INDIAN INSTITUTE OF TECHNOLOGY MANDI

KAMAND, DISTT. MANDI – 175075 (HIMACHAL PRADESH)

MINUTES OF 59TH BOARD OF ACADEMICS MEETING

VENUE	:	GUEST HOUSE (NC)CONFERENCE ROOM + ONLINE
DATE	:	16th April, 2025 (WEDNESDAY)
TIME	:	03:00 PM

Following members attended the meeting

1.	Dean Academics	Prof. Aniruddha Chakraborty
2.	Associate Dean (Courses)	Dr. P Anil Kishan
3.	Associate Dean (Research)	Dr. Maheshreddy Gade
4.	Nominee-1: School of Computing and Electrical Engineering	Dr. Padmanabhan Rajan
5.	Nominee-2: School of Computing and Electrical Engineering	Dr. Gopi Shrikanth Reddy
6.	Nominee-1: School of Civil and Environmental Engineering	Dr. Sandip Kumar Saha
7.	Nominee-2: School of Civil and Environmental Engineering	Dr. Vivek Gupta
8.	Nominee-1: School of Mechanical and Materials Engineering	Dr. Gaurav Bhutani
9.	Nominee-1: School of Chemical Sciences	Dr. Bhaskar Mondal
10.	Nominee-2: School of Chemical Sciences	Dr. Garima Agrawal
11.	Nominee-1: School of Biosciences and Bioengineering	Dr. Sumit Murab
12.	Nominee-1: School of Physical Sciences	Dr. Arko Roy
13.	Nominee-1: School of Mathematical and Statistical Sciences	Dr. Rajendra K Ray
14.	Nominee-2: School of Mathematical and Statistical Sciences	Dr. Syed Abbas
15.	Nominee-1: IKSHMA	Prof. Aniruddha Chakraborty
16.	Nominee-2: IKSHMA	Dr. Sumit Murab
17.	Nominee-1: School of Humanities & Social Sciences	Dr. Neethi Vadakkan Alexander
18.	Nominee-2: School of Humanities & Social Sciences	Dr. Ramna Thakur
19.	Nominee-1: School of Management (SoM)	Dr. Puran Singh, MBA
20.	Nominee-2: School of Management(SoM)	Dr. Ashish Bollimbala, IMBA
21.	CnP Advisor	Dr. Kala Venkata Uday
22.	Deputy Registrar (Academics): Secretary	Mr. Suresh Rohilla
23.	PG Academic Secretary	Ms. Anugraha
24.	Research Affairs Secretary	Mr. Santu Shit

Following members could not attend the meeting

Sl. No.		Name	
1.	Chairman Senate Library Committee	Prof. Anjan Kumar Swain	Member
2.	Nominee-2: School of Mechanical and Materials Engineering	Dr. Deepak Sachan	Member
3.	Nominee-2: School of Biosciences and Bioengineering	Dr. Kasturi Prasad	Member
4.	Nominee-2: School of Physical Sciences	Dr. Harsh Soni	Member
5.	Nominee-2: Centre of Human Computer Interaction (HCI)	Dr. Deepak Sachan	Member

6.	Nominee-1: Centre of Human Computer Interaction (HCI)	Dr. Dinesh Singh	Member
7.	Nominee-1: Centre of AI and Robotics	Dr. Narendra Dhar	Member
8.	Nominee-2: Centre of AI and Robotics	Dr. Jagadeesh	Member
9.	Academic Affairs Secretary	Mr. Pourush Sharma	Member
10.	Industry Member – 1	Dr. Nadeem Akhtar	Member

Special Invitee

Sl. No.	Name	
1	Dr. Gajendra Singh	Asst. Prof., SMME
2	Dr. Ekta Makhija	Asst. Prof., SBB
3	Dr. Tanmay Kayal	Asst. Prof., SMSS
4	Dr. Rishikesh Yadav	Asst. Prof., SMSS
5	Dr. Vikash Tripathi	Asst. Prof., SMSS
6	Dr. Mirza Galib Anwarul Husain Baig	Asst. Prof., SMSS
7	Prof. Manoj Thakur	Prof., SMSS
8	Dr. Qaiser Jahan	Assoc. Prof., SMSS
9	Prof. Nitu Kumari	Assoc. Prof., SMSS

PART-A

(Issues discussed by the Board of Academics when the Student Members were present)

59.1 Confirmation of the minutes of 58th meeting of the Board of Academics:

The minutes of the 58th meeting of the Board of Academics held on 8th April, 2025 were confirmed.

59.2 To consider proposal for revision of MBA Curriculum:

Dr. Puran Singh, Nominee from BoA presented the proposal for revision of MBA Curriculum. After due deliberations, the BoA approved the proposal with minor modifications and the same shall be reported to the Senate. The approved curriculum will be applicable from 2024 batch onwards.

The approved proposal is placed as **Annexure – A**

59.3 To consider proposal for revision of I- MBA Curriculum:

Dr. Ashish Bollimbala, Nominee, SoM presented the proposal for revision of I- MBA Curriculum. After due deliberations, the BoA approved the proposal with minor modifications and the same shall be reported to the Senate. The approved curriculum will be applicable from 2024 batch onwards.

The modified proposal is placed as **Annexure – B.**

59.4 To consider proposal for Course Contents for IMBA Programme:

The agenda item is deferred.

59.5 To consider new courses from SCENE:

Dr. Sandip Saha presented the proposal for new courses from SCENE. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sl.No.	Course Code	Course Name	LTPC	Remarks/Mutual Exclusion with
1.	CE-562	Numerical Methods for Engineering Computation	3-0-0-3	ME-504
2.	CE-563	Finite Element Methods in Engineering	3-0-2-4	ME-513
3.	CE-564	Fundamentals of Fracture Mechanics	2.5-0.5-0-3	ME-506
4.	CE-617	Mechanics of Composite Materials	3-0-0-3	ME-617

These courses are with mutual exclusion of ME Courses as mentioned in the remarks column above. The course description is placed at **Annexure -C.**

59.6 To consider Minor modification in BTech Civil Engineering Curriculum:

Dr. Sandip Saha presented the proposal for minor revision in B.Tech. Civil Engineering programme curriculum. After due deliberations, the BoA approved the proposal and the same shall be reported to the Senate. The approved curriculum will be applicable from 2024 batch onwards.

The modified proposal is placed as **Annexure – D.**

59.7 To consider Minor modification in M.Tech., Structural Engineering Curriculum:

Dr. Sandip Saha presented the proposal Minor modification in M.Tech., Structural Engineering Curriculum. After due deliberations, the BoA approved the proposal and the same shall be reported to the Senate.

The modified proposal is placed as **Annexure – E.**

59.8 To consider proposal for B.Tech. in General Engineering Curriculum:

Dr. Gajendra Singh presented the proposal for B.Tech. in General Engineering Curriculum. After due deliberations, the BoA recommended the proposal with minor modifications for the consideration of Senate and its approval.

The modified proposal is placed as **Annexure – F.**

59.9 To consider new courses from SMME:

Dr. Gaurav Bhutani, presented the proposal for following new courses from SMME. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	ME-530/CE-530	Continuum Mechanics	3-0-0-3

The course description is placed at **Annexure -G.**

59.10 To consider proposal for Credit Adjustment of B.Tech. in Mechanical Engineering Curriculum:

Dr. Gaurav Bhutani, presented the proposal for Credit Adjustment of B.Tech. in Mechanical Engineering Curriculum. After due deliberations, the BoA approved the proposal and the same shall be reported to the Senate:

The modified proposal is placed as **Annexure – H.**

59.11 To consider revision of BTech Engineering Physics Curriculum:

The agenda item was not presented by the proposer and dropped.

59.12 To consider revision of M.Sc. Physics Curriculum:

The agenda item was not presented by the proposer and dropped.

59.13 To consider new courses from IKSMHA:

Prof. Arnav Bhavsar presented the following new courses from IKSMHA. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	IC-182	History of Science and Technology	3-0-0-3
2.	IK-517	Philosophy of Science	3-0-0-3

The course description is placed at **Annexure -I.**

59.14 To consider new courses from CAIR:

The agenda item was not presented by the proposer and dropped.

59.15 To consider proposal for Courses on internship for 06 & 09 credits:

Dr. Kala Venkata Uday presented the proposal for Courses on internship for 06 & 09 credits. After due deliberations, the BoA approved the following and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course
1.	DP-399P	For 09 Credit Internship
2.	DP-396P	For 06 Credit online internship

59.16 To consider proposal for CGPA calculation for M.Tech (Research) Programme:

Dr. Kala Venkata Uday presented the proposal for CGPA calculation for M.Tech (Research) Programme. BoA deliberated that this has already been approved in the 39th meeting held on 25th April, 2023. The same has been notified vide notification No. IITMandi/Acad/Senate/2023/2077-82 dated 13th July, 2023. Copy of the notification has been shared with concerned and the same will be reshared accordingly.

59.17 To consider proposal for finalization of dates of Course Completion certificates to be issued to the students:

Dr. Kala Venkata Uday presented the proposal for finalization of dates of Course Completion certificates to be issued to the students. BoA deliberated to suggest 30th September, 2025 as date of course completion certificate to be issued to the students.

59.18 To consider proposal Partial modification in B.Tech. Mathematics & Computing Programme in line with current institute policies:

Prof. Rajendra Kumar Ray presented the proposal for Partial modification in B.Tech. Mathematics & Computing Program in line with current institute policies. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate.

The modified proposal is placed as **Annexure – J.**

59.19 To consider new courses from SMSS:

Prof. Rajendra Kumar Ray presented the proposal for following new courses from SMSS. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	MA-220	Partial Differential Equations	3-1-0-4
2.	MA-221	Numerical Analysis	2-0-3-4
3.	MA-222	Applied Linear Programming	3-1-0-4
4.	MA-310	Matrix Computations & Lab	3-0-2-4
5.	MA-311	Mathematical Modelling	3-0-0-3
6.	MA-321	Numerics of Differential Equations	3-0-2-4
7.	MA-322	Applied Graph Theory	3-0-2-4
8.	MA-251	Abstract Algebra	3-0-0-3
9.	MA-120	Introduction to Computing Systems and Databases	3-0-2-4
10.	MA 312	Design and Analysis of Algorithms	3-0-2-4
11.	MA 313/ CS304	Formal Languages and Automata Theory	3-0-0-3
12.	MA 323/ CS 207	Applied Databases Practicum	0-0-3-2
13.	MA-548	Abstract Algebra	3-1-0-4
14.	MA-571	Introduction to Approximation Algorithms	3-1-0-4
15.	MA-572	Applied Multivariate Statistical Analysis	3-0-2-4
16.	MA-573	Advanced Mathematical Foundations of Machine Learning	3-1-0-4
17.	MA-574	An Introduction to Probabilistic Machine Learning	3-0-2-4
18.	MA-576	Nonlinear Optimization	3-1-0-4

The course description is placed at **Annexure -K.**

59.20 To consider new courses from SHSS:

Dr. Ramna Thakur, presented the proposal for following new courses from SHSS. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	HS-210	Introduction to Poetry in English	3-0-0-3

The course description is placed at **Annexure -L.**

59.21 To consider new courses for BS in Chemical Sciences:

Dr. Bhaskar Mondal presented the proposal for new courses for BS in chemical Sciences. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	CY-200	Foundations and Applications of Chemistry	3-0-0-3

The approved proposal is placed at **Annexure M.**

59.22 To consider Proposal for modification of existing PG Level Courses:

Dr. Bhaskar Mondal presented the proposal for modification of existing PG Level Courses. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits	Remarks
1.	CY-513	Chemical kinetics and Reaction Dynamics	3-0-0-3	Content change
2	CY-514	Chemical and Statistical Thermodynamics	3-0-0-3	
3	CY-555	Introduction to Polymer Science & Technology	3-0-0-3	

The approved proposal is placed at **Annexure N.**

59.23 To consider Modifications in BS Chemical Sciences Course Credit:

Dr. Bhaskar Mondal presented the proposal for BS chemical Sciences Course credits. Due to revision of IC Credit Structure, a new course CY-200 has been proposed in place of FDP from Chemical Sciences. 03 Credits of CY-200 are added in Discipline Core and 01 Credit is increased in Discipline Elective. After due deliberations, the BoA approved the following credit distribution and the same shall be reported to the Senate:

Sr. No	Basket	No. of Credits
	Existing Credit Distribution	
1	Institute Core	52 credits
2	Discipline Core	59 credits
3	Discipline Elective	23 credits
4	Free Elective	15 credits
5	Research Commination and Projects	14 credits
	TOTAL	**163** credits
	Approved Credit Distribution	
1	Institute Core	48 credits
2	Discipline Core	59+3= 62 credits
3	Discipline Elective	23+1=24 credits
4	Free Elective	15 credits
5	Research Commination and Projects	14 credits
	TOTAL	**163** credits

The approved Curriculum for BS in CS semester wise is available at **Annexure O.**

59.24 To consider Modification in Course Codes for BS/MSc Research Project I and II:

Dr. Bhaskar Mondal presented the proposal for Modification in Course Codes for BS/MSc Research Project I and II. After due deliberations, BoA suggested to present the detailed proposal in upcoming BoA meeting.

59.25 To consider Proposal for Offering Semester Exchange Opportunities for BS Chemical Sciences:

Dr. Bhaskar Mondal presented the proposal for Offering Semester Exchange Opportunities for BS Chemical Sciences. After due deliberations BoA recommended that the proposal should be presented in the upcoming Senate for further deliberations.

59.26 To consider the proposal for revision of Course list for Minor in Intelligent Systems:

Dr. Gopi Shrikanth Reddy presented the proposal for revision of course list for Minor in Intelligent Systems. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Existing List of Courses		**Updated List of Courses**	
Course Code	**Name of the Course**	**Course Code**	**Name of the Course**
BY606	Bioinformatics Applications for System Analysis	EE511	Computer Vision
CS305	Artificial Intelligence	CS673	Advanced Computer Vision
CS506	Cognitive Modeling	CS671	Deep Learning and Applications
CS630	Speech Technology	CS672	Advanced Deep Learning
CS669	Pattern Recognition	DS413	Introduction to Statistical Learning
CS660	Data Mining for Decision Making	DS411	Optimization for Data Science
EE511	Computer Vision	CS683	Generative AI
CS671	Deep Learning and Applications	CS685	Natural Language Processing
CS670	Kernel Methods for Pattern Analysis	CS305	Artificial Intelligence
EE608	Digital Image Processing	DS412	Matrix Computation for Data Science
		EE608	Digital Image Processing
		BY606	Bioinformatics Applications for System Analysis
		CS630	Speech Technology
		CS660	Data Mining for Decision Making
		CS609	Speech Processing

59.27 To consider the proposal for revision of Course list for Minor in Computer Science Engineering:

Dr. Gopi Shrikanth Reddy presented the proposal for revision of Course list for Minor in Computer Science Engineering. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Course Code	Course Name	LTPC
	Compulsory Courses	
CS-212	Design and Analysis of Algorithms	3-0-2-4
	Suggested Courses	
CS-214	Computer Organization	3-0-2-4
CS-208	Mathematical Foundation of Computer Science	3-1-0-4
CS-302	Paradigms of Programming	3-0-2-4
CS-304	Formal Language and Automata Theory	3-0-0-3
CS-309	Information and Database Systems	3-0-2-4
CS-514	Data Structure and Algorithms II	3-0-2-4
CS-312	Operating System	3-0-2-4
CS-313	Computer Networks	3-0-2-4
CS-305	Artificial Intelligence	3-0-0-3

59.28 To consider new courses from SCEE:

Dr. Gopi Shrikanth Reddy presented the proposal for new courses from SCEE. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1	CS-521	Introduction to Post Quantum Security	2-1-0-3
2	CS-524	Computational Complexity Theory	3-1-0-4
3	EE-550	Optimal Control & Estimation	3-0-0-3

The course description is placed at **Annexure -P.**

59.29 To consider new courses for Microelectronics & VLSI Programme:

Dr. Gopi Shrikanth Reddy presented the proposal for new courses for Microelectronics & VLSI Programme. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1	VL-300	Reverse Engineering - E-Waste Management	0.5-0-0.5-1
2	VL-311	CMOS Processing and Practicum	3-0-2-4
3	VL-401	RTL Design and Verification.	2-0-2-3

The course description is placed at **Annexure -Q.**

59.30 To consider proposal for revision of criteria of admission under Project to Ph.D./ M.Tech(Research) MA(Research)/ MS(Research) Mode on the basis of 06 Months experience in project:

The agenda item was dropped as this has already been approved in 55th BoA and 44th Senate meeting held on 31st May, 2024 and 17th September, 2024 respectively. The same has already notified vide notification No. IITMandi/SM-44/2024/493-500 dated 10th October, 2024.

59.31 To consider proposal for Executive MTech program in Data Science and Machine Learning:

The agenda item was not presented by the proposer and dropped.

59.32 To consider new courses from SBB:

Dr. Sumit Murab, presented the proposal for new courses from SBB. After due deliberations, the BoA approved the following courses and the same shall be reported to the Senate:

Sr. No.	Course No.	Name of the Course	Credits
1.	BY-533	Advanced Environmental Biotechnology	3-0-0-3
2.	BY-534	Introduction to Functional Neuroimaging and Dara Analysis	2-1-0-3

The course description is placed at **Annexure -R.**

59.33 To consider proposal for Specialization degree for students of Integrated BTech-MTech Integrated Dual Degree Bioengineering Program batches 2019, 2020, 2021:

Dr. Ekta Makhija presented the proposal for Specialization degree for students of Integrated BTech-MTech Integrated Dual Degree Bioengineering Program of 2019, 2020, 2021 batches. After due deliberation BoA Suggested that the fresh proposal for specialization degree for 2020 & 2021 batch may be presented in upcoming BoA with more details. For 2019 batch, the proposal may be presented separately as the batch has already graduated.

59.34 To consider proposal for Credit distribution (IC Compulsory, IC Basket, Discipline Core, Discipline Elective) for students who applied for Exit Option from Dual Degree Bioengineering Program to BTech Bioengineering Degree program:

Dr. Ekta Makhija presented the proposal for Credit distribution (IC Compulsory, IC Basket, Discipline Core, Discipline Elective) for students who applied for Exit Option from Dual Degree Bioengineering Program to BTech Bioengineering Degree program. This curriculum is applicable for B.Tech Bioengineering 2021 & 2022 Batch Only. After due deliberation BoA recommended the proposal with minor modification for the consideration of the Senate and its approval.

The modified proposal is placed as **Annexure – S.**

Any other item with the permission of the Chair:

-NIL-

PART-B

(Issues discussed by the BoA without the Student Members being present)

-NIL-

The meeting ended with a vote of thanks to and by the Chair.

C. Venkatram
13/06/2025

Chairman, Board of Academics

Secretary, Board of Academics

Annexure A

Revised Curriculum of Two Years Master of Business Administration (Data Science and Artificial Intelligence)

Semester I MBA DS&AI			
Type	**Code**	**Course Name**	**Credits**
DC	MB509	Introduction to Bhagavad Gita	2
DC	MB510	Probability and Statistics for Data Science & AI	2
DC	MB511	Python Programming	2
DC	MB512	Mathematical Foundation of Data Science and AI	2
DC	MB514	Communication Skills for Managers	2
DC	MB515	Financial Statement Analysis	2
DC	MB516	Managerial Economics	2
DC	MB517	Marketing Management I	2
DC	MB519	Creative Thinking, Problem Solving and Decision Making	2
DC	MB562	Operations Management	2
		Semester Credits	**20**
Semester II DS and AI			
DC	MB520	Fundamentals of Data and Analytics	2
DC	MB521	Disruptive Technology in Data Science	2
DC	MB526	Strategic Management	2
DC	MB522	Machine Learning for Business	2
DC	MB523	Introduction to AI and Automation	2
DC	MB524	Organizational Behaviour	2
DC	MB518	Decision Analysis	2
DC	MB525	Project Management	2
DC	MB535	Marketing Management II	2
DC	MB531	Ethical and Legal Aspects of Business	2
DC	MB527	Financial Management	2
		Semester Credits	22
Internship	Internship	Summer Internship	2
Semester III DS and AI			
DC	MB530	Neural Network Fundamentals for Business	2
DC	MB532	Digital Business Strategy, Models and Transformations	2
DC	MB533	Entrepreneurship	2

DC		Business and Data Leadership	2
DC	MB 581	Management Insights from Indian Knowledge System	2
DC	MB528	Human Resource Management	2
DC	MB525	Qualitative Research Methods	2
FE		Free Elective 1	2
Project		Management Project I	4
		Semester Credits	20
Semester IV DS and AI			
DE		Discipline Elective 1	2
DE		Discipline Elective 2	2
DE		Discipline Elective 3	2
DE		Discipline Elective 4	2
DE		Discipline Elective 5	2
FE		Free Elective 2	2
Project		Management Project II	4
		Semester Credits	16
		TOTAL CREDITS IN TWO YEARS	80
List of Discipline Elecives (DE)*			
DE	MB550	AI for Marketing	2
DE	MB551	Causal Analytics for business decisions	2
DE	MB552	Financial Analytics	2
DE	MB553	Fintech	2
DE	MB554	Blockchain for Business	2
DE	MB555	Deep Learning for Business Application	2
DE	MB556	Natural Language Processing for Business	2
DE	MB557	Devops In ML and AI	2
DE	MB558	Intelligent Automation	2
DE	MB559	Fuzzy logic for business decision making	2
DE	MB560	Evolutionary computation for business solutions	2
DE	MB561	DevOps	2
DE	MB562	Operations Management	2
DE	MB571	Design Thinking	2
DE	MB579	Marketing Analytics	2
DE	MB580	AI In Finance	2
DE	MB585	Supply Chain Analytics	2

DE	MB592	Management Science in Practice - A Modelling and case studies approach with MS-Excel	2
List of Free Electives (FE)*			
FE	MB570	Product Management	2
FE	MB572	Social Analytics	2
FE	MB573	Cloud Computing For Business	2
FE	MB574	Cyber Securities, Ethics and Privacy	2
FE	MB575	Negotiation Analysis	2
FE	MB576	Data Stratategy	2
FE	MB577	AI Strtategy and Implemantation	2
FE	MB578	Leadership	2
FE	MB581	Leadership lessons from Indian Knowledge Systems	2
FE	MB582	Consumer Behavior	2
FE	MB583	Digital marketing	2
FE	MB584	Supply Chain Management	2
FE	MB586	Advertising and Brand Management	2
*Note: List of FE and DE are tentative and subject to change based on institutional requirements and/or student demand.			

Annexure B

Semester	Course Code	Type	Course Title	Credit
1	IC112	IC	Calculus	2
1	IC152	IC	Introduction to Python and Data Science (Previously DS I)	4
1	IC230	IC	Environmental Science	3
1	IC113	IC	Complex Variables and Vector Calculus	2
1	MB202	DC	Microeconomics (DC)	3
1	MB201	DC	Foundations of Business Management (DC)	4
1	IC181/Equivalent	DC	Introduction to Consicisness...../Equivalent	3
1	MB291	DE	Management Workshop I	1
Semester total Credits				**22**
2	IC114	IC	Linear Algebra	3
2	IC115	IC	ODE and Integral Transform	2
2	IC252	IC	Probability and Statistics (Previously DS II)	4
2	MB206	DC	Excel for data analysis	3
2	MB203	DC	Macroeconomics	3
2	MB205	DC	Written and Verbal Communication	3
2	MB301	DC	Problem solving and Decision Making for Managers	3
2	MB292	DE	Management Workshop II	1
Semester total Credits				**22**
3	DS201	DC	Data handling and Visualization	3
3	IC272	IC	Machine Learning (Previously DS III)	3
3	CS208/DS301	DC	Mathematical Foundation of Computer Science/Data Science/Management Science	4
3	MB302	DC	Business Law	3
3	MB305	DC	Business Communication	3
3	MB303	DC	Financial Accounting	3
3	MB304	DC	Ethics and Values	3
Semester total Credits				**22**
4	DS411	DC	Optimization for Data Science	4
4	DS313	DC	Statistical Foundation of Data Science	4
4	IC253	IC	Programming and Data Structures	3
4	MB306	DC	Introduction to organisational structure	3
4		FE	Free Elective (Basket-I)	3
4	MB307	DC	Cost and Financial Accounting	3
4	MB391	DC	Management Workshop III	1
Semester total Credits				**21**
5	MB401	DC	Mathematics for Business Management	3
5	MB308	DC	Introduction to Marketing	3
5	MB402	DC	Operations Research	3
5	MB403	DC	Foreign Language 1	3
5	MB404	DC	Business Research Methods	3
5	MB405	DC	Database for Managers	3
5	MB392		Management workshop IV	1
5	FE	FE	Free Elective (Basket-II)	3

Semester total Credits				**22**
6	MB309	DC	Introduction to Operations Management	3
6	MB310	DC	Introduction to Financial Management	3
6	MB393		Management Workshop V (Preferably one of the Indian Art Forms)	1
6	MB406	DC	Public Speaking and debating	2
6	FE	FE	Free Elective (Basket-III)	3
6	FE	FE	Free Elective (Basket-III)	3
6	MB407	DC	Econometrics	3
6	MB408	DC	Indian Economy	3
Semester total Credits				**21**
7	Internship		Internship/Semester exchange/Start-up	12
The IMBA curriculum for 8th, 9th and 10th semester will be the same as that of MBA curriculum being followed at that moment for 2nd, 3rd, & 4th Semester respectively.				
Semester total Credits				**12**
8	MB520	DC	Fundamentals of Data and Analytics	2
8	MB521	DC	Disruptive Technology for Data Science	2
8	MB526	DC	Strategic Management	2
8	MB522	DC	Machine Learning for Business	2
8	MB523	DC	Introduction to AI and Automation	2
8	MB524	DC	Organizational Behavior	2
8	MB518	DC	Decision Analysis	2
8	MB536	DC	Project Management	2
8	MB535	DC	Marketing Management II	2
	MB531	DC	Ethical and Legal Aspects of Business	2
Semester total Credits				**20**
Summer	MB529	DC	Summer Internship	2
Semester total Credits				**2**
9	MB530	DC	Neural Network Fundamentals for Business	2
9	MB532	DC	Digital Business Strategy, Models and Transformations	2
9	MB533	DC	Entrepreneurship	2
9	MB537	DC	Business and Data Leadership	2
9	MB538	DC	Management Insights from Indian Knowledge System	2
9	MB528	DC	Human Resource Management	2
9	MB525	DC	Qualitative Research Methods	2
9		FE	Free Elective 1	2
9	MB534	DC	Management Project I	4
Semester total Credits				**20**
10	DE	DE	Discipline Elective 1	2
10	DE	DE	Discipline Elective 2	2

10	DE	DE	Discipline Elective 3	2
10	DE	DE	Discipline Elective 4	2
10	DE	DE	Discipline Elective 5	2
10	FE	FE	Free Elective 2	2
10	MB540	DC	Management Project II	4
Semester total Credits				**16**
			Total Credits for Five Years	**200**

Free Elective Basket for IMBA first three years of IMBA.			
Course Code	**Course Title**	**School offering the course**	**Credits**
Basket 1 for semester 4 free electives			
IC241	Materials Science for Engineers (3-0-0-3)	SMME IC	3-0-0-3
IC131	Applied Chemistry for Engineers (3-0-0-3)		3-0-0-3
IC203	Environmental Science (3-0-0-3)		3-0-0-3
IC136	Understanding Biotechnology and its Application (3-0-0-3)		3-0-0-3
IK539	Sanskrit and Technology: An Overview		3-0-0-3
Basket 2 for semester 5 free electives			
MA514	Computer Programming (3-0-0-3)	SMSS	3-0-0-3
MA514P	Computer Programming Lab (0-0-3-2)	SMSS	0-0-3-2
MA312	Design and Analysis of Algorithm (3-0-2-4)	SMSS	3-0-2-4
CS304/MA313	Formal Language and Automata Theory (3-0-0-3)	SMSS	3-0-0-3
CS206	Computer Networks (3-0-0-3)	SCEE	3-0-0-3
CS212	Design and Analysis of Algorithms (3-0-2-4)	SCEE	3-0-2-4
CS211P	Network and Database Practicum (0-0-3-2)	SCEE	0-0-3-2
CS203	Discrete Structures	SCEE	3-0-0-3
IK515	Music and Cognition		3-0-0-3
Basket 3 for semester 6 free electives			
MA310	Matrix Computation & Lab (3-0-2-4)	SMSS	3-0-2-4
DS402	Matrix Computations for Data Science (2-0-2-3)	Data Science and Engineering	2-0-2-3
MA222	Applied Linear Programming (3-1-0-4)	SMSS	3-1-0-4
MA515	Applied Mathematical Programming (3-1-0-4)	SMSS	3-1-0-4
MA525	Heuristic Optimization (3-0-0-3)	SMSS	3-0-0-3
EE530	Optimization Theory	Electrical Engineering	3-0-0-3
EE530	Applied Optimization	Electrical Engineering	3-0-0-3
IK510	Cognitive Neuroscience		3-1-0-4
MA576	Nonlinear Optimization (3-1-0-4)	SMSS	3-1-0-4
MA653	Computational Financial Modelling	SMSS	2-1-0-3
MA653P	Computational Financial Modelling Lab	SMSS	0-0-2-1
MA553	Mathematical Foundations of Financial Engineering	SMSS	2-1-0-3
MA654	Financial Engineering	SMSS	2-1-0-3
MA550	Statistical Data Analysis	SMSS	2-1-0-3
IK568	Indian Performing Arts	IKSHMA	3-0-0-3
Note: The list of electives are tentative and are subject to changes based on institutional and/or student requirements.			

Revised IMBA Curriculum – Summary of Updates

1st Semester

- Total credits increased from 20 to 22.
- Moved IC230: Environmental Science from 3rd to 1st semester.
- Dropped IC136: Understanding Biotechnology and its Application
- Included IC113: Complex Variables and Vector Calculus
- IC181 or an equivalent course from the IC basket to be undertaken.

2nd Semester

- Adopted IC115: ODE and Integral Transform (2 credits) and MB206: Excel for Data Analysis (3 credits).
- Moved MB301: Problem Solving and Decision Making for Managers from 3rd semester.
- MB304: Ethics and Values not part of this semester anymore.
- Dropped Foundations of Design Practicum (4 credits).
- Credit allocation for MB301: Written and Verbal Communication revised from 4 to 3 credits.

3rd Semester

- IC201P: Design Practicum substituted (3 Credits) is not included.
- Introduced MB302: Business Law (3 Credits).
- Moved MB305: Business Communication from 5th semester.
- Introduced MB303: Financial Accounting (3 credits).
- Moved MB304: Ethics and Values from 2nd semester.
- Data Structures and Algorithms and Introduction to Bhagavad Gita are not part of the curriculum in this semester.

4th Semester

- Total credits adjusted to 21.
- IC253: Programming and Data Structures added.
- MB306: Introduction to Organisational Structures added.
- Psychological Foundations of Business Management not included.
- One Free Elective (3 credits) included. Students need to choose from FE Basket-I
- MB307: Cost and Financial Accounting added.
- MB392: Management Workshop IV, Selected Topics from Ramayana, and Business Government and Society are not included in this semester.

5th Semester

- MB401: Mathematics for Business Management (3 credits) and MB402: Operations Research (3 credits) added.
- One Free Elective (3 credits) added. Students need to choose from FE Basket-II
- MB305: Business Communication moved to the 3rd semester.
- MB392: Management Workshop IV reintroduced in this semester.

6th Semester

- Total credits revised to 21.
- MB309: Introduction to Operations Management included.
- Two Free Electives (3 credits each) added—students can choose from FE baskets-III.
- MB407: Econometrics added
- Sustainability Business Practices not included.
- Selected Topics from Mahabharata is not included.

9th Semester

- MB525: Qualitative Research Methods (2 credits) added.

10th Semester

- DE-1 (2 credits) introduced in this semester.
- Credit allocation for MB540: Management Project-II revised from 6 to 4 credits.

Note:
The overall credit requirement for the IMBA program remains unchanged at **200 credits**.

Annexure-C

IIT Mandi
Proposal for a New Course

Course number : CE-562
Course Name : Numerical Methods for Engineering Computation
Credit Distribution : 3-0-0-3
Intended for : UG/PG
Prerequisite :
Mutual Exclusion : ME-504
Distribution : Elective
Semester : Odd/Even

1. **Preamble:** Computational analysis of mathematical models is an essential facet of engineering practice and research. Numerical methods enable effective solution of problems which are not amenable to simple analytical treatment. A comprehensive introduction to the subject fundamentals provides for the handling of common mathematical problems and prepares a foundation for the learning of advanced paradigms such as finite element and finite volume analysis

2. **Course Outline:** The course introduces fundamental concepts of numerical analysis for handling of mathematical problems frequently encountered in engineering computations. The course lays a special emphasis on the development of programming skills via CPP implementation of numerical schemes to analyze common engineering problems. The exercise is expected to make the learner adept in handling mathematical problems using self-designed routines and in gaining insights into the related aspects of computational efficiency and accuracy.

3. **Course Modules:**

1) **Introduction:** Differential equations in engineering applications. Analytical vs. Numerical solution of a mathematical model. Computer representation of numbers. Errors in numerical computation. Review of CPP programming concepts - Program structure, data types, arrays, structures, functions, file handling using simple problems: Second moment of area, analysis of beams, basic statistics etc. **(3 contact hours)**

2) **Systems of linear algebraic equation:** Gauss elimination, Gauss Jordan, LU decomposition, and Gauss-Seidel methods. Thomas algorithm for tri-diagonal and Cholesky decomposition for symmetric matrices. Matrix inversion methods. CPP programs for the mentioned schemes. **(6 contact hours)**

3) **Eigen problem:** Eigenvalues and Eigen vectors. Properties. Methods of estimation of Eigenvalues and Eigenvectors – Power Iteration Methods, Jacobi Iteration, QR algorithm; Application of these concepts towards Matrix Inversion and solution of linear simultaneous equations. **(5 contact hours)**

4) **Curve fitting:** Linear regression, polynomial regression, nonlinear regression. CPP program for constitution of normal equations. **(4 contact hours)**

5) **Finite differences and interpolation:** Taylor's series, Forward, backward and central differences, Difference tables, Finite difference operators, Newton's forward and backward interpolation formulae, Stirling's, Bessel's and Laplace-Everett's interpolation formulae. Lagrange's polynomial and Newton's divided difference formula. CPP programs for implementing interpolation schemes. **(6 contact hours)**

6) **Numerical differentiation and integration:** Derivatives using forward, backward and central difference formulae. Newton-Cotes integration formulae – Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule. CPP programs for implementing numerical integration schemes. **(6 contact hours)**

7) **ODEs:** Description of initial and boundary value problems. Taylor's series, Picard's, Euler's, Runge-Kutta and Milne's methods. Finite difference solution of boundary value problems. **(6 contact hours)**

8) **PDEs:** Description of Elliptic, Parabolic and Hyperbolic PDEs. Solution of Laplace's and Poisson's equations. Solution of linear heat transfer equation - CPP programs for implementation of explicit and implicit schemes. Conditions for stability. **(6 contact hours)**

Text books:

- Numerical methods for engineers by Steven C. Chapra and Raymond P. Canale. McGraw-Hill. 2015.
- Numerical methods with C++ programming by Nita H. Shah, PHI. 2009.

Reference books:

- Numerical methods for engineers and scientists by Joe D. Hoffman. Marcel Dekker, Inc. 2001.
- Numerical methods with programs in C by T. Veerarajan and T. Ramachandran. Tata McGraw-Hill. 2006.

Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	ME 504	100%	

6. Justification of new course proposal if cumulative similarity content is >30%:

Mutual Exclusion : ME-504

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: **School: SCENE**

Signature: **Date:**

The following faculty (at least 3 faculty) discussed on..............and approved the proposal on.............

Sl. No	Faculty Name	Signature

School Chair:

School:

Date:

This proposal is reported in .... the Board of Academics on ....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: CE-563**
Course Name	: Finite Element Methods in Engineering
Credit Distribution	: 3-0-2-4
Intended for	: BTech 3rd and 4th Year; M.Tech/MS/Ph.D.
Prerequisite	: Linear Algebra (IC 111); Mechanics of Rigid Body (IC 240); Mechanics of Solids (ME 206)/Strength of Material (CE 301).
Distribution	: Discipline Core for M.Tech-Structural Engineering; Elective for BTech 3rd and 4th Year; MTech/MS/Ph.D
Semester	: Odd/Even
Mutual Exclusion	: ME 513
Comments	: The 24th Senate meeting of IIT Mandi held on 13th February, 2020 approves the discontinuation of the previous two course codes ME 352 and CE 607

---

1. **Preamble:** To provide the basic concepts of finite element method and its applications to wide range of engineering problems. This course deals with various modelling techniques and uses different numerical methods for solving a system of governing equations over the domain of a continuous physical system (such as structural problem, thermal problem, fluid mechanics problem), which is discredited into simple geometric shapes called finite element.

2. **Course Modules with Quantitative lecture hours:**

Basic concept: Introduction, Engineering applications of finite element method, Rayleigh- Ritz method, Weighted residual methods: Galerkin's method, Principal of a minimum potential energy, principle of virtual work, Boundary value problem, initial value and Eigenvalue problem, Gauss elimination method. **[8 Hours]**

Basic procedure: General description of Finite Element Method, Discretization process; types of elements 1D, 2D and 3D elements, size of the elements, location of nodes, node numbering scheme, half Bandwidth, Stiffness matrix of bar element by direct method, Properties of stiffness matrix, Pre- processing, post processing, One Dimensional Problems.

[6 Hours]

Interpolation models: Polynomial form of interpolation functions- linear, quadratic and cubic, Simplex, Complex, Multiplex elements, Selection of the order of the interpolation polynomial, Convergence requirements, 2D Pascal triangle, Linear interpolation polynomials in terms of global coordinates of bar, triangular (2D simplex) elements, Linear interpolation polynomials in terms of local coordinates of bar, triangular (2D simplex) elements, CST element. **[6 Hours]**

Higher order and isoparametric elements: Lagrangian interpolation, Higher order one dimensional elements- quadratic, Cubic element and their shape functions, properties of shape functions, Truss element, Shape functions of 2D quadratic triangular element in natural coordinates, 2D quadrilateral element shape functions – linear, quadratic, Biquadric rectangular element (Noded quadrilateral element), Shape function of beam element. Hermite shape functions of beam element.

[6 Hours]

Derivation of element stiffness matrices and load vectors: for bar element under axial loading, trusses, beam element with concentrated and distributed loads, matrices, Jacobian, Jacobian of 2D triangular element, quadrilateral, Consistent load vector, Numerical integration. **[4 Hours]**

Heat transfer and Fluid mechanics problems: 1D analysis for both heat transfer and fluid mechanics problem, heat conduction governing equation, boundary conditions, Galerkin approach, heat flux boundary condition, 1D heat transfer in thin fins. **[4 Hours]**

Elasticity problems: Review of equations of elasticity, stress-strain and strain displacement relations, plane stress and plane strain problems. **[4 Hours]**

Dynamic problems: Beam and Bar vibration; Natural frequency determination. **[4 Hours]**

Laboratory Component: [28 Hours]

- Coding for the complete solution of any suitable problem, Such as Bar, Truss and Beam.**[12 Hours]**
- Introduction to ANSYS & ABAQUS. **[4 Hours]**
- Bar and truss problem and 2-D analysis (assuming plane stress and plane strain). **[4 Hours]**
- Introduction to OPEN SOURCE PROGRAMS (like OpenSees, FEAP, Elmer etc.) **[2 Hours]**
- Some complex analysis using ANSYS or ABAQUS (complex material modelling or Geometrical modelling). **[6 Hours]**

3. Text book:

- Hutton, D.V., "Fundamentals of Finite Element Analysis", TMH, 2005.
- Logan, D. L., "A first course in the Finite Element Method", 6th edition, Cengage Learning, 2017.

4. References:

- Rao, S.S. "The finite element method in engineering", 4th edition, Elsevier, 2005.
- Reddy, J.N., "An introduction to the finite element method", McGraw-Hill, 2005.
- Huebner, K. H., Dewhirst, D. L., Smith, D. E. and Byrom, T. G., "The finite element method for engineers", 4th edition, John Wiley & Sons, 2001.
- Chandrupatla, T.R., "Finite element analysis for engineering and technology", University Press (India) Pvt Ltd, 2004.
- Fish, J. and Belytschko, T., "A first course in Finite Elements", Wiley 2007

5. Similarity Content Declaration with Existing Courses.

S.N	Course Code	Similarity Content	Approx. % of Content
1	ME 206	Plane stress and plane strain	2%

6. Justification for new course proposal if cumulative similarity content is > 30%: N

13/05/25

Chairperson, SCENE

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	: CE-564
Course Name	: Fundamentals of Fracture Mechanics
Credit Distribution	: 2.5-0.5-0-3
Intended for	: UG/PG
Prerequisite	: IC 242 Continuum Mechanics, IC 240 Mechanics of Rigid Bodies, IC 241 Materials Science for Engineers
Semester	: Odd/Even
Elective or Core	: Elective
Mutual Exclusion	: ME 506

---

1. **Preamble:** The objective of this course is to introduce the physical and mathematical principles of fracture mechanics and their applications in wide range of engineering design. This course will expand the students' knowledge on experimental methods to determine the fracture toughness and develop the students understanding on the design principle of materials and structures using fracture mechanics approaches.

2. **Course Contents:**

1) **Introduction [4 Lectures]**
Why structures fails?, An atomic view, Energy criterion, Stress intensity, Effect of material properties on fracture, Modes of failure.

2) **Linear Elastic Fracture Mechanics [10 Lectures]:** An atomic view of fracture, Effect of flaws on stress concentration, Griffith theory of fracture, Energy release rate, Instability and the *R* curve, Stress analysis of cracks, Stress Intensity Factor (SIF) , Determination SIF of different geometries, Crack tip plasticity, Irwin approach, Plane

strain fracture, Mixed mode fracture.

3) **Elastic-Plastic Fracture Mechanics [10 Lectures]**

Crack tip opening displacement (CTOD), J contour integral, Relationship between *J* and CTOD, Resistance curve, Cleavage fracture, failure criterion, Three-dimensional effect, Crack arrest.

4) **Fracture Mechanisms in Metals and Nonmetals [8 Lectures]**

Ductile fracture, Void nucleation, Void growth, coalescence, Ductile crack growth, Brittle Fracture, Cleavage, Mechanisms of cleavage initiation,

Transgranular and Intergranular fracture, Fracture Mechanisms in Nonmetals.

5) **Fracture Toughness Testing [4 Lectures]**

Specimen configurations and orientations, K_{IC} testing, CTOD testing, Measurement of J-critical, Determination of critical G in Mode I and Mode II.

6) **Fatigue Crack Propagation and Environmental Assisted Fracture Failure [4 Lectures]**

Fatigue crack growth, Crack closure, A short introduction to environmental assisted fracture failure.

7) **Computational Fracture Mechanics [2L]**
Modeling and analysis.

Text Book:

1. T.L. Anderson, Fracture Mechanics – Fundamentals and Applications, Taylor and Francis Group, CRC Press; 3 edition (24 June 2005)

Reference Book:

1. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw Hill, New Delhi, India.
G.E. Dieter, Mechanical Metallurgy, McGraw Hill, 2009

3. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	ME 506	100%	

6. Justification of new course proposal if cumulative similarity content is >30%:
Mutual Exclusion ME 506

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: **School: SCENE**

Signature: **Date:**

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……..

Sl. No	Faculty Name	Signature

जनीशशर्मा 13/05/25

School Chair:

School:

Date:

This proposal is reported in …… the Board of Academics on ……

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : CE 617
Course Name : Mechanics of Composite Materials
Credit Distribution : 3-0-0-3
Intended for : MS/PhD
Prerequisite : Mechanics of Solids
Mutual Exclusion : ME-617
Distribution : Elective
Semester : Odd/Even: odd

1. **Course Objective :**
   This course serve as an introduction to the use of Composite materials in modern structures. The bulk of the material cover the solid mechanics issues needed for preliminary design purpose.

2. **Course Outline:** Introduction classification of composite materials, Linear Anisotropic Materials: Generalized Hooke's Law, Fundamental Equations and Variational Solution Procedures. Effective Material Moduli for Composites: Elementary Mixture Rules for Fiber-Reinforced Laminae, Improved Formulas for Effective Moduli of Composites. Strength criteria of lamina. Classical Laminate Theory. Modeling and Analysis of Beams and Plates, strength of laminate.

3. **Course Modules:**
   1) Introduction, classification of Composite Materials, advantage of composite materials and application. **(4 Contact hours)**
   2) Macro-mechanical Behaviour of lamina
      Stress strain relationships for anisotropic materials, stiffness's and compliances, restrictions of engineering constants, invariant properties of lamina. Strength of the lamina. **(10 Contact hours)**
   3) Micromechanical behavior of lamina
      Mechanics of materials approach for stiffness, elasticity approach, imperial approaches, strength estimations. **(12 Contact hours)**
   4) Micromechanical behavior of laminates
      Classical laminate theory, special cases of laminates, strength of laminates, Interlaminar stresses. **(12 Contact hours)**
   5) Experimental Characterization of composites
      Uniaxial, biaxial tension and compression tests, interfacial and Inter laminate shear stress characterizations. **(4 Contact hours)**

4. **Text & Reference books:**

   1. Laszolo P Kollar and George S. Springer, Mechanics of Composite Structures, Cambridge University Press, 2003.
   2. J.N. Reddy, Mechanics of Laminated Composite Plates and Shells Theory and Analysis

शैक्षणिक अनुभाग
Inward 627
13 MAY 2025
Academics Section

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	ME 617	100%	

6. Justification of new course proposal if cumulative similarity content is >30%:
Mutual Exclusion : ME-617

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: **School: SCENE**

Signature: **Date:**

The following faculty (at least 3 faculty) discussed on.....and approved the proposal on.....

Sl. No	Faculty Name	Signature

School Chair: 13/05/25

School:

Date:

This proposal is reported in ..... the Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Proposal for a New Course

Annexure D

Program: B.Tech. in Civil Engineering (Starting 2024 entry Batch)

Table 1: Overall Credit Distribution

Division	Sub-division	Credits
Institute Core	IC Compulsory	32
	IC Baskets	6
	HSS	12
	IKSHMA	3
Discipline	Discipline Core	49
	Discipline Electives	21
Electives	Free Electives	25
	MTP + ISTP or Equivalent	12
	Total	**160**

Table 2: List of IC Compulsory Courses

Sl. No.	Course Code	Course Name	Credits
1	IC010	Internship	2
2	IC112	Calculus	2
3	IC113	Complex and Vector Calculus	2
4	IC114	Linear Algebra	2
5	IC115	ODE and Integral Transforms	2
6	IC140	Engineering Graphics/ Graphics for Design	4
7	IC152	Introduction to Python and Data Science (Computing and Data Science/Data Science I)	4
8	IC161	Applied Electronics	3
9	IC161P	Applied Electronics Laboratory	2
10	IC222P	Physics Practicum/Practicals	2
11	IC252	Probability and Statistics (Data Science II)	4
12	IC272	Machine Learning (Data Science III)	3
		Total	**32**

Table 3: IC Basket Courses

Sl. No.	Basket	Course Code	Course Name	Credits
1	IC-I	IC230	Environmental Science	3
2	IC-II	IC240	Mechanics of Rigid Bodies	3

Table 4: Substitute Credit(s) if ISTP, MTP is/are Opted Out

Course	Credit	Notified Substitute(s)
DP301 (Interactive Socio Technical Practicum; ISTP)	4	Free Elective(s)
Major Technical Project-1, 2 (MTP-1, -2/ CE498P, CE499P	3+5=8	Discipline Elective(s)

Table 5: Discipline Core Courses

Sl. No.	Course Code	Course Name	Credits
1	CE201	Surveying: Traditional and Digital	2-0-4-4
2	CE202	Introduction to Civil Engineering	1-0-0-1
3	CE203	Civil Engineering Materials	3-0-0-3
4	C203P	Building Materials Laboratory	0-0-2-1
5	CE251	Hydraulics Engineering	3-0-0-3
6	CE252	Geology and Geomorphology	2-0-2-3
7	CE303	Water Resources Engineering	3-0-0-3
8	CE304P	Hydraulics Engineering Laboratory	0-0-2-1
9	CE306P	Environmental Engineering Laboratory	0-0-2-1
10	CE310	Strength of Materials and Structures	3-0-0-3
11	CE310P	Strength of Materials and Structures Laboratory	0-0-2-1
12	CE311	Geotechnical Engineering I	3-0-0-3
13	CE311P	Geotechnical Engineering Laboratory	0-0-2-1
14	CE351	Design of Reinforced Concrete Structures	2-1-0-3
15	CE352	Transportation Engineering	3-0-0-3
16	CE352P	Transporting Engineering Laboratory	0-0-2-1
17	CE353P	Civil Engineering Drawing	0-0-2-1
18	CE356	Reverse Engineering	0-0-2-1
19	CE401	Design of Steel Structures	2-1-0-3
20	CE402	Geotechnical Engineering II	3-0-0-3
21	CE404	Analysis of Structures	3-0-0-3
22	CE405	Water and Wastewater Engineering	3-0-0-3
		Total	**49**

Table 6: Summary of Recommended Credit Distribution Across the Semesters

	Institute Core	Discipline Core and Electives	Free Electives	Other Electives	Total
Semester 1	18	0	0	0	18
Semester 2	19	1	0	0	20
Semester 3	6	11	3	0	20
Semester 4	3	15	3	0	21
Semester 5	5	14	3	0	22
Semester 6	0	17	6	0	23
Semester 7	0	6	6	7	19
Semester 8	2	6	6	5	19
	53	70	27*	12	162*

**Overall, 2 extra credits are considered for FE, leading to total credit 162. However, students may manage the credits for DE, FE , Semester Long Internship, etc., in such a way that they are completing the minimum requirements for all the categories and total credits for degree requirements.*

Semester-wise Course Distribution

Semester – I

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	IC140	Engineering Graphics/ Graphics for Design	4
2	IC112	Calculus	2
3	IC113	Complex and Vector Calculus	2
4	IC152	Introduction to Python and Data Science (Computing and Data Science/ Data Science I)	4
5	IC230	Environmental Science	3
6	HSXXX/IKXXX	HSS Course/IKSHMA Course	3
		Total Credit	**18**

Semester – II

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	CE202	Introduction to Civil Engineering	1-0-0-1
2	IC114	Linear Algebra	2
3	IC115	ODE and Integral Transforms	2
4	IC161	Applied Electronics	3-0-0-3
5	IC161P	Applied Electronics Laboratory	0-0-3-2
6	IC240	Mechanics of Rigid Bodies	1.5-1.5-0-3
7	IC252	Probability and Statistics (Data Science II)	3-0-2-4
8	IKXXX/HSXXX	IKSHMA Course/HSS Course	3
		Total Credit	**20**

Semester – III

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	CE252	Geology and Geomorphology	2-0-2-3
2	CE203	Civil Engineering Materials	3-0-0-3
3	CE203P	Building Materials Laboratory	0-0-2-1
4	CE310	Strength of Materials and Structures	2-1-0-3
5	CE310P	Strength of Materials and Structures Laboratory	0-0-2-1
6	IC272	Machine Learning (Data Science III)	3
7	HSXXX	HSS Course	3
8	FE-1	Free Elective	3
		Total Credit	**20**

Semester – IV

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	CE201	Surveying: Traditional and Digital	2-0-3-4
2	CE251	Hydraulics Engineering	3-0-0-3
3	CE311	Geotechnical Engineering I	3-0-0-3
4	CE311P	Geotechnical Engineering Laboratory	0-0-2-1
5	CE304P	Hydraulics Engineering Laboratory	0-0-2-1
6	CE404	Analysis of Structures	3-0-0-3
7	HSXXX	HSS Course	3
8	FE-2	Free Elective	3
		Total Credit	**21**

Semester – V

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	CE303	Water Resources Engineering	3-0-0-3
2	CE 351	Design of Reinforced Concrete Structures	2-1-0-3
3	CE352	Transportation Engineering	3-0-0-3
4	CE352P	Transporting Engineering Laboratory	0-0-2-1
5	CE353P	Civil Engineering Drawing	0-0-2-1
6	CE402	Geotechnical Engineering II	3-0-0-3
7	IC222P	Physics Practicum/Practicals	2
8	HSXXX	HSS Course	3
9	FE-3	Free Elective	3
		Total Credit	**22**

Internship Credit During Any Suitable Break Period After Semester – V

(To be added with 8th Semester)

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	IC 010	Internship	2

Semester – VI

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	CE306P	Environmental Engineering Laboratory	0-0-2-1
2	CE401	Design of Steel Structures	2-1-0-3
3	CE403	Water and Wastewater Engineering	3-0-0-3
4	CE356	Reverse Engineering	0-0-2-1
5	DE-1	Discipline Elective	3
6	DE-2	Discipline Elective	3
7	DE-3	Discipline Elective	3
8	FE-4	Free Elective	3
	FE-5	Free Elective	3
		Total Credit	**23**

Semester – VII

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	DE-4	Discipline Elective	3
2	DE-5	Discipline Elective	3
3	FE-6	Free Elective	3
4	FE-7	Free Elective	3
5	CE498P or Equivalent	Major Technical Project (MTP-I) or DE	3
6	DP 301P or Equivalent	ISTP or FE	4
		Total Credit	**19**

Semester – VIII

Sl. No.	Course Code	Course Name (Place Holder)	Credits
1	DE-6	Discipline Elective	3
2	DE-7	Discipline Elective	3
3	FE-8	Free Elective	3
4	FE-9	Free Elective	3
5	CE499P or Equivalent	Major Technical Project (MTP-II) or DE	5
		Total Credit (Including IC-010)	**17+2**

Annexure E

M.Tech. in Structural Engineering (STE)

Table 1: M.Tech. STE Credit Distribution

Sl. No.	Component	Credits
1	Discipline Core	18
2	Discipline Electives	12
3	Post Graduate Project	29
4	Technical Communication	1
5	Free Electives	6
6	Mini Project / Internship	4
	Total	70

Table 2: M.Tech. STE Semester-1

Sl. No.	Course Code	Course Name	L-T-P-C
1	CE511	Structural Dynamics with Application to Earthquake Engineering	3-0-0-3
2	CE555	Advanced Design of Structures	3-0-0-3
3	CE556P	Structural Engineering Laboratory	0-0-4-2
4	CE557	Solid Mechanics in Structural Engineering	3-0-0-3
5	DE-1	Discipline Elective-1	3-0-0-3
6	CE562	Numerical Methods for Engineering Computation	3-0-0-3
7	HS541	Technical Communication	1-0-0-1
		Total Credits	**18**

Table 3: M.Tech. STE Semester-2

Sl. No.	Course Code	Course Name	L-T-P-C
1	CE586	Mini Project*	0-0-6-3
2	CE563	Finite Element Methods in Engineering	3-0-2-4
3	DE-2	Discipline Elective-2	3-0-0-3
4	DE-3	Discipline Elective-3	3-0-0-3
5	DE-4	Discipline Elective-4	3-0-0-3
6	FE-1	Free Elective-1	3-0-0-3
7	FE-2	Free Elective-2	3-0-0-3
		Total Credits	**22**

*To start during the winter break.

Table 4: M.Tech. STE Semester-3

Sl. No.	Course Code	Course Name	L-T-P-C
1	CE587P	Industrial/Academic Internship$	0-0-2-1
2	CE688P	Post Graduate Project-I	0-0-28-14
		Total Credits	**25**

$To be completed during the summer break

Table 5: M.Tech. STE Semester-4

Sl. No.	Course Code	Course Name	L-T-P-C
1	CE689P	Post Graduate Project-II	0-0-30-15
		Total Credits	**15**

Table 5: M.Tech. STE Discipline Electives

Sl. No.	Course Code	Course Name	L-T-P-C
1	CE504	Slope Stability and Retaining Structures	2-1-0-3
2	CE507	Advanced Concrete Science	3-0-0-3
3	CE509	Bridge Engineering	3-0-0-3
4	CE552	Concrete Technology	3-0-0-3
5	CE554	Prestressed Concrete Structures	3-0-0-3
6	CE560	Soil Dynamics	3-0-0-3
7	CE605	Engineering Seismology and Seismic Hazard Assessment	3-0-0-3
8	CE610	Analysis and Design for Earthquake Resistant Structures	3-0-0-3
9	CE611	Structural Health Monitoring	3-0-0-3
10	CE612	Theory of Plates and Shells	3-0-0-3
11	CE617	Mechanics of Composite Materials	3-0-0-3
Any other course with prior permission			

Annexure - F

B.Tech General Engineering Curriculam (Basket wise)

IC Courses - 32		
Code	**Name**	**Credits**
IC112	Calculus	2
IC113	Complex and Vector Calculus	2
IC140	Graphics for design	4
IC152	Computing and Data Science	4
IC114	Linear Algebra	2
IC115	ODE and integral transform	2
IC161	Applied Electronics	3
IC161p	Applied Electronics Lab	2
IC222p	Physics Practicum/Practicals	2
IC010	Internship	2
IC252	Data Science 2	4
IC272	Data Science 3	3
		32

FDP+ DP + ISTP + MTP or equivalent - 19		
Code	**Name**	**Credits**
IC102p	Foundations of design practicum	4
IC202p	Design Practicum	3
DP301	ISTP	4
GE498P	Major Technical Project-1	3
GE499P	Major Technical Project-2	5
		19

IC + Basket + HSS + ISTP + IKS + FDP + DP + MTP Credits		72
Discipline Core		36
Open Elective with Specialization		22
Discipline Elective		30
Degree Credits (with Specialization)	Degree Credits (with Specialization)	160
Without Specialization (Free Electives)		52
Degree Credits (without Specialization)	Degree Credits (with Specialization)	160

Basket of IC Course - 6		
Code	**Name**	**Credits**
IC230	Enviromental Science	3
IC240	Mechanics of Rigid Bodies	3
		6

HSS; IKS- 15		
Code	**Name**	**Credits**
	IKS	3
	HSS-1	3
	HSS-2	3
	HSS-3	3
	HSS-4	3
		15

The combination of Open Elective courses should be less than 50% of DC courses of a specific branch

This will lead to a degree in **General Engineering** only

DC Courses for B.Tech General Engineering (Without specialization)		
Discipline Core - 30		
Code	**Name**	**Credits**
ME-100	Reverse Engineering	1
EE-261	Electrical System Around Us	3
EE-231	Measurement & Instrumentation	3
ME213	Thermodynamics	3
EE-201	Electromechanics	3
EE-211	Analog Circuit Design	4
ME212	Product Manufacturing Technology	3
IC241	Material Science for engineers	3
IC253	Programming and Data Structures	3
DS-201	Data handling and Visualisation	3
HS-307	Macroeconomics	3
HS-541	Technical Communication	1
ME-305	Design of Machine Elements	3
		36

DC & DE Courses for Mechatronics Specialization

Discipline Core - 36		Credits
Code	**Name**	**36**
ME100	Reverse Engineering	1
EE-261	Electrical System Around Us	3
EE-260	Signals & Systems	3
EE-201	Electromechanics	3
EE-211	Analog Circuit Design	4
ME-305	Design of Machine Elements	3
AR-503	Mechatronics	3
ME-206	Mechanics of Solids	3
ME-309	Theory of Machines	3
EE-326	CO and Processor Architecture Design	4
EE-311	Device Electronics for Integrated Circuits	3
EE-301/p	Control Systems	3

Discipline Elective - 30		Credits
Code	**Name**	**60**
ME-210	Fluid Mechanics	3
EE-231	Measurement & Instrumentation	3
ME-452	Robotics and Control	3
CS-313	Computer Networks	4
EE-536	IoT Systems	3
EE-314	Digital Signal Processing	3
CS-305	Artificial Intelligence	3
EE-529	Embedded Systems	4
ME212	Product Manufacturing Technology	3
IC241	Material Science for engineers	3
ME213	Thermodynamics	3
AR-502	Advanced Design Practicum	3
AR-505	Principles of Robot Autonomy	3
ME-510	Advance Manufacturing Process	3
AR-510	Underactuated Robots	3
AR-511	Autonomous Mobile Robots	3
ME-212	Product Manufacturing Technology	3
AR XXXX	Unmanned Areial System	3
EE-511 / AR XXXX	Deep Learning for Computer Vision	4

DC & DE Courses for Communication Tech Specialization

Discipline Core - 36		Credits
Code	**Name**	**36**
ME100	Reverse Engineering	1
EE-261	Electrical System Around Us	3
EE-231	Measurement & Instrumentation	3
EE-304	Communication Theory	3
EE-201	Electromechanics	3
DS404	Information, Security, Privacy	3
EE-203	Network Theory	3
IC-253	Programming and Data Structures	3
EE-260	Signals & Systems	3
CS-313	Computer Networks	4
EE-314	Digital Signal Processing	4
EE-202	Electromagnetic Theory	3

Discipline Elective - 30		Credits
Code	**Name**	**52**
EE608	Digital Image Processing	4
EE-641	Advanced Wireless Technologies	3
EE-536	IoT Systems	3
DS-313	Statistical Foundation of Data science	4
EE-517	Wireless Communications & Networks	3
EE-553	Fundamentals of Intelligent Communication System-I	4
EE-503	Advanced Communication Theory	3
CS-549	Performance Analysis of Computer Networks	3
EE-518	Information Theory	3
DS-201	Data handling and Visualisation	3
EE541	Tensors: .... Applications for Signal Processing, ML	3
EE-211	Analog Circuit Design	4
NPTEL	Satellite Communication	3
NPTEL	Fundamentals of Intelligent Communication System-II	3
NPTEL	Fibre Optics	3
NPTEL	Digital Audio Processing	3

DC & DE Courses for FinTech Specialization						
Discipline Core - 36		Credits		Discipline Elective - 30		Credits
Code	**Name**	**36**		**Code**	**Name**	**51**
ME100	Reverse Engineering	1		MA-511	Real Analysis	4
MAXXX	Stochastic Calculus of Financial Engineering	3		DS-201	Data handling and Visualisation	3
MA-521	Functional Analysis	4		MA-521	Functional Analysis	4
IC253	Programming and Data Structures	3		MA-220	Partial Differential Eqn	4
HS-203	Economics	3		HS-481	International Economics	3
DS-313	Statistical Foundation of Data Science	4		HS-510	Essentials of Entrepreneurship	3
MAXXX	Numerical Methods in Quantitative Finance	3		MAXXX	Fixed Income Securities	3
MAXXX	Computational Financial Modelling & Lab	4		HS-504	PFPM	3
DS-301/MA-553	Mathematical Foundation of Data science / Mathematics Foundation of Financial Engineering	4		MB-527	Financial Management	3
DS-413	Intoduction to statistical learning	4		MB-202	Microeconomics	3
HS-307/MBXXX	Macroeconomics-I	3		MB-515	Financial Statements Analysis	2
				CS671	Deep Learning and Application	4
				MAXXX	Financial Engineering	3
				HS-651	Advanced Econometrics	3
				ME-212	Product Manufacturing Technology	3
				IC-241	Material Science for engineers	3

DC & DE Courses for AI & Robotics Specialization

Discipline Core - 36		Credits
Code	**Name**	**36**
EE-201	Electromechanics	3
EE-261	Electrical System Around Us	3
IC-241	Material Science for engineers	3
IC-253	Programming and Data Structures	3
DS-201	Data handling and Visualisation	3
EE-301	Control Systems	3
ME-309	Theory of Machines	3
AR-501	Robot Kinematics, Dynamics & Control	3
AR-503	Mechatronics	3
AR-504	Robot Programming	3
AR-514	Vision & Learning Based Control	3
ME-305	Design of Machine Elements	3

Discipline Elective - 30		Credits
Code	**Name**	**67**
EE-604	Digital Image Processing	4
EE-511 / AR XXXX	Deep Learning for Computer Vision	3
EE-529	Embedded Systems	4
CE-251	Hydraulics Engineering	3
CS-683	Generative AI	4
AR-505	Principles of Robot Autonomy	3
CS-514	Data Structures and Algorithms -II	4
ME-510	Advance Manufacturing Process	3
CS-212	Design and Analysis of Algorithms	4
AR-508	Marine Robotics	3
EE-260	Signals & Systems	3
AR-502	Advanced Design Practicum	3
AR-510	Underactuated Robots	3
AR-511	Autonomous Mobile Robots	3
EE-211	Analog Circuit Design	4
ME-212	Product Manufacturing Technology	3
AR-509	Deep Learning for Robotics	3
ME-100	Reverse Engineering	1
AR XXXX	Unmanned Areial System	3
ME-213	Thermodynamics	3
ME-210	Fluid Mechanics	3

Annexure-G, Acad

SMME Office
Outward No. 1823
Date 23/04/25
Indian Institute of Technology Mandi (H.P.)

IIT Mandi
Proposal for a New Course

Course number : **CE530 / ME530**
Course Name : **Continuum Mechanics**
Credit : **3**
Distribution : ***3-0-0-3***
Intended for : **M.Tech./ M.S./ Ph.D./ B.Tech. 3rd and 4th year**
Prerequisite : **Engineering Mechanics, Engineering Mathematics or equivalent**
Mutual Exclusion: **NA**

---

1 Preamble:

Continuum mechanics deals with the mechanical behavior of deformable body modeled as a continuous mass. It pivots around estimation of stresses and strains within the body due to the application of external forces or employed displacements over the surface. Such estimations are carried out ensuring the fundamental physical laws relating to continuity, energy and momentum balance. The concepts learnt in this course will serve as the fundamental basis upon which several post-graduate courses in engineering science such as elasticity, plasticity, fluid mechanics, geomechanics, biomechanics and nanoscience are founded.

2 Course Modules with quantitative lecture hours:

Module 1: Mathematical Essentials (10)

Scalars, Vectors and Cartesian Tensors; Indicial Notation; Tensor Algebra in Symbolic Notation: Summation Convention, Kronecker Delta, Permutation Symbol, ε - δ Identity, Tensor/Vector Algebra; Matrices and Determinants; Transformations of Cartesian Tensors; Principal Values and Principal Directions; Tensor Fields, Tensor Calculus: Gradient and Divergence; Integral Theorems of Gauss and Stokes.

Module 2: Kinematics of Deformation and Motion (10)

Particles, Configurations, Deformations and Motion; Material and Spatial Coordinates; Lagrangian and Eulerian Descriptions; Material Derivative; Displacement Field, Deformation Gradient, Finite Strain Tensors, Infinitesimal Deformation Theory; Compatibility Equations; Stretch Ratios; Rotation Tensor, Stretch Tensors; Velocity Gradient, Rate of Deformation, Vorticity, Steady and Irrotational Flow; Material Derivative of Line Elements, Areas, Volumes.

Module 3: Stress Principle (8)

Body and Surface Forces, Cauchy Stress Principle, Stress Tensors: Cauchy and Piola-Kirchhoff Stress Tensors; Stress Transformation Laws; Principal Stresses, Principal Stress Directions, Mohr's Circles for Stress, Plane Stress; Deviator and Spherical Stress States; Octahedral Shear Stress.

Module 4: Balance Laws and Equation (7)

Material Derivatives of Line, Surface and Volume Integrals; Conservation of Mass, Continuity Equation; Linear Momentum Principle, Equations of Motion in Lagrangian and Eulerian Descriptions; Moment of Momentum (Angular Momentum) Principle; Law of Conservation of Energy, The Energy Equation; Entropy and the Clausius-Duhem Equation; Governing Equations of a Continuum.

Module 5: Constitutive Equations (7)

Constitutive Equations in Material Description; Linear Elasticity: Hooke's Law, Strain Energy, Elastic Symmetry, Hooke's Law for Anisotropic Media, Hooke's Law for Isotropic Media, Hyperelasticity; Nonlinear Elasticity: Strain Energy Theory for Nonlinear Elasticity, Specific Forms of the Strain Energy; Viscous Fluids: Viscous Stress Tensor, Stokesian, and Newtonian Fluids, Basic Equations of Viscous Flow.

Laboratory/practical/tutorial Modules: NA

3 Text books:

G. Thomas Mase, Ronald E. Smelser, Jenn Stroud Rossmann. Continuum Mechanics for Engineers. CRC Press, 2020.

4 References:

Morton E. Gurtin. An Introduction to Continuum Mechanics. Academic Press, 1982.
Allan F. Bower. Applied Mechanics of Solids. CRC Press, 2009.
C. S. Jog. Continuum Mechanics: Volume 1: Foundations and Applications of Mechanics. Cambridge University Press, 2015.

5 Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Constitutive Modelling of Frictional Material	CE606	The basic concepts of stress, strain and constitutive relation	20% (about 10 lecture hours of this course)*

6. Justification of new course proposal if cumulative similarity content is >30%: NA

Approvals:

Faculty interested in teaching this course: –
Gaurav Bhutani
Mousumi Mukherjee
Rajesh Ghosh

Proposed by: Mousumi Mukherjee, Gaurav Bhutani **School:** SCENE, SMME

Signature: Email approval attached **Date: 28 March 2025**

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……..

Sl. No	Faculty Name	Signature
1	Gaurav Bhutani	Email approval attached
2	Mousumi Mukherjee	Email approval attached
3	Rajesh Ghosh	Email approval attached

School Chair: P. Dileep Chandra

School:

Date:

This proposal is reported in …59……..th Board of Academics on 16 April 2025…

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Anurag Rawat <anuragrawat@iitmandi.ac.in>

Regarding approval on Course Proposal

5 messages

Anurag Rawat <anuragrawat@iitmandi.ac.in> Thu, Apr 17, 2025 at 2:58 PM
To: Mousumi Mukherjee <mousumi@iitmandi.ac.in>, Rajesh Ghosh <rajesh@iitmandi.ac.in>
Cc: Gaurav Bhutani <Gaurav@iitmandi.ac.in>, SMME Office <smmeoffice@iitmandi.ac.in>

Dear Sir/Madam
Please find the attached document for your perusal and approval.

Thanks & Regards
Anurag Rawat
SMME Office

Continuum_Mechanics_proposal_after_BoA_Apr2025.odt
13K

Rajesh Ghosh <rajesh@iitmandi.ac.in> Thu, Apr 17, 2025 at 3:36 PM
To: Anurag Rawat <anuragrawat@iitmandi.ac.in>
Cc: Mousumi Mukherjee <mousumi@iitmandi.ac.in>, Gaurav Bhutani <Gaurav@iitmandi.ac.in>, SMME Office <smmeoffice@iitmandi.ac.in>

Approved from my side.

With regards

Rajesh Ghosh
[Quoted text hidden]
--
Rajesh Ghosh, Ph.D.
Associate Professor
School of Mechanical and Materials Engineering
Indian Institute of Technology Mandi
Kamand - 175075, Mandi, Himachal Pradesh
https://scholar.google.co.in/citations?user=hd4sfNkAAAAJ&hl=en

Mousumi Mukherjee <mousumi@iitmandi.ac.in> Thu, Apr 17, 2025 at 4:54 PM
To: Anurag Rawat <anuragrawat@iitmandi.ac.in>
Cc: Rajesh Ghosh <rajesh@iitmandi.ac.in>, Gaurav Bhutani <Gaurav@iitmandi.ac.in>, SMME Office <smmeoffice@iitmandi.ac.in>

Approved from my end.

Thanks & Regards,
Mousumi

Dr. Mousumi Mukherjee
Assistant Professor
School of Civil and Environmental Engineering
Indian Institute of Technology Mandi
Office No. A11-5-31, North Campus,
Mandi - 175075, Himachal Pradesh, India
Ph. No. +91-1905-267-997(O)
Mobile No. +91-8628890339
[Quoted text hidden]

Anurag Rawat <anuragrawat@iitmandi.ac.in> Mon, Apr 21, 2025 at 10:13 AM
To: Gaurav Bhutani <Gaurav@iitmandi.ac.in>

Dear Sir
We have received the Mail approvals of Dr.Rajesh Ghosh and Dr.Mousumi on Course Proposal.
Submitted for your approval please.

Thanks & Regards
SMME Office
[Quoted text hidden]

Continuum_Mechanics_proposal_after_BoA_Apr2025.odt
13K

Gaurav Bhutani <gaurav@iitmandi.ac.in> Mon, Apr 21, 2025 at 4:26 PM
To: Anurag Rawat <anuragrawat@iitmandi.ac.in>

Approved from my side

Dr Gaurav Bhutani
Assistant Professor
School of Engineering
Indian Institute of Technology Mandi
Kamand Campus
Mandi 175005
Himachal Pradesh, India
Tel: +91 1905-267108
Email: gaurav@iitmandi.ac.in
[Quoted text hidden]

शैक्षणिक अनुभाग
Inward No. 615
23 APR 2025
Academics Section

Annexure - H.

Agenda: Reduce credits of electrical systems around us from 4 to 3 credits in Mechanical Engineering template.

Details:

The modifications to 37th Senate (07-10-2022) document titled "37.11 Revision in the BTech programme curriculum.pdf" are as follows:

Old: IC XXX; Electrical Systems Around Us; 3-0-2-4

New: EE261; Electrical Systems Around Us; 3-0-0-3

With this, the total Discipline Core credits in Mechanical Engineering Btech program will become **50**

Discipline Core credits : B.Tech Mechanical Engineering		
Course Code	**Name**	**LTPC**
EE 261	Electrical Systems Around Us	3-0-0-3
ME 2XX	Product Manufacturing Technologies	2-0-2-3
ME 213	Engineering Thermodynamics	3-1-0-4
ME 205	Machine Drawing	1-0-3-3
ME 206	Mechanics of Solids	3-0-0-3
ME 210	Fluid Mechanics	3-0-0-3
ME 303	Heat Transfer	3-0-0-3
ME 305	Design of Machine Elements	3-1-0-4
ME 307	Energy Conversion Devices	3-0-0-3
IC 241	Materials Science for Engineers	3-0-0-3
ME 308	Manufacturing Engineering 1	3-0-0-3
ME 309	Theory of Machines	4-0-0-4
ME 310	System Dynamics and Control	3-0-0-3
ME 311P	Design Lab 1	0-0-2-1
ME 312P	Design lab 2	0-0-2-1
ME 210P_ 57	Fluid Mechanics Lab	0-0-2-1
ME 315	Manufacturing Engineering 2	3-0-0-3
ME 303P	Heat Transfer Lab	0-0-2-1
ME 100	Reverse Engineering	0-0-2-1
TOTAL		50

4810.

Annexure-I

IKSMHA

IIT Mandi
Proposal for a New Course

Change code as 593 is one Time.

Course number : ~~**IK593**~~ IK517
Course Name : **Philosophy of Science**
Credit : **3-credit**
Distribution : ***L-T-P-C (3-0-0-3)***
Intended for : **PG students and high level UG students**
Prerequisite : **None**
Mutual Exclusion : (Specify the equivalent courses in other schools. These *Courses (with high similarity) are not allowed to credit by the students after or along with this course.*)

---

1. Preamble:

Learning Objectives:

- Understand and critically analyze key concepts in the philosophy of science.
- Explore the historical and philosophical development of scientific theories and methods.
- Evaluate the role of causality, determinism, and probability in scientific reasoning.
- Discuss contemporary issues and ethical considerations in scientific practice.
- Analyze case studies of scientific revolutions and paradigm shifts.

Course Description: This graduate-level course provides a comprehensive introduction to the philosophy of science. The course explores foundational concepts, including the nature of scientific laws, explanation, and prediction, as well as the role of induction and probability in scientific reasoning. Students will delve into the experimental method, quantitative concepts, and the philosophical implications of space, time, and geometry. Contemporary issues such as ethics in science, the role of technology, and the social dimensions of scientific knowledge are also discussed to provide a well-rounded understanding of the field. The course concludes with an exploration of scientific revolutions and paradigm shifts, offering students a historical and philosophical context for understanding major changes in scientific thought.

2. **Course Modules with quantitative lecture hours:**

Unit/Topic 1: Foundations of the Philosophy of Science (4 hours)

- Introduction to the Philosophy of Science
- Historical Background and Key Concepts

(metaphysics, epistemology, axiology, Aristotle's philosophy (four causes, cosmology, physics), syllogisms, a priori and a posteriori knowledge, analytic and synthetic judgements, Kant's categories and synthetic a priori)

- The Role of Philosophy in Science

Unit/Topic 2: Laws, Explanation, and Prediction (4 hours)

- The Value of Laws in Science
- Explanation and Prediction in Scientific Theories
- Case Studies in Scientific Explanation

Unit/Topic 3: Induction and Probability (4 hours)

- Problem of induction (Hume)
- Various approaches to the problem (Popper, Reichenbach, Duhem-Quine thesis)
- Bayesianism

Unit/Topic 4: Measurement and Quantitative Language (4 hours)

- The Experimental Method
- Quantitative Concepts in Science
- Extensive Magnitudes and Measurement

Unit/Topic 5: Space, Time, and Geometry (4 hours)

- Euclidean and Non-Euclidean Geometries
- Space and time in Relativity Theory
- Philosophical Implications of Space and Time

Unit/Topic 6: Causality and Determinism (4 hours)

- Hume's Empiricism and the Problem of Causation

- Kant's Response: Causality as a Synthetic A Priori Principle
- Causality and the Laws of Nature
- Determinism in Classical and Quantum Physics
- Causality in the Context of Free Will
- Contemporary Theories of Causation
- Optional Case Studies / Applications

(Chaos theory and determinism,. determinism and AI decision-making,. causal inference in epidemiology or econometrics)

Unit/Topic 7: Theories and Nonobservables (5 hours)

- Theories and Correspondence Rules
- Hempel and Carnap's contributions
- Analyticity in Scientific Theories

Unit/Topic 8: Consistency and Completeness of Mathematics and Logic (4 hours)

- Hilbert's programme
- Frege's programme
- Russell's paradox
- Gödel's theorems

Unit/Topic 9: Statistical Laws and Quantum Mechanics (5 hours)

- Statistical Laws and Indeterminism
- The Philosophy of Quantum Physics
- Case Studies in Quantum Mechanics (various paradoxes)

Unit/Topic 10: Ethics, Technology, and Social Dimensions of Science (4 hours)

- Ethics in Science
- The Role of Technology in Science
- Social Dimensions of Science

Unit/Topic 11: Philosophy of Scientific Revolutions and Contemporary Issues (4 hours)

- Philosophy of Scientific Revolutions (Kuhn)
- Contemporary Issues in Philosophy of Science (Lakatos - Feyrabend)
- Review and Synthesis

Laboratory/practical/tutorial Modules: NA

3. Text books:

(Latest, Only 2)

1. Primary Text: Rudolf Carnap, "An Introduction to the Philosophy of Science"
2. Supplementary Text: James Ladyman, "Understanding Philosophy of Science"

4. References:

(No limit on numbers, relevant)
Standard format can be followed

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Faculty interested in teaching this course: –

Proposed by: Prof. Aniruddha Chakraborty & Prof. Parthasarathy Ghose

School: IKSMHA Centre

Signature: 19/5/2025

Date: 14/05/2025

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……..

Sl. No	Faculty Name	Signature

School Chair:

School: IKSNHA Centre

Date: 19.05.2025

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

शैक्षणिक अनुभाग
Inward No. 6335
22 MAY 2025
Academics Section

Academics Section
Forward
No. 481.0
Date 23-5-25
शैक्षणिक अनुभाग

शैक्षणिक अनुभाग
Inward No. 6364
28 MAY 2025
Academics Section

IIT Mandi
Proposal for a New Course

Course number : IC 182
Course Name : History of Science and Technology
Credit : *3-Credit*
Distribution : ***L-T-P-C (3-0-0-3)***
Intended for : 1st year undergraduates
Prerequisite : **None**
Mutual Exclusion : (Specify the equivalent courses in other schools. These *Courses (with high similarity) are not allowed to credit by the students after or along with this course.*)

---

1. Preamble:

Learning objectives

- Introduce the students to prominent developments and figures in the history and evolution of science
- Provide the students with an overview of thought process about progress in science
- Provide the students with the history of scientific developments both from the western and Indian perspectives

This is the first year UG course offered by the IKSMHA center, covering various aspects of history and evolution of science and technology, starting from the developments in ancient, medieval and modern times. Through some specific examples of developments and contributions by notable scientists, the students will have an overview of such developments across various disciplines such as mathematics, physics, biology and medicine, technology etc.
Furthermore, the course has in equal measure contents covering scientific developments from both the western and Indian perspectives.

2. Course Modules with quantitative lecture hours:

Unit/Topic 1: Evolution of modern science:

- Science in Ancient Greek and Egyptian civilizations (e.g. Pythagoras, Ptolemy etc.), its decadence in the dark ages
- European scientific revolution: Copernicus, Galileo, Kepler, Brahe, Newton, Maxwell, Planck, Einstein
- Renaissance and Industrial Revolution **(7 Hours)**

Unit/Topic 2: Notable figures in evolution of mathematics, the thought processes and their contributions: Descartes, Leibniz, Laplace, Fourier, Gauss, Euler **(4 Hours)**

Unit/Topic 3: Notable Indian Scientists:

SN Bose, JC Bose, CV Raman, MN Saha, Ramanujan **(6 Hours)**

Unit/Topic 4: Developments in Bio sciences: Darwin, Wallace, Robert Cook, Mendel **(2 Hours)**

Unit/Topic 5: Ancient science in India: Examples from Indus valley civilization, Other examples about architecture, metallurgy, planning etc. **(8 Hours)**

Unit/Topic 6: Developments in Indian astronomy and mathematics: Surya Siddhanta, Bhramagupta, Aryabhatta, Bhaskara, Varahamihira.

Discovery of zero and other related concepts
Kerala school of mathematics **(5 Hours)**

Unit/Topic 7: Overview of Ayurveda:
Sushruta samhita, Charaka samhita, Ashtanga Hridaya **(5 Hours)**

Unit/Topic 8: Overview of the Darshanas, and the Indian thought systems **(5 Hours)**

Laboratory/practical/tutorial Modules: NA

3. **Text books:**

   (Latest, Only 2)

   - D.P. Chattopadhyay - History of science and technology in ancient india

4. **References:**

   - David Wootton - The invention of science: A new history of scientific revolution
   - David Lindberg - The beginnings of western science
   - Edward Dolnick - The clockwork universe: Issac Newton, the royal society, and the birth of the modern world

5. **Similarity with the existing courses:**
   (Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Faculty interested in teaching this course: –

Proposed by: Prof. Laxmidhar Behera & Prof. Parthasarathy Ghose

School: IKSMHA Centre

Signature:

Date:

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……..

Sl. No	Faculty Name	Signature

School Chair:

School: IKSMHA Centre

Date: 14.05.2025

This proposal is reported in ……..th Board of Academics on ……

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Annexure J

B. Tech. in

Mathematics and Computing

School of Mathematical and Statistical Sciences (SMSS)

Indian Institute of Technology Mandi

B. Tech. in Mathematics and Computing
in
School of Mathematical and Statistical Sciences (SMSS)

I. Program Description:

The Bachelor of Technology (B.Tech.) program in Mathematics and Computing is a comprehensive course that integrates the principles of mathematics and computing. This program is designed to equip students with a strong foundation in mathematics, computing, and computational thinking, enabling them to develop and apply analytical and problem-solving skills in a variety of fields in science and engineering. The aim of this program is two-fold, one to provide strong mathematical background for strong logical thinking, and other to prepare students for strong computing skills. The mathematics part will also give them strong foundation which enable them to be leader in the field. The program is design in such way that after important foundational courses, students can choose courses as per their interest in a particular domain.
The program aims to produce graduates who are well-versed in a broad range of mathematical and computational concepts, techniques, and tools. With the help of these skills, students can handle complex real-world problems. It will also enhance the ability of the students looking for solving new challenges in the society. With a focus on both theoretical and practical aspects of mathematics and computing, this program prepares students for a wide range of careers in industries, academia and research & development.

2. Credit Structure of the program.

The typical credit structure of the institute will be followed as shown below.

Division	Sub division	Credits
Institute Core	IC Compulsory	35
	IC Baskets	06
	Humanities and Social Sciences (HSS)	12
	Indian Knowledge System (IKS)	03
Discipline	Discipline Core (DC)	55
	Discipline Electives (DE)	15
Electives	Free Electives (FE)	22
	Major Technical Project (MTP)	08
	Interactive Socio Technical Practicum (ISTP)	04
	TOTAL	**160**

The credit structure will be followed as per the existing norms of the institute. Out of 160 credits, 55 credits will be dedicated to discipline core courses and 15 credits will be assigned for discipline electives. Total of 70 credits will be maintained for discipline (i.e., DC (55 credits) and DE (15 credits)) courses while the rest of the credits will be kept for IC and other institute level courses (90 credits). The semester wise distributions of all the courses along with credits details are given below:

B.Tech. in Mathematics and Computing –1st Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	IC112	Calculus	2	0	0	2
2	IC113	Complex variables and Vector Calculus	2	0	0	2
3	IC140	Graphics for Design	2	0	3	4
4	IC152	Introduction to Python and Data Science	3	0	2	4
5	IC136	Understanding Biotechnology & its Applications (basket – 1)	3	0	0	3
6	IC253	Data Structure & Algorithms (basket-2)	2	0	2	3
7	IC181	Introduction to Consciousness and Holistic Wellbeing	3	0	0	3

Total Credits: 21

B.Tech. in Mathematics and Computing –2nd Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	IC114	Linear Algebra	2	0	0	2
2	IC115	ODE & Integral Transforms	2	0	0	2
3	IC161	Applied Electronics	3	0	0	3
4	IC 161P	Applied Electronics Lab	0	0	3	2
5	IC252	Probability and Statistics	3	0	2	4
6	MA120	Introduction to Computing Systems and Databases	3	0	2	4
7	IC222P	Physics Practicum	0	0	3	2
8	HSXXX	HSS Course	3	0	0	3

Total Credits: 22

B.Tech. in Mathematics and Computing –3rd Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	IC202P	Design Practicum	0	0	6	3
2	IC272	Machine Learning	2	0	2	3
3	MA210	Real and Complex Analysis	2.5	0.5	0	3
4	CS208	Mathematical Foundation of Computer Sciences	3	1	0	4
5	MA211	Ordinary Differential Equation	3	1	0	4
6	FE	Free Elective				4

Total Credits: 21

B.Tech. in Mathematics and Computing – 4th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	MA220	Partial Differential Equation	3	1	0	4
2	CS201	Computer Organization	3	0	0	3
3	CS201P	Computer Organization Laboratory	0	0	2	1
4	MA221	Numerical Analysis	3	1	0	4
5	MA222	Applied Linear Programming	3	1	0	4
6	HSXXX	HSS Course	3	0	0	3
7	MA25X	Discipline Elective Basket -I (Foundation Module)	3	0	0	3

Total Credits: 22

B.Tech. in Mathematics and Computing – 5th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	MA310	Matrix Computation & Lab	3	0	2	4
2	CS304/ MA 313	Formal Language and Automata Theory	3	0	0	3

3	MA312	Design and Analysis of Algorithms	3	0	2	4
4	DE	Discipline Elective	3	0	0	3
5	MA311	Mathematical Modelling	3	0	0	3
6	HSSXXX	HSS or Management course	3	0	0	3

Total Credits: 20

B.Tech. in Mathematics and Computing – 6th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	CS207/ MA 323	Applied Databases Practicum	0	0	3	2
2	MA35X	Discipline Elective Basket-II (Advance Modelling Module)	3	0	0	3
3	MA321	Numerics of Differential Equations	3	0	2	4
4	FE	Free Elective	3	0	0	3
5	HSSXX	HSS or Management course				3
6	ISTP	ISTP				4
7	MA322	Applied Graph Theory	3	0	2	4

Total Credits: 23

B.Tech. in Mathematics and Computing – 7th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DE	Discipline Elective				3
2	FE	Free Elective				3
3	FE	Free Elective				3
4	MTP-1	MTP-1				4
5	IC010	Internship				2

Total Credits: 15

B.Tech. in Mathematics and Computing –8th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DE	Discipline Elective				3
2	FE	Free Elective				3
3	FE	Free Elective				3
4	FE	Free Elective				3
5	MTP-2	MTP-2				4

Total Credits: 16

Grand Total: 160 credits for B.Tech. in Mathematics and Computing

Two discipline elective baskets are proposed for two discipline electives to give a flexibility to the students to choose their free electives in a particular direction.

Discipline Elective Basket I: Foundation Module

Course Numbers	Course Titles	Credits
MA251	Abstract Algebra	3
MA252	Functional analysis	3
MA253	Measure Theory	3
MA254	Topology	3
MA255	Number Theory	3

Discipline Elective Basket II: Advance Modelling Module

Course Number	Course Titles	Credits
MA351	Climate Modelling	3
MA352	Computational Financial Modelling & Lab	3
MA353	Modelling of infectious disease	3
MA354	Mathematical Image Processing	3
MA355	Mathematical Control Theory	3
MA356	Modelling and Simulation	3
MA357	Modelling Population Dynamics	3

Students can take other discipline electives from the proposed list of the discipline electives. The list will be revised/modified time to time to include new discipline electives.

Discipline Electives: Discipline electives will be provided according to the requirement of the students and the availability of the faculties. The list of discipline electives is attached herewith. More elective courses will be added time to time as required. Overall, the credits distribution is as follows:

Sl. No.	Course Name	Credits
1.	Statistical Data Analysis	3
2.	Mathematical Foundations of Financial Engineering	3
3.	Numerical Methods in Quantitative Finance	3
4.	Computational Fluid Dynamics	3
5.	Financial Engineering	3
6.	Stochastic Calculus for Financial Engineering	3
7.	Semigroup of Bounded Linear Operators	3
8.	Topics in Semigroup Theory	3
9.	Fractional Differential Equations	4
10.	Compiler Design	4
11.	Artificial Intelligence	3
12.	Computer Networks	4
13.	Operating Systems	4
14.	Time Series Analysis	3
15.	Mathematical Method for Signal Processing	4
16.	Computer Vision	4
17.	Digital Image Processing	3
18.	Advanced Data Structure and Algorithms	4
19.	Speech Processing	3

20.	Pattern Recognition	3
21.	Soft Computing	3
22.	Bioinformatics	4
23.	Biomechanics	4
24.	Genetic Engineering	4
25.	Applied Biostatistics	4
26.	Transportation Engineering	3
27.	Transporting Engg. Lab	1
28.	Hydraulics Engineering	3
29.	Paradigms of Programming	4
30.	Information Systems and Databases	4
31.	Data Handling and Visualization	3
32.	Computing Systems for Data Processing	4
33.	Times Series Analysis and Applications / Bayesian Data Analysis and Applications	3
34.	Big Data: Management and Analytics	4
35.	Network Theory	3
36.	Signal & Systems	3
37.	Control Systems	4
38.	Computational Methods for Engineering	3
39.	Engineering Thermodynamics	4
40.	Fluid Mechanics	3
41.	Heat Transfer	3
42.	System Dynamics and Control	3
43.	Fluid Mechanics Lab	1
44.	Heat Transfer Lab	1
45.	Cellular Automata	3
46.	Computational Modeling of Social Systems	3

Total- 160 Credits

Discipline Core- 55 Credits

Discipline Elective- 15 Credits (out of which 6 credits would be chosen from two baskets)

Electives- Free Elective: 22 Credits; MTP + ISTP or Equivalent: 12 Credits

Institute Core & other required courses: 56 Credits

Annexure K

Agenda Items for 58th/ 59th BoA meeting from the SMSS:-

1. New Course Proposals: -

S.No.	Course Code	Course Name	Credits	Intended For	Elective/ Core	Proposed By
1	MA-220	Partial Differential Equations	*3-1-0-4*	B.Tech 2nd year students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Qaiser Jahan
2	MA-221	Numerical Analysis	*2-0-3-4*	B.Tech 2nd year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Prof. Rajendra K. Ray
3	MA-222	Applied Linear Programming	*3-1-0-4*	B.Tech 2nd year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Preeti
4	MA-310	Matrix Computations & Lab	*3-0-2-4*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Rajendra K. Ray & Dr. Tanmay
5	MA-311	Mathematical Modelling	*3-0-0-3*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Nitu Kumari
6	MA-321	Numerics of Differential Equations	*3-0-2-4*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Prof. Rajendra K. Ray
7	MA-322	Applied Graph Theory	*3-0-2-4*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Vikash Tripathi & Dr. Mirza Galib
8	MA-251	Abstract Algebra	*3-0-0-3*	B.Tech 2nd year students	Disciplines Elective (Basket 1) for B. Tech Maths & Computing, Elective for other disciplines	Dr. Vikash Tripathi & Dr. Sampat Kr. Sharma
9	MA-120	Introduction to Computing Systems and Databases	*3-0-2-4*	B.Tech Maths & Computing	Core (Replacement of IC102P: Foundations of Design Practicum) for B.Tech Maths & Computing	Dr. Mirza Galib
10	MA 312	Design and Analysis of Algorithms	*3-0-2-4*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Mirza Galib A.H. Baig and Dr. Vikash Tripathi
11	MA 313/ CS304	Formal Languages and Automata Theory	*3-0-0-3*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Mirza Galib A.H. Baig and Dr. Vikash Tripathi
12	MA 323/ CS 207	Applied Databases Practicum	*0-0-3-2*	B.Tech 3rd Year Students	Core for B.Tech Maths & Computing, Elective for other disciplines	Dr. Mirza Galib A.H. Baig and Dr. Vikash Tripathi
13	MA-548	Abstract Algebra	*3-1-0-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Dr. Vikash Tripathi & Dr.

						Sampat Kr. Sharma
14	MA-571	Introduction to Approximation Algorithms	*3-1-0-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Dr. Vikash Tripathi & Dr. Mirza Galib A H Baig
15	MA-572	Applied Multivariate Statistical Analysis	*3-0-2-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Dr. Tanmay, Rishikesh Yadav & Dr. Manoj Thakur
16	MA-573	Advanced Mathematical Foundations of Machine Learning	*3-1-0-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Dr. Tanmay Kayal, Dr. Rishikesh Yadav and Prof. Manoj Thakur
17	MA-574	Introduction to Probabilistic Machine Learning	*3-0-2-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Dr. Tanmay Kayal, Dr. Rishikesh Yadav & Prof. Manoj Thakur
18	MA-576	Nonlinear Optimization	*3-1-0-4*	M.Sc./M.Tech/ Ph.D./B.Tech	Disciplines Elective for M.Sc. Applied Mathematics, Elective for other disciplines	Prof. Manoj Thakur, Dr. Preeti

2. Partial modification in "B.Tech. Mathematics & Computing Program" in line with current institute policies.

शैक्षणिक अनुभाग
Inward No. 6179
26 APR 2025
Academics Section

IIT Mandi
Proposal for a New Course

Course number	**: MA-220**
Course Name	**: Partial Differential Equations**
Credit Distribution	**: 3-1-0-4**
Intended for	**: B.Tech 2nd Year Students**
Elective or core	**: Core for B.Tech Maths and Computing and Elective for other discipline**
Prerequisite	**: NA**
Mutual Exclusion	**: MA522**

---

1. Preamble:

This course aims to provide a thorough understanding of formation and solutions of first and second order partial differential equations. It is designed to develop the different methods of solutions of first and second order partial differential equations and its applications.

2. Course Modules with quantitative lecture hours:

1. **Unit 1:** Recall the definition of directional derivatives, chain rules and total derivatives, Introduction to PDE, First order PDEs, Solution methods for first order PDE. (5hours)
2. **Unit 2:** Classification of first order PDE, Solutions of linear and non-linear PDEs, Cauchy Problem, Cauchy Kowalevski Theorem (8hours)
3. **Unit 3:** Classification of Second Order Partial Differential Equations: normal forms and characteristics. Initial and Boundary Value Problems: Green's identity (7hours)
4. **Unit 4:** Methods of Solution, Methods of separation of variables, Characteristic method, Green's function, Fourier transform. (7hours)
5. **Unit 5:** Laplace equation: mean value property, weak and strong maximum principle, Green's function, Poisson's formula, Dirichlet's principle.(5hours)
6. **Unit 6:** Heat equation: initial value problem, fundamental solution, weak and strong maximum principle and uniqueness results. Application of Heat equation. (5hours)
7. **Unit 7:** Wave equation: uniqueness, D'Alembert's method, method of spherical means and Duhamel's principle. Application of Wave equation. (5hours)

Laboratory/practical/tutorial Modules: NA

3. **Text books:**

(Relevant and Latest, Only 2)

1. E. C. Zachmanoglou and D. W. Thoe. "Introduction to Partial Differential Equations", Dover Publications, New York, 2016.
2. L.C. Evans, Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19, AMS, Providence, 1998

4. **References:**

1. G. B. Folland, "Introduction to Partial Differential Equations", Princeton University Press, 1995
2. A. K. Nandakumaran and P. S. Datti, "Partial Differential Equations", Cambridge-IISc Series, 2020.
3. W. E. Schiesser and G. W. Griffiths, "A Compendium of Partial Differential Equation Models", Cambridge University Press, 2009.

(No limit on numbers, relevant standard format can be followed, the formats should be similar)

5. **Similarity with the existing courses:**
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.		MA522	80%	

6. Justification of new course proposal if cumulative similarity content is >30%:

This course is for B.Tech maths and computing core course of level 2 and they cannot take MA522 course which is a core course for MSc. Mathematics.

Approvals:

Other Faculty interested in teaching this course: –
All the SMSS faculties discussed this course.

Proposed by: Dr. Qaiser Jahan **School: SMSS**

Signature: **Date:** 22/04/25

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi Proposal for a New Course

Course number	**: MA-221**
Course Name	**: Numerical Analysis**
Credit Distribution	**: 2-0-3-4**
Intended for	**: B.Tech. 2nd year students**
Elective or core	**: Core for B.Tech. Mathematics and Computing, Elective for other disciplines.**
Prerequisite	**: NA**
Mutual Exclusion	**: MA-523**

---

1. Preamble:

The course emphasizes on the effective use of basic numerical methods to solve engineering and real-life problems. In this process, a theoretical knowledge will be developed as well as students will learn how to apply these methods to get numerical solutions. The theoretical knowledge should include an understanding of both the original problem being solved and of the numerical methods for its solution, including their derivation, error analysis and an idea of when they will perform well or poorly. Finally, the primary objective of the course is to develop the basic understanding of the numerical methods and perhaps more importantly, the applicability and limitations of the methods to get best possible computed results.

2. Course Modules with quantitative lecture hours:

Unit-1: Introduction to Numerical Computing: Fixed-point Representation, Floating-point Representation, Significant digits, Approximations and Errors in Numerical Computing, Error Propagation, Conditioning & Stability. **[4 contact hours]**

Unit-2: Roots Finding Methods for Nonlinear Equations: Introduction, Bisection Method, Method of False Position, Secant method, Fixed-point iteration method, Newton-Raphson Method; Roots Finding Methods for a system of Non-linear equations; Roots Finding Methods for a Complex equation. **[6 contact hours]**

Unit-3: Solution of the System of Linear Equations: Direct Solution process: Matrix Inversion Method, Gauss Elimination Method, Partial-Pivoting, Gauss-Jordan Method; Iterative Solution process: Jacobi Iteration Method, Gauss-Seidel Method, Method of Relaxation, QR decomposition Method, Convergence of Iteration Methods. **[5 contact hours]**

Unit-4: Curve Fitting using numerical methods: Interpolating polynomials, Lagrange Interpolation Polynomial; Newton Interpolation Polynomial: Newton Divided Difference formula, Newton Forward Difference formula, Newton Backward Difference formula; Cubic spline, Regression Curves, Least-Square approximations. **[6 contact hours]**

Unit-5: Numerical Differentiation: Forward, Backward and Central Difference, Richardson's Extrapolation formula. **[3 contact hours]**

Unit-6: Numerical Integration: Newton-Cotes formula, Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three-Eight formula, Romberg Integration, Gaussian quadrature. **[4 contact hours]**

Laboratory/practical/tutorial Modules: The computer lab classes will complement the theoretical understanding of the students. All the numerical methods, discussed in the lecture classes, will be used to solve mathematical/physical problems through computer programming during the lab classes. This will provide a hands-on experience to the students on this subject.

3. Text books:

i. **K. E. Atkinson, An Introduction to Numerical Analysis, 2nd Edition, John Wiley, 2008.**
ii. **Numerical Analysis, R. L. Burden and J. D. Faires, 7th ed., Thomson Learning, 2001.**

4. References:

i. **M. T. Heath, Scientific Computing: An Introductory Survey, McGraw Hill, 2002.**
ii. **Brian Bradie, A friendly introduction to Numerical Analysis, Pearson Education, 2007.**

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.		MA-523	Almost all Units	75%

6. Justification of new course proposal if cumulative similarity content is >30%: This course is a discipline course for B.Tech 2nd year students of Mathematics and Computing. Existing course is a 5-lebel course which can't be offered to the B.Tech 2nd year students. Also, the credit distribution of MA-221 is different from MA-523.

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course: –

Proposed by: Prof. Rajendra Kumar Ray **School: SMSS**

Signature: 25/4/2025 **Date:** 25/4/2025

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA 222**
Course Name : **Applied Linear Programming**
Credit Distribution : **3-1-0-4**
Intended for : **B.Tech. Mathematics & Computing 2nd Year**
Elective or core : **Core for B.Tech Maths & Computing, Elective for other disciplines**
Prerequisite : **Linear algebra**
Mutual Exclusion : **MA 515**

---

1. Preamble:

Optimization is a cornerstone of decision-making, enabling the efficient allocation of resources and the solving of complex problems in various fields. Linear Optimization and Game Theory are indispensable tools in modern operations research and analytics, providing systematic approaches to addressing continuous and discrete optimization challenges. This course offers an exploration of these methods, focusing on essential theoretical and computational aspects of linear programming (LP) and Game Theory.

2. Course Modules with quantitative lecture hours:

1. **Module 1: Linear Programming Fundamentals** [4]
   Optimization Basics and Origin of LP Problems, Systems of Linear Inequalities, Convex Sets and Feasible Regions.

2. **Module 2: Computational Aspects of Linear Programming** [14]
   Graphical Method, Simplex Method, Big-M, Dual Problem, Dual Simplex Method, Primal-Dual method.

3. **Module 3: Alternative approaches of Linear Programming** [10]
   Karmarkar's Algorithm, Transportation problems, Assignment problems, Travelling Salesman Problem.

4. **Module 4: Integer Programming** [6]
   Introduction to Integer Programming, Gomory's cutting plane algorithm, Branch and Bound Method, Solving Zero-one problem.

5. **Module 5: Game Theory** [8]
   Basic Concept and Terminologies, Minimax (Maximin) criterion, Saddle point, Two-person Zero-sum Game, and Game with Pure and Mixed Strategies, Dominance Principle, Arithmetic Method, and Graphical Method for Solving ($2\times n$) Game, Graphical Method for Solving ($m\times 2$) Game and Linear Programming Methods for Rectangular Games.

Laboratory/practical/tutorial Modules:

3. Text books:

1. Luenberger and Ye. Linear and Nonlinear Programming. Springer, 2008.
2. Elliott Mendelson and Daniel Zwillinger, Introducing Game Theory and its Applications, 2nd Edition, Taylor & Francis, 2004.

4. References:

1. M.S. Bazaraa, J.J. Jarvis and H.D. Sherali, Linear Programming and Network Flows, 2nd Edition, Wiley & Sons, 1990.
2. I. Griva, S.G. Nash, A. Sofer, Linear and Nonlinear Optimization, SIAM, 2009.
3. Nocedal and Wright. Numerical Optimization. Springer, 2006.
4. Murty, Katta G., ed., "Case Studies in Operations Research: Applications of Optimal Decision Making". Vol. 212. Springer 2014.
5. Articles as chosen by the instructor.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Applied Mathematical Programming	MA 515	LPP fundamental, Computational approaches, Alternative approaches, Integer programming.	70%

6. Justification of new course proposal if cumulative similarity content is >30%:

The proposed course is essential for students exploring the field of optimization, as it the first course in the area that introduces the fundamentals of the subject, laying a strong foundation for more advanced courses. The common concepts covered are crucial for all students, equipping them with the core skills needed to understand and apply in further advanced courses.

Approvals:

Other Faculty interested in teaching this course: – Prof. Manoj Thakur

Proposed by: Preeti **School:** SMSS

Signature: Preeti **Date:** 22-04-2025

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA-310**
Course Name : **Matrix Computations & Lab**
Credit Distribution: **3-0-2-4**
Intended for : **B.Tech 3rd Year Students**
Elective or core : **Core for B.Tech. Mathematics and Computing, Elective for other disciplines.**
Prerequisite : **Linear Algebra, Any programming language**
Mutual Exclusion : **DS 402, DS 412**

---

1. Preamble:

The objective of the course is to provide students with a thorough understanding of the principles behind matrix computations and their numerical stability. Students will learn to analyze the effects of computational errors, including round-off and perturbations, on the accuracy and reliability of numerical methods. By exploring the theoretical foundations of key matrix operations, they will develop the ability to assess and address issues related to the conditioning of problems and the stability of algorithms, preparing them to apply robust techniques in solving real-world computational challenges.

2. Course Modules with quantitative lecture hours:

Module 1: Fundamentals of Matrix Computations

Overview of matrix computations, matrix norms (Frobenius, induced, etc.), stability and conditioning related to matrix computation and their effects, introduction to perturbation theory. *(6 Lectures)*

Module 2: Linear Systems and Factorization Techniques

LU factorization, Gaussian elimination, Cholesky factorization, and their sensitivity analysis. Iterative methods for solving linear systems: Jacobi, Gauss-Seidel, and Successive Over-Relaxation (SOR) methods. Stability and sensitivity analysis. *(7 Lectures)*

Module 3: Linear Least Squares and QR Factorization

Gram-Schmidt process, rotators, reflectors, QR factorization, stability in least squares problems, normal equations, and Moore-Penrose pseudoinverse. Sensitivity analysis in rank-deficient least squares problems. *(8 Lectures)*

Module 4: Eigenvalues and Eigenvectors

Spectral theorem for symmetric matrices, eigenvalue decomposition, Jacobi method, power and inverse power methods, Rayleigh quotient iteration, Schur's decomposition. Sensitivity analysis of eigenvalues and eigenvectors. *(10 Lectures)*

Module 5: Singular Value Decomposition (SVD) and Applications

Singular Value Decomposition (SVD), its applications in solving linear systems and rank-deficient problems, QR algorithm for SVD, error propagation in eigenvalue and singular value computations Stability and computational aspects of SVD. (*11 Lectures*)

Lab Class: The computer lab classes will complement the theoretical understanding of the students. All the concepts, discussed in the lecture classes, will be used to solve practical problems through computer programming during the lab classes. This will provide a hands-on experience to the students on this subject.

3. Text books:

1. Watkins, D. S. (2004). *Fundamentals of Matrix Computations* (Vol. 64). John Wiley & Sons.
2. Golub, G. H., & Van Loan, C. F. (2013). *Matrix Computations* (4th ed.). Johns Hopkins University Press.

4. References:

1. L. N. Trefethen and David Bau, Numerical Linear Algebra, SIAM, 1997.
2. Demmel, J. W. (1997). *Applied Numerical Linear Algebra*. SIAM.
3. B. N. Datta, *Numerical Linear Algebra and Applications*, 2nd Edn., SIAM, 2010.
4. Gentle, J. E. (2017). *Matrix Algebra: Theory, Computations and Applications in Statistics*. Springer Texts in Statistics.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	DS 402	Almost same except PCA	
2.	DS 412	Almost same except PCA	

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Prof. Rajendra K. Ray & Dr. Tanmay Kayal **School:** School of Mathematical and Statistical Sciences

Signature: **Date:** 25.04.25

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	:	**MA 311**
Course Name	:	**Mathematical Modeling**
Credit Distribution	:	**L-T-P-C: 3-0-0-3**
Intended for	:	**B.Tech 3rd Year Students**
Elective or core	:	**Core for B.Tech. Mathematics and Computing, Elective for other disciplines.**
Prerequisite	:	**Ordinary and Partial Differential Equations, Linear Algebra, Basics of Programming, Basic of Statistics**

---

1. Preamble:

Mathematical modeling is essential for understanding, predicting, and optimizing real-world phenomena across various fields, such as physics, biology, economics, and artificial intelligence. This course provides a comprehensive introduction to mathematical modeling techniques, with a focus on differential equations, optimization, and machine learning applications. Through a combination of theoretical foundations, practical implementations, and case studies, students will cultivate the ability to create and analyze models that reflect complex system behaviors. By the end of the course, students will possess the necessary skills to apply mathematical modeling techniques in scientific research and industry.

2. Course Contents:

- **Module 1: Introduction to Mathematical Modeling**
  Modeling Process, Types of Models, Applications in Science and Engineering, Modeling Change, Model Fitting Techniques, Experimental Modeling, Simulation Modeling.
  (9 hours)

- **Module 2: Modeling with System of Differential Equations I**
  Compartmental Models, Population Models: Single Species Models (Exponential, Logistic, and Gompertz growth), Interacting Population Models: Prey-Predator Models.
  (10 hours)

- **Module 3: Modeling with System of Differential Equations II**
  Chemostat Models, Competition Model, Mutualism Models, Tumor Models, Structured Population Models, spatially structured and Age structured Models, Cooperative Model, Population Dispersal Model based on Diffusion, Traveling Wave Solutions, Fisher's Equation (11 hours)

- **Module 4: Mathematical Modeling with Machine Learning**
  Neural Network Modeling, Neural ODEs, Physics-Informed Neural Networks (PINNs), The Pareto Front, Model Selection criteria, Cross-Validation, Information Criteria.

  (7 hours)

- **Module 5: Case Study**
  Oscillator Generated Wave Phenomena and Central Pattern Generators, The spruce budworm outbreak model, SEIR model, PINNs for solving Heat Equation.

  (5 hours)

Evaluation Scheme:

1. Problem Sets & Computational Assignments
2. Final project: Students can choose from various modeling projects or suggest their own, in which they will develop a model addressing a real-world issue. The result of the project will be a concise technical paper outlining the problem and results. The student will use Python or MATLAB.
3. End Semester Exam

3. Textbooks:

1. Leah Edelstein Keshet, Mathematical Models in Biology, SIAM , 2005.
2. Mark Kot, Elements of Mathematical Ecology, Cambridge University Press, 2008.
3. Strogatz, S. H. (2015). *Nonlinear dynamics and chaos: With applications to physics, biology, chemistry, and engineering* (2nd ed.). Westview Press.
4. Haykin, Simon. 1999. *Neural Networks: A Comprehensive Foundation*, 2nd ed. Upper Saddle River, NJ: Prentice Hall.

4. Reference Books:

5. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
6. Strang, Gilbert. Linear algebra and learning from data. Cambridge: Wellesley-Cambridge Press, 2019.
7. C. Eck, H. Garcke and P. Knabner, Mathematical Modeling, Springer publication, 2017.
8. R. Temam, A.M. Miranville, Mathematical Modelling in Continuum Mechanics, Cambridge University Press, Cambridge, 2001.
9. J D Murray, Mathematical Biology Vol. I & II, Springer
10. A.Friedman & C. Chou, Introduction to Mathematical Biology.
11. Giordano, Frank R., William P. Fox, and Steven B. Horton. A first course in mathematical modeling. Cengage Learning, 2013.

5. Similarity Content Declaration with Existing Courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

6. Justification for new course proposal if cumulative similarity content is > 30%:

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Nitu Kumari **School: SMSS**

Signature: **Date:** 22/4/25

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……...

Sl. No	Faculty Name	Signature

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved _____

Date:_____

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: MA-321**
Course Name	**: Numerics of Differential Equations**
Credit Distribution	**: 3-0-2-4**
Intended for	**: B.Tech. 3rd year students**
Elective or core	**: Core for B.Tech. Mathematics and Computing, Elective for other disciplines.**
Prerequisite	**: NA**
Mutual Exclusion	**: MA-609**

---

1. Preamble:

Differential Equations frequently arise in the field of science and engineering. The primary goal of this course is to develop the basic understanding of the construction of numerical algorithms, sensitivity studies, and their hands-on applications through numerical computation. Through this course, students will be introduced to Finite Difference approaches and their applicability and limitations. This course is the second course (after MA-221) in numerical analysis for B.Tech. in Mathematics and Computing program. The main objective of the course is to provide basic concepts of various numerical approaches, their advantages and limitations in solving a differential equations (ODEs and PDEs) along with convergence and stability analysis with computer Lab component.

2. Course Modules with quantitative lecture hours:

Unit 1: Numerical Methods for Ordinary Differential Equations - Initial Value Problems (IVPs): Taylor series method, Euler methods, Runge-Kutta methods; Multistep methods: Milne's method, Adams-Moulton method, System of equations, Higher order equations, Stiff equations. Boundary Value Problems (BVPs): Finite difference methods, Shooting method. **[8 contact hours]**

Unit 2: Introduction to PDEs – Classification of PDEs, Physical Classifications, Mathematical classifications, Introduction to Numerical Computing. **[4 contact hours]**

Unit 3: Introduction to Finite Difference approximations– Simple method, General Method, Polynomial fitting. One-dimensional equations, Two-dimensional equations. Accuracy of Finite Difference Solutions: Consistency, Stability, Convergence analysis. **[8 contact hours]**

Unit 4: Finite Difference Methods for Hyperbolic Equations - One-dimension and Two-dimension equations, Discretization, stability, CFL conditions, Explicit and Implicit schemes, Single-step and multi-step methods. **[8 contact hours]**

Unit 5: Finite Difference Methods for Parabolic Equations - One-dimension and Two-dimension equations, Discretization, stability, Convergence of the scheme. Finite Difference methods for Convection-Diffusion Equations, sensitivity analysis.

[9 contact hours]

Unit 6: Finite Difference Methods for Elliptic Equations - One-dimension and Two-dimension equations, Discretization, stability, Convergence of the scheme. **[5 contact hours]**

Laboratory/practical/tutorial Modules: The computer lab classes will complement the theoretical understanding of the students. All the numerical methods, discussed in the lecture classes, will be used to solve mathematical/physical problems through computer programming during the lab classes. This will provide a hands-on experience to the students on this subject.

3. Text books:

i. **K. E. Atkinson, An Introduction to Numerical Analysis, 2nd Edition, John Wiley, 2008.**

ii. **G. D. Smith, Numerical Solutions to Partial Differential Equations, Oxford University Press, 3rd Edition, 2004.**

4. References:

i. **J. C. Strikwerda, Finite Difference Schemes and Partial Differential Equations, SIAM, 2004.**

ii. **M. T. Heath, Scientific Computing: An Introductory Survey, McGraw Hill, 2002.**

Indian Institute of Technology Mandi

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.		MA-609	Almost all Units except 1st Unit	70%

6. Justification of new course proposal if cumulative similarity content is >30%: This course is a discipline course for B.Tech 3rd year students of Mathematics and Computing. Existing course is a 6-lebel course which can't be offered to the B.Tech 3rd year students. Also, the credit distribution of MA-321 is different from MA-609

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course: –

Proposed by: Prof. Rajendra Kumar Ray **School: SMSS**

Signature: 25/4/2025 **Date:** 25/4/2025

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA322**
Course Name : **Applied Graph Theory**
Credit Distribution: ***3-0-2-4***
Intended for : **B.Tech 3rd Year Students**
Elective or core :**Core for B.Tech Maths & Computing, Elective for other disciplines**
Prerequisite : **None**
Mutual Exclusion : **MA530**

---

1. Preamble:

Graph theory is a fundamental area of mathematics that provides a powerful framework for modeling relationships and structures in diverse fields such as computer science, engineering, and network analysis. This course introduces core graph-theoretic concepts, including graph representations, connectivity, traversal techniques, and shortest path algorithms.

Students will explore combinatorial structures like vertex covers, matchings, and network flows, along with their algorithmic applications. The course also examines structural properties of graphs, including Eulerian and Hamiltonian cycles, coloring, and planarity. In the final unit, spectral graph theory and network models provide insights into real-world systems such as social and technological networks. By the end of this course, students will gain a deep understanding of graph theory's theoretical foundations and practical applications, enabling them to apply these concepts in research and problem-solving.

2. Course Modules with quantitative lecture hours:

Unit 1: *Fundamentals of Graph Theory*

Basic definitions of graphs, adjacency, degree, degree sequence, graph isomorphism, walks, trails, path, cycles, bipartite graphs and their characterizations, subgraphs, graph representations: adjacency matrix and adjacency list, directed graphs, tournaments. **(4 Hours)**

Unit 2: *Trees and Connectivity in Graphs*

Definition and properties of trees, forests, spanning trees, Cayley's formula, Prim's and Kruskal's algorithm, Dijkstra's Algorithm and Bellman-Ford algorithm, vertex cut, edge cut, applications of cuts, Menger's theorem. **(10 Hours)**

Unit 3: *Graph Traversal and Shortest Paths*

Breadth-First Search (BFS), Depth-First Search (DFS), topological sorting and directed acyclic graphs, strongly connected components in directed graphs, All-Pairs Shortest Paths: Floyd-Warshall Algorithm. **(5 Hours)**

Unit 4: *Vertex Cover, Independent Sets, Flows, and Matching*

Vertex covers and independent sets in a graph, matching, matching in bipartite graphs, Hall's Marriage theorem, Stable Matching and the Gale-Shapley Algorithm, Network flow, Ford Fulkerson algorithm, residual graphs, and augmenting paths. **(12 Hours)**

Unit 5: *Eulerian and Hamiltonian Graphs, Coloring and Planarity*

Eulerian graphs, Fleury's algorithms, Hamiltonian paths, Hamiltonian cycles and their properties, vertex coloring, applications of vertex coloring, edge coloring, planar graphs and their properties, coloring of planar graphs. **(6 Hours)**

Unit 6: *Spectral Graph Theory and Networks*

Basic definitions and applications of spectral graph theory, real-world networks, including social networks, biological networks, and technological networks. It covers centrality measures (degree, closeness, betweenness, eigenvector centrality, PageRank), community detection (Girvan-Newman, Louvain method), and random graph models such as Erdős–Rényi and Barabási-Albert models. **(5 Hours)**

Laboratory/practical/tutorial Modules: The algorithms and concepts discussed in the class will be implemented in the lab sessions

Indian Institute of Technology Mandi

3. Text books:

1. D. B. West, *Introduction to Graph Theory*, Pearson Education.
2. É. Tardos and J. Kleinberg, *Algorithm Design*, Pearson Education.

4. References:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, 3rd Edition, MIT Press.
2. R. Balakrishnan and K. Ranganathan, *A Textbook of Graph Theory*, Springer.
3. R. Diestel, *Graph Theory*, Springer.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Algorithm Design and Analysis, Data Structures and Algorithms-II, Graph Theory	CS-403, CS-202, CS-514, MA-530	BFS, DFS, Shortest Path Algorithms, Basic Graph Terminology, Vertex Coloring, Matching, Planarity, and some other basic definitions.	28%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by: **School:** SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s): 25-04-2025 **Date:** 25-4-2025

(Dr. Mirza Galib Anwarul Husain Baig) (Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Indian Institute of Technology Mandi

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA-251**
Course Name : **Abstract Algebra**
Credit Distribution : ***3-0-0-3***
Intended for : **B.Tech 2nd Year**
Elective or Core : **Discipline Elective for B.Tech. Mathematics and Computing, Elective for other disciplines**
Prerequisite : **None**
Mutual Exclusion : **MA-548**

---

1. Preamble:

This one semester course is designed to provide a first exposure of the concepts of abstract algebra to students of engineering as well as to show them some practical applications of these concepts. Such a course would teach students the basic objects of algebra, providing plentiful examples and enough theory to allow interested students to transition easily to more advanced abstract algebra.

The objective of this course is to introduce engineering students to the fundamental concepts of abstract algebra, emphasizing its applications in engineering and computer science. The course aims to develop a strong mathematical foundation in algebraic structures such as groups, rings, and fields, which are essential for understanding cryptography, coding theory, error detection and correction, network security, and other computational techniques. By integrating theoretical concepts with real-world applications, the course will enhance students' problem-solving skills and analytical thinking, preparing them for advanced topics in engineering mathematics and algorithm design.

2. Course Modules with quantitative lecture hours:

Unit 1: Binary operation and its properties, Groups: examples and basic properties, Subgroups, Finite Groups and Subgroups. **(6 Hours)**

Unit 2: Cyclic groups, Order of a group, Permutation groups, Isomorphism theorems, Cayley's

theorems. **(6 Hours)**

Unit 3: Coset of a subgroup, Lagrange's theorem and its consequences, Normal subgroups, Quotient group, Internal direct products. **(6 Hours)**

Unit 4: Homomorphisms, Kernel Image of a homomorphism, Direct product of groups, Structure of finite abelian groups. **(6 Hours)**

Unit 5: Rings: definition, examples and basic properties, Subrings, Zero divisors, Integral domains, Fields, Characteristic of a ring, Ideals, Prime ideal, Maximal ideals, Quotient rings. **(6 Hours)**

Unit 6: Ring Homomorphisms, Isomorphism theorems, Field of Quotients, Divison Algorithm in Polynomial Rings and its consequences. **(6 Hours)**

Unit 7: Reducibility and Irriducibility tests, Unique factorization in Z[x], Irreducibles, Primes, UFD, PID and Euclidean domains. **(6 Hours)**

Laboratory/practical/tutorial Modules: NA

Indian Institute of Technology Mandi

3. Text books:

1. **Joseph Gallian, Contemporary Abstract Algebra, 7th ed.**
2. **N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.**

4. References:

1. **M. Artin, Algebra, Prentice Hall of India, 1994.**
2. **J. B. Fraleigh, A first Course in Abstract Algebra, Narosa Publishing House, 2003.**
3. **Klima, Sigmon and Stitzinger, Applications of Abstract Algebra with Maple and MATLAB , Second Edition, 2006.**

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity	Approx. % of Content

			Content	
1.	Abstract Algebra	MA-549		95%

6. Justification of new course proposal if cumulative similarity content is >30%:

This is not a new course instead the credit for this course needs to be changed. Earlier it was a 3-credit course but the course contains so many advanced topics which need practice and hence the tutorial is a must. For this reason, the course should be revised and the credit for the course should be changed to 4. A new course code also needs to be assigned. This course was already taught with 4 credits with the approval of dean, academics.

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculties interested in teaching this course: –

- **Dr. Samir Shukla**

Proposed by:

Dr. Sampat Kumar Sharma

Dr. Vikash Tripathi

School:
School of Mathematical and Statistical sciences

Date: 25/4/2025

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Indian Institute of Technology Mandi

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

IIT Mandi
Proposal for a New Course

Course number	**: MA 120**
Course Name	**: Introduction to Computing System and Databases**
Credit Distribution	**: 3-0-2-4**
Intended for	**: B.Tech Mathematics and Computing**
Elective or core	**: Core for B.Tech. Mathematics and Computing**
Prerequisite	**: Basic Knowledge of Programming and Data Structures**
Mutual Exclusion	**: None**

---

1. Preamble:

This course introduces fundamental concepts in computer organization, operating systems, and databases. Students will develop a strong understanding of data representation, machine code, computer arithmetic, memory management, process management, and file systems. The course will also cover key topics in operating systems including process scheduling, inter-process communication, and synchronization. Through this course, students will acquire essential skills for understanding and managing computer hardware and software systems, providing a foundation for future courses in system-level programming and database management.

2. Course Modules with quantitative lecture hours:

Unit 1: Introduction to Computer Organization and Data Representation (12 Hours)

- **Data Representation**: Number systems (binary, octal, hexadecimal), signed numbers, floating-point representation.
- **Machine Code**: Introduction to machine language and assembly language, instruction formats, opcode and operands, addressing modes.
- **Computer Arithmetic**: Addition, subtraction, multiplication, and division, fixed-point and floating-point arithmetic, overflow and underflow.
- **Memory Organization and Management**: Memory hierarchy, cache design, RAM, ROM, memory addressing, memory paging and segmentation.

Unit 2: Introduction to Operating Systems **(15 Hours)**

- **Responsibilities of Operating Systems**: Basic functions of an operating system, user-interface, and system-call interface.

- **Process & Thread Management**:

    - Process model and states: Process life cycle, process control block, context switching.

    - Thread models: Difference between processes and threads, multithreading.

    - **User/Kernel Level Threads**: Thread management and scheduling at user and kernel levels.

- **Process Creation and Termination**: Forking and exec operations, process termination, exit statuses.

- **Process Synchronization**: Introduction to the Critical Section Problem, requirements of mutual exclusion, progress, and bounded waiting. Classical software solutions: Peterson's Algorithm for two-process synchronization and Lamport's Bakery Algorithm for *n*-process synchronization.
- **Inter-Process Communication (IPC)**: Message passing, shared memory, pipes, and sockets.

- **Process Scheduling**: Scheduling algorithms such as FCFS, SJF, Round Robin, Priority Scheduling.

- **File Systems**: File structure, file access methods, file system implementation, file allocation strategies.
- **Memory Organization**: Primary, secondary memory, memory blocks, paging, segmentation.

- **Virtual Memory**: Address translation, page tables, page faults, thrashing.

Unit 3: Introduction to Databases **(15 Hours)**

- **Information Modeling**: Conceptual data models, Entity-relationship diagrams, Normal Forms .

- **ACID Properties and Transactions**: Understanding Atomicity, Consistency, Isolation, Durability, and the role of transactions in databases. Serializability, concurrency control, and lock-based mechanisms like Two-Phase Locking (2PL) and

deadlock detection.

Data Manipulation Language (SQL)

- **SQL Basics**: The basic SQL commands include SELECT, INSERT, UPDATE, and DELETE for querying and modifying data.

- **Advanced SQL**: This covers more complex SQL operations such as joins, subqueries, aggregate functions, indexing, and views for efficient data manipulation.

Laboratory/practical/tutorial Modules:

Based on the contents discussed in class lab will consists of the following:

- MIPS Programming (QtSPIM)
    - Writing, running, and debugging MIPS assembly programs.
- Shell Scripting
    - Writing and executing bash scripts for task automation.
- Multiprocessing
    - Implementing threads, synchronization, and handling race conditions.
- Multithreading
    - Implementing threads, synchronization, and handling race conditions.
- SQL
    - Writing basic queries, joins, and using aggregate functions.

Indian Institute of Technology Mandi

3. Text books:

1. **Operating System Concepts** by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley.
2. **Computer Organization and Design** by David A. Patterson and John L. Hennessy, Morgan Kaufmann.
3. **Database Management Systems** by Raghu Ramakrishnan and Johannes Gehrke, McGraw-Hill.

4. References:

1. **Modern Operating Systems** by Andrew S. Tanenbaum, Pearson.
2. **Database Systems: The Complete Book** by Hector Garcia-Molina, Jeff Ullman, Jennifer Widom, Pearson.
3. **Structured Computer Organization** by Andrew S. Tanenbaum, Pearson.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Computer Organisation, Applied Database Practicum, Applied Electronics	CS 201, CS-207, IC-161	Number System, Data Representation, ISA, Memory Hierarchy, SQL,	20%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by:

School: SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s):

Date: 25-4-2025

(Dr. Mirza Galib Anwarul Husain Baig)

(Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA312**
Course Name : **Design and Analysis of Algorithms**
Credit Distribution : ***3-0-2-4***
Intended for : **B.Tech 3rd Year Students**
Elective or core : **Core for B.Tech. Mathematics and Computing, Elective for other disciplines**
Prerequisite : **IC253**
Mutual Exclusion : **CS212, CS403**

---

1. Preamble:

The proposed elective course builds on the core concepts of Data Structures and Algorithms (ADSA) and introduces students to common algorithm design techniques, performance analysis, and efficiency improvements. It aims to teach students how to design algorithms for computational tasks using various data structures, analyze their performance, and provide performance guarantees. Through theoretical learning complemented by practical programming exercises and weekly labs, students will gain the skills to analyze algorithmic efficiency, prove correctness, and apply major design paradigms to solve engineering problems. Upon completion, students will be able to classify problems, construct efficient algorithms, and assess their performance.

2. Course Modules with quantitative lecture hours:

Unit 1: The Role of Algorithms in Computing, Analyzing Algorithms, Best, Average, Worst Case Analysis, Asymptotic notations, big-oh, theta, big-omega, little-oh and little-omega, Recurrences, Master's Theorem, Amortized analysis: aggregate analysis, accounting, potential method. **(7 Hours)**

Unit 2: Divide and Conquer: Merge Sort, Quick Sort, Finding Closest Pair of Points, Strassen's Algorithms, Median Finding, Discrete Fourier Transforms. **(7 Hours)**

Unit 3: Greedy Algorithms: Un-weighted Interval Scheduling, MST-- Prims and Kruskals,

Dijkstra's shortest path, fractional knapsack, and Huffman coding. **(7 Hours)**

Unit 4: Dynamic Programming: Integral knapsack, Weighted Interval Scheduling, longest common subsequence, Rod-Cutting, matrix chain multiplication, and independent sets in trees. **(7 Hours)**

Unit 5: Geometric Algorithms: Line Segments: Properties, Intersection, sweeping lines - Convex Hull finding algorithms. **(4 Hours)**

Unit 6: Intractability: NP-completeness: reduction amongst problems, classes NP, P, NP-complete, and polynomial time reductions. **(4 Hours)**

Unit 7: Introduction to Advanced techniques: Approximation Algorithms, Vertex Cover, Set Cover, Minimum Makespan, Subset Sum Problem. Parameterized Algorithms, Vertex Cover, Feedback Vertex Set in Tournaments. **(6 Hours)**

Laboratory/practical/tutorial Modules: Coding Lab will cover topics discussed in this course.

3. Text books:

1. **T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms, MIT Press, 3/e, 2009.**
2. **J. Kleinberg and E. Tardos, Algorithm Design, Pearson, 2006.**

4. References:

1. **Algorithms, by Dasgupta, Papadimitriou and Vazirani, McGraw-Hill Education, 2006.**
2. **Computer Algorithms, by Horowitz, Sahni, and Rajasekaran, Silicon Press, 2007.**

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Design and Analysis of Algorithms	CS212	Several Algorithm Design Techniques	50%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by: **School:** SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s): **Date:** 25-4-2025

(Dr. Mirza Galib Anwarul Husain Baig) (Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

IIT Mandi
Proposal for a New Course

Course number : **MA313/CS304**
Course Name : **Formal Languages and Automata Theory**
Credit Distribution : ***3-0-0-3***
Intended for : **B.Tech 3rd Year Students**
Elective or core : **Core for B.Tech. Mathematics and Computing, Elective for other disciplines**
Prerequisite : **CS 202**
Mutual Exclusion : **CS304**

---

1. Preamble:

*The **Formal Languages and Automata Theory** course introduces students to foundational computational models and abstractions. Building on prior knowledge from courses like Discrete Structures (CS208) and Data Structures and Algorithms (CS202), the course covers essential topics such as automata theory, formal languages, regular expressions, context-free grammars, and Turing machines. Students will develop skills in designing automata, proving language properties, simplifying grammars, and classifying problems as decidable or undecidable. The course emphasizes formal mathematical methods and reasoning, helping students understand the power and limitations of different computation models. Advanced topics may be introduced based on student progress and interest.*

2. Course Modules with quantitative lecture hours:

Unit 1: DFA, NFA, Subset construction, Regular, Pumping Lemma, DFA state minimization, Myhill-Nerode relations and theorem. **[10 Hours]**

Unit 2: Grammer, Production systems, Right linear grammar and Finite state automata, Context free grammars, Normal forms, Pumping Lemma for CFLs, Subfamilies of CFL, Derivation trees and ambiguity. **[06 Hours]**

Unit 3: Pushdown Automata, Acceptance by final state and empty stack, Equivalence between pushdown automata and context-free grammars, Closure properties of CFL, Deterministic push- down automata, the CKY algorithm. **[10 Hours]**

Unit 4: Turing machines, Techniques for Turing machine construction, Generalized and

restricted versions equivalent to the basic model, Universal Turing machine, Recursively enumerable sets and recursive sets. **[09 Hours]**

Unit 5: Decidable and undecidable problems, Reduction, Post's correspondence problem, Rice's theorem, decidability of membership, emptiness and equivalence problems of languages. **[07 Hours]**

Laboratory/practical/tutorial Modules:

3. Text books:

1. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to automata theory, languages and computation, 3rd Edition, Pearson, 2006.
2. M. Sipser, Introduction to the Theory of Computation, 3rd Edition, Cengage Learning, 2012.

4. References:

1. D. C. Kozen, Automata and Computability, Springer, 1997.
2. E. A. Rich, Automata, Computability and Complexity: Theory and Applications, Pearson, 2007.
3. Peter Linz, An introduction to formal language and automata, 3rd Edition, Narosa publishing house, 2002.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by: **School:** SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s):

Date: 25/4/2025

(Dr. Mirza Galib Anwarul Husain Baig)

(Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA323/CS 207**
Course Name : **Applied Databases Practicum**
Credit Distribution : ***0-0-3-2***
Intended for : **B.Tech 3rd Year Students**
Elective or core : **Core for B.Tech. Mathematics and Computing, Elective for other disciplines**
Prerequisite : **IC152, MA120**
Mutual Exclusion : **None**

---

1. Preamble:

This course teaches students how to build database-driven applications with a graphical user interface (GUI). Topics include SQL basics, data modeling, UI design, web technologies (HTML, PHP, JavaScript, AJAX), and NoSQL databases. Students will work on a mini-project throughout the semester, progressively developing a web-based tool, from designing the data model and UI to enhancing user interaction and incorporating advanced web features. By the end, students will have practical experience in creating efficient, user-friendly applications.

2. Course Modules with quantitative lecture hours:

A few lab lectures (8 hours spread over the semester):

- Architectures of DB applications: Client-server; UI-Business logic-DBMS;
- Browser UI-Web server-Business logic-DBMS.
- Introduction to SQL
- Introduction to E-R modelling and MVC
- Transactions what, how and when?
- Introduction to a scripting language, eg PHP, Python
- Introduction to HTML and especially HTML5
- Introduction to Javascript and Ajax/Comet
- Introduction to NoSQL

Lab assignments (listed below) require 3 hours in the lab, preceded by at least 3 hours at home. The weekly assignments are stage-wise demonstrations of the

evolution of a mini-project stages are as follows:

- Week 1-2 Choice of mini-project a useful web-based tool.
- Week 3-4 Designing the data model and table schemas, testing the tables manually.
- Week 5-6 Design the UI flow the user view.
- Week 7 Creating the GUI forms and reports.
- Week 8-9 Putting together the Web UI flow with the appropriate data access.
- Week 10 Basic tool ready with full functionality
- Week 11 Improving UI using javascript and HTML5 features.
- Week 12 Using AJAX for better user-interaction.
- Week 13 Substituting portions of the data model using NoSQL databases

Laboratory/practical/tutorial Modules:

3. Text books:

1. This course will use web-resources to cover course topics.

4. References:

(No limit on numbers, relevant standard format can be followed, the formats should be similar)

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by: **School:** SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s):

(Dr. Mirza Galib Anwarul Husain Baig)

Date: 25-4-2025

(Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: MA-548**
Course Name	**: Abstract Algebra**
Credit Distribution	**: *3-1-0-4***
Intended for	**: M.Sc./M.S./PhD/B.Tech**
Elective or Core	**: Discipline Elective for M.Sc. Applied Mathematics and Elective for other disciplines**
Prerequisite	**: None**
Mutual Exclusion	**: MA-251**

1. Preamble:

This one semester course is designed to provide a first exposure of the concepts of abstract algebra to students of mathematics and engineering as well as to show them some practical applications of these concepts. Such a course would teach students the basic objects of algebra, providing plentiful examples and enough theory to allow interested students to transition easily to more advanced abstract algebra. This course aims to provide a first approach to the subject of abstract algebra, which is one of the basic pillars of modern mathematics. The focus of the course will be the study of certain structures called groups, rings and some related structures. Abstract algebra gives student a good mathematical maturity and enables to build mathematical thinking and skill. Upon completion of this course, the student will understand and be able to apply the fundamental principles of abstract algebra.

2. Course Modules with quantitative lecture hours:

Unit 1: Binary operation, and its properties, Definition of a group, Examples and basic properties, Subgroups, Cyclic groups, Order of a group. **(6 Hours)**

Unit 2: Permutation groups, Isomorphism and its properties, Cayley's theorems, Coset of a subgroup, Lagrange's theorem. **(6 Hours)**

Unit 3: Normal subgroups, Quotient group. Homomorphisms, Kernel Image of a homomorphism, Isomorphism theorems, Direct product of groups, Structure of finite abelian

groups. **(6 Hours)**

Unit 4: Group action and class equation, Sylow's Theorems and its applications, Solvable and Nilpotent groups, Lower and Upper central series. **(6 Hours)**

Unit 5: Rings: definition, examples and basic properties, Zero divisors, Integral domains, Fields, Characteristic of a ring, Quotient field of an integral domain, Subrings, Ideals, Quotient rings. **(6 Hours)**

Unit 6: Isomorphism theorems, Prime ideal, Maximal ideals, Ring of polynomials, Division Algorithm and its Consequences, Irreducibility test, Prime elements, Irreducible elements and their properties, UFD, PID and Euclidean domains. **(8 Hours)**

Unit 7: The Fundamental Theorem of Field Theory, Splitting Fields, Zeros of Irreducible Polynomials. **(4 Hours)**

Laboratory/practical/tutorial Modules: Weekly tutorials are required to practice the questions based on the contents discussed in the class

3. Text books:

1. **Joseph Gallian, Contemporary Abstract Algebra, 7th ed.**
2. **N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.**

4. References:

1. **M. Artin, Algebra, Prentice Hall of India, 1994.**
2. **J. B. Fraleigh, A first Course in Abstract Algebra, Narosa Publishing House, 2003.**
3. **Klima, Sigmon and Stitzinger, Applications of Abstract Algebra with Maple and MATLAB , Second Edition, 2006.**

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Abstract Algebra	MA-549		95%

6. Justification of new course proposal if cumulative similarity content is >30%:

This is not a new course instead the credit for this course needs to be changed. Earlier it was a 3-credit course but the course contains so many advanced topics which need practice and hence the tutorial is a must. For this reason, the course should be revised and the credit for the course should be changed to 4. A new course code also needs to be assigned. This course was already taught with 4 credits with the approval of dean, academics.

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculties interested in teaching this course: –

- **Dr. Samir Shukla**

Proposed by: **School:** School of Mathematical and Statistical sciences

Dr. Sampat Kumar Sharma

Dr. Vikash Tripathi **Date:** 25/4/2025

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

IIT Mandi
Proposal for a New Course

Course number	**: MA571**
Course Name	**: Introduction to Approximation Algorithms**
Credit Distribution	**: 3-1-0-4**
Intended for	**: B.Tech/M.Tech/MSc/Ph.D.**
Elective or core	**: Discipline Elective for M.Sc. Applied Mathematics, Elective for other disciplines**
Prerequisite	**: Data Structures and Algorithms, Linear Algebra, Probability**
Mutual Exclusion	**: None**

1. Preamble:

Given that most intriguing discrete optimization problems are NP-hard, efficient algorithms to find optimal solutions are impractical unless P = NP, under the convention that efficiency means running in polynomial time relative to the input size. Approximation algorithms provide a crucial alternative. These algorithms are efficient heuristics designed for NP-hard problems, operating within polynomial time and offering guarantees on solution quality.

Widely applicable in Computer Science and beyond, they serve as indispensable tools for tackling complex challenges. Moreover, approximation algorithms facilitate an insightful exploration of the inherent structures of NP-hard problems, revealing their varying levels of complexity both in theory and practical applications. This area of study has cultivated a robust algorithmic theory, forging deep connections with diverse branches of mathematics.

2. Course Modules with Quantitative Lecture Hours:

Unit 1: Introduction

- Why do we need approximation algorithms?
- The Class P, The Class NP, Cook Reductions, Karp Reductions, and NP-Completeness, coNP.
- Fundamentals and Definitions Pertaining to Approximation Algorithms. **(6 Hours)**

Unit 2: Greedy Approximation Algorithms: Vertex Cover, Set Cover, Layering, k-center clustering problem, Shortest superstring via set cover, Facility location problems. **(6 Hours)**

Unit 3: Combinatorial Algorithms: Traveling Salesman Problem, Hardness of Approximation of TSP, Metric TSP, Steiner Tree, Minimum Makespan Scheduling, Bin Packing, PTAS for Bin Packing, Multiway Cut and k-Cut. **(10 Hours)**

Unit 4: Dynamic Programming Algorithms

- A pseudo-polynomial time algorithm for knapsack.
- An FPTAS for knapsack, Subset Sum Problem. **(4 Hours)**

Unit 5: Local Search: Finding minimum-degree spanning trees, Edge coloring, Max-Cut.

(4 Hours)

Unit 6: Randomized Algorithms: Max 3-SAT, Min Cut Algorithm. **(3 Hours)**

Unit 7: Linear Programming (LP) Based Algorithms: Vertex Cover via LP, Set Cover via LP, The primal-dual method. **(5 Hours)**

Unit 8: Hardness of Approximation

- Techniques in proving the hardness of approximation.
- Approximation preserving reductions. **(4 Hours)**

Laboratory/practical/tutorial Modules:

3. Text books:

1. Vazirani, Vijay V., *Approximation Algorithms*. Vol. 1, Springer, 2001.
2. Williamson, David P., Shmoys, David B., *The Design of Approximation Algorithms*, Cambridge University Press, 2011.

4. References:

1. Hochbaum, Dorit S., *Approximation Algorithms for NP-hard Problems*, PWS Publishing Company, 1995.
2. Har-Peled, Sariel, *Geometric Approximation Algorithms*, American Mathematical Society, 2011.
3. Ausiello, Giorgio, et al., *Complexity and Approximation: Combinatorial Optimization Problems and Their Approximability Properties*, Springer Science & Business Media.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Algorithm Design and Analysis	CS-403	Computational complexity: Problem classes: P, NP, NP-complete, NP-hard. Reduction. Cook's theorem. Examples of NP-complete problems. (6 hours)	11%
2.	Data Structures and Algorithms-II	CS-514	Approximation Algorithms:- Greedy and Local Search algorithms, DP Algorithms (3 hours)	9%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course:

Proposed by: **School:** SMSS

1. Dr. Mirza Galib Anwarul Husain Baig
2. Dr. Vikash Tripathi

Signature(s): **Date:** 25/4/2025

(Dr. Mirza Galib Anwarul Husain Baig) (Dr. Vikash Tripathi)

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **MA 572**
Course Name : **Applied Multivariate Statistical Analysis**
Credit Distribution: **3-0-2-4**
Intended for : **Elective for B.Tech 4th year/MS/Ph.D./ MSc**
Elective or Core : **Discipline Elective for M.Sc Applied Mathematics, Elective for other disciplines**
Prerequisite :**Probability and Statistics, Linear Algebra, Computer Programming**
Mutual Exclusion : **NA**

---

1. Preamble:

This course offers a comprehensive foundation in multivariate statistical analysis. Building on fundamental concepts of linear algebra, probability, statistics, and introductory machine learning, students will explore core multivariate techniques. Key topics include multivariate normal and related distributions, multivariate regression models, multivariate hypothesis testing, canonical correlation analysis (CCA), and model validation strategies. The course also addresses practical challenges such as multicollinearity and introduces regularization methods like ridge and lasso. Through real-world case studies and hands-on lab sessions, students will develop the skills to analyze complex datasets, interpret results, and solve practical issues such as overfitting and underfitting. By combining theory with application, learners will gain proficiency in multivariate analysis techniques for solving real-world problems.

2. Course Modules with quantitative lecture hours:

Module 1: Recap of Prerequisites **(4 lectures)**

A quick overview of matrix computations, random variables, probability distributions & estimations.

Module 2: Introduction to Multivariate Analysis **(6 lectures)**

Definition and scope of multivariate analysis: from univariate to multivariate thinking and the importance of data exploration; Applications in real life scenarios; Organization of multivariate data; Data cleaning and preprocessing (handling missing values, outliers, scaling, transformations); Covariance and correlation matrices (geometric interpretation); Mahalanobis distance (geometric interpretation and outlier detection); Data visualization techniques for multivariate data (scatter plots, pair plots, heatmaps, parallel coordinate plots, Andrews curves, Chernoff faces); Real-world examples.

Module 3: Multivariate Distributions **(9 lectures)**

Multivariate normal distribution: Definition, properties (marginal and conditional distributions, linear combinations), probability density function, geometric interpretation, and applications in hypothesis testing; Wishart distribution: Definition, properties, and its role in covariance matrix estimation; Hotelling's T^2 distribution: Derivation, properties, and relation to univariate t-distribution; Multivariate t-distribution: Definition, properties, and applications in robust statistical modeling; Other multivariate distributions and their applications.

Module 4: Multivariate Regression Models **(6 lectures)**

Introduction to multivariate regression: Multiple response variables and their modeling; Fitting and estimating multivariate regression models; Model diagnostics: Residual analysis and influence measures; Assessing model fit and significance; Generalized multivariate regression: Extending multivariate regression to handle non-linear relationships; Applications of multivariate regression in practice.

Module 5: Canonical Correlation Analysis (CCA) **(4 lectures)**

Mathematical formulation of CCA: Finding linear combinations of variables from two sets that have maximum correlation; Derivation of canonical variates and canonical correlations; Interpretation of canonical correlations and canonical weights/loadings; Assumptions and limitations of CCA; Redundancy analysis; Relationship to other multivariate techniques; Applications of CCA in practice.

Module 6: Multicollinearity and Regularization Techniques **(4 lectures)**

Detecting multicollinearity: Variance inflation factor (VIF), correlation matrix; Consequences of multicollinearity on regression models; Regularization methods: Ridge regression and Lasso regression; Tuning parameters and their impact on multicollinearity; Solving multicollinearity issues with regularization.

Module 7: Multivariate Analysis of Variance (MANOVA) and Related Techniques **(6 lectures)**

Analysis of variance (ANOVA): One-way and two-way ANOVA; Assumptions, hypothesis testing; Multivariate analysis of variance (MANOVA): Comparing multiple groups with multiple response variables, assumptions, hypothesis testing, interpretation of results; Different tests such as likelihood ratio tests, etc.; Testing linear hypotheses in multivariate regression models.

Module 8: Case Studies and Model Evaluation **(3 lectures)**

Case studies from different application areas; Model validation techniques: Train-test split, cross-validation, and bootstrapping; Performance evaluation metrics: R-squared, adjusted R-squared, MSE, RMSE, precision, recall, F1-score, ROC curve, and AUC; Residual analysis, outlier detection, and influence diagnostics; Model stability, robustness, and interpretation of coefficients; Strategies for addressing overfitting and underfitting.

Lab Class: The lab component of this course focuses on the practical application of multivariate analysis techniques through hands-on implementation with real datasets. It aims to enhance students' conceptual understanding and develop their ability to apply techniques and interpret results effectively.

3. **Text books:**

1. Johnson, R. A. and Wichern, D. W. (2002). Applied multivariate Statistical Analysis, PHI learning pvt ltd.
2. Anderson, T.W. (2010), An introduction to Multivariate Statistical Analysis, Wiley-India.

4. **References:**

1. Everitt, B. S. and Dunn G. (2001), Applied Multivariate Data Analysis, Wiley–Blackwell.
2. Srivastava, M. S. (2002), Methods of Multivariate Statistics, Wiley-Interscience.
3. Tan, P. N., Steinbach M., Kumar V. (2014), Introduction to Data Mining, Pearson.
4. Flury, B. (1997), A First Course in Multivariate Statistics (Springer Texts in Statistics), Springer-Verlag New York Inc.

5. **Similarity with the existing courses: (Similarity content is declared as per the number of lecture hours on similar topics)**

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	DS 403	Cluster analysis, Lasso, Ridge	<5%

6. Justification of new course proposal if cumulative similarity content is >30%: NA

Approvals:

Faculty interested in teaching this course: –

Indian Institute of Technology Mandi

Proposed by: Dr. Tanmay Kayal, Dr. Rishikesh Yadav & Prof. Manoj Thakur
School: School of Mathematical and Statistical Sciences

Signature: **Date:** 25.04.25

The following faculty (at least 3 faculty) discussed on……and approved the proposal on……..

Sl. No	Faculty Name	Signature
1	Dr. Tanmay Sen Assistant Professor (ISI Kolkata)	Email attached
2	Dr. Yogesh Mani Tripathi	Email attached

	Associate Professor (IIT Patna)	
3	All faculty members from SMSS	

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: MA 573**
Course Name	**: Advanced Mathematical Foundations of Machine Learning**
Credit Distribution	**: 3-1-0-4**
Intended for	**: B.Tech/ MS/PhD/MSc**
Elective or core	**: Discipline Elective for M.Sc Applied Mathematics, Elective for other disciplines**
Prerequisite	**: Probability and Statistics, Linear Algebra, and Optimizations**
Mutual Exclusion	**: NA**

---

1. Preamble:

This course offers a rigorous investigation into the mathematical foundations of modern machine learning. It equips students with the theoretical tools necessary to comprehend and advance machine learning methodologies. We examine functional analysis, convex optimization, kernel methods, neural networks, and advanced dimensionality reduction, emphasizing the mathematical rigor that guides the design and analysis of learning systems. This course highlights how mathematical abstractions directly translate into the practical mechanisms of machine learning, enabling students to understand algorithms from a foundational perspective. Integrating theory with practical insights, this course seeks to develop a deeper appreciation for the mathematical structures that facilitate intelligent learning.

2. Course Modules with quantitative lecture hours:

Unit/Topic 1: Mathematical Foundations and Their Role in Learning Systems (4 Lectures)

A quick overview of matrix theory, probability distributions, and calculus Conceptual role of mathematics in representing data, modeling uncertainty, and enabling learning through optimization.

Unit/Topic 2: Functional Analysis and Kernel Methods (8 Lectures)

Functional Analysis in Machine Learning, Matrix norms, submultiplicative properties, Low-rank approximations and Eckart–Young theorem, Introduction to Reproducing Kernel Hilbert Spaces (RKHS): Properties of kernels Mercer's theorem and its implications, Representer theorem, connections to Kernel methods for regression and classification.

Unit/Topic 3: Convex Analysis and Optimization (8 Lectures)

Convex Analysis, Gradients, Subgradients and their mathematical properties, Unconstrained Optimization and Convergence of Gradient descent, Constrained Optimization Lagrangian duality and application to machine learning, Theoretical foundations of Regularization, Tikhonov regularization, Sparsity-inducing norms and applications. Connection to Bias-

variance tradeoff.

Unit/Topic 4: Kernel Methods and Support Vector Machines (6 Lectures)
Kernelized Linear Models: Kernel ridge regression, dual representation, Selection of kernels and hyperparameters, Support Vector Machines: Analytical formulation, Dual formulation and SMO algorithm, Generalization bounds using VC-dimension and Rademacher complexity. Kernel selection and influence on generalization performance.

Unit/Topic 5: Theoretical Foundations of Neural Networks and Deep Learning Optimization (8 Lectures)
Universal approximation theorem, Depth vs. width tradeoffs, Derivation using chain rule, automatic differentiation, Non-convex optimization landscapes: saddle points and local minima, Stochastic gradient descent: convergence analysis. Theoretical properties of Adam, RMSProp.

Unit/Topic 6: Advanced Dimensionality Reduction and Unsupervised Learning (8 Lectures)
Expectation Maximization and theoretical foundations Convergence, monotonicity, fixed points, Theory of Clustering: Lloyd's algorithm and convergence, Spectral Clustering and Connection to eigenvalue problems. Evaluation metrics.

Laboratory/practical/tutorial Modules: This course will also include one tutorial session every week dedicated to solving exercises relevant to the studied topics.

3. Text books:

1. **Simovici, D. A.** *Mathematical Tools for Data Mining: Set Theory, Partial Orders, Combinatorics*. Springer, 2009. (Advanced Information and Knowledge Processing Series)
2. **Shai, S. S., and Shai, B. D.** *Understanding Machine Learning: From Theory to Algorithms*. Cambridge University Press, 2014.

4. References:

1. **Sra, S., Nowozin, S., and Wright, S. J.** *Optimization for Machine Learning*. MIT Press, 2011.
2. **Bishop, C. M.** *Pattern Recognition and Machine Learning*. Springer, 2006. (Information Science and Statistics Series)
3. **Hastie, T., Tibshirani, R., and Friedman, J.** *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer, 2nd Edition, 2009.
4. **Boyd, S., and Vandenberghe, L.** *Convex Optimization*. Cambridge University Press, 2004.
5. **Tan, P. N., Steinbach, M., and Kumar, V.** *Introduction to Data Mining*. Pearson, 2014.

Indian Institute of Technology Mandi

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Title	Course Code	Similarity Content	Approx. % of Content
1.	Introduction to Statistical Learning	DS 413		< 5 %
2.	Pattern Recognition	CS 669		< 10 %
3.	Deep Learning and Applications	CS 671		< 5 %
4.	Mathematical Foundations of Data Science	DS 301		<3 %

6. Justification of new course proposal if cumulative similarity content is >30%: NA

Approvals: By the faculties of School of Mathematical and Statistical Sciences, IIT Mandi.

Other Faculty interested in teaching this course: –

Proposed by:
Dr. Tanmay Kayal, Dr. Rishikesh Yadav & Prof. Manoj Thakur

School:
School of Mathematical and Statistical Sciences

Signature: **Date:** 25.04.25

Indian Institute of Technology Mandi

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: MA 574**
Course Name	**: An Introduction to Probabilistic Machine Learning**
Credit Distribution	**: 3-0-2-4**
Intended for	**: B.Tech/ MS/MSc/PhD**
Elective or core	**: Discipline Elective for M.Sc Applied Mathematics, Elective for other disciplines**
Prerequisite	**: Probability and Statistics, Linear Algebra, and Optimizations**
Mutual Exclusion	**: DS 413, CS 669**

1. Preamble:

This course offers an introduction to the probabilistic foundations of modern machine learning. It is designed for learners seeking to understand how intelligent systems learn from data under uncertainty. Beginning with fundamental principles from probability theory, statistical inference, and information theory, the course lays the groundwork for reasoning and modeling in uncertain environments. Building upon this foundation, the course proceeds to explore both generative and discriminative learning paradigms, detailing how they approach the problem of prediction and classification. Advanced modules introduce key estimation techniques, latent variable models, and non-parametric methods, concluding with unsupervised learning approaches useful in real-world exploratory analysis. In summary, the course content is particularly interesting and useful to connect the modern machine learning topics with classical probabilistic tools, especially useful when it comes to the uncertainty quantification in machine learning.

Indian Institute of Technology Mandi

2. Course Modules with quantitative lecture hours:

Module 1: Foundations of Probabilistic Reasoning **(6 Lectures)**

Review of probability distributions and statistical inference. Maximum Likelihood Estimation (MLE), Bayesian inference, and Maximum a Posteriori (MAP) estimation. Fundamental information-theoretic concepts: entropy, conditional entropy, mutual information, and the Kullback-Leibler (KL) divergence.

Module 2: Generative Models for Supervised Learning **(8 Lectures)**

Generative approaches to classification: Naive Bayes and Gaussian Discriminant Analysis (GDA). Structured probabilistic models, Bayesian networks. Parameter estimation and inference techniques.

Module 3: Probabilistic Discriminative Models **(8 Lectures)**

Logistic regression and its theoretical foundation. Overfitting and generalization: regularization techniques. Introduction to the perceptron algorithm and comparison with probabilistic models. Overview of Bayesian logistic regression.

Module 4: Ensemble Learning and Non-linear Extensions **(10 Lectures)**

Non-linear and ensemble-based methods: decision trees, entropy, and information gain criteria. Ensemble methods: bagging, random forests, boosting, AdaBoost, and Gradient Boosting algorithms. Probabilistic interpretation of ensembles and the bias-variance trade-off. Introduction to Gaussian Processes (GPs) and how Bayesian non-parametric models define priors over functions.

Module 5: Latent Variable Models and Unsupervised Learning **(10 Lectures)**

Modeling unobserved structure: Expectation-Maximization (EM) algorithm, Gaussian Mixture Models (GMMs), and the method of moments. Unsupervised learning methods: k-means clustering and spectral clustering. Dimensionality reduction for high-dimensional data: probabilistic PCA and visualization techniques like t-SNE and UMAP.

Lab Class: The lab component of this course focuses on the practical application of concepts via hands-on implementation with actual datasets. It aims to enhance students' understanding of concepts and strengthen their ability to use statistical and machine approaches and evaluate results effectively.

Indian Institute of Technology Mandi

3. Text Books:

1. **Murphy, K. P.** *Machine Learning: A Probabilistic Perspective*. The MIT Press; Illustrated edition, 2012.
2. **Mitchell, T. M.** *Machine Learning*. McGraw Hill, 2017.

4. Reference:

1. **Shai, S. S., and Shai, B. D.** Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press, 2014.
2. **Duda, R. O., Hart, P. E., and Stork, D. G.** *Pattern Classification*, 2nd Edition, Wiley-Interscience, 2000.
3. **Tan, P. N., Steinbach, M., and Kumar, V.** *Introduction to Data Mining*. Pearson, 2014.
4. **Bishop, C. M.** *Pattern Recognition and Machine Learning*, Springer, 2006.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Title	Course Code	Similarity Content	Approx. % of Content
1.	Introduction to Statistical Learning	DS 413		< 5 %
2.	Pattern Recognition	CS 669		< 10 %
3.	Deep Learning and Applications	CS 671		< 5 %
4.	Machine Learning	IC 252		< 3 %

6. Justification of new course proposal if cumulative similarity content is >30%: NA
Approvals:

Other Faculty interested in teaching this course:

Proposed by:
Dr. Tanmay Kayal, Dr. Rishikesh Yadav & Prof. Manoj Thakur

School: School of Mathematical and Statistical Sciences

Signature: **Date:** 25.04.25

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number	**: MA 576**
Course Name	**: Nonlinear Optimization**
Credit Distribution	**: 3-1-0-4**
Intended for	**: MSc/B.Tech/MS/ PhD**
Elective or core	**: Discipline Elective for M.Sc Applied Mathematics, Elective for other disciplines**
Prerequisite	**: Linear Algebra and Applied Mathematical Programming.**
Mutual Exclusion	**: NA**

---

1. Preamble:

This course delves into theoretical foundations and algorithmic methodologies for solving nonlinear optimization problems. The course will systematically explore optimality conditions for both constrained and unconstrained optimization problems. We will analyze the principles and convergence properties of various iterative algorithms. By the course's conclusion, students will possess the analytical and algorithmic skills necessary to formulate, analyze, and effectively solve a broad spectrum of nonlinear optimization problems encountered in diverse academic and industrial settings.

2. Course Modules with quantitative lecture hours:

Unit 1: Fundamentals and Convexity **(6 Lectures)**
Introduction and Motivation: Nonlinear Optimization Problems, Convex Functions: Definition and properties, Jensen's inequality, weaker forms of convexity and relationship between different forms of convexity.

Unit 2: Unconstrained Optimization Theory **(8 Lectures)**
Optimality Conditions: First-order necessary conditions, Second-order necessary and sufficient conditions, Sub-gradients and Non-smooth Convex Optimization: Definition and properties of sub-gradients, Optimality conditions using sub-gradients, Introduction to optimization of non-smooth convex functions.

Unit 3: Unconstrained Optimization Algorithms **(12 Lectures)**
Line Search Methods: Exact and Inexact line search methods, Gradient Descent Methods: Steepest descent method and convergence, Variants of gradient descent, Newton's Method: Algorithm and motivation, Local quadratic convergence analysis, Quasi-Newton Methods: Motivation and basic principles, BFGS algorithm.

Unit 4: Constrained Optimization Theory **(8 Lectures)**
Lagrange multipliers, Slater's and Linearly Independent Constraint Qualifications, Karush-Kuhn-Tucker necessary and sufficient conditions: derivation and interpretation, Inequality

Constrained Optimization: Active and inactive constraints, Duality in Nonlinear Programming: Lagrangian dual function, weak and strong duality theorems.

Unit 5: Constrained Optimization Algorithms **(8 Lectures)**
Exterior penalty methods, Interior point methods, Practical aspects and choice of penalty/barrier parameters; Augmented Lagrangian Methods: Motivation for combining penalty and Lagrangian approaches.

Laboratory/practical/tutorial Modules: This course will also include one tutorial session every week dedicated to solving exercises relevant to the studied topics.

3. Textbooks:

1. Oliver Stein, (2024) Basic Concepts of Nonlinear Optimization. Springer.
2. Nocedal, J. & Wright, S. J. (2006). Numerical Optimization (2nd ed.). Springer.
3. Boyd, S. & Vandenberghe, L. (2004). Convex Optimization. Cambridge University Press.

4. Reference Books:

1. Antoniou, A. & Lu, W.-S. (2007). *Practical Optimization: Algorithms and Engineering Applications*. Springer.
2. Bazaraa, M. S., Sherali, H. D., & Shetty, C. M. (2006). *Nonlinear Programming: Theory and Algorithms* (3rd ed.). John Wiley & Sons.
3. H. A. Eiselt and Carl-Louis Sandblom,(2020) Nonlinear Optimization Methods and Applications, Springer.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Applied Optimization	EE 530	10%	Minor
2.	Optimization for Data science	DS 401	10%	Minor

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Prof. Manoj Thakur
Dr. Preeti

School: SMSS

Signature:
(Prof. Manoj Thakur) (Dr. Preeti)

Date: 22-04-2025

Indian Institute of Technology Mandi

School Chair: Prof. Rajendra Kumar Ray

School: School of Mathematical and Statistical Sciences

Date:

This proposal is reported in 59th Board of Academics on 16.04.2025

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

Annexure-I

SHSS Office Outward No. 349 Date 11-6-2025 IIT, Mandi (H.P.)
शैक्षणिक अनुभाग Inward No. 6469 11 JUN 2025 Academics Section

IIT Mandi

Proposal for a New Course

Course Number:	HS210
Course Name:	Introduction to Poetry in English
Credit:	3 credits
Distribution:	3-0-0-3
Intended for:	UG 2nd, 3rd and 4th years
Prerequisite:	None
Mutual Exclusion:	None

1. **Preamble:**

This course offers a comprehensive exploration of the diverse world of English poetry, encompassing both canonical and contemporary poets from various regions of the globe. By delving into the historical development of poetry, analyzing different poetic forms and techniques, and examining how poets use language to express ideas, emotions, and experiences, students will gain a deep appreciation for the power and versatility of poetic expression. Beyond the technical aspects of poetry, the course will delve into the social, cultural, and historical contexts in which poems are produced and received, exploring how poetry reflects and shapes societal values, cultural norms, and historical events. Furthermore, the course will examine the impact of globalization on contemporary poetic practices, exploring how poets from different cultures and backgrounds engage with global trends, fostering insights into the interconnectedness of the poetic world and the broader world beyond.

2. **Course Modules with quantitative lecture hours:**

Unit 1: Introduction to Poetry (8 lecture hours)

- Definition and characteristics of poetry
- Brief history of poetry in the English language
- Overview of literary movements and poetic forms and techniques
- Interpreting and reading poetry (formalist, historical, biographical, psychoanalytic, feminist, structuralist, reader-response, scansion, ecocritical, postcolonial etc.)
- Thematic approaches to poetry (including love and desire, identity and belonging, nature and environment, social and political issues, etc.)

Unit 2: Poetic Traditions and Practices Across Space and Time (20 lecture hours)

- English Poetry (with selections from Old English to the Victorian Period)
- American Poetry (with selections from the Early National to the Realist Period)

- Poetry in English from Africa and Asia (with selections from the Colonial to the Postcolonial Era)
- Poetry from Australia and New Zealand (with selections from the Early Colonial to the Postwar Era)

Unit 3: Modernist and Postmodernist Poetry (8 lecture hours)

- The modernist movements and their impact on poetry
- Key modernist figures and their work
- Fragmentation, stream of consciousness, imagism, and philosophical influences on poetry
- The role of parody, irony, and pastiche in postmodernist poetry

Unit 4: Contemporary Poetry (6 lecture hours)

- Contemporary poetic trends and innovations, including slam poetry, digital poetry, and other experimental forms
- Impact of globalization on poetry, translation and cultural exchange
- Poetry on social media and the World Wide Web
- Technology and AI in the creation, dissemination, and reception of poetry

Laboratory/practical/tutorial Modules:

- Poetry recitations and performances, critical analysis workshops, and guest lectures by practising poets.

3. Textbooks:

Norton Anthology of English Literature (9th edition)
The Oxford Book of English Verse (edited by John Carey)
Modern American Poetry (edited by Robert Bly)
The Oxford Anthology of Modern Indian Poetry (edited by Vinay Dharwadker and A. K. Ramanujan)
The Penguin Book of Postcolonial Poetry (edited by Neil Astley)

4. References:

The Cambridge Companion to English Poetry (edited by Stephen Greenblatt)
The Oxford History of English Poetry (edited by John Burrow)
Poetry: A Critical Introduction (by David Daiches)
Global Poetics: A New Anthology of World Poetry (edited by Charles Simic)
A History of Indian Poetry in English (edited by Rosinka Chaudhuri)
Postcolonial Poetry in English (by Rajeev S. Patke)
The Anxiety of Influence: A Theory of Poetry (by Harold Bloom)

5. **Similarity with the existing courses:**

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	HS151	Poets such as Sylvia Plath may overlap in the two courses. The instructor may, however, opt to select poems that are not already covered.	5%

6. **Justification of new course proposal if cumulative similarity content is >30%: NA**

Approvals:

Faculty interested in teaching this course: Dr Thirthankar Chakraborty, Dr Suman Sigroha, and Dr Neethi V. Alexander.

Proposed by: Dr Thirthankar Chakraborty

School: School of Humanities and Social Sciences (SHSS)

Signature: **Date: 25/09/2024**

The following faculty (at least 3) discussed on 25/09/2024 and approved the proposal on _____.

Sl. No	Faculty Name	Signature
1	Dr Thirthankar Chakraborty	
2	Dr Suman Sigroha	Copy attached.
3	Dr Neethi V. Alexander	

School Chair: 10/06/25

School:

Date:

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: The School is responsible for the Course Code. The Academic Office provides the IC Course Code.

5. **Similarity with the existing courses:**

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	HS151	Poets such as Sylvia Plath may overlap in the two courses. The instructor may, however, opt to select poems that are not already covered.	5%

6. **Justification of new course proposal if cumulative similarity content is >30%: NA**

Approvals:

Faculty interested in teaching this course: Dr Thirthankar Chakraborty, Dr Suman Sigroha, and Dr Neethi V. Alexander.

Proposed by: Dr Thirthankar Chakraborty

School: School of Humanities and Social Sciences (SHSS)

Signature: **Date: 25/09/2024**

The following faculty (at least 3) discussed on 25/09/2024 and approved the proposal on _____.

Sl. No	Faculty Name	Signature
1	Dr Thirthankar Chakraborty	
2	Dr Suman Sigroha	
3	Dr Neethi V. Alexander	

School Chair: 25/06/25

School:

Date:

This proposal is reported in ……..th Board of Academics on ……

Dean Academics

Annexure-M.

1st and 2nd Year (Total Credit: 84)			
Semester-I		**Semester-II**	
• Math-I: Calculus (IC)	2	• Math-III: Linear Algebra (IC)	2
• Math-II: Complex Variable and Vector Calculus (IC)	2	• Math-IV: ODE & Integral Transform (IC)	2
• Engineering Graphics (IC)	4	• Applied Electronics (IC)	3
• Introduction to Python and Data Science (IC)	4	• Applied Electronics Lab (IC)	2
• IC-I Basket (IC131 Chemistry Compulsion)	3	• Probability and Statistics (IC)	4
• HSS Course (HSS, Basket)	3	• IC-II Basket (IC121 Physics Compulsion)	3
• IKSMHA (IKS)	3	• ~~Foundations of Design Practicum (IC)~~	4
		• Foundation and Applications of Chemistry (CY)	3
		• Physics Practicum (IC)	2
	21		**21**
Semester-III		**Semester-IV**	
• Understanding Biotech. and its Application (IC-I)	3	• Discipline Elective II (DE)	~~2~~3
• Physical Chemistry-I (CY)	3	• Physical Chemistry-II (Quantum & Spec.) (CY)	3
• Basic Organic Chemistry (CY)	3	• Analytical Chemistry (CY)	3
• Principles of Inorganic Chemistry (CY)	3	• Discipline Elective III (DE)	3
• Discipline Elective I (DE)	3	• Organic Chemistry Lab (CY, Lab-II)	2
• Physical Chemistry Lab (CY, Lab-I)	2	• Inorganic Chemistry Lab (CY, Lab-III)	2
• HSS Course (HSS Basket)	3	• HSS Course (HSS Basket)	3
		• Free Elective I (FE)	3
	20		**22**

IIT Mandi
Proposal for a New Course

Course number : **CY-200**
Course Name : **Foundations and Applications of Chemistry**
Credit Distribution : 3-0-0-3
Intended for : **BS Chemical Sciences**
Prerequisite : None
Mutual Exclusion : None

---

1. Preamble:

This course bridges fundamental chemistry with its real-world applications in technology, biology, environmental science, and industry. It emphasizes the role of chemistry in solving global challenges, fostering innovation, and improving quality of life. Students will gain knowledge through lectures and discussions. By the end of the course, students will relate chemical principles to practical applications in energy, materials, healthcare, and the environment, develop problem-solving skills for analyzing chemical phenomena, and recognize the interdisciplinary nature of chemistry and its role in technological and societal advancements.

2. Course Modules with quantitative lecture hours:

Module 1: The Evolution of Chemistry **(6 hours)**

History of chemistry; Evolution of chemistry starting from the alchemist era; Modern chemistry; Significant discoveries in chemistry with Nobel Prizes; Chemistry for society; Opportunities in chemistry.

Module 2: Chemistry in Nature **(12 hours)**

Biomolecular Chemistry: Structure and function of carbohydrates, lipids, proteins, and nucleic acids; Enzyme catalysis and metabolic pathways; Carbon, nitrogen, and sulfur cycles: Chemical transformations in ecosystems; Natural products: Alkaloids, terpenes, and polyketides; Photosynthesis and Energy Cycles: Chemical principles of photosynthesis,

Carbon fixation and the Calvin cycle; Energy flow in nature: ATP and biochemical energy carriers; Chemistry of Natural Materials: Chemistry of bones, shells, and coral reefs, Cellulose, chitin, and lignin, Chlorophyll, carotenoids, and melanin, etc.

Module 3: Modern Applications of Chemistry **(12 hours)**

Chemistry in Energy and Environment: Fuels and combustion, Renewable energy, Environmental chemistry; Chemistry in Materials Science: Polymers, Nanomaterials, Semiconductors, OLEDs; Chemistry in Biology and Medicine: Biochemical molecules, Proteins, DNA, and enzymes, Pharmaceuticals, Drug design; Diagnostic tools: Chemical sensors and imaging; Industrial and Everyday Applications: Catalysis in industrial processes, Chemistry of household product, Food chemistry.

Module 4: Chemical Data Analysis with Software **(8 hours)**

Types of chemical data: Spectroscopic, kinetic, thermodynamic, and structural; Overview of software tools for chemical data visualization and analysis with examples: ChemDraw, Origin, Excel, ChemCraft, MNova, Mercury, etc.; Statistical Methods in Chemical Data Analysis: Mean, median, standard deviation, and outliers, regression analysis, and curve fitting; Chemoinformatics and Databases: Molecular representations (SMILES, InChI), Databases (SciFinder, Reaxys, Google Scholar, PubChem, ChemSpider, and ChEMBL, etc.), Ethics of scientific practices.

Module 5: Machine Learning in Chemistry **(4 hours)**

Overview of machine learning concepts: Supervised, unsupervised, and reinforcement learning; The role of ML in modern chemical research; Examples of ML applications in chemistry.

3. References: (Books and articles)

1. Lowe D.B., "The Chemistry Book: From Gunpowder to Graphene, 250 Milestones in the History of Chemistry", Sterling Publishing Company.
2. Arthur Greenberg, "A Chemical History Tour: Picturing Chemistry from Alchemy to Modern Molecular Science", Wiley-Interscience.
3. David L. Nelson and Michael Cox, "Lehninger Principles of Biochemistry" 8th Ed., Macmillan Learning.

4. Fredus Nelson Peters, "Modern Chemistry, With Its Practical Applications", Legare Street Press.
5. D. Brynn Hibbert, and J. Justin Gooding, "Data Analysis for Chemistry: An Introductory Guide for Students and Laboratory Scientists", Oxford University Press.
6. Hugh M Cartwright, "Machine Learning In Chemistry: The Impact Of Artificial Intelligence" Vol 17, Royal Society of Chemistry.

4. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	NA	NA	NA

6. Justification of new course proposal if cumulative similarity content is >30%:

NA

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Dr. Bhaskar Mondal
Dr. Amit B Pawar

School: Chemical Sciences

Signature:

Date:

Recommended/Not Recommended, with Comments:

_____ **Date:** _____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Prof. S. S. V. Ramasastry, IISER Mohali

I have gone through the course content. I am quite impressed by the content and its relevance to the 1st year students who will just be exposed to various science streams. The content is placed in such a way that those inclined to chemistry will get exposed to different facets of chemistry, especially materials chemistry and its applications, biomolecules and their relation to chemistry, the integration of chemistry with software, and it even talks about machine learning with chemistry, which is very much relevant to this generation.

Response: Thank you for your high appreciation of the course content.

I am also impressed by the topic 'ethics in scientific research'. It is essential to the students of IITs or IISERs, where the emphasis is research-oriented training, and it is important that students get exposed to such a topic at an early stage of their careers.

Response: Thank you for your appreciation of the module topic ''ethics in scientific research'.

The choice of reference books is also excellent. The suggested books are some of the best in the field.

Response: Thank you for your appreciation of the suggested books.

A suggestion is to familiarise them with navigating scientific literature (SciFinder, Reaxys, or Google Scholar). For example, they may have a science-related question, and if we can teach them how to search for an answer by digging through the literature, their dependence on Google-like search engines can decrease. We also need to emphasize that the science learned through Google results can be dangerous sometimes since some websites provide misleading (or falsified) information.

Response: We have incorporated the suggested scientific literature database in Module 4. In addition, the ethics of scientific practices will involve the topic 'Google Scholar' search results.

I strongly recommend such a course at the early stage of the BS curriculum at IIT Mandi.

Response: Thank you for your overall recommendation of the course proposal.

Annexure N

IIT Mandi
Proposal for a New Course

Course number	**: CY-513**
Course Name	**: Chemical Kinetics and Reaction Dynamics**
Credit Distribution	: 3-0-0-3
Intended for	**: BS Chemical Sciences and MSc Chemistry**
Prerequisite	: Undergraduate-Level Physical Chemistry or Teacher's Consent
Mutual Exclusion	: The Old CY513 will be replaced with this course
Distribution	**: Core**

1. Preamble:

This course provides an in-depth exploration of the fundamental principles governing the rates and mechanisms of chemical reactions. It covers classical kinetics, transition state theory, and reaction dynamics at the molecular level. Students will learn how to analyze reaction mechanisms, apply mathematical models to kinetic data, and explore the role of molecular collisions, energy transfer, and reaction pathways. Designed for advanced undergraduate and postgraduate students, the course integrates theoretical, computational, and experimental approaches to chemical kinetics and dynamics.

2. Course Modules with quantitative lecture hours:

Module 1: Kinetic Theory and Chemical Reactions **(12 hours)**

Introduction Review of the kinetic theory of gases, the kinetic model of gases, collisions with walls and surfaces, the rate of effusions, transport properties of a perfect gas, atomic and molecular collisions, collisional theory, diffusion-controlled reactions, thermodynamics properties of diffusion, potential energy surface, generation, interpretation and correlation with reaction energetics; elementary ideas on conical intersection.

Module 2: Chemical Kinetics and Rate Theories **(12 hours)**

The rates of chemical reactions, Reaction Rates and Rate Laws, Order and Molecularity of Reactions, Experimental Techniques for Kinetic Measurements, Temperature Dependence of

Reaction Rates: Arrhenius Equation, Collision Theory and Molecular Interpretations, Transition State Theory (TST) and Activation Energy, Potential Energy Surfaces and Reaction Pathways, RRKM Theory and Unimolecular Reactions.

Module 3: Reaction Dynamics and Molecular Interactions **(10 hours)**

Energy Transfer and Collision Dynamics, Reactive Collisions, Elementary vs. Complex Reactions, Atom-diatom reactions, Polyatomic reactions, State-selective, Reaction rates and cross sections, Molecular Beam and Laser Spectroscopy Studies in Reaction Dynamics, Scattering - Classical and Quantum, The Role of Solvent Effects in Reaction Kinetics.

Module 4: Catalysis – Principles and Mechanisms **(8 hours)**

Homogeneous vs. Heterogeneous Catalysis, Enzyme Catalysis and Michaelis-Menten Kinetics, Adsorption Isotherms (Langmuir, BET), Catalytic Cycles and Reaction Mechanisms Catalytic Reactions, Reaction Energetics, Activation and Deactivation of Catalysts, Auto Catalysis and its Mechanism

3. References: (Books and articles)

1. R. D. Levine, Molecular Reaction Dynamics, Cambridge University Press 2005.
2. Theories of Molecular Reaction Dynamics, Henriksen & Hansen, Oxford University Press.
3. Chemical Kinetics, K.J. Laidler, Pearson Books, 3rd Ed.
4. Physical Chemistry: A Molecular Approach by Donald A. McQuarrie and John D. Simon, Viva Books, First South Asia Ed. 1998.
5. Physical Chemistry by Peter Atkins and Julio de Paula (Oxford University Press 7th Edn. 2002.
6. Photodissociation Dynamics, by R. Schinke, Cambridge University Press 1993.

4. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	NA	NA	NA

6. Justification of new course proposal if cumulative similarity content is >30%:

NA

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Dr. Bhaskar Mondal
Prof. Aditi Halder

School: Chemical Sciences

Signature:

Date:

Recommended/Not Recommended, with Comments:

_____ **Date:** _____

Chairperson, CPC

Approved / Not Approved

_____ **Date:** _____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **CY-514**
Course Name : **Chemical and Statistical Thermodynamics**
Credit Distribution : 3-0-0-3
Intended for : **BS Chemical Sciences and MSc Chemistry**
Prerequisite : Undergraduate-Level Physical Chemistry or Teacher's Consent
Mutual Exclusion : The Old CY514 will be replaced with this course
Distribution : **Core**

---

1. Preamble:

This course provides a comprehensive understanding of thermodynamic principles in chemical systems, integrating both classical and statistical approaches. Students will explore the laws of thermodynamics, phase equilibria, chemical reactions, and molecular-level interpretations using statistical mechanics. Designed for undergraduate and postgraduate students, the course equips learners with essential analytical tools for studying energy transformations in physical and chemical processes.

2. Course Modules with quantitative lecture hours:

Module 1: The Laws of Thermodynamics **(14 hours)**

Zeroth law of Thermodynamics, Equilibrium, State Functions, Probability and distribution, Chemical Systems and Surroundings, temperature, equations of state First Law of thermodynamics: Internal energy, heat capacity, enthalpy, Isothermal, Adiabatic and Isobaric Processes , Energy, Enthalpy and Exact Differentials, Heat Capacities, Joule Thompson Effect, Heat Engines and Heat Pumps Second Law of thermodynamics: Entropy, Carnot cycles, heat engines, spontaneous changes, enthalpy and surrounding, Gibbs energy and application of Gibbs Energy Third Law of Thermodynamics: Concept of the absolute zero temperature

Module 2: Statistical Thermodynamics **(14 hours)**

Kinetic theory of gases, Probability and Maxwell Boltzmann distribution, Molecular Partition

Functions, Thermodynamics from partition Functions, Equilibrium Constants, canonical ensemble; ideal monoatomic, diatomic and polyatomic gases, quantum statistics Electronic, Vibrational, Rotational Partition Functions, Translational Partition Functions, Heat Capacities, Heat Capacities of Solids, Debye and Einstein Models

Module 3: Chemical Equilibria and Reaction Thermodynamics **(14 hours)**

Equilibrium: Free Energy and Equilibria, Application of Gibbs energy for Phase change, Helmholtz Free Energies, Gibbs Helmholtz Equation, Free Energies of Formation, phase rule, Clapeyron equation, phase diagram, Ideal and non-ideal solutions, gases, liquids and solutions, equation of states, Fugacities and their determination, Entropy and Free Energy of Mixing, Partial Molal Quantities and the Chemical Potential, Activities and Activity Coefficients, Debye Hückel Theory and Extensions, the Nernst equation, colligative properties, multicomponent phase diagram, Determination of Activity Coefficients, Thermodynamics of Surface and Catalytic Reactions: Adsorption Thermodynamics (Langmuir and BET Isotherms), Heterogeneous Equilibria and Surface Reactions, Thermodynamics of Catalysis and Enzyme Kinetics, Gibbs Energy Minimization in Industrial Processes.

3. References: (Books and articles)

1. Molecular Thermodynamics by Donald A Mcquarrie and Simon, Viva Student Edition byViva Books Private Limited (2010)
2. Chemical Thermodynamics by Glasstone Publisher: Lightning Source Inc(year 2007 March)
3. Physical Chemistry by Thomas Engel and Philips Reid Pearson Education; Third edition (2013)
4. Physical Chemistry books by Berry Rice and Ross published by OUP USA; 2 edition (11 May 2000)
5. An Introduction to Chemical Thermodynamics, R.P. Rastogi and R.R. Misra, (January 2000)

4. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	NA	NA	NA

6. Justification of new course proposal if cumulative similarity content is >30%:

NA

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Dr. Bhaskar Mondal
Prof. Aditi Halder

School: Chemical Sciences

Signature:

Date:

Recommended/Not Recommended, with Comments:

_____ **Date:** _____

Chairperson, CPC

Approved / Not Approved

_____ **Date:** _____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course Name: Introduction to Polymer Science & Technology
Course Number: CY-555
Credits: 3-0-0-3
Prerequisites: Undergraduate-Level Chemistry or Teacher's Consent
Intended for: BS-CS/MSc/PhD
Distribution: Elective
Semester: Odd/Even

Preamble:

The course forms an elective course for the M.Sc. (Chemistry) degree program. The existing core courses in this program include chemical kinetics while the other elective courses in this basket include synthesis and characterization of nanomaterials for interdisciplinary applications. This course will give a preview on designing polymer based materials. It will discuss polymers at various fronts: polymer properties, polymerization methods, kinetics of polymerization, polymer functionalization, characterization, processing, and designing polymer based advanced materials. Thus, this course will facilitate the students to develop critical thinking towards how the structure and properties of polymers can be tailored which is one of the most important prerequisites for developing new materials for desired applications. This course will provide the students an appreciation of the versatility which is inherent in polymerization processes and which is available to the polymer technologist in conjunction with other core and elective courses in the M.Sc. program.

Outline:

The course is designed to impart knowledge on a range of aspects of polymer science and technology starting from the fundamental science to practical applications. Students will learn about the advancement in the synthesis and characterization techniques. This course will also provide the students an understanding and knowledge of designing polymer based materials for advanced applications.

Modules:

Module 1: Introduction to polymers (6 hours)
History and recent developments, monomers, oligomers, polymers and their characteristics, classification and nomenclature of polymers, physical state of polymers, Tg, Tc, molecular weight and MWD, natural polymers

Module 2: Radical polymerization (6 hours)
Mechanism, kinetics, chain transfer, autoacceleration, gel effect, copolymerization, reactivity ratios, composition of copolymers, living radical polymerization: ATRP and RAFT

Module 3: Ionic polymerization (5 hours)
Mechanism and kinetics of cationic and anionic polymerization

Module 4: Stereospecific polymerization (2 hours)
Stereoisomerism, complex catalyst polymerization

Module 5: Step growth polymerization (6 hours)

Kinetics, step copolymerization, detailed methods for the preparation of polyesters, polyamides, polycarbonates etc., high performance polymers

Module 6: Techniques of polymerization (3 hours)
Bulk, solution, emulsion, suspension, melt polycondensation, solution polycondensation, interfacial and gas phase

Module 7: Polymer characterization (8 hours)
Molecular weight by GPC, light scattering, osmotic pressure etc., IR, UV, NMR, TGA, DSC, radiation scattering: SAXS, WAXS, DLS

Module 8: Processing, testing and applications of polymer materials (6 hours)
Extrusion, molding, tensile, impact, flexural testing, adhesives, foam, polymer fibers, catalysis, environment care, medicine etc.

Text Books:

1. V. R. Gowarikar, N. V. Viswanathan, J. Sreedhar, Polymer Science, New Age International. Wiley, 1995.
2. F. W. Billmeyer, Textbook of Polymer Science, Wiley, 3rd Edition, 2007.

Reference Books:

1. G. Odian, Principles of polymerization, 4th Edition, Wiley, 2004.
2. P. C. Heimenz, T. P. Lodge, Polymer Chemistry, 2nd Edition, CRC press, 2007.
3. C. E. Carraher, Seymour/Carraher's Polymer Chemistry, 6th Edition, Marcel Dekker, Inc., 2003.
4. J. M. G. Cowie, Polymers: Chemistry and Physics of Modern Materials, 3rd Edition, CRC Press, 2007.
5. H. F. Mark, Encyclopedia of Polymer Science and Technology, 3rd Edition, Wiley, 2004.

Approvals:

Other Faculty interested in teaching this course:

Proposed by: Dr. Garima Agrawal School: SCS

Signature_____Date_____

Recommended/Not Recommended, with Comments:

_____

Chairman, CPC Date:

Approved / Not Approved

_____

Chairperson, BOA Date:

Annexure O

Table 13: BS-CS Credit Distribution		
Division	**Subdivision**	**Credits**
IC Core Courses	IC Compulsory	27
	IC Basket	6
	IKS	3
	HSS	12
Discipline Courses	Discipline Core	62
	Discipline Electives	24
Free Electives	Free Electives	15
Research Projects	Research Projects	14
	Total	**163**

Table 15: BS -CS First Semester				
Sl. No	**Course Code**	**Course Name**	**LTPC**	**Credits**
1	IC 112	Calculus	1.5-0.5-0-2	2
2	IC 113	Complec Variables and Vector Calculus	1.5-0.5-0-2	2
3	IC 140	Engineering Graphics	2-0-3-4	4
4	IC 152	Introduction to Python and Data Science	3-0-2-4	4
5	IC 131	IC Core Basket-1(Chemistry Compulsion)	2-0-2-3	3
6		HSS Course	3	3
7	IC 181	Introduction to Consciousness and Holistic Wellbeing	2-0-2-3	3
Total				**21**

Table 16: BS -CS Second Semester				
Sl. No	**Course Code**	**Course Name**	**LTPC**	**Credits**
1	IC 114	Linear Algebra	2-0-0-2	2
2	IC 115	ODE and Integral transform	2-0-0-2	2
3	IC 161	Applied Electronics	3-0-0-3	3
4	IC 161P	Applied Electronics Laboratory	0-0-3-2	2
5	IC 252	Probability and Satistics	3-0-2-4	4
6	CY200	Foundation and Applications of Chemistry	3-0-0-3	3
7	IC 222P	Physics Practicum	0-0-3-2	2
8	IC-121	IC II Basket-2 (Physics Compulsion)	2.5-0.5-0-3	3
Total				**21**

Table 17: BS -CS Third Semester				
Sl. No	**Course Code**	**Course Name**	**LTPC**	**Credits**
1	IC 136	Understanding Biotechnology & its Applications	3-0-0-3	3
2	CY-301	Principles and Theories of Physical Chemistry	3-0-0-3	3
4	CY-302	Principles of Organic Chemistry	3-0-0-3	3
5	CY-303	Fundamentals of Inorganic Chemistry	3-0-0-3	3
6		Discipline Elective-1	3-0-0-3	3
7	CY-201P	Physical Chemistry Laboratory	0-0-4-2	2
8		HSS Course (HSS Basket)		3
Total				20

Table 18: BS -CS Fourth Semester				
Sl. No	**Course Code**	**Course Name**	**LTPC**	**Credits**
1		Discipline Elective -2	3-0-0-3	3
2	CY-401	Introduction to Quantum Chemistry & Molecular Spectroscopy	3-0-0-3	3
4	CY-304	Fundamental Analytical Chemistry	3-0-0-3	3
5		Discipline Elective -3	3-0-0-3	3
6	CY-202P	Organic Chemistry Laboratory	0-0-4-2	2
7	CY-203P	Inorganic Chemistry Laboratory	0-0-4-2	2
8		HSS Course (HSS Basket)		3
		Free Elective-1		3
Total				**22**

Table 19: BS -CS Fifth Semester				
Sl. No	Course Code	Course Name	LTPC	Credits
1	CY-531	Organic Reactions and Mechanisms	3-0-0-3	3
2	CY-533	Chemistry of Main Group Elements	3-0-0-3	3
4	CY-512	Advanced Quantum Chemistry	3-0-0-3	3
5		Discipline Elective -4	3-0-0-3	3
6	CY-512P	Physical Chemistry Laboratory	0-0-6-3	3
7	CY-533P	Inorganic Chemistry Laboratory	0-0-6-3	3
8	CY-501P	Research Literature Presentation 1 (Pass /Fail)	0-0-2-1	1
Total				**19**

Table 20: BS -CS Sixth Semester				
Sl. No	Course Code	Course Name	LTPC	Credits
1	CY-532	Photochemistry and Pericyclic Reactions	3-0-0-3	3
2	CY-534	Chemistry of Transition Elements	3-0-0-3	3
4	CY-511	Symmetry and Group Theory	3-0-0-3	3
5		Discipline Elective-5	3-0-0-3	3
6		Discipline Elective-6	3-0-0-3	3
7	CY-531P	Organic Chemistry Laboratory	0-0-6-3	3
8	CY-502P	Research Literature Presentation 2 (Pass /Fail)	0-0-2-1	1
Total				**19**

Table 21: BS -CS Seventh Semester				
Sl. No	Course Code	Course Name	LTPC	Credits
1		Discipline Elective-7	3-0-0-3	3
2	CY-514	Chemical and Statistical Thermodynamics	3-0-0-3	3
4	CY-535	Introduction Organometallic Chemistry	3-0-0-3	3
5		Free Elective-2	3	3
6		Free Elective-3	3	3
7		Undergraduate Research Project 1	6	6
Total				**21**

Table 22: BS -CS Eighth Semester				
Sl. No	Course Code	Course Name	LTPC	Credits
1	CY-513	Chemical Kinetics and Reaction Dynamics	3-0-0-3	3
2	CY-504	Heterocyclic Chemistry	2-0-0-2	2
4		Discipline Elective-8	3-0-0-3	3
5		Free Elective-4	3	3
6		Free Elective-5	3	3
7		Undergraduate Eesearch Project 1	6	6
Total				**20**

Table 14: BS Chemical Sciences Core Courses				
Sl. No	Course Code	Course Name	LTPC	Credits
1	CY-200	Foundations and Applications of Chemistry	3-0-0-3	3
2	CY-301	Principles and Theories of Physical Chemistry	3-0-0-3	3
3	CY-302	Principles of Organic Chemistry	3-0-0-3	3
4	CY-303	Fundamentals of Inorganic Chemistry	3-0-0-3	3
5	CY-201P	Physical Chemistry Laboratory	0-0-4-2	2
6	CY-401	Introduction to Quantum Chemistry & Molecular Spectroscopy	3-0-0-3	3
7	CY-304	Fundamental Analytical Chemistry	3-0-0-3	3
8	CY-202P	Organic Chemistry Laboratory	0-0-4-2	2
9	CY-203P	Inorganic Chemistry Laboratory	0-0-4-2	2
10	CY-531	Organic Reactions and Mechanisms	3-0-0-3	3
11	CY-533	Chemistry of Main Group Elements	3-0-0-3	3
12	CY-512	Advanced Quantum Chemistry	3-0-0-3	3
13	CY-512P	Physical Chemistry Laboratory	0-0-6-3	3
14	CY-533P	Inorganic Chemistry Laboratory	0-0-6-3	3
15	CY-532	Photochemistry and Pericyclic Reactions	3-0-0-3	3
16	CY-534	Chemistry of Transition Elements	3-0-0-3	3
17	CY-511	Group Theory and Spectroscopy	3-0-0-3	3
18	CY-531P	Organic Chemistry Laboratory	0-0-6-3	3
19	CY-514	Chemical and Statistical Thermodynamics	3-0-0-3	3
20	CY-535	Introduction Organometallic Chemistry	3-0-0-3	3
21	CY-513	Chemical Kinetics and Reaction Dynamics	3-0-0-3	3
22	CY-504	Heterocyclic Chemistry	2-0-0-2	2
Total				**62**

Table 23: BS CS Discipline Elective Courses				
Sl. No	Course Code	Course Name	LTPC	Credits
1	CY 241	Nano-scale Science and Technology	3-0-0-3	3
2	CY 342	Understanding Small Systems	3-0-0-3	3
3	CY 344	Food Chemistry: Processing, Preservation and Storage	3-0-0-3	3
4	CY 515	Advanced Inorganic Spectroscopy	3-0-0-3	3
5	CY 522	Computational Chemistry	3-0-0-3	2
6	CY 541	Fundamentals of Organic Chemistry	3-0-0-3	3
7	CY 547	Chemical Crystallography	2-0-2-3	3
8	CY 550	Bioinspired Materials	3-0-0-3	3
9	CY 552	Hydrogen Generation and Storage	3-0-0-3	3
10	CY 554	Science and Technology of Nanomaterials	3-0-0-3	3
11	CY 555	Introduction to Polymer Science & Technology	3-0-0-3	3
12	CY 556	Organic Spectroscopy	3-0-0-3	3
13	CY 641	Polymer Synthesis	3-0-0-3	3
14	CY 642	Molecular- and Bio-electronics	3-0-0-3	3
15	CY 643	Advanced Analytical Techniques	3-0-0-3	3
16	CY 644	Bioinorganic chemistry	3-0-0-3	3
17	CY 645	Reagents in organic synthesis	3-0-0-3	3
18	CY 670	Fluorescence spectroscopy, microscopy and applications	3-0-0-3	3
19	CY 402	Applied Materials Chemistry	3-0-0-3	3
20	CY 403	Numerical methods and Data Analysis in Chemistry	3-0-0-3	3

Annexure – P

Indian Institute of Technology Mandi

Proposal for a New Course

Course number : **CS521**

Course Name : **Introduction to Post Quantum Security**

Credit : **2-1-0-3**

Distribution : ***L-T-P-C***

Intended for : **M.Tech/Ph.D./B.Tech 3rd/4th year.**

Prerequisite : **DS404**

1. Preamble:

In today's interconnected world, the security of digital information is more crucial than ever. As we advance into the age of quantum computing, traditional cryptographic systems face significant challenges. This course provides an in-depth exploration of post-quantum security, equipping you with the knowledge to understand the vulnerabilities of current cryptographic systems and how quantum computing threatens the foundations of modern cybersecurity. We begin by reviewing the core principles of cryptography, including security goals, cryptographic attacks, and the mechanisms used to achieve these goals. We then delve into classical cryptography, examining symmetric (AES, DES) and asymmetric (RSA, ECC) cryptographic algorithms, and how these systems are increasingly vulnerable to quantum threats. Next, we explore the specific quantum algorithms such as Shor's and Grover's algorithms that pose significant risks to existing cryptographic systems and their implications for secure communications. Understanding these quantum threats lays the foundation for our study of post-quantum cryptography (PQC), a field focused on developing cryptographic systems resilient to the power of quantum computers. This course will cover the key post-quantum cryptographic

algorithms, including lattice-based, hash-based, and other emerging techniques that offer solutions to these quantum challenges. You will also explore how existing cryptographic protocols, such as TLS, IPSec, SSH, and Blockchain, can be adapted or replaced with quantum-resistant alternatives. By the end of the course, you will have a comprehensive understanding of post-quantum cryptography, preparing you for the challenges of securing digital infrastructures in a world where quantum computing is no longer a distant possibility but an emerging reality.

2. Course Modules with quantitative lecture hours:

1. **Introduction to Cryptography and Security Goals:** Security Goals in Cryptography, Cryptographic Attacks, Cryptographic Services and Mechanisms, Techniques for Implementing Security Goals. [4 hours]

2. **Pre-Quantum cryptography and its vulnerability**: Symmetric Cryptography: AES, DES, and Hash Function, Asymmetric Cryptography: RSA, ECC, and Diffie-Hellman, How Quantum Computers Threaten Classical Cryptosystems. [8 hours]

3. **Foundations of Post-Quantum Cryptography (PQC):** What is post-quantum cryptography, Challenges in transitioning to PQC, Overview and Motivation for PQC, The Need for Quantum-Safe Cryptography, Overview of the impact of quantum computing on cryptography [6 hours]

4. **Post Quantum Algorithms**: FIPS 203- Module-Lattice-Based Key-Encapsulation Mechanism (KEM) Standard, FIPS 204- Module-Lattice-Based Digital Signature Standard, FIPS 205-Stateless Hash-Based Digital Signature Standard. Study of recent protocols: TLS (Transport Layer Security), IPSec (Internet Protocol Security), SSH (Secure Shell), DNSSEC (Domain Name System Security Extensions), Blockchain & Cryptocurrencies, 5G-Authentication Key Agreement (5G-AKA). [10 hours].

3. **Text books:**

- → **Post Quantum Cryptography by Daniel J. Bernstein, Johannes Buchmann, and Erik Dahmen.**
- → **Quantum Cryptography: Securing the Future with Quantum Tech by by Alex C Techworth.**
- → **Understanding Cryptography: From Established Symmetric and Asymmetric Ciphers to Post-Quantum Algorithms by by Christof Paar, Jan Pelzl, Tim Güneysu**

4. **References:**

- o https://researchportal.vub.be/en/persons/an-braeken
- o **https://www.surrey.ac.uk/people/mohammad-shojafar**
- o https://www.iitr.ac.in/~CSE/Gangopadhyay_Sugata

5. **Justification of new course proposal if cumulative similarity content is >10%:**

Approvals:

Faculty interested in teaching this course: – Dr. Awaneesh Kumar Yadav

Proposed by: Dr. Awaneesh Kumar Yadav **School: SCEE**

Signature: **Date:23-03-2025**

The following external faculty provided the feedback.

Sl. No	Faculty Name	Signature
1-	Prof. An Braeken, Professor, VUB, Brussels, Belgium	
2-	Prof. Mohammad Shojafar, Associate Professor, University of Surry, United Kingdom (UK).	

School Chair:

School:

Date:

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Comments of the Reviewers:

Comments by Prof. An Braeken, Professor, VUB, Brussels, Belgium

1- Maybe you could generalize last part on PQ algorithms and protocols in title. Also include the hybrid approaches. It will be quite some work.
Response: I have included TLS, 5G-AKA, DNS, IP Sec, SSH in the table of content.

Comments by Prof. Mohammad Shojafar, Associate Professor, University of Surrey, United Kingdom (UK)

1- Not bad to add some major challenges
Response: All the major challenges of Post Quantum security will be discussed in Foundations of Post-Quantum Cryptography (PQC).

Comments by Prof. Sugata Gangopadhyay, Professor, IIT Roorkee, India

1. Can you provide references to concrete attacks on symmetric ciphers using quantum algorithms?

   I have included the text book which contains the details about the attacks on symmetric cipher.

2. How can you cover Shor's algorithm and Grover's algorithm without a course on quantum computing? Are you taking quantum computing as prerequisite?

   As per suggestions of Prof. Sugata, I removed Shor's algorithm and Grover's algorithm from table of content.

3. In order to teach post quantum algorithms you don' t have to teach quantum computing or Shor's and Grover's algorithm.

   As per suggestions of Prof. Sugata, I removed Shor's algorithm and Grover's algorithm from table of content.

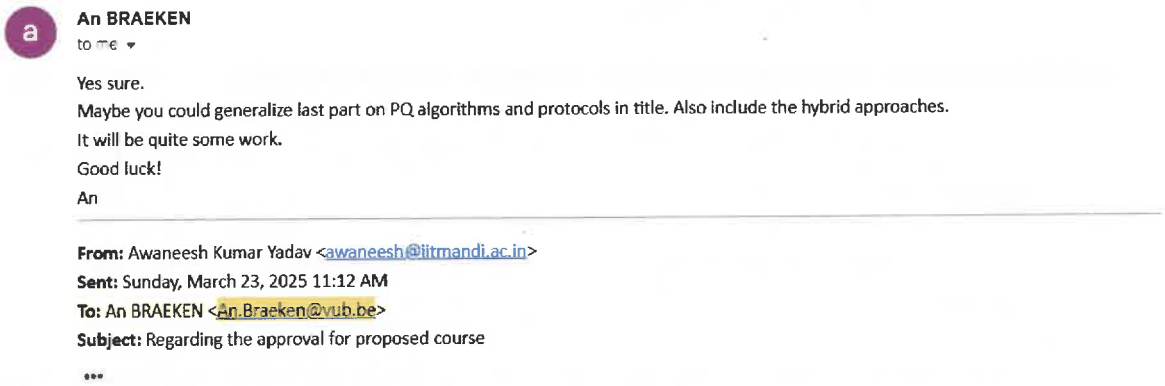
4. It may be better to provide proofs of why SVP or CVP are NP-hard.

   These SVP and CVP will be discussed in the FIPS 203 Module-Lattice-Based Key-Encapsulation Mechanism (KEM) Standard.

5. It may be better to concentrate on the code-based and lattice-based cryptosystems, KEM, and signature schemes.

I already have included recently approved algorithms based on lattice, KEM and signature (i.e., FIPS 203- Module-Lattice-Based Key-Encapsulation Mechanism (KEM) Standard, FIPS 204- Module-Lattice-Based Digital Signature Standard, FIPS 205-Stateless Hash-Based Digital Signature Standard)

The reviewers' suggestions have been incorporated into the Table of Contents.



An BRAEKEN
to me

Yes sure.
Maybe you could generalize last part on PQ algorithms and protocols in title. Also include the hybrid approaches.
It will be quite some work.
Good luck!
An

From: Awaneesh Kumar Yadav <awaneesh@iitmandi.ac.in>
Sent: Sunday, March 23, 2025 11:12 AM
To: An BRAEKEN <An.Braeken@vub.be>
Subject: Regarding the approval for proposed course

Mohammad Shojafar

Dear Awaneesh.
I have sent a few minor comments and suggestions along with my signature – see an attachment file.
Well done, and many thanks.

Dr.Sugata Gangopadhyay
to me

Sun, Mar 23, 3:54 PM (4 days ago)

I have the following observations:

1. Can you provide references to concrete attacks on symmetric ciphers using quantum algorithms?
2. How can you cover Shor's algorithm and Grover's algorithm without a course on quantum computing? Are you taking quantum computing as prerequisite?
3. In order to teach post quantum algorithms you don' t have to teach quantum computing or Shor's and Grover's algorithm.
4. It may be better to provide proofs of why SVP or CVP are NP-hard.
5. It may be better to concentrate on the code-based and lattice-based cryptosystems, KEM, and signature schemes.

Sincerely,
Sugata

Dr. Sugata Gangopadhyay
Professor
Department of Computer Science and Engineering
Indian Institute of Technology Roorkee
Roorkee
PIN Code: 247667 INDIA
Homepage:https://cse.iitr.ac.in/~CSE/Gangopadhyay_Sugata

IIT Mandi

Proposal for a New Course

Course number : **CS-524**

Course Name : **Computational Complexity Theory**

Credit : **3-1-0-4**

Distribution : ***L-T-P-C***

Intended for : **M.Tech/Ph.D./B.Tech 3rd/4th year.**

Prerequisite : **CS-212, CS-304 or instructor's consent**

1. Preamble:

Computational Complexity Theory is a fundamental area of Computer Science. It classifies computational problems based on their inherent difficulty. This course provides an introduction to this subject.

2. Course modules with quantitative lecture hours:

1. Review: P, NP, coNP, reductions, completeness, Cook-Levin theorem, some NP-complete problems. [2 hours]
2. Diagonalization, time hierarchy theorems, Ladner's theorem, Relativization, limits of diagonalization (Baker-Gill-Solovay theorem) [5 hours]
3. Space complexity, Savitch's theorem, PSPACE-completeness and NL-completeness, Immerman–Szelepcsényi theorem, Polynomial hierarchy. [7 hours]
4. Boolean circuits: P/poly, Karp-Lipton Theorem, NC and AC, P-completeness. [5 hours]
5. Randomized computation: BPP, RP, coRP, ZPP, Sipser-Gacs theorem, Valiant-Vazirani theorem. [6 hours]
6. Interactive Proofs: AM and MA, graph non-isomorphism, IP = PSPACE, zero-knowledge proofs. [7 hours]

7. Probabilistically Checkable Proofs: PCP theorem, equivalence of two views of the PCP theorem (proof checking and inapproximability), hardness of approximation. [6 hours]
8. Circuit lower bounds: Hastad's switching lemma, Parity is not in AC0. [5 hours]

3. Text books:

1. Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press, 2009.
2. Steven Rudich and Avi Wigderson, Computational Complexity Theory, American Mathematical Society, 2004.
3. Avi Wigderson, Mathematics and Computation: A Theory Revolutionizing Technology and Science, Princeton University Press, 2019.
4. Oded Goldreich, Computational Complexity: A Conceptual Perspective, Cambridge University Press, 2008

4. References:

1. Uwe Schöning, Gems of Theoretical Computer Science, Springer, 1998

5. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Faculty interested in teaching this course:– Dr. Gaurav Sood

Proposed by: Dr Gaurav Sood **School: SCEE**

Signature: Gaurav Sood **Date:** 30 March 2025

The following external faculty (at least 2 faculty) provided the feedback and it was discussed among school/centre faculty on 20 March 2025.

Sl. No	Faculty Name	Signature
1	Dr. Varunkumar Jayapaul	Varun Kumar

2	Dr. Jinesh Machchhar	

School Chair:

School:

Date:

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Comments of the Reviewers:

IIT Mandi
Proposal for a New Course

Course number : **EE550**
Course Name : **Optimal Control and Estimation**
Credit : **3-0-0-3**
Distribution : ***L-T-P-C***
Intended for : **B.Tech (3rd and Final Year), M.Tech, M.Tech (R), PhD**
Prerequisite : **For B.Tech- Control System or equivalent, For all- Linear Algebra or equivalent**
Mutual Exclusion: None

---

1. Preamble:

The goal of this course is to provide participants with an understanding of modern control theory, tailored for engineering applications such as chemical processes, power plants, robotic systems, aerospace, and more, with a particular focus on optimal control and estimation techniques. By the end of the course, students will have a thorough understanding of how to apply the Linear Quadratic Regulator (LQR), Lyapunov and Riccati equations, dynamic programming, calculus of variations and Pontryagin's minimum principle, optimal control, optimal state estimation, Kalman filter, Extended Kalman filter, Linear quadratic Gaussian controller, and H_∞ filter to the dynamical systems.

2. Course Modules with quantitative lecture hours:

Introduction [5H]: Review on probability and statistics, Dynamical systems, Continuous time system, Discrete time system, State space representation, their basic stability properties in time and frequency domain, Performance measures.

Static optimization: Optimization with and without constraints

Calculus of variations [5H]: Fundamental concepts, Functional of a single function and several independent functions, Piecewise smooth externals, Constrained extremals.

Variational approach to optimal control problems [6H]: Necessary conditions for optimal control, Algebraic Riccati equation, Linear regulator problems, Pontryagin's minimum (maximum) principle and state inequality constraints, Minimum time and control effort problems, Singular interval in optimal control problems, Two-point boundary value problem.

Dynamic programming [8H]: Optimal control law, principle of optimality, interpolation, recurrence relation of dynamic programming, discrete linear quadratic regulator problem, continuous linear regulator problem, Hamilton-Jacobi-Bellman equation.

Output feedback and structured control [6H]: Linear quadratic regulator with output feedback, Reference input tracking, Explicit model-following design, Output feedback in game theory and decentralized control.

Optimal state estimation [10H]: Least squares estimation, Propagation of uncertainty in dynamic systems, Linear optimal state estimation (Kalman filter) for continuous and discrete time systems, Extended Kalman filters, Linear quadratic Gaussian controller, H_∞ filter.

Laboratory/practical/tutorial Modules: NA

3. Text books:

1. Robert F. Stengel, Optimal control and estimation, Dover Publications, New York, 1994
2. Donald E. Kirk, Optimal control theory: An introduction, Dover publications, Inc. Mineola, NY, USA, 1998

4. References:

1. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal control, John Wiley & Sons, Inc., Hoboken, New Jersey, 2012
2. Dan Simon, Optimal state estimation, John Wiley & sons, Inc., NJ, 2006
3. Brian D.O. Anderson, John B. Moore, Optimal control, Prentice-Hall International, INC., NJ, 1989

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	NA	NA	NA	NA

6. Justification of new course proposal if cumulative similarity content is >30%:

None

Approvals:

Faculty interested in teaching this course: –
Dr. Kaushik Halder

Proposed by: Dr. Kaushik Halder **School:** SCEE

Signature: Kaushik Halder **Date:** 04-04-2025

The following faculty (at least 3 faculty) discussed on 04-04-2025 and approved the proposal on 04-04-2025

Sl. No	Faculty Name	Signature
1.	Dr. Tushar Jain	
2.	Prof. Akhilanand Pati Tiwari	04/04/2025
3.	Dr. Narendra Kumar Dhar	

School Chair:

School:

Date: 11 APR 2025

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

IIT Mandi
Proposal for a New Course

Course number : **EE550**
Course Name : **Optimal Control and Estimation**
Credit : **3-0-0-3**
Distribution : ***L-T-P-C***
Intended for : **B.Tech (3rd and Final Year), M.Tech, M.Tech (R), PhD**
Prerequisite : **For B.Tech- Control System or equivalent, For all- Linear Algebra or equivalent**
Mutual Exclusion: None

---

1. Preamble:

The goal of this course is to provide participants with an understanding of modern control theory, tailored for engineering applications such as chemical processes, power plants, robotic systems, aerospace, and more, with a particular focus on optimal control and estimation techniques. By the end of the course, students will have a thorough understanding of how to apply the Linear Quadratic Regulator (LQR), Lyapunov and Riccati equations, dynamic programming, calculus of variations and Pontryagin's minimum principle, optimal control, optimal state estimation, Kalman filter, Extended Kalman filter, Linear quadratic Gaussian controller, and H_∞ filter to the dynamical systems.

2. Course Modules with quantitative lecture hours:

Introduction [5H]: Review on probability and statistics, Dynamical systems, Continuous time system, Discrete time system, State space representation, their basic stability properties in time and frequency domain, Performance measures.

Static optimization: Optimization with and without constraints

Calculus of variations [5H]: Fundamental concepts, Functional of a single function and several independent functions, Piecewise smooth externals, Constrained extremals.

Variational approach to optimal control problems [6H]: Necessary conditions for optimal control, Algebraic Riccati equation, Linear regulator problems, Pontryagin's minimum (maximum) principle and state inequality constraints, Minimum time and control effort problems, Singular interval in optimal control problems, Two-point boundary value problem.

Dynamic programming [8H]: Optimal control law, principle of optimality, interpolation, recurrence relation of dynamic programming, discrete linear quadratic regulator problem, continuous linear regulator problem, Hamilton-Jacobi-Bellman equation.

Output feedback and structured control [6H]: Linear quadratic regulator with output feedback, Reference input tracking, Explicit model-following design, Output feedback in game theory and decentralized control.

Optimal state estimation [10H]: Least squares estimation, Propagation of uncertainty in dynamic systems, Linear optimal state estimation (Kalman filter) for continuous and discrete time systems, Extended Kalman filters, Linear quadratic Gaussian controller, H_∞ filter.

Laboratory/practical/tutorial Modules: NA

3. Text books:

1. Robert F. Stengel, Optimal control and estimation, Dover Publications, New York, 1994
2. Donald E. Kirk, Optimal control theory: An introduction, Dover publications, Inc. Mineola, NY, USA, 1998

4. References:

1. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal control, John Wiley & Sons, Inc., Hoboken, New Jersey, 2012
2. Dan Simon, Optimal state estimation, John Wiley & sons, Inc., NJ, 2006
3. Brian D.O. Anderson, John B. Moore, Optimal control, Prentice-Hall International, INC., NJ, 1989

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	NA	NA	NA	NA

6. Justification of new course proposal if cumulative similarity content is >30%:

None

Approvals:

Faculty interested in teaching this course: –
Dr. Kaushik Halder

Proposed by: Dr. Kaushik Halder **School:** SCEE

Signature: Kaushik Halder **Date:** 04-04-2025

The following faculty (at least 3 faculty) discussed on 04-04-2025 and approved the proposal on 04-04-2025

Sl. No	Faculty Name	Signature
1.	Dr. Tushar Jain	
2.	Prof. Akhilanand Pati Tiwari	04/04/2025
3.	Dr. Narendra Kumar Dhar	

School Chair:

School:

Date: 11 APR 2025

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Annexure-C9

IIT Mandi
Proposal for a New Course

Course number : **VL-300**
Course Name : **Reverse Engineering - E-Waste Management**
Credit : **1**
Distribution : ***L-T-P-C: 0.5-0-0.5-1***
Intended for : **UG**
Prerequisite : **None**
Mutual Exclusion :

1. Preamble:

Reverse engineering in electronic waste management is about analyzing how electronic waste is created, processed, and disposed of to find better ways to reduce, reuse, and recycle materials. In this course, by studying real examples, we can learn how to improve electronic waste systems and make them better for the environment. The goal is to see electronic waste as something useful instead of just trash. This course is essential for anyone who wants to help the planet and learn new ways to deal with electronic waste.

2. Course Modules with quantitative lecture hours (7 hours):

Unit 1: Introduction to Reverse Engineering and e-Waste: Definition and Importance of Reverse Engineering, Basics of E-Waste: Definition, Sources, and Types, Global and Indian e-Waste Statistics, Environmental and Health Impacts of e-Waste, Regulatory Frameworks: Basel Convention, e-Waste Management Rules (India)

Unit 2: e-Waste Generation and Composition Analysis: Lifecycle of Electronic Devices, Major Contributors to E-Waste (Smartphones, Laptops, PCBs, Batteries, etc.), Material Composition of E-Waste (Metals, Plastics, Toxic Elements), Techniques for Identifying Valuable and Hazardous Components

Unit 3: Fundamentals of Reverse Engineering in E-Waste Recycling: Concept and Applications of Reverse Engineering, Tools and Software for Reverse Engineering (CAD, Simulation Tools), Disassembly Techniques for Electronic Components, Identification and Reuse of Functional Parts, Case Study: Reverse Engineering a Mobile Phone or a Laptop

Unit 4: Material Recovery from E-Waste: Mechanical Processing (Shredding, Crushing, Sorting), Thermal Processing (Pyrolysis, Incineration), Hydrometallurgical and Bio metallurgical Methods, Precious Metal Recovery (Gold, Silver, Copper), Challenges in Efficient Material Recovery

Unit 5: Sustainable E-Waste Management Strategies: Circular Economy and Sustainable Product Design, Eco-friendly Recycling Technologies, Extended Producer Responsibility

(EPR), Urban Mining and Resource Efficiency, Case Study: Successful E-Waste Recycling Companies

Unit 6: Practical Aspects of Reverse Engineering for E-Waste: Hands-on Demonstration of Disassembly and Component Analysis, Identification of Reusable and Recyclable Components, PCB Reverse Engineering Techniques, DIY Repair and Refurbishment of Old Electronics, Lab Activity: Disassemble and Analyses an E-Waste Item

Lecture 7: Future Trends and Innovations in E-Waste Management: Emerging Technologies for E-Waste Processing, Role of AI, IoT, and Blockchain in E-Waste Management, Policy and Business Opportunities in E-Waste Recycling, Career Opportunities in E-Waste Management, Future of E-Waste Management and Reverse Engineering

Laboratory/practical/tutorial Modules:
Reverse Engineering Reports on Disassembled Devices, Real-World E-Waste Management Models, Hands-on Experience in Reverse Engineering & Recycling, Innovative E-Waste Management Solutions

3. **Text books:**
   1. **Vannessa Goodship, Ab Stevels, *Waste Electrical and Electronic Equipment (WEEE) Handbook*, 1st Ed., Woodhead Publishing, UK, 2012.**
   2. **Rakesh Johri, *Electronic Waste Management*, 1st Ed., TERI Press, India, 2008.**
   3. **Wego Wang, *Reverse Engineering: Technology of Reinvention*, 1st Ed., CRC Press, USA, 2010.**
   4. **Klaus Hieronymi, Ramzy Kahhat, Eric Williams, *E-Waste Recycling and Management: Present Scenarios and Future Perspectives*, 1st Ed., Springer, Germany, 2013.**
4. **References:**
   1. Kuan **Yew Cheong, Mohammad Tariqur Rahman**, *Sustainable Materials and Green Processing for Energy Conversion*, 1st Ed., Elsevier, Netherlands, 2021.
   2. **Varsha Bhagat-Ganguly**, *Electronic Waste Management: Issues and Strategies*, 1st Ed., Routledge, India, 2021.
   1. **Ernst Worrell, Markus A. Reuter**, *Handbook of Recycling: State-of-the-Art for Practitioners, Analysts, and Scientists*, 1st Ed., Elsevier, USA, 2014.
   2. **Bhuvan Unhelkar**, *Green IT Strategies and Applications: Using Environmental Intelligence*, 1st Ed., CRC Press, USA, 2011.

3. **Similarity with the existing courses:**
   (Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.				

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Faculty interested in teaching this course: –

Proposed by: **School:**

Signature: **Date:**

The following external faculty (at least 2 faculty) provided the feedback and it was discussed among school/centre faculty on……..

Sl. No	Faculty Name	Signature

School Chair:

School:

Date:

This proposal is reported in ……..th Board of Academics on ……

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Annexure – 9.

IIT Mandi
Proposal for a New Course

Course Number	**VL-311**
Course Name	**CMOS Processing and Practicum**
Credit Distribution	**L-T-P-C (3-0-2-4) *4-credits***
Intended for	**Discipline Core for 2^{nd} year B.Tech. in VLSI and Microelectronics Engineering students**
Prerequisite	**Device Electronics (EE-311)**
Mutual Exclusion	**None**

1. Preamble:

The complementary metal-oxide-semiconductor (CMOS) Processing and Practicum course delves into the CMOS processing technology's essential principles and practical aspects, a fundamental component of modern electronics integrated circuits (IC) processing technology. This course is designed for senior undergraduate students in applied physics, electrical, VLSI, and material science to provide a comprehensive understanding of the CMOS fabrication processes technology in a comprehensive manner.

The students will learn about the detailed steps involved in CMOS fabrication, including CMOS processing environment, crystal growth and epitaxy, semiconductor surface preparation, film formation (oxidation, metallization), lithography and etching, doping, and testing. The curriculum combines theoretical knowledge with hands-on laboratory experience, allowing students to practice processing and characterizing CMOS devices. By the end of the course, students will have a thorough understanding of the challenges and innovations within CMOS technology, preparing them with the necessary skills for advanced research and professional work in semiconductor manufacturing. Participation in this course will deepen student's knowledge and enhance practical skills, equipping them for a successful career in the dynamic field of CMOS manufacturing.

2. Course Modules with quantitative lecture hours:

- **Unit-1: Introduction to CMOS Technology (7 hours)**

  CMOS technology and device structures, substrate preference and preparation, well formation, threshold adjust implants, gate oxide and dummy gate, LDD formation, Halo implant and Source/Drain doping, adding strain to channel, contact formation, high-κ metal gate formation, interconnects and wiring.

- **Unit-2: Clean Room Environment and Vacuum Technology (9 hours)**

  Contamination sources, effects of contaminations, contamination control, clean room environment and safety requirements, Wafer Cleaning, Gettering, Vacuum basics, vacuum pumps (rotary, turbo and cryo pump), and vacuum measurement (pirani and penning gauges).

- **Unit-3: Crystal Growth, Epitaxy, and Doping (8 hours)**

  Semiconductor Crystal Growth Methods (Czochralski, Float Zone, Bridgman), Wafer Preparation, Crystal Defects, Epitaxial Growth Techniques, Defects in Epitaxial Layers, Dopant Diffusion process, Ion-Implantation, Implant Damage and Control

- **Unit-4: Film Formation and Lithography (8 hours)**

  Thermal Oxidation (Dry and Wet), Physical Vapor Deposition (Evaporation and Sputtering), Chemical Vapor Deposition, and Atomic Layer Deposition, Photoresists, Photomask, Optical Lithography, Etching (Dry and Wet).

- **Unit-5: Electrical and Material Characterization (8 hours)**

  Four Probe electrical characterization, Spectroscopic Ellipsometer, Atomic Force Microscopy, X-ray Diffractometer (XRD) and effect of glancing angle, X-ray photoelectron spectroscopy (XPS), Microscopes: Optical microscope, Scanning Electron Microscope (SEM), Transmission electron microscope (TEM) & cross-section sample preparation.

Laboratory/Practical Modules:
The course will include laboratory sessions where students will have practical demonstrations and the opportunity to learn the experimental skills needed for Wafer Surface Cleaning, Film Formation, Lithography, and Testing. The aim of the experiments to be conducted in the laboratory are as follows:

1) To design the layout of the CMOS Inverter and perform the transient & dc analysis.
2) To familiarize with the semiconductor clean room, tools & safety requirements.
3) To dice Si wafers and perform standard RCA Cleaning.
4) To grow SiO_2 using thermal oxidation.
5) To measure the thickness of SiO_2 thin film using a spectroscopic ellipsometer.
6) To deposit the thin film of metal (Al) on SiO_2/Si using a physical vapor deposition tool.
7) To spin-coat photoresist on Al/SiO_2/Si and micro-patterning using lithography for contact pads.
8) To measure photoresist thickness using a profilometer and inspection using an optical microscope.
9) To test the electrical characteristics of MOS devices using a four-probe characterization system.

3. Text Books:

- S.M. Sze and M.K. Lee, Semiconductor Devices: Physics and Technology, John Wiley & Sons, 2012.
- J.D. Plummer, P.B. Griffin, Integrated Circuit Fabrication Processes: Science and Technology, 2022.

4. References:

- S. M. Sze, VLSI Technology, Tata McGraw Hill, 2017.
- D. K. Schroder, Semiconductor Material and Device Characterization, John Wiley and Sons, 2015.
- H. Xiao, Introduction to Semiconductor Manufacturing Technology, SPIE, 2012.

a) Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx.% of content
1.	VLSI Technology	EE-611	Vacuum, PVD, CVD.	<25%

b) Justification of new course proposal if cumulative similarity content is >30%: N.A.

Approvals:

Faculty interested in teaching this course: Dr. R. Khosla

Proposed by Dr. R. Khosla **School** SCEE

Signature **Date** 06.01.2025

The following faculty discussed and approved the proposal on 06 Jan 2025.

S. No.	Faculty Name	Signature
1.	Prof. Satinder K. Sharma	
2.	Dr. Abhishek Sharma	
3.	Dr. Kunal Ghosh	

School Chair:

School: SCEE

Date:

This proposal is reported in _____ Board of Academics on _____

Dean Academics

Date:

Note: School is responsible for Course Code. Academic Office provides IC CourseCode.

IIT Mandi
Proposal for a New Course

Course number : **VL-401**
Course Name : **RTL Design and Verification**
Credit : **2-0-2-3**
Distribution : ***L-T-P-C***
Intended for : **Core course for B. Tech in Microelectronics and VLSI (3rd Year).**
Prerequisite : **Computer Organization and Processor Architecture Design (EE 326) or equivalent.**
Mutual Exclusion: **None**

---

1. Preamble:

The RTL Design and Verification course provides an in-depth understanding of Register Transfer Level (RTL) design methodologies and verification techniques, which are critical in modern digital circuit development. RTL design is the backbone of VLSI system design, enabling the transformation of high-level specifications into efficient, synthesizable hardware descriptions.

This course is designed for senior undergraduate students in VLSI and digital system design, offering a balanced mix of theoretical concepts and hands-on laboratory experience. Students will explore essential topics such as high-level synthesis, scheduling, logic optimization, and formal verification techniques. Additionally, modern verification methodologies, including assertion-based verification, model checking, and Universal Verification Methodology (UVM), will be introduced. By the end of the course, students will have a thorough understanding of RTL coding, verification strategies used in industry-standard tools. The course emphasizes practical skills and industry-relevant techniques, equipping students for careers in chip design, functional verification, and digital system validation.

2. Course Modules with quantitative lecture hours:

- **Unit 1: Introduction to RTL Design (2 Hours)**

  The concept of RTL abstraction and its role in modern VLSI design; Design methodologies and tool flows used in industry; Digital VLSI Design Flow; High Level Design Representation; Transformations for High Level Synthesis.

- **Unit 2: Hardware-synthesizable RTL Design (5 Hours)**

  Levels of abstractions in RTL; Pipelining of a design; Hardware-efficient arithmetic implementations; Hardware-software partitioning; Parallel processing; Dataflow-based hardware design; Hardware accelerators; Memory architectures for RTL-based designs.

- **Unit 3: Fundamentals of HLS, Logic Optimization and Synthesis (5 Hours)**
  Fundamental of High-Level Synthesis (HLS) including scheduling, allocation, and binding; Various scheduling algorithms and their impact on design performance; Efficient resource allocation and binding strategies; Logic optimization; Boolean logic minimization and optimization techniques; Two level Boolean Logic Synthesis; Heuristic Minimization of Two-Level Circuits; ESPRESSO logic minimizer; Finite State Machine Synthesis; Multilevel Implementation.
- **Unit 4: Temporal Logic (3 Hours)**
  Formal methods for verification using temporal logic are introduced. Fundamental operators and their applications in model checking are discussed. Introduction to formal methods for verification; Temporal Logic: Introduction and Basic Operators; Syntax and Semantics of CTL; Equivalence between CTL Formulas.
- **Unit 5: Foundations of Discrete Mathematics in Digital Logic (3 Hours)**
  Role of discrete mathematics in hardware verification; Graph Theory Basics for Logic Representation; Trees, directed acyclic graphs (DAGs), and their importance in logic design; Adjacency matrices and list representations.
- **Unit 6: Binary Decision Diagram (5 Hours)**
  Binary Decision Diagrams (BDDs) representation and manipulation of Boolean functions; Construction techniques in formal verification; Binary Decision Diagram: Introduction and construction; Ordered Binary Decision Diagram; Operations on Ordered Binary Decision Diagram; Ordered Binary Decision Diagram for Sequential Circuits; Reduced Ordered Binary Decision Diagram (ROBDD).
- **Unit 7: Verification Techniques (5 Hours)**
  Fundamental and advanced verification techniques; Model checking and symbolic model checking techniques; Advance Verification Techniques; Model Checking; Symbolic Model Checking.

Laboratory/practical Modules:

- Hands-on experience with RTL coding and synthesis using Verilog/SystemVerilog.
- Simulation of combinational and sequential circuits using industry-standard tools.
- Implementation of functional and formal verification techniques.
- Development of testbenches and assertion-based verification strategies.
- Setting up a UVM-based verification environment for large-scale designs.

3. Text books:

1. Lionel Bening and Harry Foster, Principles of Verifiable RTL Design: A functional coding style supporting verification processes in Verilog, Springer, New York, 2001
2. Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, McGraw Hill, 2012.

4. References:

1. Chris Spear, System Verilog for Verification: A Guide to Learning the Testbench Language Features, Springer, 2nd Edition, 2012.
2. Sanjay Churiwala and Sapan Garg, Principles of VLSI RTL Design: A Practical Guide, Springer, New York, 2011
3. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Compmer Organization and Processor Architecture Design	EE326	Architecture of RTL components, RTL realization in datapath design	5%
2.	Digital VLSI Architecture Design	EE523	Architectural Synthesis and Optimization	8%
3.	Network Theory	EE203	Graph Theory Basic	2%

6. Justification of new course proposal if cumulative similarity content is >30%: N.A.

Approvals:

Faculty interested in teaching this course: – Dr. Bikram Paul

Proposed by: Dr. Bikram Paul **School:** SCEE

Signature: 03/09/2025 **Date:** 01.04.2025

The following faculty discussed on 01.04.2025 and approved the proposal on 02:09:2025

Sl. No	Faculty Name	Signature
1.	Prof. Shubhajit Roy Chowdhury	
2.	Dr. Rahul Shrestha	
3.	Dr. Srinivasu Bodapati	
4.	Prof. Hitesh Shrimali	

School Chair:

School:

Date:

This proposal is reported in .....th Board of Academics on .....

Dean Academics

Date:

Note: School is responsible for the Course Code. Academic Office provides the IC Course Code.

Annexure R

IIT Mandi
Proposal for a New Course

Course number	**: BY-533**
Course Name	**: Advanced Environmental Biotechnology**
Credit Distribution	**: 3-0-0-3**
Intended for	: B.Tech. Bioengineering, MS/MSc, M.Tech, and PhD
Prerequisite	: Understanding Biotechnology and its Applications (IC136) or equivalent or Permission from instructor
Mutual Exclusion	: 'None'

---

1. Preamble:

Advanced Environmental biotechnology course will cover how biotechnology can be used to protect, restore, and sustain the environment. Environmental biotechnology is an integrated approach that includes many disciplines like biochemistry, microbiology, environmental engineering, molecular biology, and ecology. This course will cover bioremediation, phytoremediation, biodegradation, eco-friendly bioprocess, and the use of microbes to mitigate climate change. This approach enables us to tackle pressing problems, such as ensuring that human needs are met sustainably, so that everyone has access to clean water, and the resources required for agriculture and industrial activity. Environmental biotechnology is using science and technical knowledge to remediate the polluted environment. This course focuses on the application of biotechnological methods for pollution prevention, remediation, biofuels, bioplastics, biofertilizers, mining, bio-bleaching, biomarkers and sustainable management of natural resources. It prepares learners to contribute effectively to sustainability efforts in various sectors, including waste management, energy production, and pollution control.

2. Course Modules with quantitative lecture hours:

Module 1: Introduction to Environmental Biotechnology; Microbial Technology, Water and Wastewater Treatment Technologies: Environmental Biotechnology in Wastewater Treatment Resource Recovery from Wastewater. **(6 Hours)**

Module 2: Sludge treatment; Bioreactors for Wastewater Treatment; Microbial and Decentralized Wastewater Treatment Technologies. **(6 Hours)**

Module 3: Overview of Solid Waste; Environmental Biotechnology in Solid Waste Resource Recovery from Solid Waste and Sustainable Agricultural Practices, Biochar for Environmental Management and Biogas Production, Environmental Biotechnology in Plastic Waste Management; Biotechnology Application in Bioplastics, Biofuel; Biofertilizers and Biodiversity conservation **(10 Hours)**

Module 4: Bioremediation and Phytoremediation, Biodegradation of Natural Compounds and Lignin biodegradation, Advancement in Hazardous Wastes Management; Biodegradation of Xenobiotic Compounds and Nanotechnology in bioremediation, Oil Spill Cleanup; Mining and Bioleaching; Value-Added Products from Organic Wastes;

Biosensors and Microbes in GHG mitigation. **(10 Hours)**

Module 5: Applications of Nanotechnology and Latest advanced technologies for environmental remediation of Wastewater, solid waste etc., Sustainable Environmental Biotechnology, Current practices in Wastewater Treatment: examples and case studies **(10 Hours)**

3. Textbooks:

1. McCarty, Perry L., Rittmann, Bruce E. (2015). Environmental Biotechnology: principles and applications. Taiwan: McGraw Hill
2. Singh, A., Ward, O.P. (2004). Applied Bioremediation and Phytoremediation. Springer, USA.

4. References:

1. IGNOU (2024). Environmental Biotechnology (MEVE 013). New Delhi: IGNOU. ISBN 978-93-6106-062-5
2. Ulrich, A, Reuter, S., Gutterer, B. (2009). Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries. Bremen Overseas Research and Development Association (BORDA), Germany.
3. ElMekawy, A., Mohanakrishna, G., Srikanth, S., Pant, D. (2016). The Role of Bioreactors in Industrial Wastewater Treatment in Environmental Waste Management [Edited by Chandra, R.], CRC Press, USA.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Understanding Biotechnology and its Applications	IC136	Applications: Biofuels, Bioremediation, bio-medical applications	5%
2	Ecology and Environment Microbiology	CE521	biodegradation, bioremediation, bioleaching or biomining,	10%

6. Justification of new course proposal if cumulative similarity content is >30%:

Approvals:

Other Faculty interested in teaching this course: –

Proposed by: Dr Lokeshkumar Ramteke
School: School of Biosciences and Bioengineering
Signature: **Date:**

The following faculty (at least 3 faculty) discussed on.....and approved the proposal on.....

Sl. No	Faculty Name	Signature

School Chair:

School:

Date:

This proposal is reported in ……..th Board of Academics on ……

Dean Academics

Date:

Note: The school is responsible for the Course Code. The Academic Office provides the IC Course Code.

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course number : **BY-534**
Course Name : **Functional Neuroimaging and Data Analysis**
Credit Distribution : **2-1-0-3**
Intended for : **Open Elective course for B.Tech, M.Tech & PhD students**
Prerequisite : **None**
Mutual Exclusion : **None**

---

6. Preamble:

Non-invasive functional neuroimaging techniques have allowed us to visualize the function and pharmacological effects of the human nervous system. This has revolutionised our understanding of brain function and the tracing of abnormal brain activity during neurological disorders.

This course aims to equip students with a foundational understanding of the principles and methods, as well as applications, of non-invasive neuroimaging techniques, with a strong emphasis on electroencephalography (EEG), magnetoencephalography (MEG), and functional magnetic resonance imaging (fMRI). It will not only provide the theoretical background of these techniques but also offer practical exposure through hands-on exercises and real-world datasets.

7. Course Modules with quantitative lecture hours:

Unit/Topic 1: Basics of Programming **(8 Hours)**
Introduction to programming, Basic data types and structures, data input-output, functions, control statements, signal plotting, image visualisations, and basic statistics.

Unit/Topic 2: Neuroanatomy **(2 Hours)**
Anatomy of the brain, different brain lobes, cortical areas and their functions.

Unit/Topic 3: Designing Experiments to Study Brain Function **(2 Hours)**
Introduction to psychophysics, laws of psychophysics, stimulus design and considerations, data analysis, introduction to Psychophysics Toolbox.

Unit/Topic 4: Electro- and Magnetoencephalography **(8 Hours)**
The origin of EEG and MEG signals, basic preprocessing, artefact removal, independent component analysis (ICA) method for removing artefacts, evoked responses, spectral decomposition, time-frequency analysis, and multivariate pattern analysis (MVPA)

methods for EEG and MEG.

Unit/Topic 5: Functional Magnetic Resonance (fMRI) **(8 Hours)**
Basics of Magnetic Resonance Imaging (MRI), different MRI techniques, an introduction to functional MRI (fMRI), blood oxygen level-dependent signal (BOLD), preprocessing methods, a general linear model (GLM), introduction to the statistical parametric mapping (SPM) toolbox, basics of brain connectivity.

Laboratory/practical/tutorial Modules: (14 Hours)

The students will attend one hour of lab per week. This will include hands-on experience in MATLAB programming, designing experiments to study brain functioning, and basic EEG and fMRI analysis.

8. Text books:

(Relevant and Latest, Only 2)

1. Cohen, M. X. (2014). Analyzing Neural Time Series Data: Theory and Practice. MIT Press.
2. Buxton, R. B. (2009). Introduction to Functional Magnetic Resonance Imaging: Principles and Techniques (2nd ed.). Cambridge University Press.

4. References:

1. Sattar, T. A. (2017). Introduction to MATLAB for Bioengineers. Academic Press.
2. Lu, Z.-L., & Dosher, B. A. (2013). *Visual Psychophysics: From Laboratory to Theory*. MIT Press.

5. Similarity with the existing courses:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Course Name	Course Code	Similarity Content	Approx. % of Content
1.	Design and Analysis of Bioalgorithms	BE 502	Biosignal Processing module	< 5 %
2.	Biomedical Systems	EE 516	Biosignal Processing module	< 5 %
3.	Introduction to Bio-signals	IK 502	Brain signals module	< 5 %
4.	Sensory Biology	BY 528	Neuroanatomy module	< 5 %
5.	Medical Imaging & Applications	EE-XXX	MR Imaging	< 5 %

6. Justification of new course proposal if cumulative similarity content is >30%: NA

Approvals:
The following faculty (at least 3 faculty) discussed on 25-03-2025 and approved the proposal on .....

S.No	Faculty Name	Signature
1.	Dr. Hungyo Kharerin	
2.	Dr. Baskar Bakthavachalu	
3.	Prof. Tulika Srivasatava	

Other Faculty interested in teaching this course: –

Proposed by:

Dr. Sanjeev Nara

School: School of Biosciences and Bioengineering (SBB)

Signature:

Date: 25-03-25

Recommended/Not Recommended, with Comments:

_____ **Date:**_____

Chairperson, CPC

Approved / Not Approved

_____ **Date:**_____

Chairperson, BoA

Indian Institute of Technology Mandi

Annexure – 5

59.33

List of documents:

1. Curriculum for Exit Option for 2021 IDD Bioengineering students
2. Communication between Chair SBB and AD Courses.docx
3. 46th-BoA-2022May9-page12.pdf (Proposal on Exit Option of IDD Bioengineering students after 4 years)
4. UG curriculum-old-IDD-program.pdf (206 credit structure, from website)
5. Old-to-New-Curriculum.pdf (160 credit structure before 2022 from ppt on Curriculum Review by Dr. Subrata Ghosh, Dr. Rahul Vaish, Dr. Anil Kishan, Dr. Naveen Sai)

(Proposed in 59th BoA meeting on 16th April 2025)

B.Tech. Bioengineering Curriculum for Exit Option

[Note: Intended for 2021 intake students exiting from Integrated BTech-MTech Bioengineering to BTech Bioengineering]

Table 1: Credit Distribution for Exit Option

Division	Subdivision	Credits
IC Core Courses	Compulsory	54
	Basket	9
	HSS	13
Discipline Courses	Discipline Core	34
	Discipline Electives	12
Electives	Free Electives	26
	MTP + ISTP or equivalent	12
TOTAL		**160**

Table 2: List of Core Courses for BTech Bioengineering

Note:
* BE101 Reverse Engineering for Bioengineers was not offered for 2021 batch.
* BE305 Bioethics and Regulatory Affairs will be credited to the free elective basket as proposed in 46th BoA (9th May 2022) 'Proposal on Exit option of IDD Bioengineering after 4 years'
* BE306 Genetic Engineering was not offered for 2021 batch

Course No.	Course name	Credits
BE201	Cell Biology	4
BE202	Biochemistry and Molecular Biology	4
BE203	Enzymology and Bioprocessing	3
BE301	Biomechanics	4
BE303	Applied Biostatistics	4
BE304	Bioinformatics	3
BE308	Introduction to biomanufacturing	4
BE309	Biosensing and Bioinstrumentation	4
BE310	Biomaterials	4
TOTAL		**34**

Table 3: List of Discipline Electives for BTech Bioengineering

Note: All non-Core Courses from SBB (BEXXX or BYXXX) of level 3 and above can be chosen as discipline electives. Following courses from other departments can also be chosen as discipline electives. Additionally, any other course with the approval of course coordinator can also be chosen as discipline elective.

Course No.	Course Name	Relation to 'Bioengineering'
BEXXX	Any non-core Bioengineering Course	Must be of level 3 or higher

BYXXX	Any Biotechnology Course	Must be of level 3 or higher
AR506	Cognitive Robotics	Architecture of brain, theories of intelligence, human-robot interaction
CE521	Ecology and Environment Microbiology	Ecology and Microbiology
CE559	Biological Wastewater Treatment	Biological growth kinetics, Biofilms, Biogas
CS606	Computational Modeling of Social Systems	Modeling epidemics like HIV/ AIDS
CS671	Deep Learning and its applications	Artificial neurons, Computational models of neurons, Structure of neural networks
CY344	Food chemistry: Processing, Preservation and Storage	Proteins, Carbohydrates, Lipids, Enzymes, Vitamins, Minerals
CY550	Bioinspired Materials	biomimetic, self-assembly, self-replication, biofuels, tissue engineering
CY642	Molecular and Bio-electronics	DNA sensors, biofuel cells, bio-nano hybrid systems for electronic devices
CY643	Advanced Analytical Techniques	Microscopy (SEM, AFM), Spectroscopy (Absorption, Emission), Purification (HPLC)
CY644	Bioinorganic chemistry	Na-K ion pump, oxygen transport (haemoglobin), electron transport (cytochromes)
CY670	Fluorescence spectroscopy, microscopy and applications	Confocal microscopy, FRET, FLIM, FCS, TIRF
DS201	Data Handling and Visualization	Data collection (sampling), Pre-processing (normalization), Representation (curve-fitting, histogram)
DS303	Statistical foundations of data science	Probability density, Autocorrelation, Bayesian network, Random variables, Markov and Poisson process
DS313	Statistical foundations of data science	Probability density, Autocorrelation, Bayesian network, Random variables, Markov and Poisson process
EE305	Digital Signal Processing	Sampling, Filtering, Transforms (Discrete & Fast Fourier Transform, Wavelets)
EE314	Digital Signal Processing	Sampling, Filtering, Transforms (Discrete & Fast Fourier Transform, Wavelets)

EE516	Biomedical Systems	Sensing (ECG, EEG, EMG, ERG, ENG), Signal processing, Embedded systems, Ethics
EE574	Biomedical Signal and Image Analysis	electrophysiology (ECG, EEG, EMG), medical imaging (ultrasound, X-ray, CT, MRI, PET)
EE608	Digital Image Processing	Thresholding, Segmentation, Smoothing, Sharpening, Edge detection
EEXXX	Medical Imaging and Applications	X-ray, CT-scan, MRI, ultrasound image processing
IK502	Introduction to Bio-signals	Brain signals, Cardiac signals, Muscle signals, Pulse signals, blood pressure etc.
IK507	Neuroscience and Mental Health	Nervous system, Neuropsychology, Mental Health Disorders
IK510	Cognitive Neuroscience	Nervous system, sensation, perception, attention, memory, emotions, etc.
IK511	Science of Ayurveda	Ayurveda and Western medicine, Ayurvedic pharmacology, diet and nutrition, etc.
MA621	Modeling Population Dynamics	Population growth models, predator-prey systems, single- and multi- species communities
MA650	Mathematical Models for Infectious Diseases	Dynamics of viral and bacterial infections, deterministic and stochastic models
ME527	Biofluid Dynamics	Circulation in heart, blood vessels, lymphatics vessels. Flow in lungs, upper & lower airways
ME612	Introduction to Bio-materials	Structure & properties of biological cells & tissues; cell-material interactions; biocompatibility
ME622	Biomechanics of Musculoskeletal System	Biomechanics of bone, articular cartilage, muscle, tendon, ligament, joints. Gait analysis.
MT506	Biomaterials	Types of biomaterials, cell interactions, application in medical conditions

Annexure-D

Proposal on Exit option of IDD (Bioengineering) students after 4 years

1. Students enrolled in 5 years Integrated Dual Degree programme in Bioengineering can exit after 4 years.

2. Students planning to exit after 4 years can give their exit option at the end of 5^{th}, 6^{th} or 7^{th} semesters. No request for exit option will be entertained after the add/drop date of 8^{th} semester.

3. Students leaving after 4 years will leave with B.Tech in Bioengineering or B.Tech (Hons.) in Bioengineering subject to fulfillment of requirements of Honors degree. For Honours the rules laid down for B.Tech (Hons.) ordinance of IIT Mandi will be applicable.

4. Institute core and Discipline Core course criteria remains as it is for students exiting after 4 years.

5. If a student gives exit option after 5^{th} semester, then the 6 credits of M.Tech (core) already done will be renamed as Discipline Electives. He is required to do 6 more credits of Discipline Electives as per B.Tech ordinance. Bioethics and regulatory affairs which is to be taken by the IDD student in the 5^{th} semester will be credited to the free elective basket. He may do 4 credits of Discipline Electives or Interactive Socio Technical Practicum in the 6^{th} semester. He is also required to complete credit requirements of free electives and 8 credits of Major Technical Project or Discipline Electives in the remaining three semesters, apart from fulfilling the requirements of HSS credits.

6. If a student gives exit option after 6^{th} semester, then the 9 credits of M.Tech (core) already done will be renamed as Discipline Electives. Of the 9 credits of Specialization Electives already done, 3 credits will go to Discipline Elective basket and the remaining 6 credits of Specialization electives will go to the free elective basket. Bioethics and regulatory affairs which is to be taken by the IDD student in the 5^{th} semester will be credited to the free elective basket. He may do 4 additional credits of Discipline Electives or Interactive Socio Technical Practicum in the 8^{th} semester. He is also required to complete credit requirements of free electives and 8 credits of Major Technical Project or Discipline Electives in the remaining two semesters (as per B.Tech ordinance), apart from fulfilling the requirements of HSS credits.

7. If a student gives exit option after 7^{th} semester, then the 9 credits of M.Tech (core) already done will be renamed as Discipline Electives. Of the 9 credits of Specialization Electives already done, 9 credits will go to Discipline Elective basket. Bioethics and regulatory affairs which is to be taken by the IDD student in the 5^{th} semester will be credited to the free elective basket. He may do 4 additional credits of Discipline Electives or Interactive Socio Technical Practicum in the 8^{th} semester. He is also required to complete credit requirements of free electives, apart from fulfilling the requirements of HSS credits. 1 credit of Technical Communication can go to Free Elective or HSS basket. However, since Major Technical Project is not possible in this case, the student is required to substitute it suitably with 8 credits of Discipline Electives. The student is also required to ensure minimum 12 credits are registered in each semester.

UG Curriculum-Old

Integrated B. Tech-M. Tech Bioengineering

Credit Distribution

Table 118: Bio Credit Distribution

Sl. No	Component	Credits
1	Institute Core	76
2	Discipline Core	33
3	Free Electives	22
4	Humanities Electives	5
5	M. Tech Core	9
6	M. Tech Electives	21
7	Technical Communication	1
8	Bioethics and Regulatory Affairs	1
9	Mini Project, Term Paper, Seminar	4
10	M. Tech Dissertation	34
	Total	206

Table 119: Bioengineering

Semester-1				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC110	Engineering Mathematics	2.5-0.5-0-3	3
2	IC152	Data Science I	3-0-3-4	4
3	IC160	Electrical Systems Around Us	3-0-0-3	3
4	IC160P	Electrical Systems Around Us Lab	0-0-3-2	2
5	IC140	Graphics for Design	2-0-3-4	4
6	IC101P	Reverse Engineering	0-0-3-2	2
7	HS106	English I	3-0-0-3	3
8	HS10X	Creative Understanding	1-0-0-1	1
	Total		22 credits	22
Semester-2				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC111	Linear Algebra	2.5-0.5-0-3	3

[1]Discontinued with respect to 2022 B. Tech Batch

Table 119 continued from previous page

Semester-1				
2	IC141	Product Realization Technology	2-0-0-2	2
3	IC141P	Product Realization Technology Lab	0-0-3-2	2
4	IC161	Applied Electronics	3-0-0-3	3
5	IC161P	Applied Electronics Lab	0-0-3-2	2
6	IC252	Data Science II	3-0-2-4	4
7	HSXX1	HSS Language competence basket course	3-0-0-3	3
8	IC142	Engineering Thermodynamics	3-0-0-3	3
	Total		**22 credits**	22
Semester-3				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC260	Signals and Systems (Engg. Science basket)	2.5-0.5-0-3	3
2	IC136	Understanding Biotechnology and its applications (Science II basket)	3-0-0-3	3
3	IC2XX	Data Science III	2-0-2-3	3
4	IC240	Mechanics of Rigid Bodies	2.5-0.5-0-3	3
5	BEXX1	Biology-I	3-0-2-4	4
6	BEXX2	Biology-II	2-0-2-3	3
7	HSXXX	HSS Communication Skills basket course	3-0-0-3	3
	Total		**22 credits**	22
Semester-4				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC201P	Design Practicum	0-0-6-4	4
2	BEXX3	Biology-III	2-0-2-3	3
3	BEXX4	Physics and modeling of biological systems	3-0-2-4	4
4	BEXX5	Computational Biology	2-0-2-3	3
5	BEXX6	Biostatistics	3-0-2-4	4
6	BEXX7	Biomechanics	3-0-2-4	4
		Total	**22 Credits**	22
Semester-5				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC221	Foundations of Electrodynamics	3-0-0-3	3
2	ICXXX	Science I basket course	3-0-0-3	3
3	BEXX8	Bioethics and Regulatory affairs	1-0-0-1	1

Table 119 continued from previous page

Semester-1				
4	BEXX9	Biomaterials	3-0-2-4	4
5	BEXX10	Biosensing and Bioinstrumentation	3-0-2-4	4
6	HSXX3	HSS basket course	3-0-0-3	3
7	BEMC1	M.Tech Core-I	3-0-0-3	3
	Total		**21 credits**	21
Semester-6				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC222P	Physics Practicum	0-0-3-2	2
2	BEMC2	M.Tech Core-II	3-0-0-3	3
3	BEMC3	M.Tech Core-III	3-0-0-3	3
4	BEXE1	Discipline Elective-I	3-0-0-3	3
5	BEXE2	Discipline Elective-II	3-0-0-3	3
6	BEXE3	Discipline Elective-III	3-0-0-3	3
7	FEXX1	Free Elective-I	3-0-0-3	3
	Total		**20 credits**	20
Semester-7				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	ITXX1	Industrial Internship	0-0-2-2	2
2	BEXE4	Discipline Elective-IV	3-0-0-3	3
3	BEXE5	Discipline Elective-V	3-0-0-3	3
4	BEXE6	Discipline Elective-VI	3-0-0-3	3
5	HSXE1	HSS Elective-I	3-0-0-3	3
6	FEXX2	Free Elective-II	3-0-0-3	3
7	FEXX3	Free Elective-III	3-0-0-3	3
8	HS541	Technical Communication	1-0-0-1	1
	Total		**21 credits**	21
Semester-8				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	BEXE7	Discipline Elective-VII	3-0-0-3	3
2	FEXX4	Free Elective-IV	3-0-0-3	3
3	FEXX5	Free Elective-V	3-0-0-3	3
4	FEXX6	Free Elective-VI	3-0-0-3	3
5	FEXX7	Free Elective VII	4-0-0-4	4
6	BEXE8	Mini Project, Term Paper and Seminar	0-0-8-4	4
7	HSXX5	HSS Elective-II	2-0-0-2	2
	Total		**22 credits**	22
Semester-9				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	BEXE9	M.Tech Project-1	0-0-34-17	17
	Total		**17 credits**	17

Table 119 continued from previous page

Semester-1				
Semester-10				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	BEXE10	M.Tech Project-2	0-0-34-17	17
	Total		**17 credits**	17

Civil Engineering

Table 120: Civil Engineering

Semester-1				
Sl. No.	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC110	Engineering Mathematics	2.5-0.5-0-3	3
2	IC152	Computing and Data science	3-0-3-4	4
3	IC160	Electrical Systems Around Us	3-0-0-3	3
4	IC160P	Electrical Systems Around Us Lab	0-0-3-2	2
5	IC140	Graphics for Design	2-0-3-4	4
6	IC101P	Reverse Engineering	0-0-3-2	2
7	HSXXX	HSS Basket Course	3-0-0-3	3
8	HS10X	Creative Understanding	1-0-0-1	1
	Total		22 credits	22
Semester-2				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC111	Linear Algebra	2.5-0.5-0-3	3
2	IC141	Product Realization Technology	2-0-0-2	2
3	IC141P	Product Realization Technology Lab	0-0-3-2	2
4	IC161	Applied Electronics	3-0-0-3	3
5	IC161P	Applied Electronics Lab	0-0-3-2	2
6	IC252	Data Science II	3-0-2-4	4
7	HSXX1	HSS Language competence basket course	3-0-0-3	3
8	IC142	Engineering Thermodynamics	3-0-0-3	3
	Total		**22 credits**	22
Semester-3				
Sl. No	**Course Code**	**Course Name**	**L-T-P-C**	**Credits**
1	IC240	Mechanics of Rigid Bodies	3-0-0-3	3

Proposed Credit Distribution

Changes Summarized

Division	Sub-division	Credits
Institute Core	IC Compulsory	54
	IC Baskets	9
	HSS	13
Discipline	Discipline Core	33
	Discipline Electives	12
Electives	Free Electives	27
	MTP + ISTP or Equivalent	12
	TOTAL	160

Division	Sub-division	Credits
Institute Core	IC Compulsory	37
	IC Baskets	6
	HSS	12
	IKS	3
Discipline	Discipline Core*	46
	Discipline Electives*	20
Electives	Free Electives	24
	MTP + ISTP or Equivalent	12
	TOTAL	160

*The split between DC and DE is only suggested. Schools can decide the split for various branches. However, each branch must have at least and