J. Smoking on the campus of the Institute.

K. Parking a vehicle in a no parking zone or an area earmarked for parking other types of vehicles.

L. Rash driving on the campus may cause any inconvenience to others.

M. Not disclosing a pre-existing health condition, either physical or psychological, to the Chief Medical Officer which may cause hindrance to academic progress.

N. Misbehaviour at the time of student body elections or during any activity of the Institute.

O. Engaging in disorderly, lewd, or indecent conduct, including, but not limited to, creating unreasonable noise; pushing and shoving; inciting or participating in a riot or group disruption at the Institute.

P. Altercations of any kind between students or student groups will be taken seriously as a violation of the code and will be dealt with accordingly.

Q. Students encouraging, aiding, or conspiring in any prohibited conduct. And failing to comply with a disciplinary measure or disciplinary measures imposed under the procedures of this Code.

If these acts are committed off-campus, the Institute will determine whether the Code will apply after considering the seriousness of the alleged offence, the risk of harm involved, whether the victim(s) are members of the campus community and/or whether the off-campus conduct is part of a series of actions, which occurred both on, and off- campus.

12.12 IISC POLICY FOR ACADEMIC INTEGRITY

As a premier institution for advanced scientific and technological research and education, the Institute values academic integrity and is committed to fostering an intellectual and ethical environment. Academic Integrity encompasses honesty, responsibility and awareness of the ethical standards for the conduct of research and scholarship. The Institute believes that in all academic work, the ideas and contributions of others must be appropriately acknowledged. Academic integrity is essential for the success of the Institute and its research missions, and hence, violations of academic integrity constitute a serious offence.

Scope and Purpose

Academic Integrity, which forms an integral part of the Code, applies to all students at the Institute. Students are required to adhere to the said policy. The purpose of the Policy is two-fold:

i. To clarify the principles of academic integrity

ii. To provide examples of dishonest conduct and violations of academic integrity

Failure to uphold these principles of academic integrity threatens both the reputation of the Institute and the value of the degrees awarded to its students. Every member of the Institute community, therefore, bears a responsibility for ensuring that the highest standards of academic integrity are upheld.

The principles of academic integrity require that a student:

A. properly acknowledges and cites the use of the ideas, results, material or words of others, where 'others' includes both web sources and AI tools;
B. properly acknowledges all contributors to a given piece of work;
C. makes sure that all work submitted is his or her own in a course;
D. produces academic work without the aid of impermissible materials or impermissible collaboration.
E. obtains all data or results by ethical means and reports them accurately without suppressing any results inconsistent with his or her interpretation or conclusions;
F. respects the integrity of other students and their right to pursue educational goals without interference. This requires that a student neither facilitates academic dishonesty by others nor obstructs their academic progress.

Violations of this policy include, but are not limited to:

1. **Plagiarism**: It includes the use of material, ideas, figures, code or data as one's own, without appropriately acknowledging the original source. This may involve the submission of material, verbatim or paraphrased, that is authored by another person or entity or published earlier by oneself. Examples of plagiarism include:
   A. Reproducing, in whole or part, text/sentences from a report, book, thesis, publication or the internet, or AI tools.
   B. Self-plagiarism which constitutes copying verbatim from one's own earlier published work (data, illustrations, figures, images) in a journal or conference proceedings without appropriate citations.
   C. Taking material from class notes or incorporating material from the internet graphs, drawings, photographs, diagrams, tables, spreadsheets, computer programs, or other non-textual material from other sources into one's class reports, presentations, manuscripts, research papers or thesis without proper attribution.
   D. Submitting a purchased or downloaded term paper or other materials to satisfy a course requirement.
   E. Using AI tools to assist in course work in violation of policies specified by the Course, Department, Division, or Institute (in that order of priority).

2. **Cheating:** It includes, but is not limited to:
   A. Copying during examinations, and copying homework, assignments, term papers, thesis, or manuscripts.
   B. Allowing or facilitating copying or writing a report or taking an examination for someone else.
   C. Using unauthorized material, copying, collaborating when not authorized and

purchasing or borrowing papers or material from various sources.

D. Fabricating or falsifying (manipulating) data and reporting them in thesis and publications.
E. Creating sources or citations that do not exist.
F. Altering previously evaluated data and resubmitting the work for re-evaluation.
G. Signing another student's name on an assignment, report, research paper, thesis, or attendance sheet.

3. **Guidelines for academic conduct are provided below to guard against negligence as well as deliberate dishonesty:**
   A. Use proper methodology for experiments and computational work. Any use of AI tools for tasks other than word processing (see below) must be disclosed in the Methods or Acknowledgements section, including details of precisely which tools, their usage, and the extent to which these tools were used. Accurately describe and compile data. AI tools must not be used for generating novel results or interpretations.
   B. Carefully record and save primary and secondary data such as original pictures, instrument data readouts, laboratory notebooks, and computer folders. There should be minimal digital manipulation of images/photos; the original version should be saved for later scrutiny if required, and the changes made should be clearly described.
   C. Ensure robust reproducibility and statistical analysis of experiments and simulations. It is important to be truthful about the data and not to cherry pick data: omitting some data points to make an impressive figure.
   D. Laboratory notes must be well maintained in bound notebooks with printed page numbers, which can be checked during publications or patents. The date should be indicated on each page.
   E. Write clearly in your own words. It is necessary to resist the temptation to "copy and paste" from the Internet or other sources for class assignments, manuscripts and thesis. AI tools may be used freely, without acknowledgement, for word-processing tasks such as improving grammar, punctuation, clarity, etc. However, see item (G) below.
   F. Give due credit to previous reports, methods, computer programs, etc., with appropriate citations. Material taken from your own published work should also be cited.
   G. Do not input sensitive, confidential, or restricted information into open generative AI tools.

12.13 CONFLICT OF INTEREST

A clash of personal or private interests with professional activities can lead to a potential conflict of interest, in diverse activities such as teaching, research and publication, and working in committees, funding and consultancy. It is necessary to protect actual professional independence, objectivity and commitment, and also to avoid any impropriety arising from conflicts of interest. Conflict of interest is not restricted to personal financial gain; it extends to a large gamut of professional academic activities, including peer reviewing, serving on various committees, which may, for example, oversee funding or give recognition, as well as influence public policy.

To promote transparency and enhance credibility, potential conflicts of interests must be disclosed in writing to appropriate authorities, so that a considered decision can be made on a case-by-case basis.

12.14 INDIVIDUAL AND COLLECTIVE RESPONSIBILITY

The responsibility varies with the role one plays.

i. **Student roles:** Before submitting a thesis (BSc (Research) /MS, M. Tech (Res), or PhD) to the department, the student is responsible for checking the thesis for plagiarism using software that is available on the web. In addition, the student should undertake that the student is aware of the academic guidelines of the Institute, has checked the document for plagiarism, and that the thesis is an original work. A web-check does not necessarily rule out plagiarism. If a student observes or becomes aware of any violations of the academic integrity policy, such student is strongly encouraged to report the misconduct in a timely manner. Any student who uses AI tools must do so within the permitted framework. Further, the student is wholly responsible for the correctness of the content generated by such tools.

ii. **Faculty roles**: Faculty members should ensure that the students follow proper methods for experiments, computations, and theoretical developments, use of AI tools, record proper data and save them for future reference. In addition, they should review manuscripts and theses carefully. Faculty members are also responsible for ensuring personal compliance with the above broad issues related to academic integrity. Faculty members are expected to inform students at the Institute's academic integrity policy within their specific courses to ensure minimal academic dishonesty, and to respond appropriately to violations of academic integrity. Course Instructors should clearly specify, at the beginning of the course, specific policies governing the use of AI tools for the course's sessional works and final works that will be assessed.

12.15 REPORTING AUTHORITY AND PENALTIES

A. It is recommended that the faculty bring any academic violations to the notice of the Department Chair or concerned Dean. All complaints lodged against students regarding breach of academic integrity and research misconduct against students shall be governed by the Indian Institute of Science (IISc) policy for handling Misconduct in Research.

B. All cases of student-faculty conflict will be handled by the concerned Dean with assistance from the committee. Students may approach the committee or the Dean if they have a genuine problem.

C. Upon receipt of reports of scientific misconduct, the Director may appoint a committee to investigate the matter and suggest appropriate measures on a case- by-case basis.

D. A breach of academic integrity is a serious offence with long-lasting consequences for both the individual and the institute, and this can lead to various penalties. In the case of a student, the first violation of academic breach will lead to a warning and/or an 'F' grade in the course. A repeat offence, if deemed sufficiently serious, could lead to expulsion.

12.16 PRINT AND VISUAL MEDIA, AND SOCIAL MEDIA CLAUSES

A. Students are expected not to interact, on behalf of the Institute, with media representatives or invite media persons to the campus without the permission of the Institute authorities.

B. Students are not permitted to either audio or video record lectures in classrooms, actions of other students, faculty, or staff without prior permission.

C. Students are not permitted to provide audio and video clippings of any activity on campus to the media without prior permission.

D. Students are expected to use social media carefully and responsibly. They cannot post derogatory comments about other individuals from the Institute on social media or indulge in any such related activities that could have negative ramifications on the reputation of the Institute.

12.17 THE DISCIPLINARY PROCESS

A complaint of misconduct can be made by any student, staff or faculty member of the Institute at the concerned Department, Security office, the Hostel office or the Dean's office. An enquiry will be made by the concerned authority. All efforts will be made to address the issue. If the problem persists, the case may be referred to the Students Affairs Committee.

The subsequent process will be as follows: A case sheet will be opened. The student(s) will be called for a hearing and the alleged charges and circumstances will be documented. If the committee feels there is indeed an offence, the committee will make recommendations to the Dean of Science or Engineering, who are the disciplinary authorities. The recommendation will be reviewed by the Dean, who will recommend subsequent action. The officer in charge of the academic section will issue the penalty.

12.18 PENALTIES

The recommendation can be, but will not be restricted to, one or more of the following actions, depending on the nature of the offence:

A. Warning- indicating that the action of the said student was in violation of the Code and any further acts of misconduct shall result in severe disciplinary action. The student may be required to tender a written apology.

B. Community Service - for a specified period of time to be extended if need be. However, any future misconduct along with failure to comply with any conditions imposed may lead to severe disciplinary action, including suspension or expulsion.

C. Restrictions - reprimanding and restricting access to various facilities on the campus for a specified period of time.

D. Monetary Penalty - may also include suspension or forfeiting scholarship/fellowship for a specific time period.

E. Withholding Grades – withholding the grade card or certificate for the courses studied or work carried out.

F. Suspension - a student may be suspended for a specified period, which will entail prohibition from participating in student-related activities, classes, programs etc. Additionally, the student will be forbidden to use various Institute facilities unless permission is obtained from the Competent Authority. Students may be suspended and dismissed, along with the following additional penalties.

G. Expulsion - students may be expelled from the Institute permanently. The student is prohibited from entering the Institute premises or participating in any student-related activities and staying in campus residences etc.

H. Ineligibility - to reapply for admission to the Institute for a period of three years.

Note: Repeat offenders will be given a higher penalty.

12.19 DISCIPLINARY AUTHORITIES

A. For imposing the penalties 12.18 A and 12.18 B, the Students' Affairs Committee will be the Disciplinary Authority.

B. For all other penalties, the Dean Science, Dean Engineering or Dean Undergraduate will be the Disciplinary authority for students from Science, Engineering or Undergraduate Programs, respectively.

C. Hostel office with the approval of the Chair, CoW may impose penalties related to certain cases of misconduct in the hostels and messes.

12.20 APPEAL

If the delinquent student is aggrieved by the imposition of any of the afore-mentioned penalties, they may appeal to the Director. The Director may decide on one of the following:

A. Accept the recommendation of the committee and impose the punishment as suggested by the Committee or modify and impose any of the punishments as stipulated in the Code corresponding to the gravity of the proved misconduct, or

B. Refer the case back to the committee for reconsideration.

In any case, the Director's decision is final and binding in all the cases where there is possible misconduct by a student.

12.21 STUDENT PARTICIPATION IN GOVERNANCE

Students are members of the Institute campus, and they have a substantial interest in the governance of the Institute. The Code, policies and the varied procedures laid down herein seek to encourage students to be involved in governance in both administrative and academic areas. Students must, at all junctures, be encouraged to put forth their views and advice, for informed decision making. Therefore, all students who are a part of the Institute and who are going to be enrolled in the Institute, are advised to uphold the policy, inform the Institute of any violations, and assist individually and collectively to improve the quality and effectiveness of this Code and policies.

CHAPTER 13

IMPORTANT COMMITTEES

13.1 UNDERGRADUATE SENATE CURRICULUM COMMITTEE (UGSCC)

A. The Undergraduate Senate Curriculum Committee (UGSCC) is one of the important standing committees of the institute which deals with the curriculum, examination, and course-related activities at IISc for UG Program.

B. The UGSCC/SCC holds the authority to make decisions on the following matters:

- Academic Calendar
- Course Registration
- Course Dropping
- Examination Timetable
- Course-Instructor feedback
- Finalization of Marks and Publishing of Results
- Termination of Deficient academic performers
- Granting extension to complete the course work.
- To ensure that all programs and courses meet acceptable standards.
- Academic Structure of different programs

13.2 UNDERGRADUATE PROGRAMS BOARD OF STUDIES COMMITTEE (UG BoS)

The UG BoS Committee is to advise the UG program about various academic aspects providing recommendations of new courses, revising the syllabus of any existing course(s), inclusion of new elective(s)/deletions of any elective(s), and addition or modification or deletion of any core course(s) on the merit of the case in addition to any other academic matter relevant to the UG programs. The UG BoS will be for both the UG programs Four-Year Bachelor of Science (Research) & B.Tech (Mathematics and Computing).

13.3 STUDENT AFFAIRS COMMITTEE (SAC)

The Student Affairs Committee (SAC) is the standing disciplinary committee of the institute. SAC is mandated to:

- Handle all students' complaints and grievances related to academic matters, availability of academic and research facilities, student-faculty relationships and other students' affairs.
- Enquire into the alleged case and recommend suitable disciplinary action.
- Act as 'mentoring cell' on curbing the menace of ragging.
- To make review of students' code of ethics and conduct and make recommendations.

Members SAC

- Prof. Abha Misra
- Prof. Ambedkar Dukkipati
- Prof. Annapoorni Rangarajan
- Prof. Digbijoy Nath
- Prof. Harish Seshadri

- Prof. M S Bobji (Chair & Advisor)
- Nitin Anand, AR, Academic
- Prof. Partha Pratim Mondal
- Prof. Upendra Nongthomba
- Prof. Viswesha Guttal

13.4 THE SEXUAL HARASSMENT COMPLAINT COMMITTEE (SHCC)

A. Sexual harassment includes such unwelcome sexually determined behavior (whether directly or by implication) as physical contact and advances, demand or request for sexual favors, sexually colored remarks, any other unwelcome physical, verbal or non-verbal conduct of a sexual nature. It is discriminatory when the aggrieved woman has reasonable ground to believe that her objection would disadvantage her in connection with her employment, or when it creates a hostile working environment. In accordance with the Hon'ble Supreme Court's decision, a Sexual Harassment Complaint Committee (SHCC) was constituted in April 2003.

B. The SHCC will provide equal opportunity for all women in IISc, without regard to age, to lodge complaints of any sexual harassment in the workplace. The affront to personal dignity that occurs as a result of sexual and other types of harassment constitutes an action unbecoming of a student/ staff member of the Institute and will attract appropriate disciplinary action. Complaints may be made verbally or in writing at any time.

C. The Government of India (GoI) has enacted the Protection of Women from Sexual Harassment at Workplace (Prevention, Prohibition and Redressal) Act (the SH Act), 2013. For details, refer: http://www.shebox.nic.in (SHe-Box–Ministry of Women & Child Development) and https://www.rightsofemployees.com/2018/01/26/sexual-harassment-at-workplace/

13.5 INTERNAL COMMITTEE AGAINST SEXUAL HARASSMENT (ICASH)

A. The Internal Committee against Sexual Harassment (ICASH) will provide equal opportunity for all IISc personnel, without regard to gender or age, to lodge complaints of any sexual harassment in the workplace.

B. Any of the following ICASH members may be contacted verbally or in writing at any time, for lodging complaints.

Members, ICASH

- Prof. Rohini Balakrishnan (Presiding Officer)
- Prof. Annapoorni Rangarajan (Member)
- Mr. Mithun Nair (Member)
- Dr. Nirmala R (Member)
- Prof. Prerna Sharma (Member)
- Prof. Prabhu R Nott (Member)
- Prof. Shirish K Shevade (Member)
- Siddharth Arora (Student member)
- Adv. Sowmya Lakshmi Bhat (External Member)
- Stuti Shashank (Student member)

CHAPTER 14

FACILITIES AT INSTITUTE

14.1 JRD TATA MEMORIAL LIBRARY

The J.R.D. TATA Memorial Library, at the Indian Institute of Science, is one of the oldest yet modern Science and Technology libraries in India. Started in the year 1911 as one of the first set of departments in the Institute, it has become a precious national resource center in the fields of Science and Technology. The library is centrally located with four floors with lift facility and has a total area measuring about 5,000 sq. mts. The collection of the library which includes books, journals, reports, theses, Indian Patents and standards is regarded as one of the richest collections in the country. This rich and valuable collection built over ten decades has some of the rare reference materials and back volumes of several important journals. Apart from its print resources, the library has access to a large collection of e-journals, eBooks and databases. Functioning as an effective support system for information services across the campus continues to be the primary goal of the library.

The library has a total collection of about 5 lakh documents which includes books and monographs, bound volumes and periodicals, theses, standards, technical reports etc. It subscribes to over 750 current e-journals. In addition to Library subscriptions, the **e-Shodh Sindhu Consortium (INFLIBNET)** provides access to over 8000+ e- journals. The library continues to maintain pre-eminence in providing access to a large number of eresources.

A. **EPrints & ETD Digital Repositories**

ePrints@IISc (ePrints@IISc) is one of the earliest and largest Institutional Repositories in the country. The ePrints@IISc was started by the erstwhile National Centre for Science Information. It is currently being managed by the J.R.D. Library. The repository collects, preserves, and disseminates in digital format the research output created by the IISc research community. The repository content can be accessed through the search and browse functionalities. As on date, the total number of publications in the repository is about 46,000+.

etd@IISc (etd@IISc) is the digital repository of Theses and Dissertations of IISc, Bangalore, India. This repository has been developed to capture, disseminate, and preserve the research theses of IISc. The repository content can be accessed through the search and browse functionalities. As on date, the total number of records in the repository is about 3800+.

A.1. Library Automation

The library has been using LIBSYS, a Library Management Software for its functions such as Acquisition, Cataloguing, Serials Control, and Circulation. Online access to Library holdings data is through WEB-OPAC. Users have the facility to browse and search the library catalogue and view the status of a document or their own transactions and make on-line reservations for a document issued.

A.2. Working hours

Monday – Saturday Open 24 hours Sunday and IISc Holiday's 10:00 to 17:00 hrs.

A.3. Circulation rules and procedures

- Items that can be borrowed:
  a) Books
  b) Series Publications
  c) Reference Books (except Handbooks, Dictionaries, Encyclopedias, etc.)
- Loan Period:
  a) Books (General): 14 days
  b) Periodicals (bound/series/references): 48 hours.

A.4. Library Website

The Library maintains its own web portal (Library iisc.ac.in) and the portal acts as a one-stop-shop to access all the information related to the library including services & facilities available, Web OPAC, links to all e-resources subscribed, Staff etc.
Contact No: 080 2293 2408
E-mail: library@iisc.ac.in
Website: Library.iisc.ac.in

14.2 SUPERCOMPUTING EDUCATION AND RESEARCH CENTRE AND COMPUTATIONAL FACILITIES

The Supercomputing Education and Research Centre (SERC) is a state-of-the-art supercomputing facility in Indian Institute of Science (IISc). It primarily caters to the computational and specifically, high performance computing needs for scientific and engineering research in IISc. The Centre hosts 24/7 supercomputing facilities and services including supercomputers of Petaflop capacities for traditional HPC (High performance computing), deep learning and AI based applications, HPC software and about 2 Petabytes of storage.

SERC currently boasts of a supercomputing system called Param Pravega installed under the National Supercomputing Mission (NSM), a prestigious project in the country. Param Pravega is a 2.6 PFlop system with 28000 CPU cores, 80 GPUs and 4 Petabytes storage. It is the largest supercomputing system in an academic Institution in India. Besides this, SERC also has a medium-scale cluster with about 2000 CPU cores and latest GPU resources. In addition to the hardware, SERC has a wide array of attractive computational and visualization softwares including MPI, OpenMP, MATLAB, Mathematica, Scalapack, Ansys, and other domain-specific software for various fields of research.

The supercomputer systems in SERC have served about 44 departments, 134 research groups and 450 users of the Institute in various fields including Aerospace, Brain Research, Chemistry, Climate Modelling, Computational and Data Sciences, Computer Science, Earth Sciences, Electronics System Engineering, Inorganic and Physical Chemistry, Materials Research, Mechanical Engineering, Microbiology and Cell Biology, Molecular Biophysics, Physics etc.

About 150 million CPU core hours per year are being provided and used for research by both faculty and students in these areas. Supercomputing usage results in a total of about 50 publications every year across the Institute. SERC resources are also being used by researchers from other academic organizations, government-funded R&D laboratories and industries.

Students can easily access these attractive state-of-the-art resources by filling in a simple form mentioning their program and other details and submitting to SERC which then facilitates the access within a day. Students can then remotely log in to these resources from the convenience

of their labs, hostel rooms, or even their homes and submit jobs for executions 24/7. The center also provides periodic HPC training courses to both the Institute community and personnel from outside the Institute and offers HPC consulting services. Students can avail themselves of these training programs to get acclimatized with the usage of the latest resources in SERC.
Contact No: 080 2360 0492
E-mail: office.serc@iisc.ac.in
Website: https://www.serc.iisc.ac.in/

14.3 HEALTH CENTRE

14.3.1 Medical services for students are provided at the Health Centre. It has out-patient and in- patient facilities served by Medical Officers and nursing staff. Specialists in the areas of eye, dental and psychiatry visit the Health Centre regularly. There is a doctor on duty to look after emergency cases at night.

14.3.2 Diagnostic facilities like a clinical laboratory, an X-ray facility, ECG and ultrasonography are available. Cases requiring other specialist services are referred to appropriate centers/ hospitals.

14.3.3 All regular students are covered by the "Students Health Care Scheme" which permits reimbursement of medical expenses incurred as per norms. Students must undergo a medical examination at the time of joining only and medically fit candidates are admitted to the Institute. Health insurance is mandatory for all Institute students.

14.3.4 Appointments can be done through the website: Health Centre Login (iisc.ac.in)

14.3.5 Important Contacts:

14.3.5.1 Medical Officers

1. Dr. Satish Rao. C, Sr. Medical Officer, Officer-in-charge, Ph:2293 2226(off), 2293 2031(res)
2. Dr. Nirmala. R, Sr. Medical Officer, Ph: 2293 2411 (off), 2293 2073 (res)
3. Dr. Aditya Malladi, Medical Officer, Ph: 2293 2936 (off)
4. Dr. Neethi Ravindran, Medical Officer 2293 2552 (off)
5. Dr. Rohan Khot, Authorized Medical Officer, Ph No. 2293 2346
6. Dr. Chelsy Anna, Authorized Medical Officer, Ph No. 2293 2346
7. Dr. K. T. Bharath, Authorized Medical Officer, Contact No. 080 2293 3468
8. Dr. Ravi Kiran, Authorized Medical Officer, Ph No. 2293 2346
9. Authorized Medical Officer (Night-Duty): Ph: 2293 2006 / 2390

14.3.5.2 Consultants

1. Dr. Shyam Prasad, Skin/Dermatology, Ph: 2293 2552 (off), 2331 8936 (res)
2. Dr. Sanjay B Patil, ENT, Ph: 2293 2226 (off), 2349 3487 (res)
3. Dr. M. N. Srinivasan, Consultant Radiologist, Ph: 2293 2412 (off), 98451 66705 (mob)
4. Dr. Nandyala Sundari, Consultant Gynecologist, Ph. No. 080 2293 2412
5. Dr. Kailash Chhabria, Consultant Ophthalmologist, Ph. No. 080 2293 2412
6. Dr. Suryanarayana, Endocrinologist, Ph: 2293 2226 (off)
7. Dr. Basavaraj Kuntoji, Physician, Ph. 2293 2411
8. Dr. Shalini Sharma, Pediatrician, Ph. 2293 2990
9. Ms. Savitha M. S, M.Sc. (Clinical Psychology), PDCP Ph: 080 2294 3628
10. Mr. Shridhar B. G, M.Sc. (Clinical Psychology), Ph: 080 2293 3629

14.3.5.3 Allied Specialty

1. Mr. K. Vishnu Kumar Reddy, Physiotherapy, Ph: 080 2293 3468
2. Mrs. Ruth Boyle, Physiotherapy, Ph: 080 2293 3468

14.3.5.4 Other Contacts

1. Office	:	080 2293 2234/3617
2. Reception	:	080 2293 2227
3. Laboratory	:	080 2293 2007
4. Nursing	:	080 2293 2390/2006
5. X-ray	:	080 2293 2348
6. Pharmacy	:	080 2293 2412

14.4 HOSTELS AND DINING HALLS

14.4.1 The registered students at the Institute are eligible to apply for the available on campus hostel accommodation.

14.4.2 There are four dining halls: Vegetarian 'A', 'D' & 'E'; and Composite 'B' and 'C' (both vegetarian and non-vegetarian).

14.4.3 Contact No: 080 2293 2593 / 080 2293 2822

14.4.4 For information on Married Student Apartments, please contact the Housing Allotment Committee (HAC) office.

14.4.5 Charges towards Hostel facilities per month are given below:

14.5 STUDENTS' COUNCIL

14.5.1 Students' Council (SC) is the representative body of the entire student community of the Indian Institute of Science. It is an interface between the students and the administration and works together with the students to identify and address concerns that affect them, directly or indirectly. The Students' Council also represents the interests of the students and takes an active role in discussions and decisions affecting the student community.

14.5.2 The Students' Council is also vested in the all-round development of the students and organizes several extracurricular activities throughout the year. These activities include sporting and cultural events organized in association with the Gymkhana and the different activity clubs on campus. The Students' Council also coordinates the student volunteer effort for the various Institute events like Sangam - Freshers' welcome party and the Open Day thus actively encouraging student participation and contribution. The motivation is to instill a sense of social responsibility and a drive to give back to society.

14.5.3 Students' Council takes a stand on issues of social importance and organizes the student body in their protests and acts as united voice of the students at the institute. This is aimed at making the students aware of the outside world and encouraging them to take a stand for what is right.

14.5.4 The office bearers of Students' Council are elected for a term of one year. Nominated members constitute the Steering and Executive Committee of Students' Council. Additionally, two representatives from each of the departments are members of the Council. The

Students' Council is also responsible for the constitution of the following committees:

- **Academic:** All issues relating to courses, academic resources
- **Amenities:** Looking after on-campus amenities and monitoring quality of the existing ones
- **Communication:** Media interface and dissemination of information to student's Hostel – Looking after students' Hostel
- **Student Support Network:** Coordinate with Counselling center to provide counselling platform for students.
- **Placements:** Looking after the campus placements and other career opportunities
- **Health:** Coordination between health center and students
- **Women's Welfare:** Work with Women Cell for the welfare of the women students
- **Cultural:** Organizing and promoting intra and inter-institute cultural events.
- **Environment:** Reducing the institute's environmental footprint, expanding the green cover

14.5.5 There are also other committees like social, UG Welfare, Foreign Student Welfare. Contact No: 080 2293 2653
Email: office.sc@iisc.ac.in

14.6 STUDENTS' BODY FOR INNOVATION AND ENTREPRENEURSHIP (ENTIISC)

14.6.1 **EntIISc** is the abbreviation for 'Entrepreneurship and Innovation at IISc'. It is a student-run forum to encourage, promote and support entrepreneurship and innovation activities at IISc. It aims to become a welcoming forum to promote and sustain entrepreneurial spirit and facilitate ideas and networking by means of events, workshops, and training. The beneficiaries include students, faculty, research staff and associates.

- **Vision:** The vision of this club is to leverage the unique ecosystem of IISc to create an international hub for entrepreneurship and innovation.
- **Mission:** The mission of EntIISc is to be a welcoming forum to promote and sustain entrepreneurial spirit and facilitate ideas and networking by means of events, workshops, and training.
- **Stakeholders:** IISc students primary, IISc community (Faculty, supporting staff and others), external entities (IISC alumni, Industry, Partners (VCs, Industry bodies, Govt., other academic institutes and interested individuals)
- **Objectives:** Be a world class showcase for entrepreneurship and innovation by executing professionally through:
  - Innovative and comprehensive IT-driven operations
  - Creative, engaging, and useful events that benefit the stakeholders.
  - Metrics-driven achievements, demonstrating transparency and integrity in actions and thoughts via constant communication to all stakeholders on a regular basis.

14.6.2 **Events at EntIISc:**

Since its formal inception, the office bearers of EntIISc have established this forum as the go-to place for all IISc students and entities external to IISc on matters related to student entrepreneurship and innovation. EntIISc has been able to engage about 500 students from the campus through more than 10 events conducted during the first six months of its

operation. Students and other scholars of IISc, professionals, entrepreneurs, and innovators benefited from the various sessions of these events.
Website: entiisc.iisc.ac.in

14.7 RECREATIONAL FACILITIES

14.7.1 **Gymkhana** is a center of cultural activity at the Institute. It has a cricket ground, tennis, volleyball, and basketball courts and a cinder track. An indoor badminton court, table tennis, billiards, karate, shaolin-chu-kung-fu, taekwondo, chess and carrom are a few among the many facilities in the gymkhana. Athletic and recreational facilities at the gymkhana provide a conducive atmosphere for interaction between students and staff, as also a break from the regular work schedules at the Institute.

The gymkhana also has a good gymnasium with facilities like Home Gym, a Hercules multi trainer and wall bar equipment.

Attached with the gymkhana is a small well-kept swimming pool where coaching classes are also conducted during summers. The gymkhana subscribes to about 14 magazines in English at its Ranade Library, apart from making available about 10,000 books to readers. The music room in the gymkhana houses a stereo system and record player, with a good collection of records. There is a separate TV lounge. An indoor Students' Auditorium where cultural activities can be organized, is available as a facility. There is also an open-air auditorium.

14.7.2 General Facilities

- The Film Club regularly screens popular and classic films in its main hall.
- The gymkhana organizes inter-departmental, inter-collegiate and inter-university tournaments in sports, games and cultural events. 'VIBRATIONS', a weeklong annual cultural festival, which attracts students from institutions all over the country and helps to bring out their inherent cultural talent, is celebrated at the gymkhana.
- A dark room facility for the photographic club situated at the gymkhana caters to the needs of camera-loving members.
- A snack parlor, which serves coffee, snacks and soft drinks to the members, is also situated in the gymkhana premises.
- Other general facilities at the Institute include banks, Xerox centers (photocopying facility), travel agencies, bookstores, and a cafe and tea kiosk.

  Contact No: 080 2293 2257
  Email: office.gym@iisc.ac.in
  Website: iiscgym.iisc.ac.in

14.8 OFFICE OF DEVELOPMENT AND ALUMNI AFFAIRS (ODAA)

14.8.1 INTRODUCTION

The Office of Development and Alumni Affairs spearheads IISc's efforts to raise funds from alumni, corporates and philanthropists. These contributions have been used for a number of initiatives at the Institute including construction of new buildings, establishment of new research/academic centers, establishment of student fellowships, travel fellowships, chair professorships and setting up of new labs.

14.8.2 FELLOWSHIPS

Multiple fellowships have been established for students of the Institute through ODAA.

ODAA has also spearheaded IISc's efforts to encourage more women students to pursue careers in science and engineering, in order to address the gender inequality in science and technology. These efforts have resulted in the establishment of a number of fellowships for women students. These include the IISc-AANA Midwest Chapter UG Women Fellowship and the Mallika Women in Science for undergraduate students.

For a complete list of fellowships, please visit: Fellowships | ODAA (iisc.ac.in)

14.8.3 TRAVEL GRANTS

A number of travel grants have been instituted by various corporations/alumni endowments through ODAA. These include the Tata Trusts Travel Grant, the IDR Division Travel Awards and the Apra Labs travel grants for women students. Students are encouraged to write to: alumniaffairs.odaa@iisc.ac.in for more details.

14.8.4 ALUMNI ENGAGEMENT

ODAA is IISc's main point of contact with its alumni from all over the world. The office updates alumni of all programs ongoing at the Institute and works with them on initiatives aimed at benefiting existing students. An example of this is the Institute Gold Medals for the best outgoing students, established with endowments from various alumni. The details of these endowments/contributions are available here: https://odaa.iisc.ac.in/alumni-2/

14.8.5 LABS

ODAA's fundraising efforts have resulted in the development of a number of new facilities available to students of different departments.

This includes the four new labs established for the two-year M Tech (AI) joint degree program offered by the Division of Electrical, Electronics and Computer Sciences. These labs have been established with CSR funding from SBI Cards, Tata Elxsi, GroupM and Timken. An Instructional Laboratory for Secure and Intelligent Computer Systems was also established at the department of Computer Science and Automation using the CSR funding given by Wells Fargo International Solutions. The complete list of benefactors is available here: https://odaa.iisc.ac.in/corporates/

Contact No: 080 2293 3590

Email: office.odaa@iisc.ac.in

Website: odaa.iisc.ac.in

14.9 OFFICE OF INTERNATIONAL RELATIONS (OIR)

The Office of International Relations (OIR) was constituted in 1998. Since its inception, OIR has been overseeing all the international programs and bilateral activities of the Institute as well as admission of international students to various programs offered by the Institute, including Bachelor of Science (Research), B Tech (Mathematics & Computing), MS, M Tech (Course and Research), and PhD in Science & Engineering. Currently, the Institute has a small proportion of international students enrolled in the full-time UG/PG/PhD programs in various disciplines of Science and Engineering. All these students are provided with the campus accommodation and fellowships on par with the Indian students. OIR has formulated several mechanisms for engaging with foreign universities and

research institutions. This includes joint supervision of research students, joint degree programs (including PhD), visiting programs for international faculty, researchers and students, nurturing joint research ventures through bilateral exploratory workshops, webinars and seed funds, supporting study abroad programs and internship opportunities with selected partners. Furthermore, OIR provides the required documents and support for Visa processing, registration with FRRO/e-FRRO. OIR facilitate the networking of our international students by organizing orientation programs for newly admitted students and connect them to the Institute's international student body and student council.

Contact No: 080 2293 2560
Email: oir.admin@iisc.ac.in
Website: oir.iisc.ac.in

14.10 OFFICE OF COMMUNICATIONS (OoC)

The Office of Communications (OoC) at the Indian Institute of Science (IISc) is the single point of contact for all external communications related to the Institute. OoC's activities include publishing periodic magazines and newsletters related to research and campus life, as well as books by faculty members, maintaining and archiving historical documents, disseminating science news and organizing talks on diverse science-related topics. The office also coordinates the publication of the Institute's Annual Reports, brochures, and other publicity material.

Contact No: 080 2293 2750/2066
Email: office.ooc@iisc.ac.in
Website: ooc.iisc.ac.in

14.11 DIGITAL CAMPUS AND IT SERVICES (DIGITS)

DIGITS (Digital Campus and IT Services) Office is IISc's hub for digitalization. It is a unit set up by the Institute to plan and create a best-in-class information technology (IT) and networking system for the campus, and to implement agile IT and networking services for operational excellence in the Institute.

Some of the main activities of DIGITS are:

- maintenance of emails, SAP and Scholar One,
- making available legal copies of widely used softwares,
- Broadcast Service for IISc wide announcements,
- maintenance of the campus wide network and various portals, and IISc website.

For more information, see https://digits.iisc.ac.in
Contact No: 080 2293 3006
Email: office.digits@iisc.ac.in
Website: digits.iisc.ac.in

14.12 OFFICE OF CAREER COUNSELLING AND PLACEMENT (OCCaP)

14.12.1 About the Office of Career Counselling and Placement (OCCaP)

The Office of Career Counselling and Placement (OCCaP) (previously known as 'Placement Cell') provides centralized support for the internship and full-time placements for the M Tech, M Tech (Res), MDes, MMgmt, Master of Science, Bachelor of Science (Research), PhD, Post Doc scholars at IISc.

14.12.2 Internship placements

The Institute allows students to take up internship positions in the industry for up to three months without affecting their academic activities. Undergraduate and Master's students may take up these internships during the summer months (May to July). Research students can avail internship if their coursework is completed, subject to approvals from the advisor and department. Longer internships are allowed with special arrangements. OCCaP organizes special events to facilitate interactions between students and companies interested in hiring them as interns. For further information on internship, please refer to respective program rules.

14.12.3 Full-time placements

The placement season begins in October and goes on till May. Interested and eligible students (as per the criteria specified by the recruiter) show their willingness to appear for the recruitment process of a company by entering their details online. Details of all such students become available to the organization for downloading or viewing through the OCCaP account. OCCaP will schedule recruiters' visits for pre-placement talks, tests, and personal interviews.

For more details visit: https://occap.iisc.ac.in/
Contact No: 080 2293 2005
Email: occap@iisc.ac.in
Website: occap.iisc.ac.in

14.13 WELLNESS CENTRE

IISc has an active Wellness Centre for students and all members of the Campus community. The mandates of the Wellness Centre are:

- Promotion of psychological well-being of the llSc community
- Identification of resources required for early communication, including emergency hotline and other modes of communication, or advice from consulting psychiatrists and psychologists (outside campus), as well as psychological social workers.
- Organization of events such as workshops, seminars etc. to create awareness.

The Wellness Centre is a part of the overall health support system at the Institute. It is chaired by Prof. P. S. Anil Kumar (Dean Administration & Finance) and, in addition to medical doctors, psychologists and psychiatrists, has representatives from students, faculty and staff at IISc. There are various options for seeking and receiving help – 24 x 7 helpline, Online counselling (DOST), and one-on-one meetings. Students are encouraged to help themselves and one-another at the first appearance or signs of emotional and physical distress.

Contact No: 080 2293 3627
Email: office.wellness@iisc.ac.in
Website: wellness.iisc.ac.in

14.14 SECURITY AT IISC

14.14.1 IISc has a vibrant and diverse campus set in 440 acres of greenery in the city of Bengaluru (formerly Bangalore), which includes administrative buildings, departmental buildings, gymkhana, students' hostels & messes, auditoriums, amenities shops, food outlets, faculty, and staff residential quarters and other in-house facilities spread in seven blocks / clusters. IISc is maintaining a safe and secure campus for all students, faculty, staff, visitors and institute's property and physical assets.

14.14.2 The mission of the Security Department at the Institute is to create an environment that is conducive, secure, safe and practical where faculty, students and staff work in comfort, move freely within the Institute campus to complete their time targeted task/s without many barriers or restrictions. The institute is under professional security cover 24x7. All security personnel are sufficiently trained & qualified, and all supervisory staff are retired from Paramilitary Forces/ Armed Forces.

Emergency contact (24x7) – 080-2293 5555
Security Control Room (24x7) – 080-2293 2400 / 2225 / 2841
Assistant Registrar (Security) – 080-2293 2617
Email: security.officer@iisc.ac.in

CHAPTER 15

AUXILIARY RULES AND PROCEDURES

15.1 IMPORTANT PROCEDURES

A. **ID Cards**

A.1. Issuance of ID card

Students will be provided with a temporary ID card with 3 months validity at the time of Document Verification as a part of the admission process. To request a permanent ID card, the student should submit a copy of the temporary ID card along with their recent passport size photograph to the Academic Section (UG).

A.2. Application for validity extension of ID Card

Student should submit a duly filled **Proforma for Student ID Card** to Academic Section (UG) for the validity extension (specifying the date to which the validity has to be extended) enclosing photocopy of old ID card and passport size photograph. The old ID card has to be surrendered upon collecting the new ID card.

A.3. Request for change in address or any corrections in ID card /damaged BARCODE /damaged due to wear & tear of ID card

Fill the **Proforma for Student ID Card** along with your recent passport size photograph and submit the same at the Academic Section (UG), enclose the photocopy the old ID card. The old ID card has to be surrendered upon collecting the new ID card.

A.4. Request for the lost or duplicate ID Card

Students will have to pay Rs. 250/- at Finance Section and submit the original receipt at the Academic Section (UG) and the duly filled **Proforma for Student ID Card** with the recent passport size photograph along with the copy of **Lost Article Report** registered through e-Lost Reports (kspapp.in).

NOTE: If the ID card was confiscated by the security personnel for any reason, the student is required to report to the UG Office immediately.

15.2 CERTIFICATES ISSUED BY UG OFFICE

15.2.1 PROVISIONAL DEGREE CERTIFICATE (PDC)

Provisional Degree Certificate (PDC) mentioning the date of degree award, can be requested by students on AdSeR portal. The Provisional Degree Certificate will be issued only after the recommendation in the Governing Council meeting.

15.2.2 BONAFIDE CERTIFICATE

The request for Bonafide certificate for various purposes should be made on AdSeR portal and have to mention the reason for applying for the certificate. The request for issuance of bonafide certificate for undertaking internship/summer project etc. should be made with the recommendation from the faculty advisor/coordinator and invitation, if any, received. The certificate is issued only to the students whose registration has not been cancelled.

15.3 IMPORTANT INFORMATION

15.3.1 Conversion of CGPA from 8-point scale to 10-point scale

The CGPA obtained in 8-point scale should be multiplied by 1.25 to get equivalent CGPA in 10-point scale

15.3.2 Conversion of CGPA to percentage

The Grade points awarded are not convertible into percentage. However, notionally, to obtain percentage of marks, the CGPA may be multiplied by 10 (for CGPA on the 10-point scale) or 12.5 (for CGPA on 8-point scale).

Note: Use the following links for conversion of CGPA certificate, medium of instruction of course certificate and Migration Certificate:

IISc-CGPA-Percentage-Conversion-notification-signed.pdf

IISc-medium-of-instruction-certificate.pdf

IISc_Migration_TC_generic_certificate_signed.pdf

CHAPTER 16

SCHEME OF INSTRUCTIONS (SOI)

FOUR-YEAR BACHELOR OF SCIENCE (RESEARCH) PROGRAM

BIOLOGY

Curriculum applicable From Batch 2022 onwards

Basic Core Courses (for Biology Major and Minor)

Sl. No.	Code	Title	Credits	Semester
1	UBL 101T	Introductory Biology I	3:0	I
2	UBL 101L	Introductory Biology I (Lab)	0:1	I
3	UBL 102T	Introductory Biology II	3:0	II
4	UBL 102L	Introductory Biology II (Lab)	0:1	II
5	UBL 201T	Introductory Biology III	3:0	III
6	UBL 201L	Introductory Biology III (Lab)	0:1	III

Curriculum applicable until Batch 2021

Basic core courses

Sl. No.	Code	Title	Credits	Semester
1	UB 101T	Introductory Biology	2:0	I
2	UB 101L	Introductory Biology (Lab)	0:1	I
3	UB 102T	Introductory Biology II	2:0	II
4	UB 102L	Introductory Biology II (Lab)	0:1	II
5	UB 201T	Introductory Biology III	2:0	III
6	UB 201L	Introductory Biology III (Lab)	0:1	III

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Biology Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course type
1	UB 205	Introductory Physiology	2:0	IV	Major- Core, Minor- Elective
2	UB 206	Experiments In Biochemistry and Physiology	0:2	IV	Major- Core, Minor- Elective
3	UB 207	General Biochemistry	2:0	IV	Major- Core, Minor- Core
4	UB 301L	Experiments In Microbiology	0:1	V	Major- Core Minor- Elective
5	UB 307L	Experiments In Ecology and Evolution	0:2	V	Major- Core Minor- Elective
6	UB 309	Genetics	2:0	V	Major- Elective Minor- Elective
7	UB 302	Developmental Biology	2:0	VI	Major- Core Minor- Elective
8	UB 303	Experiments In Molecular Biophysics	0:1	VI	Major- Core Minor- Elective
9	UB 304	Experiments In Neurobiology	0:1	VI	Major- Elective Minor- Elective
10	CH 248	Molecular Systems Biology	3:0	VI/ VIII	Major- Elective Minor- Elective
11	CH 242	Special Topics in Theoretical Biology	3:0	V/ VII	Major- Elective Minor- Elective
12	DS 301	Bioinformatics	2:0	V/ VII	Major- Elective Minor- Elective
13	UB 400	Project: Biology	0:16	VIII	Bachelor's Project
14	UB 500	Project: Biology	0:20	X	Master's Project

Note: **Electives for Biology Major and Minor**

In addition to the above courses, courses offered by the Biological Sciences departments i.e; Biochemistry (BC) / Microbiology and Cell Biology (MCB) / Centre for Neuroscience (CNS) / Centre for Ecological Sciences (CES) / Molecular Biophysics Unit (MBU) / Developmental Biology and Genetics (DBG), Course offered for Integrated PhD by Biological Science Division -DB Course codes & Department of Bioengineering (formally BSSE) will be considered towards Biology Major and Minor electives.

Credit Requirements for Biology Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Major Electives	Project	Assortment/ Institute Elective	Total
Till Batch 2021	36	19	9	12	24	16	15	131
From Batch 2022 onwards	40	6	9	12	23	16	25	131

Course Details

Coordinators: Mahavir Singh, Sumanta Bagchi
Instructors UG: Aarthi Saminathan, Karthik V Rao, Vikrant Kumar Sinha and Safeena Majeed
Teaching Assistants: Sana Coreya, Padma S, Raga S S, Smitha B B and Monica S

SEMESTER 1 (AUGUST)

UB 101T (2:0)/ UBL 101T (3:0): Introductory Biology I

Instructors: Sumanta Bagchi and Jayanta Chatterjee

Organismal Biology and the Molecular Basis of Life

Introduction to the World of Living Organisms; Levels of Biological Organisation; the Scientific Method and Causation in Biology; Diversity of life on Earth; Evolution: History and Evolution of Life on Earth; Mechanisms of Evolution; the Evidence for Evolution and Natural Selection; Adaptation, Speciation and Diversification; Phylogenetics; Sex and Sexual selection; Animal Behavior: Classical Experiments in Ethology; Communities and Ecosystem: Species Interactions, Trophic Cascades, Ecology and Global Change; Why Biodiversity Matters?

Introduction to Chemical Evolution; Thermodynamic Principles and Biological Macromolecules (water, lipids, carbohydrates, nucleic acids, proteins, enzymes); Placing Biomolecules in the Cellular Context: Cell as a Unit of Life and the Site for Life Processes. Central themes of Metabolism; General Principles underlying the Design of Metabolic Pathways; Elementary Enzymology; Pathway Integration and Regulation

UB 101L (0:1)/ UBL 101L (0:1): Introductory Biology I (Lab)

Instructors: Sumanta Bagchi and Jayanta Chatterjee

Understanding methods and concepts in evolution, ecology, and behaviour by observing, describing and quantifying; experimental manipulations; representing and interpreting data; titration of amino acids, estimation of reducing and nonreducing sugars, estimation of proteins, DNA, RNA, lipids. Techniques like thin layer chromatography for lipids, melting curves for DNA and SDS-PAGE for proteins.

SUGGESTED BOOKS:

1. Campbell Biology (10th/11th editions) By JB Reese, LA Urrey, ML Cain, SA Wasserman. Pearson Global Editions. ISBN 10: 0321739752; ISBN 13: 9780321739759, 2010/ 2013
2. Ernst Mayr, This is Biology: The Science of the Living World, Harvard University Press, 1997
3. Jerry A. Coyne, Why Evolution is True, Viking Penguin, New York, USA, 2009
4. Jonathan Weiner, The Beak of the Finch, Vintage Books, New York, USA, 1995
5. Sean B. Carroll, The Serengeti Rules: The Quest to Discover How Life Works and Why it Matters, Princeton University Press, New Jersey, 2016
6. Wilson, E. O., Life on Earth. Freely available at: http://eowilsonfoundation. org/e-o- wilson-s-life- on-earth
7. Wilson, E. O. The Future of Life, Alfred A. Knopr, 2002
8. Lodish, H., Berk, A., Kreiger, C. A., Scott, M. P., Bretscher, A., Ploegh, H. and Matsudaira, P., Molecular Cell Biology, W. H. Freeman Publishers, 6th Edition, 2008
9. Krebs, J. E., Goldstein E. S., and Kilpatrick, S. T., Lewin's Genes X, Jones and Bartlett Publishers, 10th Edition, 2011
10. Nelson, D. L. and Cox, M. M., Lehninger Principles of Biochemistry, W. H. Freeman Publishers, 5th Edition, 2009
11. Berg, J. M., Tymoczko, J. L. and Styrer, L., Biochemistry, W. H. Freeman & Co., 6th Edition, 2006
12. Voet, D. and Voet, J. G., Biochemistry, Wiley, 4th Edition, 2010

SEMESTER 2 (JANUARY)

UB 102T (2:0)/ UBL 102T (3:0): Introductory Biology II

Instructors: Dipshikha Chakravortty, Sachin Kotak and Arun Kumar

Introduction to the microbial world and its diversity; the importance of microbes in the exploration of basic principles of biology; bacterial growth and its modulation by nutrient availability in the medium; structure and function of a bacterial cell; structure of cell wall; isolation of auxotrophs; introduction to viruses – life cycles of temperate and lytic bacteriophages, structure and function of extra-chromosomal elements and their applications in molecular microbiology.

Introduction to cell biology, eukaryotic cells and their intracellular organization; introduction to the light microscopes and other methods of studying intracellular organelles; further studies on endoplasmic reticulum, Golgi apparatus, lysosomes, mitochondria, nucleus (organization and function), plasma membrane structure and its function, the cytoskeleton, the cell cycle.

Mendelian genetics (segregation and independent assortment); sex determination and sex linkage in diploids; cytoplasmic inheritance; pedigrees, markers, mapping and genetic disorders; gene frequencies and Hardy-Weinberg principle.

UB 102L (0:1)/ UBL 102L (0:1): Introductory Biology II (Lab)

Instructors: Dipshikha Chakravortty, Sachin Kotak and Arun Kumar

Light microscopy, identification of microorganisms, staining techniques (Gram's, acid fast), bacterial plating, tests for antibiotic resistance, cell media and tissue culture; cell counting, immunostaining for actin, microtubules, DNA and identifying interphase and various mitotic phases; Drosophila crosses using red eye and white eye mutants, observation of Barr body in buccal mucosa cells, preparation of mitotic/ polytene chromosomes from Drosophila larvae; and karyotyping using human metaphase plate photos.

SUGGESTED BOOKS:

1. Berg, J. M., Tymoczko, J. L. and Styrer, L., Biochemistry, W. H. Freeman & Co., 6th Edition, 2006
2. Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L., General Microbiology, MacMillan Press, 5th Edition, 2007
3. Alberts, B., Molecular Biology of the Cell, Garland Science, 5th Edition, 2008
4. Strick berger, M. W., Genetics, Prentice-Hall, India, 3rd Edition, 2008
5. Daniel, H., Essential Genetics: A genomics perspective, Jones & Bartlett, 3rd Edition, 2002
6. Strachan, T. and Read, A. P., Human Molecular Genetics, Garland Science, 3rd Edition, 2004

SEMESTER 3 (AUGUST)

UB 201T (2:0)/ UBL 201T (3:0): Introductory Biology III

Instructors: Tanweer Hussain, Dipankar Nandi, Arnab Barik and Ashesh Dhawale

Molecular biology (central dogma, DNA repair, replication, transcription, genetic code and translation); examples of post-transcriptional and post-translational modifications; genetic methods of gene transfer in bacteria.

Introduction to the immune system – the players and mechanisms, innate immunity, adaptive responses, B cell receptor and immunoglobulins, T cell activation and differentiation and Major Histocompatibility Complex encoded molecules.

Overview of the nervous system, ionic basis of resting membrane potential and action potentials, neuro-

development, neurotransmitters, sensory systems, motor systems, learning and memory, attention and decision making.

UB 201L (0:1)/ UBL 201L (0:1): Introductory Biology III (Lab)

Instructors: Tanweer Hussain, Dipankar Nandi, Arnab Barik and Ashesh Dhawale

M13 infection, plaque assay, preparation of bacterial competent cells, transformation, transduction, conjugation, β -galactosidase assay. Immune organs and isolation of cells from lymph node, spleen and thymus; lymphocyte and macrophage activation studies, nitrite detection, ELISA and cell cycle analysis; gross anatomy of the human brain; staining of mouse brain sections; generation of action- potential; psychophysical and cognitive neurobiology experiments.

SUGGESTED BOOKS:

1. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H. and Matsudaira, P., Molecular Cell Biology, W. H. Freeman Publishers, 6th Edition, 2007
2. Kindt, T., Goldsby, R. and Osborne, B. A., Kuby Immunology, W. H. Freeman Publishers, 6th Edition, 2006
3. Bear, M., Connors, B. and Paradiso, M., Neuroscience: Exploring the Brain, Lippincott Williams & Wilkins, 3rd Edition, 2006

SEMESTER 4 (JANUARY)

UB 205 (2:0): Introductory Physiology

Instructors: N Ravi Sundaresan and C Jayabaskaran

Mammalian Physiology: Introduction to physiology, internal environment, control of internal environment by feedback systems, renal physiology, body fluids and kidneys, urine formation by the kidneys, principles of membrane transport, transporters, pumps and ion channels, cell signalling and endocrine regulation, hormonal regulation of energy metabolism, hormonal regulation of calcium metabolism, hormonal control of reproduction in males and females, pregnancy and lactation; structure of heart, cardiac muscle contraction, cardiac cycle, electric conductivity of heart, regulation of cardiac homeostasis, structure and function of arteries and vein, blood pressure, blood flow, capillary exchange, physiology of lymphatic system.

Plant Physiology: Plant cell structure and cell wall, water uptake, photosynthesis and photorespiration, secondary metabolites, phytochrome and light signaling, hormone signaling in plants, control of flowering, stress physiology.

SUGGESTED BOOKS:

1. Hall, J. E., Guyton and Hall Textbook of Medical Physiology, Elsevier, 12th Edition, 2011
2. Jameson, J. L. and De Groot, L. J., Endocrinology, Elsevier, 6th Edition, 2010
3. Taiz, L. and Zeiger, E., Plant Physiology, Sinauer Associates, 5th Edition, 2010

UB 206 (0:2): Experiments in Biochemistry and Physiology

Instructors: Shantanu Shukla, Mahipal Ganji

Expression of recombinant proteins, purification and characterization. Quantitation of proteins using biochemical assays and physicochemical characterization of proteins by immunoassays (solid phase and Western blotting). Enzyme assays and determining the specific activity of enzymes. Assessing metabolic activity of cells and their susceptibility to drugs.

UB 207 (2:0): General Biochemistry

Instructors: Somnath Dutta and D N Rao

Biochemical properties of proteins, nucleic acids, lipids, and carbohydrates, basics of protein structures, protein sequencing, protein purification and characterization strategies, methods of DNA sequencing, biological membranes and membrane proteins, structure of nucleic acids, protein–nucleic acid (DNA/RNA) interaction.

Basic concepts of enzymes and enzyme kinetics, mechanisms of enzyme actions, basic concepts of metabolism and its design, catabolism and anabolism, energy generation and storage, glycolysis, citric acid cycle, oxidative phosphorylation, gluconeogenesis, fatty acid metabolism, integration of metabolism etc.

SUGGESTED BOOKS:

1. Voet, D. and Voet, J. G., Biochemistry, Wiley, 4th Edition, 2010
2. Berg, J. M., Tymoczko, J. L. and Styrer, L., Biochemistry, W. H. Freeman & Co., 7th Edition, 2011

SEMESTER 5 (AUGUST)

UB 301L (0:1): Experiments in Microbiology

Instructor: Dipshikha Chakravortty

Students will get hands-on experience in understanding the basic concepts of microbiology. The topics include the microbial growth curve, microbial nutritional requirements, genetic engineering techniques, plasmid isolation, creation of genetic knockout in bacteria, bacterial infection in cell culture system, estimation of infection by colony forming unit (CFU) analysis and fluorescence technique.

UB 307L (0:2): Experiments in Ecology and Evolution

Instructor: Kartik Shanker

Students will explore key concepts in Ecology, Evolution and Behavior using field methods, laboratory manipulations and computer simulations. Students will design many of their own experiments and will utilize different modes of scientific communication, including oral presentations and documentaries. Topics include niche and population dynamics, competition and predation, trophic interactions, evolution and adaptation, natural and sexual selection, and conservation. This module also includes a mandatory field trip where students develop an independent research project.

UB 309 (2:0): Genetics

Instructor: Kavita Babu

Genes to genomics with an emphasis on model systems, Mendel's Principals, Extension of Mendel's laws, Inheritance with respect to chromosomes, Gene mapping, DNA structure and replication, Gene mutation analysis, Gene expression, Gene and genome analysis, Gene regulation in prokaryotes, Epigenetics, Gene regulation in Eukaryotes, Genetics of Development, Genetics of Cancer, Population Genetics

SUGGESTED BOOKS:

1. Genetics: From Genes to Genomes
2. Leland Hartwell, Michael Goldberg, Janice Fisher and Leroy Hood 6th Edition, Copyright@2018

SEMESTER 6 (JANUARY)

UB 302 (2:0): Developmental Biology

Instructors: Usha Vijayraghavan, Ramray Bhat and Utpal Nath

Introduction, history, and concepts of developmental biology; the current understanding on the mechanisms of development using model organisms, including invertebrates, vertebrates and plants; general principles for the making of a complex, multicellular organism from a single cell; the creation of multi-cellularity (cellularization, cleavage), reorganization into germ layers (gastrulation), cell type determination; creation of specific organs, (organogenesis); molecular mechanisms underlying morphogenetic movements, differentiation, and interactions during development; fundamental differences between animal and plant development; embryogenesis in plant – classical and modern views; axis specification and pattern formation in angiosperm embryos; organization and homeostasis in the shoot and root meristems; patterning in vegetative and flower meristems; growth and tissue differentiation in plants; stem cells and regeneration; evolution of developmental mechanisms

SUGGESTED BOOKS:

1. Wolpert, L. and Tickle, C., Principles of Development, Oxford University Press, 4th Edition, 2010
2. Gilbert, S. F., Developmental Biology, 9th edition, Sinauer Associates, 2010
3. Slack, J. M. W., Essential Developmental Biology, John Wiley & Sons, 3rd Edition, 2012
4. Leyser, O. and Day, S., Mechanisms in Plant Development, Willey-Blackwell, 2003
5. Taiz, L. and Zeiger, E., Plant Physiology, 5th edition, Sinauer Associates, 2010
6. Alberts, B., Molecular Biology of the Cell, Garland Science, 5th Edition, 2008

UB 303 (0:1): Experiments in Molecular Biophysics

Instructor: Siddhartha P Sarma

UV spectroscopy of proteins (quantitation and determination of extinction coefficient), Estimation of free sulfhydryl groups in proteins by Ellman's assay, Fluorescence spectroscopy of proteins, determination of tryptophan accessibility by acrylamide quenching, CD spectroscopy of proteins and calculation of helical contents, CD spectroscopy of DNA (monitoring the role of salt and oligonucleotide sequence in the formation of G-quadruplexes), UV spectroscopy of DNA (determination of melting temperature and influence of buffer composition), computational biophysics: molecular visualization and graphics.

UB 304 (0:1): Experiments in Neurobiology

Instructors: Arnab Barik and Ashesh Dhawale

The vertebrate nervous system and its organization; demonstration of tissue sectioning techniques; preparation of primary neuronal cultures and imaging neurons; recording and manipulating activity live neurons; rate coding; macrostimulation; effect of temperature and stretch on conduction velocity; neuropharmacology – effects of nicotine MSG; measuring the somatosensory homunculus; measuring alpha rhythm and surprise potentials with EEG; building a blink interface by recording eye potentials.

PREREQUISITE: NS 201 or NS 202 (AUG) (2:0)

SEMESTER 8 (JANUARY)

UB 400 (0:16): Project: Biology

Instructors (UG): Mahavir Singh and Sumanta Bagchi

An independent research project will be carried out by all the UG-Biology Major students under the supervision

of the faculty members. It is recommended that students initiate laboratory work during the summer break after completing their sixth semester. The progress of the project will initially be monitored at the end of the seventh semester. Finally, the submitted project report will be graded before the end of the eighth semester as follows: faculty assessment (40% marks), independent referee (40% marks) and presentation by the students (20%). Based on the student's performance, the final grades will be determined. Criteria for finding a faculty member for the UG project guide:

i. Faculty members in the Division of Biological Sciences, IISc.
ii. Faculty members outside the Division of Biological Sciences can also act as Project Guides. In that case, the student and the Project Guide are required to briefly describe the project in a one-page write-up and get it approved by the Biology Coordinators before starting the project. The proposal will be approved by the coordinators if they find it sufficiently biological in nature and content.
iii. Scientists outside of IISc CANNOT act as Project Guides for the UG students.
iv. Students must inform the UG Biology Coordinators about their chosen project guide before the start of the 7th semester, students are encouraged to work in their chosen lab during both 7th and 8th semesters to work on longer-term projects.

ADDITIONAL COURSES IN SEMESTERS 5, 6, 7 AND 8:

Please see courses listed in the Scheme of Instruction for postgraduate students and select appropriate courses in consultation with the faculty advisor and UG Biology Coordinators.

Please note that the following courses that are not offered by the Division of Biological Sciences will be considered a part of UG-Biology Major (Electives):

CH 248 (JAN) 3:0 Molecular Systems Biology

INSTRUCTOR: Rahul Roy

DS 301 (AUG) 2:0 Bioinformatics

INSTRUCTORS: K. Sekar & Debnath Pal

CH 242 (AUG) 3:0 Special Topics in Theoretical Biology

INSTRUCTOR: Narendra M Dixit

Master of Science

Fulfillment of 12 credits from the courses offered by the following departments and 20 credits from the project.

Biochemistry (BC)
Centre for Ecological Sciences (CES)
Centre for Neuroscience (CNS)
Microbiology and Cell Biology (MCB)
Molecular Biophysics Unit (MBU)
Developmental Biology and Genetics (DBG)
Department of Bioengineering (BE) formally BSSE
Course offered for Integrated PhD by Biological Science Division -DB Course codes.

Project:

UB 500 (0:20): Project: Biology

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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CHEMISTRY

Curriculum applicable From Batch 2022 onwards

Basic Core Courses (for Chemistry Major and Minor)

Sl. No.	Code	Title	Credits	Semester
1	UCY 101T	Introductory Chemistry I	3:0	I
2	UCY 101L	Introductory Chemistry I (Lab)	0:1	I
3	UCY 102T	Introductory Chemistry II	3:0	II
4	UCY 102L	Introductory Chemistry II (Lab)	0:1	II
5	UCY 201T	Introductory Chemistry III	3:0	III
6	UCY 201L	Introductory Chemistry III (Lab)	0:1	III

Curriculum applicable until Batch 2021

Basic core courses

Sl. No.	Code	Title	Credits	Semester
1	UC 101T	Introductory Chemistry I	2:0	I
2	UC 101L	Introductory Chemistry I (Lab)	0:1	I
3	UC 103T	Introductory Chemistry II	2:0	II
4	UC 103L	Introductory Chemistry II (Lab)	0:1	II
5	UC 206T	Basic Organic Chemistry	2:0	III
6	UC 206L	Basic Organic Chemistry (Lab)	0:1	III

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Chemistry Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UC 202 UCY 204 *	Thermodynamics And Electrochemistry	2:0 3:0	IV	Major- Core Minor- Elective
2	UC 204 UCY 205 *	Inorganic Chemistry: Chemistry Of Elements	2:0 3:0	IV	Major- Core Minor- Elective
3	UC 205 UCY 206 *	Basic Organic Reactions	2:0 3:0	IV	Major- Core Minor- Elective
4	UC 207T	Instrumental Methods of Chemical Analysis	2:0	IV	Major- Core Minor- Core
5	UC 207L	Instrumental Methods of Chemical Analysis (Lab)	0:1	IV	
6	UC 301 UCY 301 *	Organic And Inorganic Chemistry (Lab)	0:1 0:3	V	Major- Core Minor- Elective
7	CD 211	Physical Chemistry I - Quantum Chemistry and Group Theory	3:0	V	Major- Core Minor- Elective
8	CD 212	Inorganic Chemistry-Main Group and Coordination Chemistry	3:0	V	Major- Core Minor- Elective
9	CD 213	Organic Chemistry – Structure & Reactivity	3:0	V	Major- Core Minor- Elective
10	UC 302 UCY 302 *	Physical And Analytical Chemistry (Lab)	0:1 0:3	VI	Major- Core Minor- Elective
11	UC 303 CY 303 *	Basic Organometallic Chemistry	3:0 3:0	VI	Major- Core Minor- Elective
12	CD 221	Physical Chemistry II- Statistical Mechanics	3:0	VI	Major- Core Minor- Elective
13	CD 222**	Materials Chemistry	3:0	VI	Major- Core/ Elective Minor- Elective
14	CD 223	Organic Synthesis	3:0	VI	Major- Core Minor- Elective
15	UC 402	Molecular Spectroscopy, Dynamics and Photochemistry	3:0	VII	Major- Core Minor- Elective
16	UC 400 UCY 400 *	Project: Chemistry	0:14 0:12	VIII	Bachelor's Project
17	UC 500	Project: Chemistry	0:20	X	Master's Project

Note:

i) * Effective from the Batch of 2022

ii) * *CD 222: Major core course until Batch 2021 and Major elective for Batch 2022 onwards.

iii) Electives for Chemistry Major and Minor

In addition to the above courses, courses offered by the Chemical Sciences Division i.e; Inorganic and Physical Chemistry (IPC), Organic Chemistry (OC), Solid State and Structural Chemistry Unit (SSCU), Materials Research Centre (MRC) and Chemical Division Courses offered for Integrated PhD students -

CD & Courses offered for MSc Chemical Sciences Program-CY) will also be considered towards Chemistry Major and Minor electives.

Credit Requirements for Chemistry Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Major Electives	Project	Assortment/ Institute Elective	Total
Till Batch 2021	36	19	9	35	3	14	15	131
From Batch 2022 onwards	40	6	9	39	0	12	25	131

Course Details

Coordinators: Santanu Mukherjee and Sai Ganesh Ramesh
Instructors UG: Dayamani Allumolu, Tanaya Kundu and Mamata Mahato
Teaching Assistants: Guruprasad P B, Mahitha M K and Nishprah Saraswat

SEMESTER 1 (AUGUST)

UC 101T (2:0) / UCY 101T (3:0): Introductory Chemistry-I

Instructor: Anshu Pandey

Overview of atoms, molecules and chemical bonding, intermolecular forces and interaction potentials. Introduction to quantum mechanics, postulates, exemplary exact solutions. Chemical thermodynamics, state functions, spontaneity, reaction thermodynamics. Chemical equilibrium and chemical kinetics, reaction coordinate diagrams. Properties of solutions, colligative properties.

SUGGESTED BOOKS:

1. D. A. McQuarrie, and J. D. Simon, Physical Chemistry – A Molecular Approach
2. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry
3. R. S. Berry, S. A. Rice and J. Ross, Physical Chemistry

UC 101L (0:1)/UCY 101L (0:1): Introductory Chemistry-I

Instructors: Chinmoy Ranjan and Veerabhadrarao Kaliginedi

SEMESTER 2 (JANUARY)

UC 103T (2:0)/ UCY 102T (3:0): Introductory Chemistry-II

Instructor: Sreedhara M B

Multi-electron atoms – periodic trends, Chemical bonding: ionic solids, CFT: d-orbital splitting, tetrahedral, square planar, cubic and octahedral crystal fields, covalent bonding, Lewis model (2 Dim), VSEPR (3 Dim) hybridization, Molecular orbital theory: heteronuclear diatomics, triatomics, Shapes of main group compounds, Acid-base chemistry: concepts, measures of acid-base strength, HSAB, Main group chemistry: carbon group compounds and noble gases.

SUGGESTED BOOKS:

1. Lee, J. D. Concise Inorganic Chemistry, 5/E, Oxford University Press, Indian Edition
2. Miessler, G. L. and Tarr, D.A. Pearson Inorganic Chemistry, Third Edition
3. Shriver, D. F., Atkins, P. W. and Langford, C. H. Inorganic Chemistry, Oxford University Press
4. Huheey, J. E., Keiter, E.A. and Keiter, R. L. Inorganic Chemistry, 4/E, Pearson Education Asia

UC 103L (0:1)/ UCY 102L (0:1): Introductory Chemistry-II (Lab)

Instructors: Subinoy Rana and Sandya Sukumaran

SEMESTER 3 (AUGUST)

UC 206T (2:0)/ UCY 201T (3:0): Introductory Chemistry-III

Instructors: Akkattu T Biju, Durga Prasad Rao Hari

Part 1: Nomenclature of Organic Compounds, Orbital Picture of Molecular Structure, Aromaticity, Acids and Bases, Organic Reactions and Mechanism: Substitution, Aromatic Substitution, Elimination, Addition And Rearrangements, Oxidation-Reduction etc.

Part 2: Introduction to Chirality and Stereochemistry; Elements of Symmetry; Configurational Nomenclatures; Optical Activity; Chiral Resolution and Kinetic Resolution; Stereospecific and Stereoselective Reactions and Mechanisms; Conformation of Acyclic and Cyclic Systems.

SUGGESTED BOOKS:

1. Solomons, T. W. G. and Fryhle, C. 2009 Organic Chemistry, John Wiley & Sons
2. McMurry, J. E. 2007 Organic Chemistry 7th edition, Thomson
3. Bruice, P. Y. Organic Chemistry, 6th edition, Pearson
4. Nasipuri, D. Stereochemistry of Organic Compounds, Principles and Applications
5. Eliel, E. L. Stereochemistry of Carbon Compounds

UC 206L (0:1)/ UCY 201L (0:1): Introductory Chemistry-III (Lab)

Instructors: Ramakrishnan S and Vignesh Palani

SEMESTER 4 (JANUARY)

UC 202 (2:0)/ UCY 204 (3:0): Thermodynamics and Electrochemistry

Instructor: Naga Phani Aetukuri

Equations of state, Laws of thermodynamics, State and path functions, Intensive and extensive quantities, Energy, Enthalpy, Specific heat, Entropy; Application to engines; Free energy; Chemical potential, Activity and activity coefficient; Mixtures, and chemical equilibrium, Solution thermodynamics; Phase transitions; Unary and binary phase diagrams; Introductory Electrochemistry, Electrode thermodynamics, Nernst equation and electrochemical cells; Electrode kinetics, Transition state theory and Butler-Volmer equation; Mass transfer and cyclic voltammograms; Interfacial phenomena and Electrical double layers; Electrolyte theory, Debye-Hückel theory and conductivity of electrolytes.

SUGGESTED BOOKS:

1. D.A Mc Quarrie, and J.D Simon, Physical Chemistry – A Molecular approach
2. R.J Silbey, R.A. Alberty, and M.G. Bawendi, Physical Chemistry
3. R.S. Berry, S.A. Rice, and J. Ross, Physical Chemistry
4. E. Fermi, Thermodynamics
5. D.R. Crow, Principles and Applications of Electrochemistry
6. A.J. Bard and L.R. Faulkner, Electrochemical Methods: Fundamentals and Applications
7. J. Newman and K.E. Thomas-Alyea, Electrochemical Systems
8. P.T. Kissinger and W.R. Heineman, Laboratory Methods in Electroanalytical Chemistry

UC 204 (2:0)/ UCY 205 (3:0): Inorganic Chemistry: Chemistry of Elements

Instructor: Susanta Hazra

Main Group: Hydrogen and its compounds – ionic, covalent, and metallic hydrides, hydrogen bonding; chemistry of lithium, beryllium, boron, nitrogen, oxygen and halogen groups. MOT - polyatomic molecules (distortion), bioinorganic chemistry: s and p-block elements in biology (Na, Ca, Mg, P, Cl). Chemistry of lanthanides and actinides. Chemistry of d-block elements: MOT, descriptive chemistry of metals: periodic trends, chemistry of various oxidation states of transition metals, oxidation states and EMFs of groups.

SUGGESTED BOOKS:

1. D. F. Shriver and P. W. Atkins, Inorganic Chemistry (4th edition)
2. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity
3. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements
4. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry

Pre-requisite: Successful completion of UC 103/UCY 102

UC 205 (2:0)/ UCY 206 (3:0): Basic Organic Reactions

Instructor: Garima Jindal

Acids and Bases: Effect of Structure, Kinetic and Thermodynamic Acidity, General and Specific Acid/ Base Catalysis; Reactions of Carbon-Carbon Multiple Bonds: Addition of Halogens, Hydrogen Halides and Inter- Halogen Compounds, Hydration, Epoxidation, Dihydroxylation, Ozonolysis, Cyclopropanation, Hydrogenation; Reactions of Carbonyl Compounds: Addition to Carbonyls, Oxidation, Reduction, Rearrangements and their Applications, C–C Bond Forming Reactions involving Carbonyls; Introduction to Pericyclic Reactions: Cycloadditions, Electrocyclic Reactions, Sigmatropic Rearrangement and Group Transfer Reactions. Introduction to Organometallic Reagents: Grignard Reagents, Organolithium, Organocopper and Organozinc Compounds.

SUGGESTED BOOKS:

1. R. O. C. Norman, and J. M. Coxon, 1993 Principles of Organic Synthesis, 3rd edition
2. W. Carruthers and I. Coldham, Modern Methods of Organic Synthesis, 4th edition, Cambridge University Press
3. J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford University Press
4. F.A. Carey and J.R. Sundberg, Advanced Organic Chemistry, Part A & Part B, 5th edition, Springer

Pre-requisite: Successful completion of UC 206/UCY 201

UC 207T (2:0): Instrumental Methods of Chemical Analysis

Instructor: Veerabhadrarao Kaliginedi and Anoop Thomas

Propagation of errors in measurement, statistical analysis of data, etc., Separation Techniques: extraction and separation, principles of chromatography, Electroanalytical Techniques: voltammetry and its variants, ion selective electrodes and electrochemical techniques for analysis, Spectroscopic Techniques: atomic absorption/emission, electronic, fluorescence, and vibrational (IR and Raman), Spectroscopy: basic principles, operation and application to chemical problems, NMR Spectroscopy, Basic principles and operation, Application of one dimensional NMR for identification of chemicals, Mass Spectrometry: Principles and Applications.

SUGGESTED BOOK:

1. Skoog, Fundamentals of Analytical Chemistry, 8th edition, West, Holler and Crouch

UC 207L (0:1): Instrumental Methods of Chemical Analysis (Lab)

Instructor: Veerabhadrarao Kaliginedi and Anoop Thomas

SEMESTER 5 (AUGUST)

CD 211 (3:0): Physical Chemistry I - Quantum Chemistry and Group Theory

Instructor: Sujit Das and Upendra Harbola

Postulates of Quantum Mechanics and introduction to operators; Exactly solvable problems Perturbational and Variational Methods, Hückel model, Many electron Atoms, Slater determinants, Hartree-Fock Variational method for atoms; Molecular Quantum Mechanics, Symmetry and Group theory, Point Groups, Reducible and Irreducible Representations (IR), Great Orthogonality theorem, Projection operators, applications to molecular orbitals and normal modes of vibration and selection rules in spectroscopy.

SUGGESTED BOOKS:

1. I. N. Levine, Quantum Chemistry
2. D. Griffiths, Introduction to Quantum Mechanics
3. F. A. Cotton, Chemical Applications of Group Theory

CD 212 (3:0): Inorganic Chemistry-Main Group and Coordination Chemistry

Instructor: Abhishake Mondal and Geetharani Kalimuthu

Unusual bonding in hyper- and low valent compounds. Multiple bonding in main group compounds. Chains, rings, and cage. Main group organometallics. Chemistry of Group 8 elements. Coordination chemistry: Spectral properties; Orgel diagrams; Tanabe- Sugano diagrams; Magnetic properties; inorganic reactions and mechanisms: hydrolysis reactions, substitution reactions trans-effect; isomerization reactions, redox reactions; metal-metal bonding and clusters; mixed valence systems.

SUGGESTED BOOKS:

1. Shriver and Atkins, Inorganic Chemistry by: Atkins, Overton, Rourke, Weller and Armstrong, Fifth Edition. South Asia Edition (paperback), Oxford University Press, 2010
2. Bochmann, M., Cotton, F. A., Wilkinson, G. and Murilla, C. A. 2007 Advanced Inorganic Chemistry, 6th edition, Wiley Student Edition, NY
3. Huheey, J. E., Keiter, E. A., Keiter, R. L. and Medhi, O. K. 2006 Inorganic Chemistry, Principles of Structure and Reactivity, 4th edition, Pearson

CD 213 (3:0): Organic Chemistry – Structure & Reactivity

Instructor: Garima Jindal and Mrinmoy De

Stereochemistry and chirality; Conformation of acyclic and cyclic compounds including medium rings, effect of conformation on reactivity. Methods of deducing organic reaction mechanisms: Kinetic analysis, Hammond

postulate, Curtin-Hammett principle. Linear free energy relationships – Hammett equation. Kinetic isotope effects. Solvent effects on reaction rates.
Reactive intermediates, classical and nonclassical carbocations, carbanions, free radicals, carbenes, nitrenes, arynes, radical ions, diradicals. Photochemistry. Concerted reactions. FMO theory, Wood- ward-Hoffman rules.

SUGGESTED BOOKS:

1. Anslyn, E. V. and Dougherty, D. A. 2006 Modern Physical Organic Chemistry, University Science Books
2. Smith, M. B. and March J. 2007 March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 6th edition, Wiley
3. Carey, F. A. and Sundberg, R. J. 2008 Advanced Organic Chemistry, Part A, 5th edition, Plenum
4. Lowry, T. M. and Richardson, K. S. 1998 Mechanism and Theory in Organic Chemistry, Third Edition, Addison - Wesley – Longman

UC 301 (0:1)/ UCY 301 (0:3): Organic & Inorganic Chemistry (Lab)

Instructor: P Rajamalli and Sharvan Kumar

1. Synthesis of Fe-acac complex using two different methods.
2. Acetylferrocene: synthesis and purification.
3. Tris-(8-hydroxyquinoline) aluminium: synthesis and characterisation.
4. VO(acac)2: Synthesis, characterization and catalytic applications; oxidation of anthracene.
5. Suzuki-Miyaura cross-coupling Reaction in aqueous media and purification of product using column chromatography.
6. Synthesis of Pd2(dba)3 and catalytic applications.
7. Synthesis and characterization of Mn (III) salen complex - Catalyst for the epoxidation of alkenes.
8. Synthesis and characterization of polyoxometallate complexes and grafting the amino group.
9. Structural analysis of diamagnetic and paramagnetic Ni (II) Schiff base complexes by NMR spectroscopy.
10. Synthesis and characterization of Europium (III) and Terbium (III) complexes.
11. Cu(I) catalyzed fast and organic solvent-free tandem click chemistry in aqueous micellar medium.
12. Synthesis and characterization Cr-coordination complexes and use of Tanabe-Sugano diagram to assign the bands in UV-Vis spectra.
13. Wittig reaction, including synthesis of ylide.
14. Grignard Reaction: Preparation of Triphenylmethanol.
15. Estimation of concentration of a n-BuLi solution and lithiation reaction.
16. Diels Alder reaction between anthracene and maleic anhydride.
17. Oxidation of Isoborneol to Camphor.
18. Reduction of (R)-(+)-3-Methylcyclohexanone.
19. NHC preparation and complexation.
20. Pinacol - pinacolone rearrangement.
21. Beckmann rearrangement – nylon synthesis via caprolactam.
22. Coumarin synthesis.
23. Synthesis of azo dyes.
24. Favorskii rearrangement.

SEMESTER 6 (JANUARY)

CD 221 (3:0): Physical Chemistry II: Statistical Mechanics

Instructor: Sai G Ramesh

Thermodynamics: Basic Ideas and postulates (2), equilibrium conditions (2), thermodynamic potentials and extremum conditions (2), maximum work theorem (1), stability conditions (2), phase transitions (2); Postulates of

statistical mechanics (1): Phase space, ensembles, ergodic hypothesis; Ensembles (3): Canonical ensemble, grand canonical ensemble, Isothermal-Isobaric ensemble and Fluctuations; Fermi-Dirac and Bose-Einstein Statistics (2): Derivations in the grand-canonical ensemble and behaviour in the classical limit; Ideal Monatomic and Diatomic Gases (5): Translational, vibrational and rotational partition functions, rigid rotor-harmonic oscillator approximation, thermodynamic functions; Black Body Radiation (2): Stefan-Boltzmann law and Wien's-displacement law; Crystals (2): Einstein and Debye models; Electron Conduction in Metals (2): Contribution to heat capacity at low temperatures; Non-Ideal Gases (3): Virial equation of state, and Virial coefficients in the classical limit; Classical Liquids (6): Distribution functions, radial distribution function and relation to thermodynamic quantities, Ornstein-Zernike equation, PY and HNC closure; Debye-Hueckel Theory (3): Theory for ionic solutions; Ising Model (3): Solutions in one-dimension for different boundary conditions and mean field theory.

SUGGESTED BOOKS:

1. E. Fermi, Thermodynamics
2. H .B. Callen, Thermodynamics and Introduction to Thermostatistics
3. D. A. McQuarrie, Statistical Mechanics
4. D. Chandler, Introduction to Modern Statistical Mechanics
5. B. Bagchi, Statistical Mechanics for Chemistry and Material Science

CD 222 (3:0): Materials Chemistry

Instructor: Prabeer Barpanda

Structure of solids, symmetry concepts, crystal structure. Preparative methods and characterization of inorganic solids. Crystal defects and non-stoichiometry. Interpretation of phase diagrams, phase transitions. Kinetics of phase transformations, structure property correlations in ceramics, glasses, polymers. Composites and nano-materials. Basics of magnetic, electrical, optical, thermal and mechanical properties of solids.

SUGGESTED BOOKS:

1. West, A. R. 1984 Solid State Chemistry and its Applications, John Wiley and Sons
2. Shackelford, J. F. 1988 Introduction to Materials Science for Engineers, MacMillan

CD 223 (3:0): Organic Synthesis

Instructors: Vignesh Palani and Durga Prasad Rao Hari

Synthetic methods, methodologies and mechanisms in reductions, oxidations of carbon-carbon and carbon-heteroatom bonds; Carbon-carbon bond-forming methodologies through ionic, radical, concerted and organometallic reaction mechanisms; Approaches to multi-step synthesis with examples of chosen natural and un-natural product synthesis, through anti-thetic analysis and logical synthesis.

SUGGESTED BOOKS:

1. House, H. O. 1972 Modern Synthetic Methods, W. A. Benjamin, Inc
2. Smith, M. B. 2002 Organic Synthesis, McGraw-Hill
3. Corey, E. J. and Chung, 1989 Logic in Chemical Synthesis, John-Wiley & Sons
4. Chosen primary literature and review articles

PREREQUISITES: UG students having completed UC 205/UCY206, CD 213;

UC 302 (0:1)/ UCY 302 (0:3): Physical and Analytical Chemistry (Lab)

Instructor: Soumen Ghosh

Chemical kinetics. Langmuir adsorption, chemical analysis by potentiometric and conductometric methods, cyclic voltammetry, flame photometry, electronic states by UV-Visible spectroscopy, IR spectroscopy, solid state chemistry synthesis of solids and chemical analysis. Thermogravimetry. X-ray diffraction, electrical and magnetic properties of solids. Vacuum techniques in preparative chemistry.

SUGGESTED BOOK:

1. Vogel, A. I. 1989 Vogel's text book of quantitative chemical analysis Longman

UC 303 (3:0)/ CY 303 (3:0): Basic Organometallic Chemistry

Instructor: P Thilagar

Structure and bonding in organometallic compounds – isolobal analogies, metal carbonyls, carbenes and NHC complexes, olefin and acetylene complexes, alkyls and allyl complexes, metallocenes. Major reaction types – oxidative addition, reductive elimination, insertion, isomerization and rearrangement reactions. Catalytic reactions: metathesis, hydrogenation, allylic activation, C-C coupling reactions, C-X coupling.

SUGGESTED BOOKS:

1. Elschenbroich, Ch. 2005 Organometallics, 3rd edition, Wiley-VCH, Weinheim
2. Gupta, B. D. and Elias, A. J. 2013 Basic Organometallic Chemistry: Concepts, Syntheses and Applications (Second edition)

SEMESTER 7 (AUGUST)

UC 402 (3:0): Molecular Spectroscopy, Dynamics and Photochemistry

Instructor: Soumen Ghosh

Energy levels of molecules and their symmetry, Polyatomic rotations and normal mode vibrations. Electronic energy states and conical intersections (6); time-dependent perturbation theory and selection rules (6); microwave, infrared and Raman, electronic spectroscopy (12); energy transfer by collisions, both inter and intramolecular. Unimolecular and bimolecular reactions and relations between molecularity and order of reactions, rate laws (6); temperature and energy dependence of rate constants, collision theory and transition state theory, RRKM and other statistical theories (6); photochemistry, quantum yield, photochemical reactions, chemiluminescence, bioluminescence, kinetics and photo- physics (6)

SUGGESTED BOOKS:

1. L5evine, I. N., Molecular Spectroscopy
2. McHale, J. L., Molecular Spectroscopy
3. Steinfeld, J. I., Fransisco, J. S. and Hase, W. L., Chemical Kinetics and Dynamics
4. Laidler, K. J., Chemical Kinetics

SEMESTER 8 (JANUARY)

UC 400 (0:14)/ UCY 400 (0:12): Project: Chemistry

Instructor: Santanu Mukherjee and Sai G Ramesh

The final year research project aims to introduce undergraduate students to actual research. Students perform research under the supervision of a faculty member of the chemical sciences division. The project supervisor

is decided by the mutual consent of the student and the concerned faculty member. The project is evaluated at the end of the eighth semester by a committee of faculty from the division of chemical sciences. Students are required to submit a project report towards the end of the semester as well as make a short presentation emphasizing their novel findings.

Master of Science

Instructors: Santanu Mukherjee and Sai G Ramesh

Minimum of 6 credits (200 or 300 level) from within the Chemical Sciences Division i.e; Inorganic and Physical Chemistry (IPC), Organic Chemistry (OC), Solid State and Structural Chemistry Unit (SSCU), Materials Research Centre (MRC), Chemical Division Courses offered for Integrated PhD students -CD & Courses offered for MSc Chemical Sciences Program-CY) and 6 credits (200 or 300 level) from any division OR all 12 credits (200 or 300 level) from within the Chemical Sciences Division and 20 credits from the project.

UC 500 (0:20): Project: Chemistry

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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EARTH AND ENVIRONMENTAL SCIENCES

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Earth and Environmental Sciences Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UES 206T UEES 206T*	Experimental Methods in Environmental Chemistry	1:0 2:0	IV	Major- Core Minor- Elective
2	UES 206L UEES 206L*	Experimental Methods in Environmental Chemistry (Lab)	0:2 0:1	IV	Major- Core Minor- Elective
3	UEES 207	Geophysical Processes	3:0	IV	Major- Core Minor- Elective
4	UEES 208T	Introduction To Mineralogy and Petrology	2:0	IV	Major- Core Minor- Elective
5	UEES 208L	Introduction To Mineralogy and Petrology (Lab)	0:1	IV	
6	UEES 301T*	Introduction To Earth Systems	2:0	V	Major- Core Minor- Elective
7	UEES 301L*	Introduction To Earth Systems Lab	0:1	V	Major- Core Minor- Elective
8	UES 302 UES 314*	Design Principles in Environmental Engineering	2:0 3:0	V	Major- Core Minor- Elective
9	UEES 313T*	Experimental Methods in Environmental Engineering	2:0	V	Major- Core Minor- Elective
10	UEES 313L*	Experimental Methods in Environmental Engineering (Lab)	0:1	V	
11	UES 400 UEES 400*	Project: Earth and Environmental Science	0:16 0:15	VIII	Bachelor's Project
12	UES 500	Project: Earth and Environmental Science	0:20	X	Master's Project

Note:

i) *** Effective from the Batch of 2022**

ii) **Electives for EES Majors**

Students majoring in EES must take 6 courses (18 credits) from the departments participating in the EES program i.e; Centre for Earth Sciences (CEaS), Centre for Sustainable Technologies (CST), Civil Engineering (CiE), Centre for Atmospheric and Oceanic Sciences (CAOS) and selected courses from ICWaR after a discussion with the EES coordinators.

iii) **Requirements for Minor in EES (15 credits)**

Students taking a minor in EES must take a minimum 3 out of the 6 core courses listed for EES Majors. Remaining 2 courses can be taken for courses offered in departments participating in the EES program i.e; Centre for Earth Sciences (CEaS), Centre for Sustainable Technologies (CST), Civil Engineering (CiE), Centre for Atmospheric and Oceanic Sciences (CAOS)

Credit Requirements for ENVS Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Major Electives	Project	Assortment/ Institute Elective	Total
Till Batch 2021	36	19	9	15	21	16	15	131
From Batch 2022 onwards	40	6	9	18	18	15	25	131

Course Details

Coordinators: Sekhar M and Ramananda Chakrabarti
Instructor UG: Pintu Prusty and Saranya K
Teaching Assistants: Soorya P S and Veeresh S

SEMESTER 4 (JANUARY)

UES 206T (1:0)/ UEES 206T (2:0): Experimental Methods in Environmental Chemistry

Instructor: Sreenivasan Ramaswami

Introduction to enviro/water laboratory: fundamental instruments, lab water types and grades of chemicals. Solutions: concentration, dilution factor, preparing solutions. Water quality parameters: pH, electrical conductivity, turbidity & dissolved oxygen. Solids in water: total, suspended, dissolved. Hardness and alkalinity. Spectrophotometric determination: principle, limits, determination of ammonium-nitrogen, phosphate-phosphorous. Nitrogen in water – determination of nitrogen compounds ($N\text{-}NH_4^+$, $N\text{-}NO_2^-$, $N\text{-}NO_3^-$ and TN) and material balance. Organic parameters: COD, BOD, TOC. Chromatographic techniques, determination of anions by ion chromatography. Different wastewater sources, water & environmental pollution.

SUGGESTED BOOKS:

1. APHA, Standard methods for the examination of water and wastewater. American Public Health Association, 23rd edition, Washington DC, (2017)
2. ISO standards

UES 206L (0:2)/ UEES 206L (0:1): Experimental Methods in Environmental Chemistry (Lab)

Instructor: Sreenivasan Ramaswami

Safety instructions. Introduction to enviro/water laboratory: grades of chemicals, glassware classes, checking pipettes; pH meter calibration and pH measurement in different water samples. pH of solutions of acids and bases of different strengths. Electrical conductivity of different water samples. Conductivity of solutions with varying NaCl content; Turbidity standards and calibration; Determination of turbidity in water samples. Dissolved oxygen measurement by iodometric method and optical probe; Determination of total, suspended, and dissolved solids concentrations in water samples; Determination of hardness and alkalinity of water samples; Determination of ammonium-N: calibration curve and measurement; Calibration curves for nitrite-N and nitrate-N; Determination of ammonium-N, nitrite-N, nitrate-N and total nitrogen in water samples. Material balance; Determination of COD, BOD and TOC in water samples; Determination of anions in water samples by ion chromatography.

UEES 207 (3:0): Geophysical Processes

Instructors: Attreyee Ghosh, Pawan Bharadwaj and Binod Sreenivasan

Description of Processes: Subduction zone processes (earthquakes, volcanism, India-Eurasia collision, Pacific northwest subduction); Processes in divergent zones (mid-oceanic ridge system, types of spreading ridges, continental rifting; Transform faults (continental and oceanic transforms); Hotspots and mantle plumes; Large igneous provinces; LIPs and mass extinctions. Applications of Physics and Computation to the Earth Sciences: The second half of this course will focus on the applications of the basic principles of classical physics, computation, and mathematics to the earth sciences. Topics will be selected from: mechanics of rotating bodies, Geo dynamo, thermal convection, maxwell's equations, oscillations and normal modes, seismic wave propagation, mechanics of faulting, diffusion, and heat transfer.

SUGGESTED BOOK:

1. William Lowrie, Fundamentals of Geophysics, Cambridge University Press

UEES 208T (2:0): Introduction to Mineralogy and Petrology

Instructors: K. Sajeev

Introduction to crystallography and mineralogy, Classification and nomenclature of sedimentary, igneous, and metamorphic rocks and their textures, igneous structures and field relationships, introduction to thermodynamics and phase rule, chemical petrology, Mantle melting, Magma diversity, tectonics and magmatism, metamorphic textures and mineral assemblages, Metamorphic facies and reactions, Geochronological methods
Lab: Study of minerals and rocks in hand specimens, optical mineralogy, and study of thin sections.

SUGGESTED BOOKS:

1. John D. Winter, Principles of Igneous and Metamorphic Petrology, 2nd Edition, 2010
2. S. M. Sengupta, Introduction to Sedimentology, 1994

UEES 208L (0:1): Introduction to Mineralogy and Petrology (Lab)

Instructors: K. Sajeev

SEMESTER 5 (AUGUST)

UEES 301T (2:0): Introduction to Earth Systems

Instructors: Sambuddha Misra

Geological time scale and Evolution of Vertebrates, invertebrate and Plants, Origin Of Atmosphere and compositional-structural-energy evolution, Greenhouse effect, oxygenation and genesis of ozone layer, Evidence of early Life, residence time of trace gases in the atmosphere, radiation laws and budget, glacial interglacial cycles, Carbon cycle, rock cycle, energy balance model, Hydrosphere, hydrological cycle, Ocean circulation, aqueous contamination and effect on biosystem, weathering and erosion, evolution of ocean, Life diversification.

***SUGGESTED BOOKS*:**

1. Roland Martin, Earth's evolving systems; The history of Planet Earth 2nd edition
2. Steven M. Stanley and John A. Luczaj Earth System History, W. H. Freeman and Company

UEES 301L (0:1): Introduction to Earth Systems (Lab)

Instructors: Sambuddha Misra

UES 302 (2:0)/ UES 314 (3:0): Design Principles in Environmental Engineering

Instructor: Lakshminarayana Rao

Laws of Conservation: Mass, Energy and Momentum Balances. Fundamentals of Chemical Reaction Engineering: Thermodynamics, Stoichiometry, and Kinetics of Chemical Reactions, Chemical Reactors – Stirred Tank and Plug Flow Reactors. Design for wastewater treatment processes: Physical Unit Operations such as Sedimentation and Filtration, Chemical and Biological Treatment Processes. Design for Air Pollution Control: Gas-Liquid Interactions, Absorption and Adsorption Processes, Particulate Emission Control.

***SUGGESTED BOOKS*:**

1. Davis, M. and Masten, S. 2004. Principles of Environmental Engineering, McGraw Hill
2. Davis, M. and Cornwell, D. 2006. Introduction to Environmental Engineering, McGraw Hill
   Mihelcic, J. and Zimmerman, J. B. 2010. Environmental Engineering: Fundamentals
3. Sustainability and Design, John Wiley
4. Spellman F. R. and Whiting, N. E. 2005. Environmental Engineer's Mathematics Handbook, CRC Press

UEES 313T (2:0): Experimental Methods in Environmental Engineering

Instructor: Yagnaseni Roy

Selection strategy of environmental remediation method for practical applications, Adsorption for pollutants in liquid and gaseous effluents - mechanisms of adsorption, isotherm & kinetic studies, desorption overview of packed and fluidized beds for practical scale. Absorption for CO2 sequestration - stripping, practical implementation in tray and packed columns, system design and sizing. Zero liquid discharge by evaporative techniques - energy requirement calculation, determination of salt composition. Coagulation, flocculation, and sedimentation - fundamental principles, design and sizing of settling tanks. Membrane filtration - osmotic pressure, fouling, practical-scale system design parameters. Environmental impact of discussed remediation techniques - fuel requirement, global warming potential.

***SUGGESTED BOOKS*:**

1. "Industrial Separation Processes: Fundamentals", André B. de Haan, Hans Bosch, Year: 2013, Publisher: De Gruyter
2. "Separation Process Principles, 3rd Edition" Seader, Henley, and Roper, Year: 2011, Publisher: Wiley

UEES 313L (0:1): Experimental Methods in Environmental Engineering (Lab)

Instructor: Yagnaseni Roy

Batch adsorption of dye molecules using activated carbon, desorption using sodium hydroxide solution. Implementation of the same in a lab-scale adsorption column; CO_2 absorption in a packed column; Evaporation experiment of water from artificial seawater and measurement of boiling point elevation. Evaporation of water can be done to obtain distilled water as well as to obtain salt crystals, thereby illustrating the concept of zero liquid discharge; Calculation of solubility limit of salts in artificial sweater using software (PHREEQC) and demonstration of the same in the lab; Coagulation and flocculation of humic acid using alum; Filtration of solution with dye molecules using a stirred vacuum filtration setup, investigation of different membrane samples (microfiltration, ultrafiltration, nanofiltration, reverse osmosis).

SEMESTER 8 (JANUARY)

UES 400 (0:16)/ UEES 400 (0:15): Project: Earth and Environmental Sciences

Instructors: Faculty members involved in Earth and Environmental Sciences Program

An independent research project will be performed by all UG-Earth and Environmental Science Major students under the supervision of faculty. It is recommended that students initiate laboratory/ computational work during the summer break post completion of the sixth semester. The progress of the project will be monitored at the end of the seventh semester by a committee comprising of project supervisor, common examiner and external examiner. The student shall submit project report at end of 8th semester and make a presentation to the committee. Based on the overall student's performance, final grade will be awarded to the research project by the committee.

Master of Science

Any 4 courses (12 credits) from Departments/Centres participating i.e; Civil Engineering (CiE)/ Centre for Atmospheric and Oceanic Sciences (CAOS)/ Centre for Earth Sciences (CEaS)/ Centre for Sustainable Technologies (CST) in the E & ES program or equivalent courses as per students' handbook after a discussion with the EES coordinators and 20 credits from the project with the Masters' thesis advisor.

UES 500 (0:20): Project: Earth and Environmental Science

An independent research project will be performed by all UG-Earth and Environmental Science Major students for their master's under the supervision of faculty from the four participating Departments/Centres. Faculty from other departments working on Earth and Environmental Science related research areas can act as thesis supervisors only after approval of the EES coordinators. It is recommended that students initiate laboratory/ computational work during the summer break post completion of the eighth semester. The student shall submit a project report at the end of the 10th semester and make a presentation to the committee. Based on the overall student's performance, final grade will be awarded to the research project by the committee.

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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ENGINEERING

Curriculum applicable From Batch 2022 onwards

Core courses for completion of Engineering Credits

Sl. No.	Code	Title	Credits	Semester
1	UENG 103	Introduction to Earth and Its Environment	3:0	II
2	UENG 201	Introduction to Materials Science	3:0	III

Engineering courses offered in 2nd and 3rd semester (Optional)

Sl. No.	Code	Title	Credits	Semester
1	UENG 102T	Introduction to Electrical and Electronics Engineering	3:0	II
2	UENG 102L	Introduction to Electrical and Electronics Engineering (Lab)	0:1	II
3	UENG 101T	Algorithms And Programming	3:0	III
4	UENG 101L	Algorithms And Programming (Lab)	0:1	III

Note: Courses registered from the above table will be considered towards Assortment/ Institute Elective pool

UG -Level Engineering courses offered in other semesters

Sl. No.	Code	Title	Credits	Semester
1	UE 201	Introduction To Scientific Computing	2:1	Aug
2	UE 204	Elements Of Solid Mechanics	3:0	Jan
3	UE 203T	Sensor Technologies For Biomedical Applications	2:0	Jan
4	UE 203L	Sensor Technologies For Biomedical Applications	0:1	Jan
5	UMC 102	Computer Systems	3:0	Jan
6	UMC 201	Data Structures and Algorithms	3:1	Aug
7	UMC 301	Applied Data Science and AI	3:1	Aug
8	UMC 205	Automata And Computability	3:1	Jan
9	UMC 203	Introduction To AI & ML	3:1	Jan

10	UMT 202T	Structure Of Materials	2:0	Jan
11	UMT 202L	Structure Of Materials (Lab)	0:1	Jan
12	UMT 203	Thermodynamics Of Materials	3:0	Jan
13	UMT 205	Mechanical Behaviour of Materials	3:0	Jan
14	UMT 301	Materials Kinetics	3:0	Aug
15	UMT 302T	Introduction To Materials Manufacturing	2:0	Aug
16	UMT 302L	Introduction To Materials Manufacturing Lab	0:1	Aug
17	UEES 313T	Experimental Methods in Environmental Engineering	2:0	Aug
18	UEES 313L	Experimental Methods in Environmental Engineering Lab	0:1	Aug

Note: Courses registered from the above table will be considered towards Assortment/ Institute Elective pool

Curriculum applicable until Batch 2021

Core Engineering courses

Sl. No.	Code	Title	Credits	Semester
1	UE 101T	Algorithms and Programming	2:0	I
2	UE 101L	Algorithms and Programming (Lab)	0:1	I
3	UE 102T	Introduction To Electrical and Electronics Engineering	2:0	II
4	UE 102L	Introduction To Electrical and Electronics Engineering (Lab)	0:1	II
5	UE 200	Introduction To Earth and Its Environment	2:0	II
6	UE 202	Introduction To Materials Science	2:0	III

List of Engineering Elective Courses – The update list of engineering electives can be accessed by clicking on the below link. For more details refer instructions given below, under the list of approved engineering elective courses section.

UG-Engineering-Courses-2024-25.docx.

Coordinators: Deepak D'Souza
Instructor UG: Devnath Shah

SEMESTER 2 (JANUARY)

UE 102T (2:0)/ UENG 102T (3:0): Introduction to Electrical and Electronics Engineering
UE 102L (0:1)/ UENG 102L (0:1): Introduction to Electrical and Electronics Engineering (Lab)

Instructor: Kaushik Basu

Refer Chapter -17 for the syllabus

UE 200 (2:0)/ UENG 103 (3:0): Introduction to Earth and Its Environment

Instructors: Ramananda Chakrabarti, Attreyee Ghosh and Sambuddha Misra

Nucleosynthesis, formation of planets, minerals, rocks and bulk earth composition; radioactivity and age of the earth; mantle convection and plate tectonics; introduction to stable isotope geochemistry; general application of stable isotopes; the carbon cycle; The S cycle; The nitrogen cycle; chemical weathering and global thermostat; short-term climate variation; wind and oceanic circulation; Thermohaline circulation and its role in climate change; surficial water cycle aqueous chemistry; redox chemistry in aquatic environment – implication and application; carbonate chemistry and its application; instrumentation in environmental and low-temperature geochemistry

SUGGESTED BOOKS:

1. Environmental and Low-temperature Geochemistry - Peter Ryan
2. How to Build a Habitable Planet - Langmuir and Broecker

SEMESTER 3 (AUGUST)

UE 101T (2:0)/ UENG 101T (3:0): Algorithms and Programming
UE 101L (0:1)/ UENG 101L (0:1): Algorithms and Programming (Lab)

Instructors: Y. Narahari and Viraj Kumar

Refer Chapter -17 for the syllabus

UE 202 (2:0)/ UENG 201 (3:0): Introduction to Materials Science

Instructor: T. A. Abinandanan

Bonding, types of materials, basics of crystal structures and crystallography. Thermodynamics, thermochemistry, unary systems, methods of structural characterization. Thermodynamics of solid solutions, phase diagrams, defects, diffusion. Solidification. Solid-solid phase transformations. Mechanical behaviour: elasticity, plasticity, fracture. Electrochemistry and corrosion. Band structure, electrical, magnetic and optical materials.

Classes of practical materials systems: metallic alloys, ceramics, semiconductors, composites.

SUGGESTED BOOK:

1. W.D. Callister: Materials Science and Engineering, Wiley India (2007)

SEMESTERS 4, 5 AND 6

UE 203T (2:0): Introduction to Sensor Technologies for Biomedical Applications

Instructor: Hardik J Pandya

Introduction and Overview to Sensors, Microelectromechanical Systems and Electronic Systems. Introduction to Microfabrication Facility: Cleanrooms, Standard Operating Procedures, Gowning Procedure, Operating Conditions, Clean Room Protocols, Safety and Contamination, and Overview of Cleanroom Hazards. Fundamentals of Material Deposition Techniques: Physical Vapor Deposition and Chemical Vapor Deposition. Fundamentals of Lithography: Hard and Soft Lithography, Bright Field and Dark Field Masks, and Photoresists. Tools in Photolithography: Fume Hood, Spin Coater, Hotplates, Ovens, Mask Aligner Systems, and Wet Benches. Fundamentals of Etching: Wet and Dry Etching, Understanding Terminology in Etching, Etching of Metals, Semiconductors and Insulators, Lift-Off Process. Dry Etching Process: Plasma Assisted Etch Process, Reactive Ion Etching (RIE) and Deep Reactive Ion Etching (DRIE). Design of Process Flow for Device Fabrication: Microheater, Interdigitated Electrodes, Gas Sensors, Microcantilever and Force Sensors. Fundamentals of Diffusion and Ion Implantation. Introduction to MEMS packaging. Understanding electrocardiogram (ECG or EKG), electroencephalogram (EEG), Electrocorticography (ECoG). Understanding drug efficacy using microchips, Technologies (Micro/Nano and circuits) for measuring EC0G, EEG and ECG. Fabrication of devices for neural recordings and stimulations. System Engineering with Microfabricated Sensors (Case Studies). Microtechnology and Processes for Medical Devices: Sensors/Biosensors for Cancer Screening/Diagnosis, Microfluidic Chips for Communicable Disease, Understanding tissue properties from onset to disease progression.

UE 203L (0:1): Introduction to Sensor Technologies for Biomedical Applications (Lab)

Familiarization with Gowning Procedure and Safety Protocols. Introductory Clean Room Visit and Overview of Equipment. Hands-On-Training on Wafer Cleaning Processes. Familiarization with E-beam Evaporation of Metals and Insulators. Familiarization with Photolithography: Photoresist Coating, Soft Bake, UV Exposure using Mask Aligner System, Development, Hard Baking, and Litho-Inspection. Familiarization with Wet Etching of Metals, Semiconductors, and Insulators. Device Design Considerations, FEM Simulations and Mask Design using Clewin. Device Fabrication: From Wafer to Microchips: Fabrication, characterization, and testing of the devices that students designed. Soft Lithography: Microfluidic Device Fabrication by Poly Dimethyl Siloxane (PDMS) Molding and Bonding with Plasma Bonder, Microfluidic Device: Demonstration. System Engineering with Microfabricated Sensors: Case studies of System-Level Integration of Microfabricated Sensors with Data Acquisition and Testing (using NI-DAQ Card, Impedance Analyzer, and Micromanipulator), Calibration of Force Sensors.

Prerequisites (Preferred for better understanding **not mandatory**)**:**

- Fundamentals of undergraduate level physics, chemistry, and mathematics
- Fundamentals of undergraduate level material science
- Fundamentals of electrical and electronics engineering

Main Textbooks:

1. Fundamentals of Microfabrication by Madou Marc J.
2. Silicon VLSI Technology: Fundamentals, Practice, and Modeling by James D. Plummer, Michael Deal, and Peter D. Griffin

Reference Textbooks:

3. Fundamentals of Semiconductor Fabrication by S M Sze
4. VLSI Technology by S M Sze
5. Fundamentals of Microelectronics by B Razavi
6. Franco, S., 2002. Design with operational amplifiers and analog integrated circuits. New York: McGraw-Hill.
7. Pallas-Areny, R. and Webster, J.G., 2012. Sensors and signal conditioning. John Wiley & Sons.

UE 204 (3:0): Elements of Solid Mechanics

Instructor: Ananth Ramaswamy

Elastic Bodies. Axial and Shear Stresses, Hooke's Law, Stress Resultants, Axially Loaded Members, Torsion of Circular Bars, Shear Force, Bending Moment, and Axial Thrust, Theory of Simple Bending, Bending and Shear Stress Distribution in Beams, Two Dimensional State of Stress, Principal Stresses and Strains, Mohr's Diagram, Pressure Vessels, Combined States of Stress and Failure Theories, Detection of Beams, Statically Indeterminate Beams, Unsymmetrical Bending, Shear Centre, Buckling of Columns, Energy Methods, Principle of Virtual Work, Castigliano's Theorems and Applications.

SUGGESTED BOOKS:

1. Gere, J. M. and Timoshenko, S. P., Mechanics of Materials, CBS Publishers, New Delhi, 2nd edition, 1984
2. Popov, E. P., Engineering Mechanics of Solids, Prentice Hall, New Jersey, 1990
3. Utku, S., Norris, C. H. and Wilbur, J. B., Elementary Structural Analysis, McGraw-Hill, New York, 1991
4. Crandall, S. H. and Dahl, N. C., An Introduction to Mechanics of Solids, McGraw-Hill, New York,1959
5. Burden, R. L. and Faires, J. D., Numerical Analysis: Theory and Applications, Indian Edition, Cengage Brooks, Cole Publishers, 2010

UE 201 (2:1): Introduction to Scientific Computing

Instructor: Ratikanta Behera

Number Representation, Stability and Convergence and Error Analysis; Interpolation: Lagrange, New-Ton's Divided Difference, Neville; Root Finding: Bisection, Newton- Raphson, Secant, Regula Falsi, RidDers, Steffensen; Data Analysis and Fitting: Goodness of Fit, Chi-Square Test; Numerical Integration and Differentiation: Newton-Cotes, Gaussian Quadrature, Romberg Integration, Importance Sampling; Numerical Solution of Odes: Euler and Runge-Kutta Methods; Fourier Series and Fourier Transforms, Basics of Sampling Theory, DFT And FFT; Simple Computer Implementation Exercises.

SUGGESTED BOOKS:

1. Kreyszig, E. Advanced Engineering Mathematics, John Wiley & Sons, 10th edition, 2011
2. Press, W. H., Teukolsky, S. A., Vetterling, W. T. and Flannery, B. P. Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, 3rd edition, 2007
3. Hildebrand, F. B., Introduction to Numerical Analysis, 2nd edition, Dover Publications, 1987

Students can choose to take courses from within pool of elective courses listed, towards their Engineering credits for this academic year.

List of Approved UG Engineering Courses

- Courses listed below will be counted towards Engineering Credits for the BS students until Batch 2021, subject to the following caveats. From Batch 2022 onwards below courses will be counted towards Assortment/ Institute Elective. Students are requested to get the approval of their faculty advisor and major coordinator for the courses they choose.
- A course being listed here **does not** mean that it will be offered in this academic year: for that please check the (PG) SoI or the department/instructors' webpage.

Caveats

- Among UE 204, PD 202, and AE 221 only one can be chosen.
- Among PD 202 and ME 201, only one can be chosen.
- Among CH 204 and ME 271 only one can be chosen.
- Among CH 202, DS 288, DS 289, UE 203 only one can be chosen.
- Among PD 205 and ME 228, only one can be chosen.
- UE 201 and DS 288 are equivalent courses. If UE 201 is offered students must register for UE 201 if they wish to take one of these courses.

DIVISION OF MECHANICAL SCIENCES

Department of Materials Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
NE 240	Materials Design Principles	3:0	Aug		
MT 271	Introduction to Biomaterials Science and Engineering	3:0	Jan		
MT260 / CH 237	Polymer Science and Engineering	3:0	Aug		

Department of Mechanical Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
ME 201	Fluid Mechanics	3:0	Aug	UP 101, UP 202	Max 20 students
ME 271	Thermodynamics	3:0	Jan	UC 202	

Department of Aerospace Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
AE 221	Flight Vehicle Structures	3:0	Aug		Max 10 students
AE 266	Introduction to Neural Network and Engineering Applications	3:0	Aug/ Jan		Max 10 students
AE 264	Vibrations	3:0	Jan		
AE 201	Flight and Space Mechanics	3:0	Aug		

Centre for Atmospheric and Oceanic Sciences

Course No	Title	Credit	Sem	Prerequisites	Remarks
UES 204	Fundamentals of Climate Science	3:0	Jan		

Department of Chemical Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
CH 202	Numerical Methods	3:0	Aug		
CH 203	Transport Processes	3:0	Aug		
CH 204	Thermodynamics	3:0	Aug		
CH 205	Chemical Reaction Engineering	3:0	Jan		
CH 251	Machine Learning for Materials and Molecules	3:0	Jan	Basics of Linear Algebra, Probability and Statistics	

Centre for Product Design and Manufacturing

Course No	Title	Credit	Sem	Prerequisites	Remarks
PD 201	Elements of Design	2:1	Aug		
PD 202	Elements of Solid and Fluid Mechanics	2:1	Aug		
PD 212	Computer Aided Design	2:1	Jan		Max 15 students
PD 216	Design of Automotive Systems	2:1			
PD 214	Advanced Materials & Manufacturing	3:0	Jan	Materials Science	Max 15 students

Centre for Sustainable Technologies

Course No	Title	Credit	Sem	Prerequisites	Remarks
UES 302	Design Principles in Environmental Engineering	2:0	Aug		
ST 202	Energy Systems and Sustainability	3:0	Aug		Max 20 Students
ST 213	Turbo Machines in Renewable Energy	3:0	Jan		

Civil Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
CE 207	Geoenvironmental Engineering	3:0	Jan		

CE 214	Ground Water Hydrology	3:0	Jan		
CE 235	Optimisation Methods	3:0	Jan		
CE 262	Public Transportation Systems Planning	3:0	Jan		

DIVISION of ELECTRICAL, ELECTRONICS and COMPUTER SCIENCES

Department of Computer Science and Automation

Course No	Title	Credits	Sem	Prerequisites	Remarks
E0 206	Theorist's Toolkit	3:1	Aug		
E0 214	Linear Algebra and Optimization	3:1	Aug		
E0 220	Graph Theory	3:1	Jan		
E0 222	Automata Theory and Computability	3:1	Aug		
E0 224	Computational Complexity Theory	3:1	Aug		
E0 225	Design and Analysis of Algorithms	3:1	Aug	A or S in UE101 and UG Math courses.	Only 5th Sem or later; max 10 students
E0 227	Program Analysis and Verification	3:1	Aug		
E0 229	Foundations of Data Science	3:1	Aug	Basic probability	
E0 230	Computational Methods of Optimization	3:1	Aug		
E0 235	Cryptography	3:1	Aug		
E0 254	Network and Distributed Systems Security	3:1	Aug		
E0 256	Theory and Practice of Computer Systems Security	3:1	Aug		
E0 259	Data Analytics	3:1	Aug	UM201 Probability and Statistics	
E0 267	Soft Computing	3:1	Aug		Only 5th Sem or later
E0 271	Graphics and Visualization	3:1	Aug		
E1 201	Foundations of Robotics	3:1	Aug		
E0 205	Mathematical Logic and Theorem Proving	3:1	Jan		
E0 207	Computational Topology: Theory and Applications	3:1	Jan		
E0 208	Computational Geometry	3:1	Jan		

E0 209	Principles of Distributed Computing	3:1	Jan		
E0 210	Dynamic Program Analysis: Algorithms and Tools	3:1	Jan		
E0 212	Graph Algorithms	3:1	Jan	E0 225 Design and Analysis of Algorithms	
E0 234	Introduction to Randomized Algorithms	3:1	Jan		
E0 238	Intelligent Agents	3:1	Jan		Only 5th Sem or later
E0 248	Theoretical Foundations of Cryptography	3:1	Jan		
E0 249	Approximation Algorithms	3:1	Jan	E0 225	
E0 251	Data Structures and Algorithms	3:1	Jan		
E0 255	Compiler Design	3:1	Jan		
E0 261	Database Management Systems	3:1	Jan		
E0 264	Distributed Computing Systems	3:1	Jan		
E0 270	Machine Learning	3:1	Jan	Basic courses in Linear Algebra and Probability	
E0 272	Formal Methods in Software Engineering	3:1	Jan		
E1 254	Game Theory	3:1	Jan	A or S in UE 101 and all Mathematics courses.	Only sixth semester or later; Max 10 students;
E1 277	Reinforcement Learning	3:1	Jan		

Department of Electrical Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
E1 213	Pattern Recognition & Neural Networks	3:1	Jan		
E1 241	Dynamics of Linear Systems	3:0	Aug		Max 10 students
E1 251	Linear and Nonlinear Optimization	3:0	Aug	Linear Algebra, Multivariate Calculus	
E5 253	Dielectrics and Electrical Insulation Engineering	3:0	Aug		

E9 201	Digital Signal Processing	3:0	Aug		
E9 241	Digital Image Processing	2:1	Aug		
E9 253	Neural Networks and Learning Systems	3:1	Aug		
E9 291	DSP System Design	2:1	Aug		
E1 216	Computer Vision	3:1	Jan		Only 6th semester or later;
E1 242	Nonlinear Systems and Control	3:0	Jan		Max 50 students
E9 205	Machine Learning for Signal Processing	3:1	Jan		
E9 213	Time-Frequency Analysis	3:0	Jan		

Department of Electrical Communication Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
E2 201	Information Theory	3:0	Aug		
E2 205	Error-Control Coding	3:0	Aug	Basic Linear Algebra	Max 10 students
E2 206	Quantum Information Theory	3:0	Aug	Matrices and Linear Algebra	
E2 237	Statistical Learning Theory	3:0	Aug		
E3 220	Foundations of Nanoelectronic Devices	3:0	Aug		
E3 238	Analog VLSI Circuits	2:1	Aug	UE 102	Max 10 students
E7 213 / NE 213	Introduction to Photonics	3:0	Aug		3rd or 4th yr students
E3 222 T	Micromachining for MEMS Technology	2:1			
E1 244	Detection and Estimation Theory	3:0	Jan		
E1 260	Optimization for Machine Learning and Data Science	3:1	Jan		
E2 204	Stochastic Processes and Queueing Theory	3:0	Jan		
E2 210	Quantum Error-Correcting Codes	3:0	Jan		

E2 236	Foundations of Machine Learning	3:1	Jan		
E7 214	Optoelectronic Devices	3:0	Jan		
E7 221	Fiber Optic Communications	2:1	Jan		
BE 218	Computational Epidemiology	3:1	Jan		

Department of Electronic Systems Engineering

Course No	Title	Credit	Sem	Prerequisites	Remarks
E3 235	Design for Analog Circuits	2:1	Aug		Max 10 students
E2 270	Quantum Information Theory	3:0	Aug		
E3 282	Basics of Semiconductor Devices and Technology	3:0	Aug		
E9 253	Neural Networks and Learning Systems	3:1	Jan		
UENG 203	Sensor Technologies for Biomedical Applications	2:1	Jan		
E3 253 **(defunct)**	Industrial Instrumentation	2:1	Jan		
E3 267 / IN 222 **(defunct)**	Microcontroller Applications	2:1	Jan		

DIVISION OF INTERDISCIPLINARY RESEARCH

Department of Computational and Data Sciences

Course No	Title	Credits	Sem	Prerequisites	Remarks
DS 201	Bioinformatics	2:0	Aug		
DS 215	Introduction to Data Science	3:0	Aug		
DS 221	Introduction to Scalable Systems	3:1	Aug		
DS 226	Introduction to Computing for AI and ML	2:1	Aug		
DS 284	Numerical Linear Algebra	2:1	Aug		
DS 288	Numerical Methods	3:0	Aug		
DS 290	Modeling and Simulation	3:0	Aug		
DS 216	Machine Learning for Data Science	3:1	Jan		
DS 202	Algorithmic Foundations of Big Data Biology	2:1	Jan		
DS 260	Medical Imaging	3:0	Jan	Knowledge of systems theory	
DS 294	Data Analysis and Visualization	3:0	Jan	Basic Numerical Methods	

Center for Biosystems Science and Engineering

Course No	Title	Credits	Sem	Prerequisites	Remarks
BE 201	Fundamentals of Biomaterials & Living Matter	3:0	Aug		

Center for Nanoscience

Course No	Title	Credits	Sem	Prerequisites	Remarks
NE 201	Micro and Nano Characterization Methods	2:1	Aug		Splited into two courses NE 201A and NE 201B
NE 231	Microfluidics	3:0	Aug		
NE 327	Nanoelectronics Device Technology	3:1	Aug		

MISCELLANEOUS

Centre for Neuroscience

Course No	Title	Credits	Sem	Prerequisites	Remarks
NS 212	Neural signal processing	3:0	Jan		

Instrumentation and Applied Physics

Course No	Title	Credits	Sem	Prerequisites	Remarks
QT 202	Introduction to Quantum Measurement and Control	3:0	Jan		
QT 204	Introduction to Materials for Quantum Technologies	3:0	Jan		
QT 207	Introduction to Quantum Computation	3:0	Aug		
QT 209	Introduction to Quantum Communication and Cryptography	3:0	Aug		
QT 211	Basic Quantum Technology Lab	1:2	Aug		

Mathematics

Course No	Title	Credits	Sem	Prerequisites	Remarks
MA 208	Proofs and Programs	3:1	Jan		

Cyber Physical Systems

Course No	Title	Credits	Sem	Prerequisites	Remarks
CP 214	Foundations of Robotics	3:1	Aug		

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HUMANITIES

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UH 101	Ways of Knowing	2:0	I	Humanities
2	UH 102	Ways of Seeing	2:0	II	Humanities
3	UH 201	Ways of doing: Mapping Science-Society Relationship	2:0	III	Humanities
4	UH 203	Mapping India through folk arts	1:0	IV	Humanities
5	UH 301	Journalism for Scientists	1:0	V	Humanities
6	UH 302	Introduction to Governance	1:0	VI	Humanities
7	UH 303	Essentials of Research Communications	1:0	VII	Elective

Course Details

Dr. Bitasta Das
Instructor UG: Rupesh Kumar Monu

The Humanities course as part of the Undergraduate Program offered at the Indian Institute of Science is an opportunity to bring about synergy between the Humanities and Social Sciences (or 'Human Sciences') with the Natural Sciences. With this aim in mind, IISc offers one course in Humanities in the first six semesters of the eight semester-BS Program. These courses are not designed to teach Humanities as a series of distinct disciplines but are designed to create an intellectual milieu in which the students learn science.

SEMESTER 1 (AUGUST)

UH 101 (2:0): Ways of Knowing

Instructor: Course Faculty

MODULE 1: Ethnographic Methods

How are cultural practices and patterns reproduced and carried forward in time? Questions such as these can be explored with the help of qualitative ethnographic methods. Originating in cultural anthropology, these are now widely used across human sciences. Typically, ethnography collects empirical data about human societies, using fieldwork, participant observation, questionnaires interviews, chain sampling, and the like, to understand how social meanings are created. Of special interest to science students would be the reflexive and interpretive emphasis of ethnography, since it has a bearing on how to read and write scientific findings. The module will expose students to some key debates in this area through short readings and documentary films.

MODULE 2: Psychological Methods

How do we understand experience of the self in a way that is not purely subjective? How do we understand the experience of other people (eg: how do we know when someone is in pain?) What is the importance of language as a medium by which to comprehend things? What would be the challenge to experimental sciences when language is brought into the picture? This module introduces students to some of these important debates.

MODULE 3: Historical Analysis

What is the past? Where may we draw a line differentiates the past and present: Is the past a millisecond ago or a century ago? The course will examine when and how this differentiation between past and present - and with it, the discipline and method of history - emerges. It would show that the past or present distinction is essential to the 'objectivity' of the historical method. The claim to objectivity is something that the social and human sciences share with the natural sciences. In India, postcolonial thinkers have critiqued history as a western way of knowing the past. Their contention is that professional history-writing is imbued with a ‘historical consciousness’, which many Indians who inhabit epistemic worlds outside of the University and the social sciences do not share. For many Indians, the relationship to the 'past' may not be premised on questions of facticity, evidence, and 'truth' in the scientific sense. Is there a way of understanding the ancient Indian texts which go beyond this fact or myth dyad? The course will end with this question.

MODULE 4: Textual Analysis

This module introduces students to key concepts and issues in textual analysis, a method not only adopted by students of literature but also History and other disciplines. It begins with the discussion of what a text is and the relationship of the writer to the text written by him or her. It then goes on to discuss how meaning is produced from a text and who produces it. It then returns to the problem of interpretation, discussed in the

earlier modules, to focus on the reader's role in interpreting texts and generating meaning, examine how texts are, and what is the role of the reader in interpreting textual meaning? In this module, students will be introduced to methods of close reading drawn from literary criticism and cultural studies.

SEMESTER 2 (JANUARY)

UH 102 (2:0): Ways of Seeing

Instructor: Course Faculty

This course introduces students to (a) the ways in which cultural forms and genres represent the world around us and (b) how we see and understand the world as refracted by these forms. There will be three modules. In short, this is a course about seeing and interpreting the forms that show us the world. Each module discusses a particular cultural form and also focuses on one theme.

MODULE 1: Visual Arts

How do paintings represent reality? Is realism more "scientific" than other ways of presenting the world? How does technology determine the evolution of art forms? What problems did artists face in the Indian context as they adopted western styles and forms? Special focus on mythology and its representation in modern Indian art.

MODULE 2: Literature

What do we need to know in order to appreciate creative writing? How do we read and interpret literary works? Where does meaning lie? How do we 'learn' from literature? Special focus on science fiction: good science and bad science, space or distance and time or history, human and non-human, science & technology, and nature.

MODULE 3: Cinema and Theatre

History of cinema as a technological form, technophobic reactions to film. Audiences and spectator- ship. Film as an urban, democratic form. How fiction and non-fiction films "document" reality and what they can they tell us about society, how to "read" films. Special focus on the city, as subject of cinema, and site of film production and viewing.

SEMESTER 3 (AUGUST)

UH 201 (2:0): Ways of Doing: Mapping Science-Society Relationship

Instructor: Course Faculty

MODULE 1: Economics

The aim of this module is to introduce the study of Macroeconomics, which is concerned with the analysis of major economic problems such as unemployment, inflation, and economic growth. The module will introduce and analyze several theoretical models that are developed to address these issues. The module will highlight the fundamental differences in these theoretical models that give rise to diametrically opposite policy prescriptions as solutions for the macroeconomic problems of un- employment and economic growth. This module will also help locate various policy regimes that dominated various periods of the past century in the context of the theoretical models developed in macroeconomics.

MODULE 2: People and Nature

This module will approach the theme of people and nature from different perspectives-natural science, social science, humanities, and arts. The course will discuss the evolution of our conception of nature, our understanding of our place in nature and how nature works, and our attempts to describe, appreciate, control and manipulate nature. This module will be more multidisciplinary than interdisciplinary and will attempt to showcase the significant variation across disciplines, historical time and geographical space in our approach to nature, and the inevitable conflicts such variation generates.

MODULE 3: Sustainable Development

This module will approach the gradually evolving concepts of sustainable development from the Indian to a Global perspective and in this process, bring about the various societal forces (local and global) that evolve(d) the meanings of sustainability and sustainable development, emerging debates and likely conflicts in the future. Is sustainability Science? Examining how people of natural, engineering and social sciences perceive sustainability in different perspectives or domains and the potential to integrate these perspectives for completeness, S&T in championing sustainable development. Measuring sustainability and evolving indices for sustainability.

MODULE 4: Law and Science

Law and science in various ways are constitutive of modernity. This course will examine the foundational authority of law in violence and how this is enmeshed with the authority of science. Law and justice are often assumed to bear the same meaning, but law, unlike justice, is about the application of general norms that are blinded to the unique, particular realities of people. This is again different from laws in science that are based on experiment and observation. The functioning of law in society is based on legal fictions especially that of the "reasonable man" that is borrowed from Western legal tradition. The figure of the reasonable man is emblematic of the hierarchies and exclusions inbuilt into the legal system. In this course, we will explore citizenship and gender as issues where questions of legal and scientific authority are raised, firstly biometric authentication in UID and the reliance on technology to resolve issues of poverty and crisis, secondly variance in gender or transgender described as a medical pathology by the courts.

SEMESTER 4 (JANUARY)

UH 203 (1:0): Mapping India through Folk Arts

Instructor: Course Faculty

The objective of this course is to understand the seven regions of India - North, West, East, South, Central, North-East and the Islands a little better - by looking at their folk arts. The course considers the art forms, as viewed in the discipline of Folkloristics, as means of knowing the regional cultures from "inside-out rather than outside-in". The aim of this seminar course is to provide the students a broad idea of India as a "nation", its diverse regional specificities and the relevance of the folk arts in understanding the "national" and the "regional". Every year a different folk-art form is focused upon, which is narrative, visual or performative. The students get an opportunity to interact with folk artists and gain first-hand knowledge about various aspects of the arts. This is to enable the understanding of the synergy between artistic worldview and the contemporary social milieu. The course is useful in recognizing how meaning is produced and expressed in folk domain, and at the same time, aids the students to gain cognizance of Indian multiculturalism. The assignments given in this course is a deliberate attempt to express science through the folk arts.

SEMESTER 5 (AUGUST)

UH 301 (1:0): Journalism for Scientists

Instructor: Course Faculty

The Course will be useful in acquainting students with journalistic skills which they may apply in their own work to observe and communicate better for instance or to their field as future science reporters, perhaps or as individuals who might have to explain science to the lay person. It also seeks to provoke thoughts on the practice of journalism, its tenets, its limitations and its influence with a view to encouraging a more critical engagement with media and to position science within the media.

The following will be discussed:

What is News? The media shapes society's perception of what is newsworthy. How does one identify an event as news?

Reporting- News gathering methods; an analysis of samples of reportage

How to investigate? Innovative or extraordinary methods used in journalism to uncover truths not available by conventional means

New Media- Print, television, video, satellite TV, and the small screen of the cell phone. A discussion on how technological advance affects journalism

Reporting Science How is science reported in the mainstream media? Is the coverage adequate and informed?

Science Journalism Trends and approaches in Indian and international science magazines

How to research and write an article for a newspaper or magazine? Practical tips and guidelines

Expressing an opinion Constructing and presenting a point of view as in a column or a review

The Art of the Interview Practical tips and guidelines on conducting interviews

Ethics and Dilemmas The media is both a public service and a business. What are the conflicts and compromises that journalists face?

Preparing to write a book- Early steps in turning an idea into a book: laying the ground and writing a proposal

Class Discussion possibly with Guest Speaker on dealing with the newsroom

Class Exercise in reading news or anchoring media debates, and so on

Concluding Discussion Elaborating points of interest raised in earlier classes and answering queries

SEMESTER 6 (JANUARY)

UH 302 (1:0): Introduction to Governance

India Past 75." the people called are all very engaging speakers. *

1. Tagore and the Making of India - **Ms. Achala Moulik**, IAS (Retd) former Secretary MHRD, historian and author. She had delivered the address organized by the Nobel Prize Committee in Stockholm to mark the centenary of the award of the Nobel Prize for Literature to Rabindranath Tagore
2. Nationhood and Nationalism China and India - **Professor Viren Murthy** **, Professor of East Asian Studies, University of Wisconsin
3. The role of the media in democracies - **Ms. Vaishan Roy,** Editor Frontline, The Hindu and one of India's leading journalists
4. India's Security Concerns - **Lt General CA Krishnan,** Former Deputy Chief of the Indian Army. He has four decades of operational experience across high altitude remote areas of Ladakh, Arunachal Pradesh and Siachen Glacier as well as vast experience in combating terrorism in Jammu & amp; Kashmir and North- East
5. Forest Communities - A lived experience - **Amogh Shaje** who, after completing his MTech in Mech Engineering at IISc went to live and work in Shelgda the small and primitive tribal village inhabited by the

Pawara tribe in Nadurbar district of Maharashtra. He has also worked for the UN in Southern Sudan on sustainable technologies

6. Introduction to crypto currency and implications for India- **Dr A V Arun Kumar,** R V University, Mysore Road, Bangalore
7. Experience of schooling during the pandemic **Dr Jyotsna Jha**, Centre for Budget and Policy Studies, Bangalore
8. Issues of agriculture in India **Dr Sukhpal Singh**, Indian institute of management, Ahmedabad
9. Implications for India's federal structure of interstate disparities **Gen Sudhir Vombatkere**, (retired) from Mysore
10. The various topics discussed in the context of economic policy for India

SEMESTER 7 (AUGUST)

UH 303(1:0): Essentials of Research Communications

Instructor: Kaushal Verma

Course goal: The course seeks to help senior undergraduate students develop the professional communication skills required to make the transition to the next stage of their careers

Course learning outcomes:

- To communicate your research more effectively
- To understand the structure of a research paper
- To understand the history and philosophy of research communication
- To understand the common ethical issues involved in communicating one's research
- To learn about other forms of research communication (poster and oral presentation)
- To reflect on your own calling
- To understand the process of applying to graduate school and other academic programs.

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IN-SEMESTER PROJECT

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UI 202	In-semester project	0:1	IV	Elective
2	UI 301	In-semester project	0:1	V	Elective
3	UI 302	In-semester project	0:1	VI	Elective

SEMESTER 4 (JANUARY)

UI 202 (0:1): In-semester project

Instructor: Major discipline coordinators

SEMESTER 5 (AUGUST)

UI 301 (0:1): In-semester project

Instructor: Major discipline coordinators

SEMESTER 6 (JANUARY)

UI 302 (0:1): In-semester project

Instructor: Major discipline coordinators

Course modalities: Student should reach out to any faculty member willing to host a UG student for an in- semester project. The student should discuss the project details with the faculty member and carry out the project. At the end of the semester, the student needs to write a report and submit it to the project advisor which will be evaluated by a committee (written or written and oral both) and a grade will be given. Once the student finds a faculty member, this information must be passed on to the major discipline coordinator and the UG office for record keeping.

Note:

1. Students are allowed to take ONLY one of these three courses. For example, if a student of 4th semester takes UI202, that student is not allowed to take UI301 or UI302. Likewise, if a student of 5th semester takes UI301, then the student is not allowed to take UI302.

2. The course credit for the above courses will be counted towards Assortment course (AC) pool.

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MATERIALS

Courses offered from the 4th semester onwards

[Core, elective courses for Materials Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UMT 202T	Structure of Materials	2:0	IV	Major- Core Minor- Core
2	UMT 202L	Structure of Materials (Lab)	0:1	IV	Major- Core Minor- Core
3	UMT 203	Thermodynamic of Materials	3:0	IV	Major- Core Minor- Soft core
4	UMT 205	Mechanical Behavior of Materials	3:0	IV	Major- Core Minor- Soft core
5	UMT 301	Materials Kinetics	3:0	V	Major- Core Minor- Soft core
6	UMT 302T	Introduction To Materials Processing	2:0	V	Major- Core Minor- Soft core
7	UMT 302L	Materials Processing (Lab)	0:1	V	Major- Core Minor- Soft core
8	UMT 309*	Functional Properties of Materials I	3:0	V	Major- Core Minor- Soft core
9	UMT 312T	Mechanical Testing and Failure of Materials	2:0	V	Major- Core
10	UMT 312L	Mechanical Testing (Lab)	0:1	V	Major- Core
11	UMT 310T	Introduction To Materials Manufacturing	2:0	VI	Major- Core
12	UMT 310L	Materials Manufacturing (Lab)	0:1	VI	Major- Core
13	UMT 311	Functional Property Characterization (Lab)	0:1	VI	Major- Core
14	UMT 401**	Functional Properties of Materials II	3:0	VI	Major- Core
15	UMT 400	Project: Materials	0:13	VIII	Project
16	UMT 500	Project: Materials	0:20	X	Project

The courses listed in the above table other than the Minor Core courses would be treated as electives for Materials Minor.

Note:

i) * Course was offered during in VI semester until Batch- 2021

ii) ** Course was offered during in VII semester until Batch- 2021

The following PG Courses listed below will be considered towards both Major/ Minor electives

Sl. No.	Code	Title	Credits	Semester
1	MT 209	Defects in Materials	3:0	VI or VIII
2	MT 260	Polymer Science and Technology	3:0	V or VII
3	MR 303	Nanomaterial Synthesis and Devices	3:0	V or VII
4	MR 306	Electron Microscopy in Materials Characterization	3:0	V or VII
5*	MT 271 or MR 203	Introduction to Biomaterials Science and Engineering Or Introduction to Biomaterials	3:0 3:0	V or VII
6	MT 201	Phase Transformations	3:0	VII
7	MT 307	Materials In Extreme Environments	3:0	VII
8	MT 255	Solidification Processing	3:0	VII
9	MT 248	Modeling And Simulations in Materials Engineering	3:0	VI or VIII
10	MR 308	Computational Modeling of Materials	2:1	V or VII

The following PG Courses listed below will be considered towards Major electives

1	MT 211	Magnetism, Magnetic Materials and Devices	3:0	V or VII
2	IN 232	Concepts In Solid State Physics	3:0	VII
3	NE 201	Micro And Nano Characterization Methods	2:1	VI
4	IN 201	Analytical Instrumentation	3:0	V or VII
5	NE 241	Materials Synthesis: Quantum Dots to Bulk Crystals	3:0	VI
6	SS 205	Symmetry And Structure in The Solid State	3:0	V or VII
7	ME 251	Biomechanics	3:0	VII
8	ER 206	Transport Phenomena in Energy Systems	3:0	VII
9	IP 323	Topics In Basic and Applied Electrochemistry	3:0	VII
10	PH 351	Crystal Growth, Thin Films and Characterization	2:0	VII
11	NE 205	Semiconductor Devices and Integrated Circuit Technology	3:0	VII
12	IN 214	Semiconductor Devices and Circuits	3:0	VII
13	E3 282	Basics Of Semiconductor Devices and Technology	3:0	VII
14	IN 224	Nanoscience and Device Fabrication	3:0	VII
15	NE 310	Photonics Technology: Materials and Devices	3:0	VII
16	PD 202	Elements Of Solid and Fluid Mechanics	3:0	VII
17	ME 273	Solid And Fluid Phenomena at Small Scales	3:0	VII
18	MT 207	Introduction To Electronic Properties of Materials	2:0	VII
19	MT 217	Computational Mathematics for Materials Engineers	3:0	VII
20	MT 261	Polymer Science and Engineering II: Organic Electronics	3:0	VII
21	NE 316	Advanced Electron Microscopy in Materials Characterization	3:0	V or VII

Note: Sl. No. 5* - Only one of two (or four) courses will count towards materials elective credits. For instance, if you credit both MT 271 and MR 203, only one of them will count towards materials elective, the other will count as a non-materials elective.

Credit Requirements for Materials Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Major Electives	Project	Assortment/ Institute Elective	Total
Till Batch 2021	36	19	9	28	11	13	15	131
From Batch 2022 onwards	40	6	9	28	10	13	25	131

Course Details

Coordinator: Sai Gautam Gopalakrishnan
Instructors UG: Elumalai and Arathi Ramachandran
Teaching Assistants: Shukla Harshit Kirtbhai and Jeevan S

SEMESTER 4 (JANUARY)

UMT 202T (2:0): Structure of Materials

Instructor: N. Ravishankar

Elements of bonding, structures of simple metallic, ionic and covalent solids; Coordination polyhedra, projections of structures, stacking; Lattices, symmetry operations, stereographic projection; Structure and thermodynamics of point defects and solid solutions, non-stoichiometry, ordered structures; Dislocations and slip, twinning and interfaces.

SUGGESTED BOOKS:

1. Kelly, A. and Groves, G. W., Crystallography & Crystal Defects, Addison Wesley
2. Barrett, C.S. and Massalski, T. B., Structure of Metals, Pergamon
3. West, A. R., Introduction to Solid State Chemistry, John Wiley

UMT 202L (0:1): Structure of Materials (Lab)

Instructor: S. Karthikeyan

UMT 203 (3:0): Thermodynamics of Materials

Instructor: T. A. Abinandanan

First law, enthalpy, thermochemistry; Second law, entropy, statistical interpretation; Helmholtz and Gibbs free energies, chemical potential; Solution thermodynamics; Conditions for equilibrium, phase rule, phase diagrams; Chemical reactions and equilibria; Surfaces and interfaces

SUGGESTED BOOKS:

1. DeHoff, R.T. 2006. Thermodynamics in Materials Science, Taylor & Francis
2. Gaskell, D. R. 2003. Introduction to the Thermodynamics of Materials (4th Ed), Taylor & Francis

UMT 205 (3:0): Mechanical Behavior of Materials

Instructor: S. Karthikeyan

Structures, vector mechanics (statics) and types of loads; Introductory concepts in stress and strain and their transformation; Linear elasticity in single and poly-crystals and in amorphous solids; Stresses in constrained systems – thermal and misfit stresses; Viscoelasticity and hyper elasticity in polymers; Stress concentration; Fracture mechanics and toughening mechanisms; Introduction to plastic deformation; Uniaxial stress-strain curve and flow instabilities; Effect of strain, strain-rate and temperature of flow stress; Continuum-based yield criteria; Plastic deformation mechanisms – slip, twinning and diffusion; Introduction to dislocation theory – slip systems, critical resolved shear stress, strengthening mechanisms.

***SUGGESTED BOOKS*:**

1. Beer, F. P., Johnston, E. R., DeWolf, J. T., and Mazurek, D.F. 2014. Mechanics of Materials, 7th edition, McGraw Hill
2. Hosford, W. 2010. Mechanical Behavior of Materials, 2nd edition, Cambridge University Press
3. Courtney, T. H. 2001. Mechanical Behavior of Materials, 2nd edition, Tata McGraw Hill
4. Ward, I. M. and Sweeney, J. 2012. Mechanical Properties of Solid Polymers, 3rd edition, Wiley

SEMESTER 5 (AUGUST)

UMT 301 (3:0): Materials Kinetics

Instructor: Chandan Srivastava

Point defects, Fick's laws of diffusion, concept of jump frequency, activation energy, Kirkendall effect, solidification, nucleation, constitutional supercooling, sintering, interfaces, grain growth, solid state transformations, JMA theory, GP zone, Spinodal decomposition, ordering and martensitic transformations, effect of stress and electric current.

***SUGGESTED BOOKS*:**

1. Reed-Hill, R. E. and Abbaschian, R. 2009. Physical Metallurgy Principles, Cengage
2. Porter, D. A. and Easterling, K. E. 2009. Phase Transformations in Metals and Alloys, Taylor and Francis

UMT 302T (2:0): Introduction to Materials Processing

Instructor: Surendra Kumar Makineni

Metals: Principles of extraction of metals, mineral beneficiation, hydrometallurgy, electrometallurgy, pyrometallurgy.
Ceramics: Synthesis of ceramic powders, consolidation, sintering.
Polymers: Introduction to polymer science and engineering, polymer synthesis, introduction to polymer processing.

SUGGESTED BOOKS:

1. Alcock, C. B. 1976. Principles of Pyrometallurgy, Academic Press, London
2. Venkatachalam, S. 1998. Hydrometallurgy, Narosa, New Delhi
3. Kingery, W. D., Bowen, H. K. and Uhlmann, D. R. 1976. Introduction to Ceramics, Wiley
4. Billmeyer, F. W. Textbook of Polymer Science
5. Gowarikar, V. R., Vishwanathan, N. V. and Sreedhar, J., Polymer Science

UMT 302L (0:1) Materials Processing (Lab)

Instructor: Surendra Kumar Makineni

UMT 309 (3:0): Functional Properties of Materials I

Instructor: Subho Dasgupta

Brief review of the fundamentals of quantum mechanics, statistical mechanics, electrostatics and electrodynamics; Energy bands in crystals, density of states, electric conduction in metals and alloys, thermoelectric phenomenon and applications, semiconductors and devices, electrical properties of polymers, ceramics, dielectric and amorphous materials, classical and quantum mechanical description of optical properties, lasers, LEDs, photonics, magnetic phenomenon and applications, thermal properties of materials.

SUGGESTED BOOKS:

1. Kittel, C., Introduction to Solid State Physics, McGraw-Hill
2. Solymar, L. and Walsh, D., Lectures on Electrical Properties of Materials
3. Omar, M. A., Elementary Solid State Physics
4. Hummel, R. E., Electronic Properties of Materials
5. Hench, L.L, West, J.K. 1990. Principles of Electronic Ceramics, Wiley
6. West, A.F., Solid State Chemistry and its Applications, Wiley (2nd ed.)

UMT 312T (2:0): Mechanical Testing and Failure of Materials

Instructor: S. Karthikeyan

Overview of solid mechanics, Overview of deformation and failure mechanisms in metals, ceramics and polymers, Mechanical testing techniques: Tensile and compression, hardness, fatigue, impact, creep, fracture, Introduction to instrumentation, controls and data acquisition.

SUGGESTED BOOKS:

1. Hosford, W. 2010. Mechanical Behavior of Materials, 2nd edition, Cambridge University Press
2. Courtney, T. H. 2001. Mechanical Behavior of Materials, 2nd edition, Tata McGraw Hill
3. Ward, I. M. and Sweeney, J. 2012. Mechanical Properties of Solid Polymers, 3rd edition, Wiley

UMT 312L (0:1): Mechanical Testing (Lab)

Instructors: S. Karthikeyan

SEMESTER 6 (JANUARY)

UMT 310T (2:0): Introduction to Materials Manufacturing

Instructors: Prosenjit Das

Processing of metallic materials: Principles of hot, warm and cold working of metallic materials; Fundamentals of metal forming processes – rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming; Introduction to metal casting and joining; Powder processing of metallic and ceramic materials: Powder production, compaction and sintering.

Polymer processing: Basic concepts of compounding and processing; concept of master batches; classification and type of additive for plastics: antioxidants, light stabilizers, UV stabilizers; Processing techniques: Basics of various processing techniques, Extruders: single screw and twin screw extruders, film blowing, fiber spinning, thermoforming; Molding: Injection molding, blow molding, compression molding, injection stretch blow molding, gas and water assisted injection molding.

SUGGESTED BOOKS:

1. Grover, M. P. 2011. Introduction to Manufacturing Processes, Wiley
2. Dieter, G. E. 1988. Mechanical Metallurgy, McGraw-Hill
3. Billmeyer, F. W. Textbook of Polymer Science, 3rd Edition
4. Gowarikar, V. R., Vishwanathan, N. V. and Sreedhar, J., Polymer Science

UMT 310L (0:1): Materials Manufacturing (Lab)

Instructors: Prosenjit Das, Avadhani G S

UMT 311 (0:1): Functional Property Characterization (Lab)

Instructor: Subho Dasgupta

Resistivity measurement by different methods, four probe method, determination of B-H curve, Curie point measurement Hall effect experiment, magnetostriction measurement, measurement of dielectric constant as function of temperature, Seebeck effect, efficiency of solar Cell

UMT 401 (3:0): Functional Properties of Materials II

Instructor: V. Jayaram

Crystal chemistry, point defects and associated thermodynamic equilibria, microstructural control (texture, porosity and grain size), energy levels (band structure in metals and semiconductors, junctions, electrical double layers), thermodynamic relationships, symmetry dependence and tensorial representation of properties; Introduction to properties: dielectric (piezoelectric, ferroelectric, pyroelectric), magnetic (ferro-, ferri-, magnetostriction), electrical conductivity (ionic and electrical), thermoelectricity; Specific examples of systems: piezoelectric, ferro-electric and -magnetic materials (domain structure, poling, influence on endurance, soft and hard materials), Actuator materials, Energy conversion devices (common batteries, fuel cells, supercapacitors)

SUGGESTED BOOKS:

1. Kingery, D.W., Bowen, H.K., Uhlmann, D.R, Introduction to Ceramics, Wiley (2nd Ed.)
2. Solymar, L. and Walsh, D. Electrical Properties of Materials, Oxford University Press (8th ed.)
3. Newnham, R.E. 2004. Properties of Materials, Oxford University Press
4. Hench, L.L, West, J.K. 1990. Principles of Electronic Ceramics, Wiley
5. West, A.F., Solid State Chemistry and its Applications, Wiley (2nd ed.)

SEMESTERS 8 (JANUARY)

UMT 400 (0:13): Project: Materials

Instructors: Faculty from Department of Materials Engineering OR Materials Research Centre

Master of Science

Students are required to complete 32 additional credits in their fifth year to qualify for a Master's degree. These credits are divided into 12 classroom credits and 20 credits for UMT 500, the Master's Project. The classroom credits include four courses - two mandatory PG-level core courses, one PG-level soft-core course from a prescribed list of courses and one PG-level elective as indicated below:
The choice of 4 classroom courses (12 credits) should be as follows:

1. **Two core courses**

Sl. No.	Code	Title	Credits	Semester
1	MT 202	Thermodynamics and Kinetics	3:0	Aug
2	MT 204	Structure and Properties of Materials	3:0	Aug

2. **Any one out of the following soft-core courses:**

Sl. No.	Code	Title	Credits	Semester
1	MT 213	Electronics Properties of Materials	3:0	Jan
2	MT 209	Defects in Materials	3:0	Jan
3	MT 217	Computational Mathematics for Materials Engineers	3:0	Aug
4	MT 307	Materials in extreme environments	3:0	Aug
5	MT 253	Mechanical Behavior of Materials	3:0	Aug
6	MT 260	Polymer Science and Engineering	3:0	Aug
7	MT 206	Texture and Grain Boundary Engineering	3:0	Aug
8	MT 240	Principles of Electrochemistry and Corrosion	3:0	Jan
9	MT 220	Microstructural Engineering of Structural Materials	3:0	Jan
10	MT 205	Structure and Characterization of Materials	3:0	Aug
11	NE 316	Advanced Electron Microscopy	3:0	Aug

3. **Any one PG-level course offered in Materials Engineering or Materials Research Centre**

* Those who have already taken MT 202 and/ or MT 204 in their Bachelor's program, must substitute the same from the above list of soft-core courses.

Additionally, Masters students need to complete **UMT 500 (0:20): Project: Materials**

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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MATHEMATICS

Curriculum applicable From Batch 2022 onwards

Basic Core Courses (for Mathematics Major and Minor)

Sl. No.	Code	Title	Credits	Semester
1	UMA 101	Analysis and Linear Algebra – I	4:0	I
2	UMA 102	Analysis and Linear Algebra - II	4:0	II
3	UMA 201	Probability And Statistics	4:0	III

Curriculum applicable until Batch 2021

Basic core courses

Sl. No.	Code	Title	Credits	Semester
1	UM 101	Analysis and Linear Algebra – I	3:0	I
2	UM 102	Analysis and Linear Algebra - II	3:0	II
3	UM 201	Probability And Statistics	3:0	III

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Mathematics Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UM 204	Introduction to Basic Analysis	3:1	IV	Major- Core Minor- Core
2	UM 205	Introduction to Algebraic Structures	3:1	IV	Major- Core Minor- Core
3	MA 200	Multivariable Calculus	3:1	V	Major- Core Minor- Core
4	MA 212	Algebra I	3:0	V	Major- Core Minor- Core
5	MA 219	Linear Algebra	3:1	V	Major- Core Minor- Core
6	MA 231***	Topology	3:1	V	Major- Core
7	MA 213#**	Algebra II	3:1	VI	Major- Core/ Soft core
8	MA 222#**	Measure & Integration	3:1	VI	Major- Core/ Soft core
9	MA 224	Complex Analysis	3:1	VI	Major- Core
10	MA 241	Ordinary Differential Equations	3:1	VI	Major- Core
11	UM 400	Project: MATHEMATICS	0:13	VIII	Bachelor's Project
12	Electives Offered in August-December Semester				Electives
13	Electives Offered in January-April Semester				Electives
14	UM 501	Master's Project A	0:6	IX	Project
15	UM 502	Master's Project B	0:6	X	Project

Note:

i) # Core until Batch 2021

ii) * Effective from the Batch of 2022

iii) ** From Batch 2022 onwards, students have to complete either MA 213 or MA 222

iv) * Only students from Batch 2022 are allowed to register MA 231 either in 5th semester or 7th semester**
Students from Batch 2023 and onwards needs to register MA 231 mandatorily in the 5th semester

v) Requirements for Minor in Mathematics

The courses listed in the above table as minor core courses would be treated for Mathematics Minor. Either MA 200 or MA 219 can be taken

Credit Requirements for Mathematics Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Soft core	Major Electives	Project	Assortment/ Institute Elective	Total
Till Batch 2021	36	19	9	39	0	0	13	15	131
From Batch 2022 onwards	40	6	9	31	8	0	13	24	131

ELECTIVES OFFERED IN AUGUST – DECEMBER SEMESTER

Course Code	Title	Credits	Instructors
MA 215	Introduction to Modular Forms	3:0	Ravitheja Vangala & Rishabh Agnihotri
MA 223	Functional Analysis	3:0	Swarnendu Sil
MA 232	Introduction to Algebraic Topology	3:0	Siddhartha Gadgil
MA 242	Partial Differential Equations	3:0	Harish Seshadri
MA 261	Probability Models	3:0	Sanchayan Sen
MA 312	Commutative Algebra	3:0	Abhishek Banerjee
MA 313	Algebraic Number Theory	3:0	Mahesh Kakde
MA 307	Riemann Surfaces	3:0	Ved Datar
MA 333	Riemannian geometry	3:0	Vamsi Pritham Pingali
MA 388	Topics in nonlinear functional analysis	3:0	Arka Mallick
MA 361	Probability theory	3:0	Manjunath Krishnapur

ELECTIVES OFFERED IN JANUARY-APRIL SEMESTER

Course Code	Title	Credits	Instructors
MA 208	Proofs and Programs	3:0	Siddhartha Gadgil
MA 216	Introduction to Graph Theory	3:0	Vineeth Chintala
MA 218	Number theory	3:0	Radhika Ganapathy
MA 220	Representation theory of finite groups	3:0	Soumya Das
MA 237	Introduction to Tilings	3:0	Subhojoy Gupta
MA 262	Introduction to Stochastic Processes	3:0	Sanchayan Sen
MA 305	Analysis on Lie Groups	3:0	Muna Naik
MA 310	Algebraic Geometry I	3:0	Abhishek Banerjee
MA 321	Analysis III	3:0	Swarnendu Sil
MA 345	Complex Manifolds	3:0	Purvi Gupta
MA 356	Class field Theory	3:0	Mahesh Kakde
MA 368	Topics in Probability and Stochastic Processes	3:0	Biltu Dan
MA 372	Harmonic Analysis	3:0	E K Narayanan
MA 379	Linear Algebraic Groups	3:0	Pinakinath Saha

Course Details

Coordinators: Vamsi Pritham Pingali and Purvi Gupta
Instructor: Manpreet Singh and Kamla Kant Mishra

SEMESTER 1 (AUGUST)

UM 101 (3:0)/ UMA 101 (4:0): Analysis and Linear Algebra – I

Instructor: Bharathwaj Palvannan

One-variable Calculus: Real and Complex numbers; Convergence of sequences and series; Continuity, intermediate value theorem, existence of maxima and minima; Differentiation, mean value theorem, Taylor series; Integration, fundamental theorem of Calculus, improper integrals. Linear Algebra: Vector spaces (over real and complex numbers), basis and dimension; Linear transformations and matrices.

SUGGESTED BOOKS AND REFERENCES:

1. Apostol, T. M., *Calculus, Volume I, 2nd edition*, Wiley, India, 2007
2. Strang, G., *Linear Algebra and its Applications, 4th Edition*, Brooks/Cole, 2006

SEMESTER 2 (JANUARY)

UM 102 (3:0)/ UMA 102 (4:0): Analysis and Linear Algebra - II

Instructor: Tirthankar Bhattacharyya

Linear Algebra continued: Inner products and Orthogonality; Determinants; Eigenvalues and Eigenvectors; Diagonalisation of symmetric matrices. Multivariable calculus: Functions on R^n partial and total derivatives; Chain rule; Maxima, minima and saddles; Lagrange multipliers; Integration in R^n, change of variables, Fubini's theorem; Gradient, Divergence and Curl; Line and Surface integrals in R^2 and R^3; Stokes, Green's and Divergence theorems. Introduction to Ordinary Differential Equations; Linear ODEs and Canonical forms for linear transformations.

SUGGESTED BOOKS AND REFERENCES:

1. Apostol, T. M., *Calculus, Volume II, 2nd edition*, Wiley, India, 2007
2. Strang, G., *Linear Algebra and its Applications, 4th Edition*, Brooks/Cole, 2006
3. Artin, M., *Algebra*, Prentice Hall of India
4. Hirsch, M., Smale, S. and Devaney, R. L., *Differential Equations, Dynamical Systems, and an Introduction to Chaos, 2nd edition*, Academic Press, 2004

SEMESTER 3 (AUGUST)

UM 201 (3:0)/ UMA 201 (4:0): Probability and Statistics

Instructor: Srikanth K Iyer

Basic notions of probability, conditional probability and independence, Bayes' theorem, random variables and distributions, expectation and variance, conditional expectation, moment generating functions, limit theorems. Samples and sampling distributions, estimation of parameters, testing of hypotheses, regression, correlation and analysis of variance.

SUGGESTED BOOKS AND REFERENCES:

1. Ross, S., Introduction to Probability and Statistics for Engineers and Scientists, Academic Press; 4th ed. (2009)
2. Freedman, Pisani and Purves, *Statistics*, Viva Books; 4th ed. (2011)
3. Feller, W., *An Introduction to Probability Theory and its Applications - Vol. 1*, Wiley; 3rd ed. (2008)
4. Ross, S., *A First Course in Probability*, Pearson Education; 9th ed. (2013)
5. Athreya, S., Sarkar, D. and Tanner, S., *Probability and Statistics (with Examples using R)*, Unfinished book

SEMESTER 4 (JANUARY)

UM 204 (3:1): Introduction to Basic Analysis

Instructor: Gautam Bharali

Basic notions from set theory, countable and uncountable sets. Metric spaces: definition and examples, basic topological notions. The topology of R^n: topology induced by norms, the Heine-Borel theorem, connected sets. Sequences and series: essential definitions, absolute versus conditional convergence of series, some tests of convergence of series. Continuous functions: properties, the sequential and the open- set characterizations of continuity, uniform continuity. Differentiation in one variable. The Riemann integral: formal definitions and properties, continuous functions and integration, the Fundamental Theorem of Calculus. Uniform convergence: definition, motivations and examples, uniform convergence and integration, the Weierstrass Approximation Theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Tao, T. 2014., *Analysis I, 3rd edition*, Texts and Readings in Mathematics, vol. 37, Hindustan Book Agency
2. Tao, T. 2014., *Analysis II, 3rd edition*, Texts and Readings in Mathematics, vol. 38, Hindustan Book Agency
3. Apostol, T. M., *Mathematical Analysis, 2nd edition*, Narosa

UM 205 (3:1): Introduction to Algebraic Structures

Instructor: Arvind Ayyer

1. Set theory: equivalence classes, partitions, posets, axiom of choice/Zorn's lemma, countable and uncountable sets.
2. Combinatorics: induction, pigeonhole principle, inclusion-exclusion, Möbius inversion formula, recurrence relations.
3. Number theory: Divisibility and Euclids algorithm, Pythagorean triples, solving cubics, Infinitude of primes, arithmetic functions, Fundamental theorem of arithmetic, Congruences, Fermat's little theorem and Euler's theorem, ring of integers modulo n, factorisation of polynomials, algebraic and transcendental numbers.
4. Graph theory: Basic definitions, trees, Eulerian tours, matchings, matrices associated to graphs.
5. Algebra: groups, permutations, group actions, Cayley's theorem, dihedral groups, introduction to rings and fields.

SUGGESTED BOOKS AND REFERENCES:

1. L. Childs, *A Concrete Introduction to Higher Algebra, 3rd edition*, Springer-Verlag
2. M. A. Armstrong, *Groups and Symmetry*, Springer-Verlag
3. Miklos Bona, *A Walk Through Combinatorics: An Introduction to Enumeration and Graph Theory*, World Scientific
4. D. M. Burton., *Elementary Number Theory*, McGraw Hill

5. Niven, Zuckerman, H. S. and Montgomery, H. L., *An Introduction to the Theory of Numbers, 5th edition*, Wiley Student Editions
6. Fraleigh, G., *A First Course in Abstract Algebra, 7th edition*, Pearson

SEMESTER 5 (AUGUST)

MA 200 (3:1): Multivariable Calculus

Prerequisite courses for Undergraduates: UM 204

Instructor: Muna Naik

Functions on R^n, directional derivatives, total derivative, higher order derivatives and Taylor series. The inverse and implicit function theorem, Integration on R^n, differential forms on R^n, closed and exact forms. Green's theorem, Stokes' theorem and the Divergence theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Munkres, Analysis on manifolds (Primary text)
2. Spivak, Calculus on manifolds
3. Rudin, Principle of Mathematical Analysis
4. J. H. Hubbard and B.B. Hubbard, Vector Calculus, Linear algebra and differential forms

MA 212 (3:0): Algebra I

Prerequisite course: UM 203

Instructor: Soumya Das

Part A: Group theory

1. Basic definitions, examples
2. Cyclic groups and its subgroups
3. Homomorphisms, quotient groups, isomorphism theorems
4. Group actions, Sylow's theorems, simplicity of A_n for $n \geq 5$
5. Direct and semi-direct products
6. Solvable and nilpotent groups
7. Free groups

Part B: Ring theory

1. Basic definitions, examples
2. Ring homomorphisms, quotient rings, properties of ideals
3. Localization, ring of fractions
4. The Chinese remainder theorem
5. Euclidean domains, principal ideal domains, unique factorization domains
6. Polynomial rings over fields, irreducibility criteria

Part C: Module theory

1. Basic definitions and examples
2. Homomorphisms and quotient modules
3. Direct sums and free modules
4. Tensor product of modules
5. Structure theorem of modules over PID's and consequences
6. Noetherian rings and modules, Hilbert basis theorem

SUGGESTED BOOKS AND REFERENCES:

1. Artin, *Algebra*, M. Prentice-Hall of India, 1994
2. Dummit, D. S. and Foote, R. M., *Abstract Algebra*, McGraw-Hill, 1986
3. Lang, S., *Algebra (3rd Ed.)*, Springer, 2002
4. Hungerford, *Algebra*, Graduate Texts in Mathematics 73, Springer Verlag, 1974
5. Nathan Jacobson, *Basic Algebra I & II*, Dover, 2009
6. Nathan Jacobson, *Lectures in Abstract Algebra I, II & III*, Graduate Text in Mathematics, Springer Verlag, 1951

MA 219 (3:1): Linear Algebra

Prerequisite course: UM 102/UMA 102

Instructor: Apoorva Khare

Vector spaces: Definition, Basis and dimension, Direct sums. Linear transformations: Definition, Rank-nullity theorem, Algebra of linear transformations, Dual spaces, Matrices.

Systems of linear equations: Elementary theory of determinants, Cramer's rule. Eigenvalues and eigenvectors, the characteristic polynomial, the Cayley- Hamilton Theorem, the minimal polynomial, algebraic and geometric multiplicities, Diagonalization, The Jordan canonical form. Symmetry: Group of motions of the plane, Discrete groups of motion, Finite groups of SO(3). Bilinear forms: Symmetric, skew symmetric and Hermitian forms, Sylvester's law of inertia, Spectral theorem for the Hermitian and normal operators on finite dimensional vector spaces.

SUGGESTED BOOKS AND REFERENCES:

1. Artin, M., *Algebra*, Prentice Hall of India, 1994
2. Halmos, P., *Finite dimensional vector spaces*, Springer-Verlag (UTM), 1987
3. Hoffman, K. and Kunze, R., *Linear* Algebra *(2nd Ed.)*, Prentice-Hall of India, 1992

MA 231 (3:1): Topology

Instructor: Subhojoy Gupta

Open and closed sets, continuous functions, Metric topology, Product topology, Connectedness and path-connectedness, Compactness, Countability axioms, Separation axioms, Complete metric spaces, Quotient topology, Topological groups, Orbit spaces, Urysohn's lemma, Metrizability, Baire Category theorem.

SUGGESTED BOOKS:

1. Armstrong, M. A., Basic Topology, Springer (India), 2004
2. Munkres, J. R., Topology, Pearson Education, 2005
3. Viro, O.Ya., Ivanov, O.A., Netsvetaev, N., and Kharlamov, V.M., Elementary Topology: Problem Textbook, AMS, 2008

SEMESTER 6 (JANUARY)

MA 213 (3:1): Algebra II

Prerequisite course: MA 212

INSTRUCTOR: Shaunak Deo

Part A: Field theory

1. Theory of symmetric polynomials – Newton's theorem
2. Basic theory of field extensions
3. Algebraic and transcendental extensions (and transcendence degree)
4. Construction with straight edge and compass; Gauss-Wantzel theorem
5. Algebraic closure – Steinitz's theorem
6. Splitting fields, normal extensions
7. Separable extensions
8. Finite fields: construction, subfields, Frobenius
9. Primitive element theorem
10. Dedekind-Artin linear independence of (semi)group characters

Part B: Galois theory

1. Fundamental theorem of Galois theory (including Normal Basis Theorem)
2. Composite extensions and Galois group
3. Galois group of cyclotomic extensions, finite fields
4. Galois groups of polynomials, Fundamental theorem of Algebra
5. Solvable and radical extensions, insolvability of a quintic

SUGGESTED BOOKS AND REFERENCES:

1. Artin, M., Algebra, Prentice Hall of India, 1994
2. Dummit, D. S. and Foote, R. M., Abstract Algebra, McGraw-Hill, 1986
3. Lang, S., Algebra (3rd Ed.), Springer, 2002
4. Jonathan Alperin and Rowen Bell, Groups and Representations, Graduate Texts in Mathematics 162, Springer Verlag, 1995
5. Hungerford, Algebra, Graduate Texts in Mathematics 73, Springer Verlag, 1974
6. Galois Theory, Artin, E., University of Notre Dame Press, 1944
7. Nathan Jacobson, Basic Algebra I & II, Dover, 2009
8. Nathan Jacobson, Lectures in Abstract Algebra I, II & III, Graduate Text in Mathematics, Springer Verlag, 1951

MA 222 (3:1): Measure & Integration

Prerequisite course: UM 204

INSTRUCTOR: Arka Mallick

Construction of Lebesgue measure, Measurable functions, Lebesgue integration, Abstract measure and abstract integration, Monotone convergence theorem, Dominated convergence theorem, Fatou's lemma, Comparison of Riemann integration and Lebesgue integration, Product sigma algebras, Product measures, Sections of measurable functions, Fubini's theorem, Signed measures and Radon-Nikodym theorem, Lp-spaces, Characterization of continuous linear functionals on Lp - spaces, Change of variables, Complex measures, Riesz representation theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Royden, H. L., Real Analysis, Macmillan, 1988
2. Folland, G.B., Real Analysis: Modern Techniques and their Applications (2nd Ed.), Wiley
3. Hewitt, E. and Stromberg, K., Real and Abstract Analysis, Springer, 1969

MA 224 (3:1): Complex Analysis

Prerequisite course: UM 204

Instructor: E K Narayanan

Complex numbers, holomorphic and analytic functions, Cauchy-Riemann equations, Cauchy's integral formula, Liouville's theorem and proof of fundamental theorem of algebra, the maximum-modulus principle. Isolated singularities, residue theorem, Argument Principle. Mobius transformations, conformal mappings, Schwarz lemma, automorphisms of the disc and complex plane. Normal families and Montel's theorem. The Riemann mapping theorem. If time permits - analytic continuation and/or Picard's theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Ahlfors, L. V., *Complex Analysis*, McGraw-Hill, 1979
2. Conway, J. B., *Functions of One Complex Variable*, Springer-Verlag, 1978
3. Stein, E.M, and Shakarchi, R., *Complex Analysis*, Princeton University Press, 2003

MA 241(3:1): Ordinary Differential Equations

Prerequisite course: UM 204

Instructor: Vamsi Pritham Pingali

Basics concepts: Introduction and examples through physical models, First and second order equations, general and particular solutions, linear and nonlinear systems, linear independence, solution techniques. Existence and Uniqueness Theorems: Peano's and Picard's theorems, Grownwall's inequality, Dependence on initial conditions and associated flows. Linear system: The fundamental matrix, stability of equilibrium points, Phase- plane analysis, Sturm-Liouvile theory. Nonlinear system and their stability: Lyapunov's method, Non-linear Perturbation of linear systems, Periodic solutions and Poincare- Bendixson theorem.

SUGGESTED BOOKS AND REFERENCES:

1. Hartman, *Ordinary Differential Equations*, P. Birkhaeuser, 1982
2. Coddington, E. A. and Levinson, N., *Theory of Ordinary Differential Equations*, Tata McGraw-Hill, 1972
3. Perko, L., *Differential Equations and Dynamical Systems*, Springer-Verlag, 1991

SEMESTER 7 (AUGUST)

The coursework for this semester comprises electives. Refer the table above for the list of electives offered by the Department of Mathematics.

SEMESTER 8 (JANUARY)

UM 400 (0:13): Project: Mathematics

Mandatory project for undergraduate Mathematics Majors in their fourth year, second semester.

Master of Science

Following mandatory courses to be fulfilled:

MA 389A (1:0): Seminar on topics in mathematics I (AUG)
MA 389B (1:0): Seminar on topics in mathematics II (JAN)
MA 213 (3:1): Algebra II (JAN)
MA 222 (3:1): Analysis II (JAN)

Soft core courses requirement: Any 3 courses from the list below

MA 223 (3:0): Functional Analysis
MA 232 (3:0): Introduction to Algebraic Topology
MA 242 (3:0): Partial Differential Equations
MA 361 (3:0): Probability Theory
MA 235 (3:0): Introduction to Differentiable Manifolds
MA 220 (3:0): Representation Theory of Finite Groups
MA 312 (3:0): Commutative Algebra
MA 313 (3:0): Algebraic Number Theory
MA 262 (3:0): Introduction to Stochastic Processes
MA 321 (3:0): Analysis III

The remaining 21 credits could be comprised of the following Master's projects A & B and courses offered by any department or a combination thereof.

Courses offered in August Semester

UM 501 (0:6): Masters Project A
Optional reading project.

Courses offered in January Semester

UM 502 (0:6): Masters Project B
Optional reading project.

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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PHYSICS

Curriculum applicable From Batch 2022 onwards

Basic Core Courses (for Physics Major and Minor)

Sl. No.	Code	Title	Credits	Semester
1	UPH 101T	Introductory Physics I Mechanics, Oscillations and Waves	3:0	I
2	UPH 101L	Introductory Physics I Mechanics, Oscillations and Waves (Lab)	0:1	I
3	UPH 102T	Introductory Physics II (Electricity, Magnetism and Optics)	3:0	II
4	UPH 102L	Introductory Physics II (Electricity, Magnetism and Optics) (Lab)	0:1	II
5	UPH 201T	Introductory Physics III (Thermal and Modern Physics)	3:0	III
6	UPH 201L	Introductory Physics III (Thermal and Modern Physics) (Lab)	0:1	III

Curriculum applicable until Batch 2021

Basic core courses for Physics Major

Sl. No.	Code	Title	Credits	Semester
1	UP 101T	Introductory Physics I Mechanics, Oscillations and Waves	2:0	I
2	UP 101L	Introductory Physics I Mechanics, Oscillations and Waves (Lab)	0:1	I
3	UP 102T	Introductory Physics II (Electricity, Magnetism and Optics)	2:0	II
4	UP 102L	Introductory Physics II (Electricity, Magnetism and Optics) (Lab)	0:1	II
5	UP 201T	Introductory Physics III (Thermal and Modern Physics)	2:0	III
6	UP 201L	Introductory Physics III (Thermal and Modern Physics) (Lab)	0:1	III

Courses offered from the 4th semester onwards (All batches)

[Core, elective courses for Physics Major/Minor]

Sl. No.	Code	Title	Credits	Semester	Course Type
1	UP 202T	Intermediate Mechanics, Oscillations and Waves	2:0	IV	Major- Core Minor- Elective
2	UP 202L	Intermediate Mechanics, Oscillations and Waves (Lab)	0:1	IV	Major- Core Minor- Elective
3	UP 203T	Intermediate Electromagnetism and the Quantum Physics of Radiation	2:0	IV	Major- Core Minor- Elective
4	UP 203L	Intermediate Electromagnetism and the Quantum Physics of Radiation (Lab)	0:1	IV	Major- Core Minor- Elective
5	UP 204T	Intermediate Thermal Physics and the Physics of Materials	2:0	IV	Major- Core Minor- Core
6	UP 204L	Intermediate Thermal Physics and the Physics of Materials (Lab)	0:1	IV	Major- Core Minor- Core
7	PH 201	Classical Mechanics	3:0	V	Major- Core Minor- Elective
8	PH 203	Quantum Mechanics I	3:0	V	Major- Core Minor- Elective
9	PH 205	Mathematical methods of Physics	3:0	V	Major- Core Minor- Elective
10	PH 211	General Physics Laboratory	0:3	V	Major- Core Minor- Elective
11	PH 202	Statistical Mechanics	3:0	VI	Major- Core Minor- Elective
12	PH 204	Quantum Mechanics II	3:0	VI	Major- Core Minor- Elective
13	UP 400 UPH 400*	Project: Physics	0:16 0:15	VIII	Bachelor's Project
14	UP 500	Project: Physics	0:20	X	Master's Project

Note: i) * Effective from the Batch of 2022

ii) Electives for Physics Major and Minor

Any courses offered by Centre for High Energy Physics (CHEP) / Instrumentation and Applied Physics (IAP) / Physics departments will be considered towards Major and Minor electives with the consent of the course instructor.

Credit Requirements for Physics Major

Course Type	Basic Courses (Sem 1-3)	Engg (Sem 1-3)	Humanities (Sem 1-3)	Core (Sem 4-8)	Major Electives	Project	Assortment/ Institute Elective	Total
Until Batch 2021	36	19	9	27	9	16	15	131
Batch 2022 onwards	40	6	9	27	9	15	25	131

Course Details

Coordinator: Victor Suvisesha Muthu
Instructors UG: C Jayachandraiah, A Simimol and Haritha Pamuluri
Teaching Assistants: Sushma Athokpam, Rashmi R K, Sonali Rana, Vishnu P N and Tyby Monachan

SEMESTER 1 (AUGUST)

UP 101T (2:0)/ UPH 101T (3:0): Introductory Physics I – Mechanics, Oscillations and Waves

Instructor: Sebabrata Mukherjee

Kinetics, laws of motion. Circular motion, work. Kinetic and potential energy. Line integrals. Conservative forces. Friction, terminal velocity in air. Systems of particles. Conservation of linear momentum. Scattering in one and two dimensions. Angular momentum. Moment of inertia. Rotation about one axis. Precession of gyroscope. Central force. Reduction of two- body problem to one-body problem and effective one-body potential. Planetary motion and Kepler's laws. Simple pendulum damped and forced, resonance. Coupled oscillators, normal modes. Small oscillations. Transverse waves on a string. Linear superposition, interference, beats. Fourier series. Sound waves in air. Doppler effect.

SUGGESTED BOOKS:

1. Kittel,C., Knight, W.D., Ruderman, M.A., Helmholz, A.C. and Moyer,B.J.2011 Mechanics, Berkeley Physics Course: Volume 1, 2nd edition
2. Kleppner,D. and Kolenkow,R.J.2007 An Introduction To Mechanics (Special Indian Edition)
3. David Halliday, Robert Resnick, Jearl Walker: Fundamentals of Physics
4. Raymond A. Serway and John W. Jewett: Physics for Scientists and Engineers with Modern Physics
5. Hugh D. Young and Roger A. Freedman: University Physics with Modern Physics
6. Vector Analysis (Schaum's Series) by M. R. Spiegel
7. Classical Mechanics By N. C. Rana & P. S. Joag

UP 101L (0:1)/ UPH 101L (0:1): Introductory Physics I – Mechanics, Oscillations and Waves (Lab)

Instructors: Victor Muthu, Animesh Kuley and Binita Tongbram

SEMESTER 2 (JANUARY)

UP 102T (2:0) / UPH 102T (3:0): Introductory Physics II – Electricity, Magnetism and Optics

Instructor: Ranjan Laha

Introduction, review of vector algebra, vector calculus: gradient, divergence, curl, Gauss' theorem and Stokes' theorem, Laplacian etc. Coulomb's law, electric field, electrostatic potential, Uniqueness theorem, conductors, capacitance, method of images, bound charges and dipole moment density, energy stored in electric fields. Magnetostatics: electric currents, Biot-savart law, Ampere's law, magnetic fields of straight wires, circular loops and infinite solenoids, vector potential, magnetic dipole moment and bound currents. Lorentz force and Faraday's law, inductance, energy stored in a magnetic field. Linear dielectric and magnetic materials, bound current, magnetism, charge conservation, displacement current, Maxwell's equations.

SUGGESTED BOOKS:

1. Purcell, E.M.2011 Electricity and Magnetism, Berkeley Physics Course-Volume2, 2nd edition, Tata Mc Graw Hill
2. Griffiths, D.J.2003 Introduction to Electrodynamics, 3rd edition, Prentice- Hall of India. SICS

UP 102L (0:1)/ UPH 102L (0:1): Introductory Physics II – Electricity, Magnetism and Optics (Lab)

Instructors: Arnab Pariari, Sanjiv Sambandan and Nadig D. S

SEMESTER 3 (AUGUST)

UP 201T (2:0) / UPH 201T (3:0): Introductory Physics III- Thermal and Modern Physics

Instructors: Baladitya Suri

Temperature, The First Law of Thermodynamics, Kinetic Theory of Gases and Maxwell-Boltzmann Statistics, Heat Engines, Entropy and the Second Law of Thermodynamics, Relativity, Introduction to Quantum Physics, Basics of Quantum Mechanics, Atomic, Molecular and Solid-state physics, Nuclear Physics, Particle Physics and Cosmology.

SUGGESTED BOOKS:

1. Serway and Jewett, Physics for Scientists and Engineers (7th Edition)
2. Young and Freedman, University Physics (12thEdition)
3. Halliday, Resnick and Walker, Fundamentals of Physics, Extended (8thEdition)
4. Harris Benson, University Physics, Revised Edition
5. KennethKrane, Modern Physics, Second Edition
6. Resnick -- introduction to special theory of relativity
7. Beiser -- Modern Physics

UP 201L (0:1) / UPH 201L (0:1): Introductory Physics III- Thermal and Modern Physics (Lab)

Instructors: Subroto Mukerjee and Manish Jain

SEMESTER 4 (JANUARY)

UP 202T (2:0): Intermediate Mechanics, Oscillations and Waves

Instructor: Gaurav Narain

Special theory of relativity. Lorentz transformations. Energy-momentum relation. Lorentz four-vectors. Motion in non-inertial frames. Fictitious forces. Coriolis force. Foucault pendulum. Basic scattering theory. Vibrations of particles on a circle and a line. Orthonormal basis. Wave equation. Fourier transform Phase space. Hamiltonian equations, fixed points and stability. Nonlinear equations. Chaos. Logistics map and period doubling. Fluid mechanics. Euler equation. Bernoulli's equation. Waves in fluids. Gravity waves. Viscosity. Navier-Stokes equation. Basic ideas about turbulence. Elasticity. Strain and stress tensors. Elastic moduli. Bending of rods. Waves in solids.

SUGGESTED BOOKS:

For Fluid Mechanics:

1. https://www.damtp.cam.ac.uk/user/tong/fluids.html
2. http://www.fluiddynamics.it
3. Elementary Fluid Dynamics by D. J. Acheson
4. Griffiths Electrodynamics for some parts of Special Relativity
5. For Classical Mechanics I: `Classical Mechanics' by Tom W.B. Kibble and Frank H. Birkshire.
6. For non-linear dynamics and Chaos: `Non-Linear Dynamics and Chaos' by Steven H. Strogatz
7. Kleppner, D. and Kolenkow, R.J.2007 An Introduction to Mechanics (Special Indian Edition)
8. https://www.amazon.com/Classical-Mechanics-John-R-Taylor/dp/189138922X
9. The Feynman Lectures on Physics: https://www.feynmanlectures.caltech.edu/
10. Spacetime Physics by Taylor and Wheeler: https://www.amazon.in/Spacetime- Physics- Introduction-Special-Relativity/dp/0716723271

UP 202L (0:1): Intermediate Mechanics, Oscillations and Waves (Lab)

Instructors: K. Ramesh and R. Ganesan

UP 203T (2:0): Intermediate Electromagnetism and the Quantum Physics of Radiation

Instructor: Akshay Singh

Electromagnetic Waves: Wave equation from Maxwell's equations, polarization, energy and momentum in EM waves, propagation in linear media, reflection and refraction, Snell's law and Fresnel's equations, Brewster angle and total internal reflection. EM waves in conductors, skin depth, simple theories for dispersion of EM waves. Wave guides and coaxial cables, optical fibers Geometrical optics: Fermat's principle, Snell's law, reflection and refraction at spherical surfaces, convex and concave mirrors and lenses, real and virtual images.

Physical Optics: Coherence, Young's two slit experiment, multiple slits, diffraction grating, wavelength resolution and fringe visibility, Newton's rings, Michelson and Fabry-Perot interferometer, diffraction from rectangular and circular apertures, Airy disc and resolving power of microscopes.

Quantum optics: Photons, spontaneous and stimulated emission, Einstein A and B coefficients and relation to the Planck distribution, rate equations for absorption and emission, two level and three level systems, population inversion and light amplification, optical resonators and the basic working principle of a laser, examples of lasers: Ruby, He-Ne, semiconductor etc.

SUGGESTED BOOKS:

1. Griffiths, D.J.2003 Introduction to Electrodynamics, 3rdedition, Prentice-Hall of India
2. Hecht, E. and Ganesan, A.R.2008 Optics,4 the edition, Pearson
3. Ghatak, A. and Thyagarajan K 1991Optical Electronics, Cambridge University Press

UP 203L (0:1): Intermediate Electromagnetism and the Quantum Physics of Radiation (Lab)

Instructors: Manukumara Manjappa and Jyosthna Rani Komaragiri

UP 204T (2:0): Intermediate Thermal Physics and the Physics of Materials

Instructor: Prerna Sharma

Review of kinetic theory and thermodynamics, Free energies, Phases and phase transitions, Vander Waals gas and the liquid gas transition, Thermodynamics of magnetic systems, Ensembles and rules of Statistical Mechanics, The Ideal Maxwell-Boltzmann Gas, The Ideal Fermi Gas, The Ideal Bose Gas, Crystal Structure, Lattice Vibrations, Band theory of electrons in crystalline solids, Thermal properties of crystalline solids.

SUGGESTED BOOKS:

1. Callen, H.B. Thermodynamics and Introduction to Thermostatics (2nd edition), Wiley Student Edition
2. Ken Dill and Sarina Bromberg, Molecular Driving forces, CRC Press
3. Kittel, C. Introduction to Solid State Physics, 5th/6th/7 the edition, Wiley International
4. S. J. Blundell and K. M. Blundell, Concepts in thermal physics, Oxford University Press

UP 204L (0:1): Intermediate Thermal Physics and the Physics of Materials (Lab)

Instructors: Upendra Behera and Minakshi Nayak

SEMESTER 5 (AUGUST)

PH 201 (3:0): Classical Mechanics

Instructor: Sumantra Sarkar

Newton's laws generalized co-ordinates. Lagrange's principle of least action and equations. Conservation laws and symmetry. Integrable problems, elastic collisions and scattering. Small oscillations including systems with many degrees of freedom, free and forced oscillations, damped and undamped oscillations, normal modes, counting and density of states, parametric oscillations and Floquet's theorem, numerical computations in parametric oscillations. Hamilton's equations. Poisson brackets. Hamilton Jacobi theory. Canonical perturbation theory, chaos, elements of special relativity. Lorentz transformations, relativistic mechanics. Nonlinear dynamics – nonlinear oscillator, critical points, flow, linearization, Lyapunov exponents, general Lyapunov stability. Introduction to Classical Field Theory -- Massive and massless scalar fields, Noether's theorem.

SUGGESTED BOOKS:

1. Landau, L.D and Lifshitz, E.M.Mechanics, Third Edition, Butterworth- Heinemann
2. Goldstein H., Poole C., and Safko J Classical Mechanics, Third Edition (Pearson Education)
3. Rana, N.C. and Jog,P.S. Classical Mechanics, Mc Graw-Hill Education, New Delhi
4. Strogatz Steven H., Nonlinear dynamics and Chaos: CRC press, 2nd edition, Special Indian Edition
5. R Shankar, Principles of Quantum Mechanics, Second Edition, Springer (India), 2010
6. Kleppner D and Kolenkow R J, An Introduction to Mechanics (Special Indian Edition) (2021)

PH 203 (3:0): Quantum Mechanics I

Instructor: Diptiman Sen

Wave function for a single particle. Hamiltonian. Schrodinger equation. Probability current. Wave packets. One-dimensional problems: particle in a box and on a circle, step, barrier and delta-function potentials. Tunneling, scattering and bound states. Energy bands in periodic potentials. Simple harmonic oscillator, operator approach. Ehrenfest's theorem. Particle in an electromagnetic field. Aharonov-Bohm effect. Uncertainty relations. Hermitian and unitary operators. Orthonormal basis. Postulates of quantum mechanics. Matrix formulation of quantum mechanics Three-dimensional problems. Rotations, angular momentum operators, commutation relations. Spherical harmonics. Hydrogen atom, its spectrum and wave functions. Spin angular momentum. Spin-1/2 and two-level systems. Addition of angular momentum. Spin-orbit and hyperfine interactions. Time-independent perturbation theory. Stark and Zeeman effects.

SUGGESTED BOOKS:

1. C. Cohen-Tannoudji, B. Diu and F. Laloe, Quantum Mechanics, Vol.1 and 2,John Wiley & Sons, 2005
2. D. J. Griffiths, Introduction to Quantum Mechanics, Pearson, 2005
3. L.D .Landau and Lifshitz, Quantum Mechanics, (Vol. 3 of Course of Theoretical Physics), 1999
4. F. Schwabl, Quantum Mechanics, Springer, 1995
5. R. Shankar, Principles of Quantum Mechanics, Springer, 2010

PH 205 (3:0): Mathematical Methods of Physics

Instructor: Justin David

Linear vector spaces, linear operators and matrices, systems of linear equations. Eigen values and Eigenvectors, classical orthogonal polynomials. Linear ordinary differential equations, exact and series methods of solution, special functions. Linear partial differential equations of physics, separation of variables method of solution. Complex variable theory; analytic functions. Taylor and Laurent expansions, classification of singularities, analytic

continuation, contour integration, dispersion relations. Fourier and Laplace transforms.

***SUGGESTED BOOKS*:**

1. Arfken, G, Weber H. and Harris F., Mathematical methods for Physicists, 7th edition, Academic Press
2. Dennery, P. and Krzywicki, A. 1967 Mathematics for Physicists, Harper and Row
3. Riley, K. Hobson M.,Bence, S. Mathematical Methods for Physics and Engineering, CUP, 1997

PH 211L (0:3): General Physics (Lab)

Instructors: T Das Gupta, Chandni

Identification of NaCl monocrystals (with X-ray unit). Gamma ray absorption with Multi Channel Analyzer (calibration & attenuation coefficient). NMR: Nuclear Magnetic Resonance (find the magnetogyric ratio of Hydrogen and Fluorine). Velocity of sound in liquids (Raman-Nath experiment). Normal modes in (3D) acoustic chamber. Solar cell (IV Characteristics). UV-VIS spectroscopy (Band gap of semiconductor, thickness measurement). X-ray fluorescence with Multi Channel Analyzer. Rutherford Scattering. Elastic Plastic Deformation.

SEMESTER 6 (JANUARY)

PH 202 (3:0): Statistical Mechanics

Instructor: Aveek Bid

Phenomena and experiments; thermodynamic entropy and the 0th, 1st and 2nd Laws; Free energies, Legendre transformations, Maxwell relations; Stability, equilibrium, van der Waals eqn of state & phase transitions; Elements of probability theory and the central limit theorem; The postulates of equilibrium classical statistical mechanics and their mechanical basis; the postulates of quantum statistical mechanics; the density matrix; the 3rd Law; Partition functions; ensembles and their equivalence; numerical methods; Noninteracting systems: ideal classical and quantum gases with examples; interacting systems: virial expansion, lattice gas, Ising model (1D and Bragg-Williams/Curie-Weiss); Random walks, Brownian motion, and the Langevin equation.

SUGGESTED BOOKS:

1. Kardar, M. 2007: Statistical Physics of Particles. Cambridge University Press
2. Mazenko G.F. 2000: Equilibrium statistical mechanics, Wiley, New York
3. Reif, F. 2010: Fundamentals of Statistical and Thermal Physics, Sarat Book Distributors
4. Bhattacharjee, J.K. 1996: Statistical Physics: Equilibrium and Nonequilibrium Aspects, Allied, New Delhi
5. Landau, L.D. and Lifshitz, E.M. 1980 Statistical Physics, Pergamon
6. Statistical Mechanics, R K Pathria
7. Reif, F. 2010: Fundamentals of Statistical and Thermal Physics, Sarat Book Distributors
8. Concepts in Thermal Physics, Blundell and Blundell

PH 204 (3:0): Quantum Mechanics II

Instructor: Biplob Bhattacharjee

Recap of quantum mechanics I, WKB approximation and variational methods, Density Matrices, Time dependent perturbation theory, Fermi golden rule, Transitions caused by a periodic external field, Dipole transitions and selection rules, Decay of an unstable state, Born cross section for weak potential scattering, Adiabatic and sudden approximations, Berry phase and the Aharonov-Bohm effect, Scattering theory: partial wave analysis, low energy scattering, scattering length, Born approximation, optical theorem, Wigner-Eckart theorem, Quantization of the radiation field. One out of the following topics: Entanglement, the Dirac equation and Hartree-Fock theory.

SUGGESTED BOOKS:

1. Landau, L.D. and Lifshitz, E.M.1974 Quantum Mechanics, Pergamon, NY
2. Cohen-Tannoudji, C.,Diu,B.andLaloe,F.1977 Quantum Mechanics(2Vols.),John Wiley
3. Modern Quantum Mechanics, by Sakurai and Napolitano
4. Quantum Mechanics by Schwabl
5. Quantum Mechanics by Schiff
6. The Principles of Quantum Mechanics by Dirac

UP 400 (0:16) / UPH 400 (0:15): Project: Physics

Coordinator: Victor S Muthu

This is a 15/16 credit project course of six months duration and is compulsory for the completion of the BSc Research course. The student can choose any faculty of his or her choice from any of the three departments: Physics, Centre for High Energy Physics (CHEP), Instrumentation and Applied Physics (IAP) with mutual consent and take up an advanced topic of research either in the experimental or theoretical stream. At the end of the term, the student will submit a soft copy and hard copy of the report with proper binding. The viva-voce examination will be conducted with two examiners and evaluated accordingly.

Master of Science

The following courses are mandatory for the 5th year UG (MS) students and 20 credits from the project:

PH 206 (3:0): Electromagnetic Theory
PH 208 (3:0): Condensed Matter Physics 1 or IN 232 (3:0): Concepts in Solid State Physics
PH 217 (3:0): Fundamentals of Astrophysics
PH/HE 215 (3:0): Nuclear and Particle Physics

The students have to complete 12-credit blackboard courses during the 5th year.

In case none of the above-mentioned mandatory courses are completed by the students during the first 4 years (Bachelor of Science), they have to credit all of them in the 5th year.

In case the students already completed all of the above-mentioned mandatory courses during the first 4 years (Bachelor of Science), to fulfill the 12-credit requirement, they can take any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor, and UG coordinator.

In case the students completed part of the above-mentioned mandatory courses during the first 4 years (BS), they have to complete the remaining mandatory courses and, to fulfill the 12-credit requirement, any other course(s) (200 or 300 level) from any department, with the consent of their respective advisor, Instructor and UG coordinator.

UP 500 (0:20) : Project: Physics

Coordinator: Victor S Muthu

This is a 20-credit project course of six months duration and is compulsory for the completion of the MSc course. The student can choose any faculty of his or her choice from any of the three departments: Physics, Centre for High Energy Physics (CHEP), Instrumentation and Applied Physics (IAP) with mutual consent and take up an advanced topic of research either in the experimental or theoretical stream. At the end of the term, the student will submit a soft copy of the report to the coordinator. The viva-voce examination will be conducted with two examiners and evaluated accordingly.

Note: For credit carry over from BS (Research) to MS please refer to Chapter – II, section - 2.3

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BIOENGINEERING

Minor in Bioengineering for IISc Undergraduates

Bioengineering is a thriving interdisciplinary field in academic research and industrial practice today. On one hand, Bioengineering is the engineering counterpart to life sciences just as aerospace, chemical, civil, electrical, material, and mechanical engineering disciplines are engineering extensions of physics and chemistry. On the other hand, bioengineering is much more expansive. At one end of its broad spectrum, it deals with quantitative aspects of biomolecules and cells to organs and systems. In a nutshell, bioengineering is engineering of biology, for biology, and with biology.

Understanding biology at the fundamental level using engineering principles and techniques is a hall- mark of bioengineering. Emerging areas of systems and synthetic biology, which use computational methods, are also within the ambit of bioengineering. Biomaterials, cell and tissue engineering, immunoengineering, and regenerative medicine are pursued within bioengineering towards the development of novel drug-delivery techniques, implants, prosthetics, and artificial organs. Neuroengineering interfaces neuroscience to not only understand how brain works but also to study neurological diseases and their treatment.

Development of novel diagnostic and therapeutic devices, orthotics, human-assistive devices, etc., lie at the other end of the spectrum of bioengineering. Biosensors and implantable prostheses involve micro and nano technologies. Developing novel instruments from microscopes to biochemical assays is an integral part of bioengineering. Development biomedical instruments that are crucial for medical diagnosis and treatment is also an important component of bioengineering. Signal processing, bio- electronics, medical imaging, etc., also come within the purview of bioengineering.

Working with clinicians and clinical researchers is also an aspect of bioengineering or its extension called biomedical engineering. Familiarity with physiology and anatomy empowers engineers to work on the unmet needs of clinical practice and explore careers in biomedical industry. Bioengineering also has organic links to biopharma industry.

IISc undergraduates who opt for a minor in bioengineering will become familiar with the basics of bioengineering and touch upon its multiple facets. This minor program is administered by the Department of Bioengineering – earlier known as the Centre for Biosystems Science and Engineering (BSSE). BSSE was founded in 2015 based on the critical mass that became evident due in response to the Interdisciplinary PhD program in Bioengineering that started in 2012. The Department of Bioengineering (BE) is an inclusive department that works with several other departments as well as it numerous clinical partners. BE is a place of confluence of biologists, clinicians, designers, and engineers. It has primary faculty of its own, associate faculty, adjunct faculty, research staff, and PhD students. Its thematic common laboratories support research and teaching.

BE has a well-thought-out and growing curriculum to train and nurture students with different back- grounds to become bioengineers with expertise and appreciation for biology and engineering. In view of bioengineering minor, a few courses are selected from BE's curriculum to serve as core and elective courses, as shown in two tables to fulfil 15 credits required for the minor in the undergraduate program of IISc. The core courses provide basics of traditional and emerging areas of biomaterials, biosensors, biomechanics, cell mechanics, microfluidics, and systems biology. The electives provide an opportunity to study these topics in depth, depending on the interests of the students after taking the core courses. It may be noted that the core courses are offered by BE while the electives are taught by BE and other departments at IISc. While most courses are lecture oriented, some have hands-on laboratories.

Coordinator: Mohit Kumar Jolly

Total credits required for the Minor subject option: 15

Core courses (10 credits):

BE 213 (2:0) Fundamentals of Bioengineering 1 (AUG)
BE 214 (2:0) Fundamentals of Bioengineering 2 (JAN)
BE 210 (3:0) Drug Delivery: Principles and Applications (AUG)
BE 211 (3:0) Cell Mechanics (AUG)

Elective (5 credits): To be selected from the following:

BE 216 (3:0) Dynamical Systems Biology
BC 302 (3:0) Current Trends in Drug Discovery
MT 271 or MR 203 (3:0) Introduction to Biomaterials (AUG/JAN)
BE 202 (3:0) Thermodynamics and Transport in Biological Systems (AUG)
ME 251 (3:0) Biomechanics (JAN)
NE 203 (3:0) Advanced micro- and nanofabrication technology and processes (AUG)
NE 231 (3:0) Microfluidics (AUG)
EC 303 (2:1) Stochastic and spatial dynamics in Biology (AUG)
CH 248 (3:0) Molecular Systems Biology (AUG)
BE 218 (3:1) Computational Epidemiology (JAN)

QUANTUM TECHNOLOGY

Inclusion of Quantum Technology as a Minor in the UG Program (from Batch-2021 onwards)

Coordinator: Apoorva Patel

Total credits required for the Minor subject option: 15

Core courses (12 credits):

QT 207 (3:0) Introduction to Quantum Computation (AUG)
QT 209 (3:0) Introduction to Quantum Communications and Cryptography (AUG)
QT 202 (3:0) Introduction to Quantum Measurement and Sensing (JAN)
QT 204 (3:0) Introduction to Materials for Quantum Technologies (JAN)

Elective (3 credits): To be selected from the following:

QT 306 (3:0) Advanced Quantum Computation and Information (JAN)
E0 213 (3:0) Quantum-safe Cryptography (JAN)
E2 210 (3:0) Quantum Error-correcting Codes (JAN)
E2 270 (3:0) Quantum Information Theory (AUG)
E7 211 (2:1) Photonics Integrated Circuits (AUG)
NE 203 (3:0) Advanced Micro and Nanofabrication Technology and Process (AUG)
NE 222 (3:0) MEMS Modelling, Design and Implementation (AUG)
NE 310 (3:0) Photonics Technology: Materials and Devices (AUG)
NE 320 (3:0) Quantum Optics and Advanced Quantum Measurement (JAN)
PH 359 (3:0) Physics at the Nanoscale (JAN)
NE 312 (3:0) Nonlinear and Ultrafast Photonics (AUG)

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CHAPTER 17

SCHEME OF INSTRUCTIONS (SOI)

BACHELOR OF TECHNOLOGY (MATHEMATICS AND COMPUTING) PROGRAM

Core Courses: Mathematics and Computing

Sl. No.	Code	Title	Credits	Semester
1	UENG 101T	Algorithms and Programming	3:0	I
2	UENG 101L	Algorithms and Programming (Lab)	0:1	I
3	UMA 101	Analysis and Linear Algebra - I	4:0	I
4	UENG 102T	Electrical and Electronics Engineering	3:0	II
5	UENG 102L	Electrical and Electronics Engineering (Lab)	0:1	II
6	UMA 102	Analysis and Linear Algebra - II	4:0	II
7	UMC 102	Computer Systems	3:0	II
8	UMC 103	Discrete Mathematics	2:0	II
9	UMA 201	Probability and Statistics	4:0	III
10	UMC 201	Data Structures & Algorithms	3:1	III
11	UMC 202	Numerical Methods	3:1	III
12	UM 204	Analysis	3:1	IV
13	UM 205	Algebraic Structures	3:1	IV
14	UMC 203	Introduction to Artificial Intelligence and Machine Learning	3:1	IV
15	UMC 205	Automata and Computability	3:1	IV

Core Courses: Humanities

Sl. No.	Code	Title	Credits	Semester
1	UH 101	Ways of Knowing	2:0	I
2	UH 102	Ways of Seeing	2:0	II
3	UH 201	Ways of Doing	2:0	III
4	UH 203	Mapping India Through Folk Arts	1:0	IV
5	UH 301	Journalism for Scientists	1:0	V
6	UH 302	Introduction to Governance	1:0	VI

Breadth Soft Core Courses

Sl. No.	Code	Title	Credits	Semester
1	UBL 101T	Introductory Biology I	3:0	I
2	UBL 101L	Introductory Biology I (Lab)	0:1	I
3	UCY 101T	Introductory Chemistry I	3:0	I
4	UCY 101L	Introductory Chemistry I (Lab)	0:1	I
5	UPH 101T	Introductory Physics I	3:0	I
6	UPH 101L	Introductory Physics I (Lab)	0:1	I
7	UBL 102T	Introductory Biology II	3:0	II
8	UBL 102L	Introductory Biology II (Lab)	0:1	II
9	UCY 102T	Introductory Chemistry II	3:0	II
10	UCY 102L	Introductory Chemistry II (Lab)	0:1	II
11	UENG 103	Introduction to Earth and its Environment	3:0	II
12	UPH 102T	Introductory Physics II (Elec-Mag-Optics)	3:0	II
13	UPH 102L	Introductory Physics II (Elec-Mag-Optics) (Lab)	0:1	II
14	UBL 201T	Introductory Biology III	3:0	III
15	UBL 201L	Introductory Biology III (Lab)	0:1	III
16	UCY 201T	Introductory Chemistry III	3:0	III
17	UCY 201L	Introductory Chemistry III (Lab)	0:1	III
18	UENG 201	Introduction to Materials Science	3:0	III
19	UPH 201T	Introductory Physics III	3:0	III
20	UPH 201L	Introductory Physics III (Lab)	0:1	III

Project

Sl. No.	Code	Title	Credits	Semester
1	UMC 401	Independent Study Project I (ISP I)	6	VII
2	UMC 402	Independent Study Project II (ISP II)	6	VIII
3	UMC 403	Project	12	VIII

Note: Refer to Section 3.6 for detailed rules regarding projects.

Soft Core: Mathematics

Sl. No.	Code	Title	Credits
1	E0 220	Graph Theory	3:1
2	E0 228	Combinatorics	3:1
3	E0 265	Convex Optimization and Applications	3:1
4	E0 298	Linear Algebra and its Applications	3:1
5	E1 222	Stochastic Models and Applications	3:0
6	E1 251	Linear and Nonlinear Optimization	3:0
7	E2 202	Random Processes	3:0
8	E2 212	Matrix Theory	3:0
9	MA 200	Multivariable Calculus	3:1
10	MA 212	Algebra I	3:0
11	MA 216	Introduction to Graph Theory	3:0
12	MA 218	Number Theory	3:0
13	MA 219	Linear Algebra	3:1
14	MA 222	Analysis – II Measure and Integration	3:1
15	MA 223	Functional Analysis	3:0
16	MA 224	Complex Analysis	3:1
17	MA 231	Topology	3:1
18	MA 232	Introduction to Algebraic Topology	3:0
19	MA 235	Introduction to Differential Manifolds	3:0
20	MA 241	Ordinary Differential Equations	3:1
21	MA 242	Partial Differential Equations	3:0
22	MA 262	Introduction to Stochastic Processes	3:0
23	MA 278	Introduction to Dynamical Systems Theory	3:0
24	MA 361	Probability Theory	3:0
25	PH 205	Mathematical Methods of Physics	3:0

Note:

1. Among E1 222, E2 202 and MA 262, only one can be chosen
2. Between E2 212 and MA 219, only one can be chosen
3. Between E0 220 and MA 216, only one can be chosen

Soft Core: Computing

Sl. No.	Code	Title	Credits
1	UMC 204	Digital Systems Design	3:0
2	UMC 301	Applied Data Science and Artificial Intelligence	3:1
3	DS 211	Numerical Optimization	3:0
4	DS 221	Introduction to Scalable Systems	3:1

5	DS 250	Multigrid Methods	3:1
6	DS 256	Scalable Systems for Data Science	3:1
7	DS 284	Numerical Linear Algebra	2:1
8	DS 289	Numerical Solution of Differential Equations	3:1
9	DS 291	Finite Elements: Theory and Algorithms	3:1
10	DS 294	Data Analysis and Visualization	3:0
11	DS 295	Parallel Programming	3:1
12	DS 301	Bioinformatics	2:0
13	E0 205	Mathematical Logic and Theorem Proving	3:1
14	E0 206	Theorist's Toolkit	3:1
15	E0 208	Computational Geometry	3:1
16	E0 209	Principles of Distributed Software	3:1
17	E0 224	Computational Complexity Theory	3:1
18	E0 225	Design and Analysis of Algorithms	3:1
19	E0 227	Program Analysis and Verification	3:1
20	E0 230	Computational Methods of Optimization	3:1
21	E0 235	Cryptography	3:1
22	E0 240	Modelling and Simulation	3:1
23	E0 244	Computational Geometry and Topology	3:1
24	E0 248	Theoretical Foundations of Cryptography	3:1
25	E0 259	Data Analytics	3:1
26	E0 267	Soft Computing	3:1
27	E0 270	Machine Learning	3:1
28	E0 272	Formal Methods in Software Engineering	3:1
29	E1 213	Pattern Recognition and Neural Networks	3:1
30	E1 244	Detection and Estimation Theory	3:0
31	E1 254	Game Theory	3:1
32	E1 277	Reinforcement Learning	3:1
33	E2 201	Information Theory	3:0
34	E2 230	Network Science and Modelling	3:0
35	E2 232	TCP/IP Networking	2:1
36	QT 207	Introduction to Quantum Computation	3:0
37	BE 218	Computational Epidemiology	3:1
38	MA 208	Proofs and Programs	3:1

Suggested Institute Electives

Sl. No.	Code	Title	Credits
1	MG 201	Managerial Economics	3:0
2	MG 265	Data Mining	3:0
3	MG 221	Applied Probability and Statistics	2:1
4	MG 226	Time Series Analysis and Forecasting	3:0
5	MG 258	Financial Instruments and Risk Management Strategies	3:0
6	PH 202	Statistical Mechanics	3:0
7	PH 204	Quantum Mechanics II	3:0
8	PH 206	Electromagnetic Theory	3:0
9	BC 302	Current Trends in Drug Discovery	3:0
10	MA 253	Numerical Methods for Partial Differential Equations	3:0
11	EC 201	Theoretical and Mathematical Ecology	2:1
12	EC 303	Spatial dynamic in Biology	2:1
13	NE 101	Entrepreneurship, Ethics and Societal Impact	1:0
14	E1 396	Stochastic Approximation Algorithms	3:1
15	MA 331	Topology and Geometry	3:0
16	E0 259	Data Analytics	3:1
17	BE 218	Computational Epidemiology	3:1
18	CP 214	Foundations of Robotics	3:1
19	PH 354	Computational Physics	3:0
20	E2 270	Quantum Information Theory	3:0
21	DS 301	Bioinformatics	2:0
22	E0 207	Computational Topology	3:1

STUDY TRACKS

The program structure encourages interested students to pursue a study track should they wish to do so. Here is an indicative list of study tracks.

A. MATHEMATICS
- Linear Algebra, Multivariable calculus
- Algebra: Algebra-I, Algebra-II, Number theory, Graph theory, Cryptography
- Analysis: Measure and Integration, Functional Analysis, ODE, PDE, Convex Optimization, Numerical solutions to Differential Equations
- Geometry/Topology: Topology, Differentiable Manifolds, Algebraic Topology, Graph theory, Computational Geometry and Topology
- Probability: Measure and Integration, Probability Theory, Random Processes, Stochastic Processes, Percolation and Random Graphs, Random Matrix Theory

B. INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
- Random Processes
- Applied Data Science and Artificial Intelligence
- Computational Methods of Optimization
- Machine Learning, Game Theory
- Data Mining
- Soft Computing
- Reinforcement Learning
- Scalable Systems for Data Science
- Foundations of Robotics
- Data Analysis and Visualization

C. COMPUTATIONAL SCIENCE
- Numerical Optimization
- Multigrid Methods
- Numerical Solution of Differential Equations
- Finite Element Methods, Bioinformatics

D. THEORETICAL COMPUTER SCIENCE
- Algorithms and Complexity: Design and Analysis of Algorithms, Theorist's Toolkit, Computational Complexity Theory, Introduction to Randomized Algorithms, Approximation Algorithms
- Combinatorics and Geometry: Computational Geometry, Computational Topology, Combinatorics, Graph Theory
- Cryptography and Security: Theoretical Foundations of Cryptography, Cryptography, Network and Distributed Systems Security, Foundations of Secure Computation
- Logic and Verification: Mathematical Logic and Theorem Proving, Formal Methods in Software Engineering, Program Analysis and Verification, Proofs and Programs

E. QUANTUM COMPUTING
- Mechanics
- Electricity, Magnetism and Optics
- Quantum Mechanics I
- Physics/Engineering foundations of Quantum Technologies
- Introduction to Quantum Computation
- Introduction to Quantum Communication & Cryptography
- Advanced Quantum Computing & Information

F. COMPUTATIONAL BIOLOGY
- Biology for Engineers
- Fundamentals of Bio Engineering I, II
- Theoretical and Mathematical Ecology
- Dynamical Systems in Biology
- Introduction to Molecular Simulation
- Current Trends in Drug Discovery
- Digital Epidemiology
- Neural Signal Processing
- Theoretical and Computational Neuroscience
- Algorithmic foundations of Big Data Biology

G. SIGNAL PROCESSING
- Detection and estimation theory
- Random processes
- Linear and non-linear optimization
- Matrix theory or Computational linear algebra
- Pattern recognition and neural networks
- Signal processing in practice
- Digital Signal Processing
- Digital Image Processing
- Neural Signal Processing

H. MATHEMATICAL FINANCE
- Probability Theory
- Stochastic Finance
- Random Processes
- Detection and Estimation
- Data Analysis
- Financial Instruments and Risk Management
- Statistics
- Time Series Analysis
- Numerical Solutions to Differential Equations

SEMESTER 1 (AUGUST)

Core Courses:

UENG 101T (3:0): Algorithms and Programming
UENG 101L (0:1): Algorithms and Programming (Lab)

Instructors: Y. Narahari and Viraj Kumar

The emphasis of this course is on translating algorithms (either implicitly known or taught during the course as pseudocode) into both a high-level programming language (Python) and a systems-level high- performance programming language (C). This course is broadly divided into three parts.

Part 1: Introduction to Python
Implementation, testing and debugging of elementary algorithms in Python involving operators and expressions, basic data types (integers, floats, Booleans, strings, lists), variables (references vs. objects), assignments, conditionals, iteration, functions, recursion, and modules.

Part 2: Basic Algorithms and Data Structures
Implementation of iterative algorithms (linear and binary search, string matching, iterative sorting algorithms, etc.) and recursive algorithms (exponentiation, recursive sorting, etc.). Introduction to asymptotic analysis. Big O notation. Recursive relations. Arrays versus Linked lists. Improving running times of algorithms using appropriate data structures such as hash tables, binary search trees, heaps, etc. Simple graph algorithms (shortest path, minimal spanning tree).

Part 3: Introduction to C
Differences between C and Python with respect to syntax and semantics (basic data types: integers, C arrays vs. Python lists, and strings; passing arguments to functions). Pointers and managing dynamic memory in C. Comparing the runtime performance of Python and C implementations of algorithms.

SUGGESTED BOOKS

1. How to Think Like a Computer Scientist: Interactive Edition, based on the book by Allan Downy and Jeff Elkner (https://runestone.academy/ns/books/published/thinkcspy/index.html)
2. How to Solve it by Computer by R. G. Dromey, Pearson Education, 2007
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language. Prentice Hall of India, 2009
4. Introduction to Programming in Python by Robert Sedgewick, Kevin Wayne, and Robert Dondero, 1st edition, 2015 (https://introcs.cs.princeton.edu/python/home/)
5. A Byte of Python by Swaroop C H (https://python.swaroopch.com/)
6. CPython implementation of binary heaps (https://github.com/python/cpython/blob/3.10/Lib/heapq.py)
7. Graphs and Graph Algorithms (https://runestone.academy/ns/books/published/pythonds3/Graphs/toctree.html)
8. An Introduction to Programming through C++ by Abhiram Ranade. McGraw Hill, 1st edition, 2017
9. C for Python Programmers (https://realpython.com/c-for-python-programmers/)

UH 101 (2:0): Ways of Knowing

Refer Chapter -16 for the syllabus

UMA 101 (4:0): Analysis and Linear Algebra – I

Refer Chapter -16 for the syllabus

Breadth Soft Core Courses:

UBL 101T (3:0): Introductory Biology I
UBL 101L (0:1): Introductory Biology I (Lab)

Refer Chapter -16 for the syllabus

UCY 101T (3:0): Introductory Chemistry - I
UCY 101L (0:1): Introductory Chemistry - I

Refer Chapter -16 for the syllabus

UPH 101T (3:0): Introductory Physics I – Mechanics, Oscillations and Waves
UPH 101L (0:1): Introductory Physics I – Mechanics, Oscillations and Waves (Lab)

Refer Chapter -16 for the syllabus

SEMESTER 2 (JANUARY)

Core Courses:

UENG 102T (3:0): Introduction to Electrical and Electronics Engineering
UENG 102L (0:1): Introduction to Electrical and Electronics Engineering (Lab)

Instructor: Kaushik Basu

Circuit analysis: KVL, KCL, dependent voltage/current sources, series and parallel equivalent, mesh and nodal analysis, Norton and Thevenin's equivalent, network theorems (superposition, maximum power transfer, Tellegen, Millman etc.), Laplace transform, first and second order RLC circuit transient analysis, RLC circuit analysis in sinusoidal steady state using phasors, idea of complex impedance, active and reactive power, Fourier series, Bode plots and passive filters. P-N junction theory. Ideal diode, Zener diodes, rectifier, clipper and clamper circuits, Zener-based power supply. MOSFET device theory and derivation of circuit model. MOSFET DC biasing and large signal analysis, small signal analysis CE, CG, CC amplifiers, differential amplifier and source coupled pair, a three-stage differential amplifier. Biasing with MOSFETs, current mirror, cascode, source degeneration. Amplifiers at high frequency. Two stage CMOS Operational Amplifier. Ideal Op-Amp. Op-Amp nonidealities, gain bandwidth product. Op-Amp with negative feedback and applications such as instrumentation amplifier, active filters, and analog computers. Operational Amplifier with positive feedback and applications such as Schmidt trigger, multivibrator, Wein-Bridge oscillator. Sample and Hold, ADC, DAC circuits. Combinational logic functions and its implementation using Boolean algebra (AND/OR/NOT), sum of products-product of sums, reduction with Karnaugh maps. Binary arithmetic, ripple carry adder and multiplier circuits. Multiplexer, de-multiplexer, decoder, encoders, and tri-state buffer. Logical sufficiency of NAND/NOR gates and their implementation with CMOS. Digital circuit design considerations-noise margin, propagation delay, fan- out, power loss. Sequential circuits with RS latch, D-T-JK flipflops and metastability. Asynchronous and synchronous counters. Finite state machines and its implementation. Introduction to computer organization: microprocessors and microcontrollers.
Software: SPICE and Verilog/VHDL.

SUGGESTED BOOKS:

1. Electrical Engineering: Principles and Applications, Allan R Hambley
2. Microelectronic Circuits: Theory And Applications, Sedra, Smith and Chandorkar
3. Fundamentals of digital logic with Verilog design, Stephen Brown and Jovonko Vranesic

UH 102 (2:0): Ways of Seeing

Refer Chapter -16 for the syllabus

UMA 102 (4:0): Analysis and Linear Algebra – II

Refer Chapter -16 for the syllabus

UMC 102 (3:0): Introduction to Computer Systems

Instructor: Vinod Ganapathy

Computer Programs as Instructions and Data; Instruction Execution; Representation of Data: Signed Integers, Reals; Program Execution: Function Call and Return, Memory Layout, Exceptions; Overview of System Software; Memory Hierarchy and Locality; Operating System Concepts: Process, Virtual Memory, File; Concurrency and Parallelism.

SUGGESTED BOOKS:

1. Computer Systems: A Programmer's Perspective, by Randal E. Bryant and David R. O'Hallaron, Pearson, 2015

UMC 103 (2:0): Discrete Mathematics

Instructor: C. Pandu Rangan

Mathematical Logic: Propositional logic: connectives, tautologies, and contradictions, logical equivalences, normal forms and applications. Predicates and quantifiers, interpretation and validity, proving validity, rules of inference.

Sets, Functions and Relations: Sets and cardinality, relations, functions, partial orders, total orders, linear orders, equivalence relations, partitions, n-ary relations.

Induction and Recursion: Induction, strong induction, well-ordering principle, recursive definitions and structural induction.

Basic Counting Principles: Pigeon-hole principle, permutations and combinations, Binomial coefficients and identities, elementary applications to discrete probability, recurrence relations and equations, generating function techniques, principles of inclusion and exclusion and its applications.

Graph Theory: Graphs and graph models, basic notions and operations, matchings, Hall's marriage theorem, vertex and edge connectivity, Euler and Hamiltonian circuits, vertex coloring. Trees.

SUGGESTED BOOKS:

1. Kenneth H Rosen: Discrete Mathematics and its Applications, McGraw Hill (2012)
2. Winfield K Grassmann and Jean-Paul Tremblay: Logic and Discrete Mathematics: A Computer Science Perspective, Prentice-Hall (1996)
3. M. Ben Ari: Mathematical Logic for Computer Science, 3rd edition, Springer (2012)
4. Eric Lehman, F Thomson Leighton, Albert R Meyer: Mathematics for Computer Science, (Open Edition 2013)

Breadth Soft Core Courses:

UBL 102T (3:0): Introductory Biology - II
UBL 102L (0:1): Introductory Biology - II (Lab)

Refer Chapter -16 for the syllabus

UCY 102T (3:0): Introductory Chemistry - II
UCY 102L (0:1): Introductory Chemistry - II (Lab)

Refer Chapter -16 for the syllabus

UENG 103 (3:0): Introduction to Earth and its Environment

Refer Chapter -16 for the syllabus

UPH 102T (3:0): Introductory Physics II – Electricity, Magnetism and Optics
UPH 102L (0:1): Introductory Physics II – Electricity, Magnetism and Optics (Lab)

Refer Chapter -16 for the syllabus

SEMESTER 3 (AUGUST)

Core Courses:

UH 201 (2:0): Ways of Doing: Mapping Science-Society Relationship

Refer Chapter -16 for the syllabus

UMA 201 (4:0): Probability and Statistics

Refer Chapter -16 for the syllabus

UMC 201 (3:1): Data Structures and Algorithms

Instructor: C. Pandu Rangan & Viraj Kumar

Review of Basic Data Structures - Arrays, Linked Lists, Stacks, Queues. Asymptotic complexity functions. Standard Data Structures - Heaps, Balanced Search Trees. Algorithmic Paradigms - Divide and Conquer, Greedy, Dynamic Programming. Graph Algorithms - Traversals, Shortest Paths, Minimum Spanning Trees. Advanced Data Structures - Union Find, Hashing. Amortized analysis, Splay trees, Fibonacci trees.

SUGGESTED BOOKS:

1. Data Structures and Algorithm Analysis in C by Mark Allen Weiss, Second edition, 1997 (Pearson)
2. Algorithm Design by Kleinberg and Tardos, 2006 (Pearson)
3. Introduction to Algorithms by Thomas H. Cormen, Charles
4. E. Leiserson, Ronald L. Rivest, Clifford Stein, Fourth edition, 2022 (MIT Press)

UMC 202 (3:1): Introduction to Numerical Methods

Instructor: Thirupathi Gudi

Numerical Solution of Algebraic and Transcendental Equations, Iterative Algorithms, Convergence, Newton Raphson Procedure, Solutions of Polynomial and Simultaneous Linear Equations, Gauss Method, Relaxation Procedure, Error Estimates, Numerical Integration, Euler-Maclaurin Formula. Newton-Cotes Formulae, Error Estimates, Gaussian Quadratures, Extensions to Multiple Integrals.

Numerical Integration of Ordinary Differential Equations: Methods of Euler, Adams, Runge-Kutta and Predictor – Corrector Procedures, Stability of Solution. Solution of Stiff Equations.
Solution of Boundary Value Problems: Shooting Method with Least Square Convergence Criterion, Galerkin Method (Finite Element) Solution of Partial Differential Equations: Finite-Difference Techniques, Stability and Convergence of the Solution, Finite Element Methods.

SUGGESTED BOOKS:

1. Richard L. Burden and J. Douglas Faires, Numerical Analysis: Theory and Applications, India Edition, Cengage Brooks-Cole Publishers, 2010
2. Press, W. H., Teukolsky, S.A., Vetterling, W. T., and Flannery, B. P., Numerical Recipes in C/FORTRAN, Prentice Hall of India, New Delhi, 1994
3. Borse, G. J., Numerical Methods with MATLAB: A Resource for Scientists and Engineers, PWS Publishing Co., Boston, 1997
4. Conte, S. D. and Carl de Boor., Elementary Numerical Analysis, McGraw-Hill, 1980
5. Hildebrand, F. B., Introduction to Numerical Analysis, Tata McGraw-Hill, 1988
6. Froberg, C. E., Introduction to Numerical Analysis, Wiley, 1965

Breadth Soft Core Courses:

UBL 201T (3:0): Introductory Biology - III
UBL 201L (0:1): Introductory Biology - III (Lab)

Refer Chapter -16 for the syllabus

UCY 201T (3:0): Introductory Chemistry - III
UCY 201L (0:1): Introductory Chemistry - III (Lab)

Refer Chapter -16 for the syllabus

UENG 201 (3:0): Introduction to Materials Science

Refer Chapter -16 for the syllabus

UPH 201T (3:0): Introductory Physics - III - Thermal and Modern Physics
UPH 201L (0:1): Introductory Physics - III - Thermal and Modern Physics (Lab)

Refer Chapter -16 for the syllabus

SEMESTER 4 (JANUARY)

Core Courses:

UH 203 (1:0): Mapping India Through Folk Arts

Refer Chapter -16 for the syllabus

UM 204 (3:1): Introduction to Basic Analysis

Refer Chapter -16 for the syllabus

UM 205 (3:1): Introduction to Algebraic Structures

Refer Chapter -16 for the syllabus

UMC 203 (3:1): Introduction to Artificial Intelligence and Machine Learning

Instructors: Chiranjib Bhattacharyya and Shishir N Kolathaya

Overview: Machine Learning Paradigms; Supervised, Unsupervised, and Reinforcement Learning. Supervised Learning: Bayes Classifier, Optimality; Risk Minimization; Generalisation Error Estimation. Perceptron, Logistic Regression, Least Squares, Regularization, Kernel Methods; SVMs, Multilayer Perceptrons, CNNs and Other Neural Network Models. Classifier Ensembles, Adaboost Algorithm. Unsupervised Learning: Generative Models, Parameter Estimation – Maximum Likelihood, Bayesian Methods; Latent Variables and EM Algorithm; Graphical Models, Deep Generative Models, Principal Component Analysis, Independent Component Analysis.
Reinforcement Learning and Markov Decision

SUGGESTED BOOKS:

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006
2. S. Shalev-Shwartz and S. Ben-David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014
3. Kevin Murphy, Machine learning: A probabilistic perspective, 2012
4. T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction', Springer, 2009
5. A. Zhang, Z. C. Lipton, M. Li, A. J. Smola, Dive into Deep Learning, 2019 (free PDF available)
6. I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press, 2016

UMC 205 (3:1): Automata Theory and Computability

Instructor: Deepak D'Souza

Finite-state automata: deterministic finite-state automata, pumping lemma, non-determinstc automata, regular expressions, Myhill-Nerode theorem, and ultimate periodicity.

Pushdown automata and context-free languages: Context-free grammars, Chomsky normal form, pumping lemma for CFLs, Parikh's semilinearity theorem, non-deterministic pushdown automata, equivalence of context-free grammars and pushdown automata, pushdown systems and reachability, and complementing deterministic PDAs.

Turing machines and undecidability: deterministic Turing machines, notion of computable functions using Turing machines, recursive and recursively enumerable languages, halting problem, reductions, Rice's theorems, undecidable problems related to context-free languages, and Godel's Incompleteness theorem.

Finite-State Automata, including the Myhill-Nerode Theorem, Ultimate Periodicity, and Buchi's Logical Characterization. Pushdown Automata and Context-Free Languages, Including Deterministic PDA's, Parikh's Theorem, and The Chomsky-Shutzenberger Theorem. Turing Machines and Undecidability, Including Rice's Theorem and Godel's Incompleteness Theorem.

SUGGESTED BOOKS:

1. Dexter Kozen: Automata and Computability. Springer 1997.
2. Hopcroft J.E. and Ullman J.D.: Introduction to Automata, Languages and Computation. Addison Wesley, 1979.

SEMESTER 5 (AUGUST)

Core Courses:

UH 301 (1:0): Journalism for Scientists

Refer Chapter -16 for the syllabus

Soft Core/Electives Courses – 16 Credits (Please refer to the table of Soft Core courses)

UG Soft Core Courses:

UMC 301 (3:1): Applied Data Science and Artificial Intelligence

Instructor: Deepak Subramani

Data Science Fundamentals: Identifying and framing a data science problem in different fields; Different types of Analytics; Introduction to Machine Learning, Artificial Intelligence; Is MUAI the right tool for your problem?; Stakeholder Discussion Guidelines; End-to-end Problem Solving through a 6-Step Data Science Process. Model selection for different data types. Assess the effectiveness of AI/ML models using A/B testing.

Exploratory Data Analysis: Visualizing data. Framing questions from data. Analyzing statistical relationships via Hypothesis Testing. How much data is sufficient data? Pre- processing of data: Data Distributions, Imputation, Outlier handling.

Data Science for Tabular Data: CART Algorithm, Random Forest Models, Gradient Boosted Models (XGBoost, CatBoost, LightGBM), Feature Importance and Selection, Development-Testing Paradigm. Cross Validation

Deep Learning for AI: A unified view of data-driven neural models for AI - From Linear Regression to Neural Networks, Basics of Stochastic Gradient Descent and Backpropagation, Hyperparameter Tuning, Different types of Layers, Neural models as data-processing pipelines.

Computer Vision: Practical computer vision with Transfer Learning. Identifying key AI tasks in Computer Vision. Choosing the right model, applying it, and taking the models to production.

Natural Language Processing: Natural Language Processing with Bag of Words and sequence Transformer Models. BERT-class models for Natural Language Understanding tasks; GPT-class models for Natural Language Generation Tasks. LLMOps – Taking an NLP problem from scratch to production.

SUGGESTED BOOKS:

1. Aurelien Geron. Hands-On Machine Learning with Scikit-Leam. Keras, and TensorFlow, 3rd Edition. O'Reilly Media. Inc.• 2022
2. F. Chollet. Deep Learning with Python. 2nd Edition. Manning 2021
3. Raschka, Sebastian, Yuxi Hayden Liu, Vahid Mirjalili, and Dmytro Dzhulgakov. Machine Learning with PyTorch and Scikit·Leam: Develop machine learning and deep learning models with Python. Packt Publishing Ltd. 2022
4. Lakshmanan. Valliappa. Martin Gomer. and Ryan Gillard. Practical machine learning for computer vision. O'Reilly Media, Inc.• 2021
5. Tunstall, Lewis, Leandro Von Werra. and Thomas Wolf. Natural language processing with transformers. O'Reilly Media, Inc.• 2022

UMC 204 (3:0): Digital Systems Design

Instructor: Mayank Shrivastava

Binary numbers and digital systems, digital vs. analog; Boolean algebra, logic gates, Boolean and switch level representation of logic gates; Gate level minimization: minimization of functions using Boolean identities and Karnaugh map; Combinational Circuits: Analysis and Design Procedure, Binary Adder– Subtractor, Binary Multiplier, Decoders and Encoders, Multiplexers; Synchronous Sequential Logic:
latches and flip-flops, uses of clock, counters,
shift-registers and finite state machines; Synchronous and Asynchronous machines; Basics of Design of Asynchronous machines; basics of sample and hold circuits, basics of ADCs and DACs; basics of Semiconductor memories: ROM, SRAM, DRAM; basics of CMOS implementation of Gates, basics of microprocessor: architecture, programming, memory and I/O interfacing.

SUGGESTED BOOKS:

1. Digital Design (Pearson, 5th Edition) by M. Morris Mano & Michael D. Ciletti
2. Digital Electronics: Principles, Devices and Applications (Wiley) by Anil Kumar Maini
3. Digital Logic and Computer Design (Pearson, 1st edition), by M. Morris Mano
4. Microprocessor Architecture, Programming and Applications with the 8085 by R. Gaonkar

Note: For details of the other soft core and elective courses please refer to respective department websites.

SEMESTER 6 (JANUARY)

Core Courses:

UH 302 (1:0): Introduction to Governance

Refer Chapter -16 for the syllabus

Soft Core/Electives Courses – 16 Credits
(Please refer to the table of Soft Core/Electives courses)

SEMESTER 7 (AUGUST)

UMC 401 ISP I (0:6)/ Soft Core/ Electives (6) + Soft Core/ Electives (6)

SEMESTER 8 (JANUARY)

- **UMC 402 ISP II (0:6)/ Soft Core/Electives Courses (6) + Electives (6) OR**
- **UMC 403 Project (12)**

Note: For Semesters 7 and 8 please refer to Section 3.6 for eligibility criteria for taking ISP I / ISP II / Project.

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