

INDIAN INSTITUTE OF TECHNOLOGY MANDI
KAMAND, DISTT. MANDI – 175075 (HIMACHAL PRADESH)



MINUTES OF 46TH BOARD OF ACADEMICS MEETING

VENUE	:	A-4 (SC) and GUEST HOUSE (NC) CONFERENCE ROOM + ONLINE
DATE	:	09 th MAY, 2022 (MONDAY)
TIME	:	03:00 P.M.

Following members attended the meeting

Sl. No	Responsibilities	Name
1	Dean Academics	Prof. Rahul Vaish
2	Associate Dean (Research)	Dr. Rajanish Giri
3	Associate Dean (Courses)	Dr. P. Anil Kishan
4	Chairman Library Advisory Committee	Dr. Rajeshwari Dutt
5	Chairman Course Proposal Committee	Dr. Venkata Uday Kala
6	Course Coordinator (HSS Courses)	Dr. Rajeshwari Dutt
7	Course Coordinator (B.Tech.-DSE)	Dr. Manoj Thakur
8	Course Coordinator (B.Tech.-CE)	Dr. Maheshreddy Gade
9	Course Coordinator (B.Tech.-EP)	Dr. Pradeep Kumar (SBS)
10	Course Coordinator (B.Tech.-M.Tech. Integrated Dual Degree in Bio-Engg.)	Dr. Shubhajit Roy Chowdhury
11	Course Coordinator (M.Tech.-(Fluid and Thermal Engg.))	Dr. Gaurav Bhutani
12	Course Coordinator (M.Tech.-Biotechnology)	Dr. Amit Prasad
13	Course Coordinator (M.Tech.-Electric Transportation) (ET)	Dr. Narsa Reddy Tummuru
14	Course Coordinator (M.Tech.-(VLSI))	Dr. Srinivasu Bodapati
15	Course Coordinator M.Sc. (Chemistry)	Dr. Bhaskar Mondal
16	Course Coordinator (M.Sc.-Physics) + (I-Ph.D. (Physics))	Dr. C.S.Yadav
17	Course Coordinator (MA Dev.Studies)	Dr. Devika Sethi
18	Nominee-1: School of Engineering	Dr. Arpan Gupta
19	Nominee-1: School of Computing & Electrical Engineering	Dr. Gopi Shrikanth Reddy
20	Nominee-2: School of Computing & Electrical Engineering	Dr. Manas Thakur
21	Nominee-1: School of Basic Sciences	Dr. Tulika Srivastava
22	Nominee-1: School of Humanities & Social Sciences	Dr. Suman
23	Nominee-2: School of Humanities & Social Sciences	Dr. Saumya Dixit
24	Academic Affairs Secretary	Mr. Bhumanyu Goyal
25	Industry Member – 1	Dr. Nadeem Akhtar
26	Assistant Registrar (Academics): Secretary	Mr. Vivek Tiwari

Following members could not attend the meeting

Sl. No.		Name	
1	Course Coordinator (IC Courses)	Dr. Hitesh Shrimali	Member
2	Course Coordinator (B.Tech.-CSE)	Dr. Jinesh Machchar	Member
3	Course Coordinator (B.Tech.-EE)	Dr. Rahul Shrestha	Member
4	Course Coordinator (B.Tech.-ME)	Dr. Himanshu Pathak	Member
5	Course Coordinator (M.Tech.-(Mechanical Engg. (Energy Systems)) (MES)	Dr. Rajeev Kumar	Member
6	Course Coordinator (M.Tech.-(Structural Engg.))	Dr. Sandip Kumar Saha	Member
7	Course Coordinator (M.Tech.-(Communication and Signal Processing))	Dr. Siddartha Sarma	Member
8	Course Coordinator (M.Tech.-(Power Electronics and Drives))	Dr. Himanshu Misra	Member
9	Course Coordinator (M.Tech.-(Computer Science and Engg.))	Dr. Sriram Kailasam	Member
10	Course Coordinator (M.Sc.-Applied Mathematics)	Dr. Muslim Malik	Member
11	Nominee-2: School of Engineering	Dr. Mousumi Mukherjee	Member
12	Nominee-2: School of Basic Sciences	Dr. Girish Sharma	Member
13	Course Coordinator (M.Tech.- (Materials and Energy Engg.)) (MEE)	Dr. Sudhir K Pandey	Member
14	Research Affairs Secretary		Member

Special Invitee

Sl. No.	Name	
1	Prof. Prem Felix Siril	Professor, SBS
2	Dr. Atul Dhar	Asso. Prof. SE
3	Dr. Arnav Bhavsar	Asso. Prof. SCEE
4	Dr. Varun Dutt	Asso. Prof. SCEE

PART-A

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

At the onset of the meeting, the Chairman, Board of Academics thanked the earlier Associate Dean (Courses) Dr. Srikant Srinivasan and Associate Dean (Research) Prof. Chayan K Nandi for their contributions. The BoA welcomed the new Associate Dean (Courses) Dr. P Anil Kishan and new Associate Dean (Research) Dr. Rajanish Giri.

46.1 Confirmation of the minutes of 45th meeting of the Board of Academics:

The minutes of the 45th meeting of the Board of Academics held on 18th February, 2022 were confirmed.

46.2 To consider the recommendations of the committee for Academic Organization / Structure of the Schools:

Prof. Rahul Vaish, Dean (Academics) presented a proposal/recommendations of the Committee for Academic Organization/Structure of the Schools. The Board discussed the recommendation of the Committee.

After due deliberations, the BoA recommended the proposal for consideration of the Senate and its approval. The proposal is placed as **Annexure – A**.

46.3 To consider the revision in the Regulations of the MS/PhD programme regarding course selection approval by Supervisor/Guide.

Dr. Atul Dhar, Chairperson, SE presented the below mentioned proposal regarding course registration of MS/Ph.D.

Existing clause: R.11 The Doctoral Committee will prescribe the courses to complete minimum 12 credits for the students.

Proposed Modification: The student will select the relevant courses with the approval of the thesis supervisor.

The same should also be applicable to the MS students.

After due deliberations, the BoA recommended the proposal for consideration of the Senate and its approval.

46.4 To consider the revision in the Regulations for the MS/PhD programme regarding ERP/Part-Time scholars and amendment in allotment of caretaker faculty-in-charge/co-guide in the absence of guide.

Prof. Prem Felix Siril, Chair of the designated committee presented the following proposals:

1. Proposal regarding revision in the Regulation for the MS/PhD programme regarding ERP/Part-Time scholars.
2. Amendment in allotment of caretaker faculty-in-charge/co-guide in the absence of guide from the Institute for longer duration (> 3 months).

After due deliberations, the BoA recommended the proposal with minor modifications for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-B**.

46.5 To consider the format of Digilocker Degree on National Academic Depository (NAD) portal:

Dr. P Anil Kishan, Associate Dean (Courses) presented the format of Digilocker Degree certificate to be uploaded on National Academic Depository (NAD) portal. After due deliberations, the BoA recommended the format for approval. The proposal is placed as **Annexure-C**.

46.6 To consider the modified proposal regarding Exit options for IDD (Bioengineering) students after 4th year.

Dr. Shubhajit Roy Chowdhury, Programme Coordinator for B.Tech-M.Tech (Dual Degree (Bioengineering)) programme presented the modified proposal regarding exit options for IDD (Bioengineering) students after 4th year. After due deliberations, the BoA recommended the proposal with minor modifications for consideration of the Senate and its approval. The proposal is placed as **Annexure-D**.

46.7 To consider the proposal for Second Major in Bioengineering programme:

Dr. Shubhajit Roy Chowdhury, Programme Coordinator for B.Tech-M.Tech (Dual Degree (Bioengineering)) programme presented a proposal regarding second major in Bioengineering. After brief discussion, the BoA suggested modification in the proposal. Further, the BoA recommended the proposals for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-E**.

46.8 To consider revision in the curriculum for M.Tech in VLSI programme

Dr. Srinivasu Bodapati, Course Coordinator for M.Tech in VLSI programme presented a proposal regarding revision in the curriculum for M.Tech in VLSI programme. After brief discussion, the BoA suggested modification in the proposal. Further, the BoA recommended the proposal for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-F**. The above provision would be applicable for students admitted in Academic Year 2022-23 onwards.

46.9 To consider revision in the curriculum of I-Ph.D. (Physics) programme.

Dr. C.S. Yadav, programme Coordinator for I-Ph.D. (Physics) programme presented a proposal regarding revision in the curriculum of I-Ph.D. (Physics) programme. After brief discussion, the BoA deferred the proposal and gave inputs for modification of the proposal.

46.10 To consider approval of the courses presented by the Course Proposal Committee:

The Chairperson, Course Proposal Committee (CPC) described about the following courses. The BoA approved the courses as placed at **Annexure – G**.

Sl.No.	Course Code	Course Title	L-T-P-C
1	CY 523	Colloids and Interface Science and Technology	3-0-0-3
2	MA 526	An Introduction to Wavelets	3-0-0-3
3	MA 527	Field and Galois Theory	3-1-0-4
4	MA 560	Nonlinear Dynamics and Chaos	3-0-0-3
5	ME 522	High-Performance Scientific Computing	2-0-1-3
6	PH 528	Introduction to General Relativity	3-0-0-3

7	PH 607	Physics of Ultracold Quantum Gases	3-0-0-3
8	IC 141	Product Realization Technology	2-0-4-2

46.11 Any other item with the permission of the Chair.

With the permission of the Chairman, the BoA deliberated on the following points:

(i) **Center on Indian Knowledge System and Mental Health (CIKSMH):**

Dr. Varun Dutt and Dr. Arnav Bhavsar presented a proposal to establish a Center on Indian Knowledge System and Mental Health (CIKSMH) at IIT Mandi. After due deliberations, the BoA recommended the proposal with minor modifications for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-H**.

(ii) **To start MBA programme from Academic Year 2022-23:**

Dr. Manoj Thakur, Chair of the Committee presented a proposal to start new MBA programme from Academic Year 2022-23. After due deliberations, the BoA recommended the proposal with minor modifications for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-I**.

(iii) **Certificate regarding minimum requirement for the award of Ph.D. degree:**

Dean (Academics) presented a certificate format similar to UGC guidelines which is generally required by Ph.D. scholars to apply for recruitment. After due deliberations, the BoA approved that research work area will be included in the certificate as recommended by the Doctoral Committee (DC).

(iv) **Minor modification in FTE:**

Dr. Atul Dhar presented a proposal for minor modification in FTE (Fluid and Thermal Engineering) programme. After due deliberations, the BoA recommended the proposal with minor modifications for consideration of the Senate and its approval. The modified proposal is placed as **Annexure-J**. The above provision would be applicable for students admitted in the Academic Year 2022-23 onwards.

(v) **Entrepreneurship Practicum Proposal:**

Mr. Bhumanyu Goyal, Academic Affairs Secretary, 2021-2022 presented the proposal for Entrepreneurship Practicum. After due deliberations, the BoA recommended the proposal for consideration of the Senate and its approval. The proposal is placed as **Annexure-K**

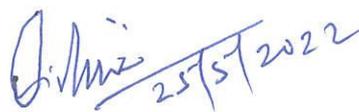
PART-B

(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.


Chairman, Board of Academics


Secretary, Board of Academics

Annexure-A

Recommendations of the committee constituted to look into the Academic Organization/ Structure of the Schools

The matter was discussed in the faculty meetings of School of Basic Sciences, School of Computing and Electrical Engineering and School of Engineering. After due deliberation the committee proposes the following.

School of Basic Sciences may be broken into four separate Schools:

1. School of Biosciences and Bioengineering
2. School of Chemical Sciences
3. School of Mathematical and Statistical Sciences
4. School of Physical Sciences

School of Engineering may be broken into two Schools

1. School of Mechanical and Materials Engineering
2. School of Civil and Environmental Engineering

The School of Computing and Electrical Engineering and School of Humanities may remain unchanged. *for the time being.*

The part time programme at the Institute provides opportunities to

- (1) individuals employed in R & D environments in scientific institutions (including IIT Mandi) or industries and
- (2) faculty members of all Engineering Colleges/Universities recognized by appropriate government agencies.

Eligibility

The required qualification remains the same as for the regular candidates except for the requirement of qualifying in one of the national entrance tests. Further, the candidate should have atleast two years work experience.

Additional Requirements

DC/APC can recommend requirement (if any) of co-guide from the sponsoring organization. A co-guide from the sponsoring organisation is not mandatory.

There is a desirable 16 weeks campus residential semester requirement to complete course work. However, DC can recommend to complete courses (from IIT Mandi) via online mode. In such cases not less than 50% assessment of individual courses should be evaluated in offline mode. The residential requirement may be made flexible as courses are recommended partially in online mode. Hence, the scholars may be allowed to complete the residential semester requirement in **multiple visits** adding up to at least 16 weeks on campus (i.e. equivalent to one semester). However, the minimum period of residency for each visit **should not be less than 2 weeks**.

In case of Part-Time scholars employed at radial distance in the range of **50-60 KM from IIT Mandi** campus, the scholar will be permitted by the Dean (Academics) to complete course work without residential requirement as these scholars can be treated day-scholars.

Candidate admitted to the programme on part-time basis must continue to remain in the same organization and place of work until the research work is completed. If the candidate is transferred or joins a new organization before the submission of the thesis, he/she should get the approval from the new organization for continuation of the programme and IIT Mandi.

Amendment in allotment of caretaker faculty in-charge/co-guide in the absence of guide from the institute for longer duration (> 3 months)

In case the guide leaves the Institute/ retires from the Institute, the doctoral committee needs to propose co-guide/caretaker faculty in-charge (depending on fraction of thesis completed by the candidate).

In case of long leaves (>3 months and < 1 year) of the supervisor, DC needs to propose co-guide/caretaker faculty in-charge depending upon the nature of research and progress made by the candidate.

Role of caretaker faculty in-charge is to look into administrative matters pertaining to the candidate.

If the leaves are more than a year, there should be an allotment of co-guide, on the recommendation of DC and school chair.

Dean, Academic will appoint (in above mentioned cases) the suitable guide/co-guide/caretaker in consultation with the school chair.

Indian Institute Of Technology, Mandi

Degree Certificate



This is to certify that
{Student Name}
was awarded the degree
of
{Course Name}
in
{Stream Name}
for the Examination held in **{Year}**.

Dated : **{Date}**



Digitally signed on
Date : 06/05/2022 16:57:27 IST

Note:-

1. This is a digital certificate. The format of this certificate may differ from the document issued by the University.
2. This certificate is electronically generated by DigiLocker - National Academic Depository.
3. This digitally signed document is legally valid as per the IT Act 2000 when used electronically.
4. To verify this certificate, download DigiLocker Android application from Google Play and scan the QR code on the certificate.

Sr. No. : {Certificate Number}

Enrolment No. : {Registration Number}

Indian Institute Of Technology, Mandi

{State Name}

{Course Name}



This is to certify that

{Student Name}

after having passed the prescribed course of study

was awarded the degree of

{Course Name}

on

{thesis}

in the year **{Year}** with Grade **{Grade}**.



Digitally signed on
Date : 04/05/2022 16:47:37 IST

Note:-

1. This is a digital certificate. The format of this certificate may differ from the document issued by the Institute.
2. This certificate is electronically generated by DigiLocker - National Academic Depository.
3. This digitally signed document is legally valid as per the IT Act 2000 when used electronically.
4. To verify this certificate, download DigiLocker Android application from Google Play and scan the QR code on the certificate.

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 5th, 6th or 7th semesters. No request for exit option will be entertained after the add/drop date of 8th 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 5th 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 5th semester will be credited to the free elective basket. He may do 4 credits of Discipline Electives or Interactive Socio Technical Practicum in the 6th 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 6th 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 5th 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 8th 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 7th 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 5th 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 8th 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.

Proposal on second major programme in Bioengineering

1. Students pursuing B.Tech in streams other than Bioengineering can pursue a second major in Bioengineering. All the norms for Double major programme for B.Tech students as approved in the 32nd Senate meeting of IIT Mandi held on September 22, 2021, will be applicable for Double major in Bioengineering.
2. Students need to pursue a set of foundational courses and a set of electives in Bioengineering to earn a second major in Bioengineering. The total number of credits should add up to 40 as approved in the 32nd Senate meeting of IIT Mandi.
3. The following are the foundational courses being identified:
 - BE201 Cell Biology - 4 credits (3-0-2-4)
 - BE202 Biochemistry and Molecular Biology - 3 credits (2-0-2-3)
 - BE203 Enzymology and Bioprocessing - 3 credits (2-0-2-3)
 - BE304 Bioinformatics - 3 credits (2-0-2-3)
 - BE503 Biosensing and Bioinstrumentation - 4 credits (3-0-2-4)This adds up to 17 credits
4. The remaining 23 credits can be taken as electives. The list of electives in the area of Bioengineering can be opted with faculty advisor and PFG (Bioengg) chair's consent.

Revision in the curriculum of M.Tech VLSI programme

To get a degree in M.Tech [VLSI] from IIT Mandi, a student has to complete 70 credits (minimum). The course structure has discipline core, mostly offered in the first semester of the program. The core practicum courses will be going in parallel to the theory courses. A student can choose any of the discipline electives as per his/her choice of interest. Some general details about the M.Tech in VLSI at IIT Mandi are as follows.

1. There are six discipline core courses with a total of 17 credits.
2. There are three discipline elective courses with a total of 9 credits (minimum).
3. Two electives from outside discipline with a total of 6 credits.
4. A student can choose the elective (discipline and outside electives) courses in any semester.
5. The post graduate project is of one year in duration. Evaluated in two parts (17 credits for each semester) with a total of 34 credits.
6. A technical communication course of 1 credit as institute core.
7. A research study course as a discipline core course, which will be offered in the winter break is of 3 credits.

Overall credit structure:

Category	Discipline Core	Discipline Elective	Free Elective	Institute Core	Project	Total
Credits	17+3*	9	6	1	34	70

*Research study (3 credit) course as a discipline core for M.Tech VLSI program, which will be offered in the winter break after first semester.

List of Core courses for M.Tech in VLSI

(Total credits for discipline core = 17)

S. No	Course Code	Name	L-T-P-C	Semester
1	EE 524	Digital MOS LSI Circuits	3-0-0-3	I
2	EE 519P	CMOS Digital IC Design Practicum	0-0-3-2	I
3	EE 520	Microelectronic Devices and Modelling	3-0-0-3	I
4	EE 512	CMOS Analog IC Design	3-0-2-4	I
5	EE 611	VLSI Technology	3-0-0-3	II
6	EE 611P	VLSI Fabrication Practicum	0-0-3-2	II

Semester wise Course Schedule for M.Tech (VLSI)

Total No. of Credits	70
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FIRST SEMESTER (1st Sem)

Number	Title of the Course	L-T-P-C	Credits
EE 524	Digital MOS LSI Circuits	3-0-0-3	3
EE 519P	CMOS Digital IC Design Practicum	0-0-3-2	2
EE 520	Microelectronic Devices and Modelling	3-0-0-3	3
EE 512	CMOS Analog IC Design	3-0-2-4	4
	Open Elective Outside Discipline – I	3-0-0-3	3
HS 541	Technical Communication	1-0-0-1	1
EE xxx	Research Study*	0-0-6-3	3
Total Credits			19

*The course will be part of winter vacation and grades to be submitted at the beginning of second semester.

SECOND SEMESTER (2nd Sem)

Number	Title of the Course	L-T-P-C	Credits
EE 611	VLSI Technology	3-0-0-3	3
EE 611P	VLSI Fabrication Practicum	0-0-3-2	2
	Open Elective Outside Discipline - II	3-0-0-3	3
	Discipline Elective - I	3-0-0-3	3
	Discipline Elective - II	3-0-0-3	3
	Discipline Elective - III	3-0-0-3	3
Total Credits			17

THIRD SEMESTER (3rd Sem)

Number	Title of the Course	L-T-P-C	Credits
EE 650P	Post Graduate Project-1	0-0-34-17	17
Total Credits			17

FOURTH SEMESTER (4th Sem)

Number	Title of the Course	L-T-P-C	Credits
EE 651P	Post Graduate Project-2	0-0-34-17	17
Total Credits			17

List of Discipline Electives:

1. EE 516 - Biomedical systems (2.5-1.5-0-4)
2. EE 523 - Digital VLSI Architecture (3-0-2-4)
3. EE 526 - Power semiconductor devices (3-0-0-3)
4. EE 529 - Embedded System Design (3-0-2-4)
5. EE 560 - Reconfigurable Computing (3-0-2-4)
6. EE 592 - Selected topics on Formal Verification (3-0-0-3)
7. EE 593 - Selected topics on Low Power VLSI Design (3-0-0-3)

8. RFIC Design
9. CAD for VLSI Design
10. Mathematical optimization
11. EE 507 - Transmission lines and Basic Microwave engineering
12. EE 615 - Nano electronics and Microfabrication (3-0-0-3)
13. EE 619 - Mixed signal VLSI Design (3-0-2-4)
14. EE 621 - Microwave integrated circuits (3-0-0-3)
15. CS 541P - IOT systems and cloud (1-0-3-3)
16. CS 507 – Computer Architecture (4-0-0-4)
17. PH 502 - Photonics (3-0-0-3)
18. ME 509 - Nanomanufacturing (3-0-0-3)
19. PH 504 - Organic opto electronics (3-0-0-3)
20. PH 511 - Mathematical Physics (4-0-0-4)



Course number	: CY-523
Course Name	: Colloids and Interface Science and Technology
Credit Distribution	: 3-0-0-3
Intended for	: PG
Prerequisite	: B.Sc./B.Tech. with Chemistry as a subject or consent of the instructor
Mutual Exclusion	: None

1. Preamble:

This course provides the students an understanding of colloidal behaviour, interparticle interactions and interfaces with brief introduction to possible applications of these concepts such as self-assembly, functional materials, nano-composites, super-hydrophobicity, super-glue, etc. which are gaining booming interest in recent years.

2. Course Modules with quantitative lecture hours:

Module 1: Introduction to Colloids (8 Hours)

Introduction: applications and importance of colloid chemistry, definition, classification and physical properties of colloids, colloids in nature, stability of colloids, electrostatic, steric and electrosteric stabilization, synthesis of colloids, self-assembly, micelles, reverse micelles, critical micellar concentration and its determination, interfaces, commonly observed interfacial phenomena, applications, phase diagram, structure and rheology of surfactant solutions

Module 2: Interactions in Colloids (6 Hours)

Origin of van der Waals interactions, van der Waals interactions between particles, Hamaker constant, effect of medium on van der Waals interactions, van der Waals forces in nature.

Module 3: Colloid Polymer Interactions (4 Hours)

Colloid-polymer mixtures, phase diagram, polymer-solvent interaction, effect of polymer addition on colloidal dispersion, factors affecting phase behavior, depletion interactions, steric interactions.

Module 4: Electrical Double Layer Interactions (6 Hours)

Surface charge origin, electrical double layer, Helmholtz model, Gouy Chapman model, Debye Huckel approximation, structure of double layer, DLVO theory.

Module 5: Electrokinetics and Particles at Interfaces (4 Hours)

Electrokinetic phenomenon, electrophoretic mobility, zeta potential, Schultz-Hardy rule, colloidal particles at interface, contact angle, HLB.

Module 6: Characterization of Colloids (6 Hours)

Dynamic and static light scattering – Light scattering by objects, Scattering by small and large particles, experimental aspects of light scattering, dynamic light scattering, particle size, particle shape, particle surface functionalization, response to stimuli, particle density, surface area, surface charge, viscosity

Module 7: Advanced Functional Colloids and Interfaces (8 Hours)

Applications of colloids and interface science in superhydrophobic surface, functional coatings, nanocomposites, detergents, personal care products, pharmaceuticals, food, textile, paint and petroleum industries, Particle adsorption to interfaces, energy of attachment, wetting, interaction forces, microstructure and rheology of particle laden interfaces, emulsions and foams.

Laboratory/practical/tutorial Modules: NA

3. Text books:

1. P. C. Hiemenz and R. Rajagopalan, Principles of Colloid and Surface Chemistry, Third Edition Revised and Expanded, CRC Press Taylor & Francis Group, USA, 1997.
2. J. C. Berg, An Introduction to Interfaces and Colloids: The Bridge to Nanoscience, World Scientific, Singapore, 2010.

4. References:

1. J. Israelachvili, Intermolecular and Surface Forces, Third Edition, Academic Press (Elsevier), San Diego, 2011.
2. Principles of Colloid and Surface Chemistry, Paul C. Hiemenz, Marcel Dekker, any edition starting with the 2nd edition, 1986.
3. Interfacial Forces in Aqueous Media, Carel J. van Oss, Marcel Dekker or Taylor & Francis, 1994.
4. R. J. Hunter, Foundations of Colloid Science Oxford University Press, New York, 2005.
5. Related journal articles

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.	Nil	-	-	-

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

NA

Approvals:

Other Faculty interested in teaching this course: – None



Course number	: MA 526
Course Name	: An Introduction to Wavelets
Credit Distribution	: 3-0-0-3
Intended for	: UG/PG
Prerequisite	: Basic Knowledge of Real Analysis and Linear Algebra
Mutual Exclusion	: None

1. Preamble:

This is an introductory course on wavelet analysis. In this course we will introduce the basic notion of wavelets in different settings, namely for finite groups, discrete infinite groups and real line. This will provide the students an opportunity to know perspective applications of linear algebra and real analysis in mathematics and beyond. Wavelets have a wide range of applications for example signal processing, image processing etc.

2. Course Modules with quantitative lecture hours:

Unit/Topic 1: Review of Linear Algebra (5 hours)

Complex Series, Euler's Formula, Roots of Unity, Linear Transformations and Matrices, Change of Basis, diagonalization of Linear Transformations and Matrices, Inner Product, Orthogonal Bases, Unitary Matrices.

Unit/Topic 2: The Discrete Fourier Transform (7 Hours)

Definition and Basic Properties of Discrete Fourier Transform, Translation- Invariant Linear Transformations, The Fast Fourier Transform.

Unit/Topic 3: Wavelets on Finite Group \square_N (6 Hours)

Convolution, Fourier Transform on \square_N , Definition of Wavelets and Basic Properties, Construction of Wavelets on \square_N .

Unit/Topic 4: Wavelets on Infinite Discrete Group \square (8 Hours)

Definition and Basic Properties of Hilbert spaces, Complete orthonormal sets in Hilbert Spaces, The spaces $\ell^2(\square)$ and $L^2([- \pi, \pi])$, Basic Fourier Series, The Fourier Transform and Convolution on $\ell^2(\square)$ Wavelets on \square .

Unit/Topic 5: Wavelets on \square (16 Hours)

Convolution and Approximate Identities, Fourier Transform on \square , Bases for The Space $L^2(\square)$, Belian-Low Theorem, Wavelets on \square , Multiresolution Analysis, Construction of Wavelets from multiresolution Analysis, Construction of Compactly supported Wavelets, Haar Wavelets, Band-Limited Wavelets, Applications.

Laboratory/practical/tutorial Modules: Nil

3. Text books:

1. Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer-Verlag, New York, 1999.
2. Eugenio Hernandez, Guido Weiss, A First Course on Wavelets, CRC Press, 1996.

4. References:

1. Ingrid Daubechies, Ten Lectures on Wavelets, CBMS -NSF Regional Conference Series in Applied Mathematics, 61. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, PA, 1992.
2. George Bachman, Lawrence Narici, Edward Beckenstein, Fourier and Wavelet Analysis, Springer-Verlag New York, 2000.
3. Howard L. Resnikoff, Raymond O. Wells, Jr., Wavelet Analysis, Springer-Verlag New York, 1998.

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.	Linear Algebra	MA512	5 hours	12%

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

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Course number : MA-527
Course Name : Field and Galois Theory
Credit Distribution : 3-1-0-4
Intended for : M.Sc./M.S./PhD/B.Tech
Prerequisite : MA-549 (Abstract Algebra)
Mutual Exclusion : (None)

1. Preamble: This one semester course is designed to provide exposure to the concepts of fields and to teach students how one can use group theory to solve field theory problems. The main idea of Galois theory is to associate a group, the Galois group, to a field extension. Since the Galois group of a finite dimensional extension is finite, we can utilize the numerical information about finite groups to help investigate such field extensions. It turns out that field theory is the right context for solving some of the famous classical problems that stumped mathematicians for centuries. As an application of field theory, we give proofs of the famous impossibilities of certain ruler and compass constructions, and we determine why roots of polynomials of degree 5 or greater need not be given by formulas involving field operations and extraction of roots.

2. Course Modules with quantitative lecture hours:

Module 1: Fields, Characteristics and prime subfields, Field extensions, Automorphisms, Normal extensions and Splitting fields, Separable and Inseparable extensions, Algebraic closures **(12 Hours)**

Module 2: Galois groups, The fundamental theorem of Galois theory, Finite fields, Cyclotomic extensions, Composite extensions, Norm and Traces, Cyclic extensions, Hilbert theorem 90 and Group cohomology, Kummer extensions **(16 Hours)**

Module 3: Discriminants, Polynomials of degree 3 and 4, Ruler and Compass constructions, Solvability by radicals, Polynomials with Galois group S_n , Transcendental extensions, Solution of a cubic by Cardan's method, Solution of biquadratic by Ferrari's method **(14 Hours)**

3. Text books:

1. P. Morandi, Field and Galois Theory, Springer-Verlag, New York, 1996

2. D.S. Dummit and R. M. Foote, Abstract Algebra, 2nd Edition, John Wiley, 2002.

4. References:

1. M. Artin, Algebra, Prentice Hall of India, 1994.
2. N. Jacobson, Basic Algebra I, 2nd Edition, Hindustan Publishing Co., 1984, W.H. Freeman, 1985.
3. S. Lang, Algebra, 3rd Edition, Springer (India), 2004.
4. J.S. Milne, Online notes : <https://www.jmilne.org/math/CourseNotes/FT.pdf>

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.	Definition of a field, finite and algebraic extension	MA549	3 Hours	~7%



Course number	: Nonlinear Dynamics and Chaos
Course Name	: MA 560
Credit Distribution	: 3-0-0-3
Intended for	: Elective for M.Sc./ MTech/PhD/BTech (All Branches)
Prerequisite	: IC 110, IC 111 for BTech, Ordinary Differential Equations for M.Sc/MTech/PhD
Mutual Exclusion	: None

1. Preamble:

It is an applied mathematics course designed to provide an introduction to the theory and basic concepts of Nonlinear Dynamics and Chaos. This course will concentrate on simple models of dynamical systems, their relevance to natural phenomena. The main goal of this course is to introduce and describe nonlinear phenomena in physical systems by only using a minimum background in physics and mathematics. The emphasis will be on nonlinear phenomena that may be described by few variables that evolve with time. There will be problem sets that will require use of computer. The computer exercises will be mainly based on the use of MATLAB, but students will be free to use different software tools as desired.

2. Course Modules with quantitative lecture hours:

Module 1: Introduction to Nonlinear Dynamics and Chaos, Recent applications of Chaos, Computer and Chaos, Dynamical view of the world (3hours)

Module 2: Basics of nonlinear science: Dynamics, Representations of Dynamical Systems, Types of Dynamical Systems, Nonlinearity, Vector Fields of Nonlinear Systems, Nonlinear systems and their classification, Dissipative Systems, Deterministic vs. Stochastic Systems, Degree of Freedom, State Space, Phase Space, Attractor (5 hours)

Module 3: Existence and uniqueness of solutions, Fixed points and Linearization, Flows on line, Fixed Points and its Stability, Analytical Approach, Graphical approach, Simulation of Equations (5 hours)

Module 4: Elementary Bifurcation Theory: Saddle Node, Transcritical, Pitchfork, Imperfect, Hopf bifurcation (4 hours)

Module 5: Two dimensional Flows, Simple Harmonic Mass-Spring Oscillator (4 hours)

Module 6: Limit Cycle, Ruling out closed orbits, Poincare Benedixson theorem (4 hours)

Module 7: Chaos and tools for its Detection: Chaos and Butterfly effect (SDIC), Center manifold theory and Poincare maps, Lyapunov Exponents, Power spectrum, phase, Stable and Unstable Manifolds, Frequency Spectra of Orbits, Dynamics on a Torus, analysis of Chaotic Time Series. Examples of chaotic systems: Lorenz Equations, Application of Chaos in sending secret messages, Rossler Equations, Chua's Circuit, Introduction to Fractals, Dimensions of fractals, Cantor Set and Koch curve (6 hours)

Module 8: One dimensional map, Logistic Map, Henon map, Period doubling Route to chaos, Feigenbaum constants (5 hours)

Module 9: Statistical description of Chaotic Systems: The concepts of invariant measure, Sinai-Ruelle-Bowen measures, ergodicity and mixing, Lyapunov exponents, and the dynamical (Kolmogorov-Sinai) entropy, and connecting them to the fractal dimension of invariant sets, and to the escape rate from a chaotic repeller. (6 hours)

Laboratory/practical/tutorial Modules: NA

3. Text books :

1. Nonlinear Dynamics: a two-way trip from Physics to Maths, H.G. Solari, M.A. Natiello and G.B. Mindlin, Overseas publication, 2019.
2. Jordan, D. W., and P. Smith. Nonlinear Ordinary Differential Equations. New York, Oxford University Press 2007

4. References:

3. Chaos: An Introduction to Dynamical systems, K. Allgood, T.Sauer, J.A.Yorke, Springer Verlag 1998.
4. Does God Play a Dice? The Mathematics of Chaos, Ian Stewart, Blackwell, New York.
5. Nonlinear Dynamics Integrability Chaos and Pattern, Laksmanan M

Rajsekhar, Springer.

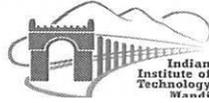
6. Chaotic and Fractal Dynamics, F.C. Moon, Wiley
7. M W Hirsch, S Smale, R L Devaney, Differential Equations, Dynamical Systems, and an Introduction to Chaos
8. Anatole Katok et Boris Hasselblatt, Introduction to the modern theory of dynamical systems, Cambridge University Press, 1995
9. Peter Walters, An introduction to ergodic theory, Springer, 1982

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.		Nil	Nil	Nil

6. Justification of new course proposal if cumulative similarity content is >30%: Not Applicable



Course number	: ME 522
Course Name	: High-Performance Scientific Computing
Credit Distribution	: 2-0-1-3
Intended for	: BTech / MTech / MS / MSc / PhD
Prerequisite	: Engineering Mathematics, Introduction to Programming or an equivalent course
Mutual Exclusion	: CS508 (Introduction to Heterogeneous Computing)

1. Preamble:

To introduce high-performance scientific computing (HPSC) to the postgraduate students in engineering and sciences starting their research in numerical sciences (e.g. computational mechanics, molecular dynamics, etc.). This course will cover efficient programming techniques (including Python and shell scripting), version control, parallel programming using OpenMP and MPI, graphics and visualisation, and cloud computing. These techniques will help the students carry out their numerical research more effectively. Fortran/C will be used as the base programming language for implementing OpenMP and MPI directives. *Each course lecture is supplement by a one-hour lab helping reinforce the concepts.* In addition, the course will make significant use of the *HPC cluster of IIT Mandi* for course assignments and projects, helping students get comfortable with the infrastructure for future use in research.

2. Course Modules with quantitative lecture hours:

Introduction to the course: Definition of HPC, history and latest developments, Moore's law, introduction to scientific computing, challenges with setting up HPC/data centres (storage, power supply and thermal management), topology of processors, demonstration of the use of HPC to solve a heat conduction problem, sparse matrices, binary storage, fixed-point and floating-point real numbers, IEEE standards, virtual machines, Unix shell and commands. **(2 Hours)**

Introduction to programming languages, version control and makefiles: Introduction

to compiled programming languages (precision, compiler optimisation, timing codes, LAPACK and BLAS), Git (Git commands, Github, graphical Git tools, Git demo), build systems and dependency checking. **(6 Hours)**

Python: Introduction, interpreted versus compiled languages, object-oriented language, syntax, conditionals, loops, functions, modules, data structures (lists and arrays), mutable and immutable objects, NumPy, linear algebra in Python, Pylab, SciPy, IPython, IPython notebook (Jupyter), unit test, nosetests, graphics and visualisation (matplotlib, Mayavi, Visualisation Tool Kit, ParaView), debugging, just-in-time compilers for Python (such as PyPy, Numba, LLVM), ASCII and binary output, HDF and NetCDF binary formats, demonstrations. **(4 Hours)**

Parallel computing: Introduction to parallelization, computer architecture (memory hierarchy, CPU, registers, cache), latency and throughput, cache lines, spatial locality, array ordering, cache collisions, padding, parallelizing algorithms (strip mining and loop reordering), shared-memory and distributed-memory parallelism, threads, parallelization issues (contention, dependencies, synchronization, and cache coherence), scaling (Amdahl's law, speedup, strong and weak scaling), SPMD (single program, multiple data) and SIMD (single instruction, multiple data), fine grain and coarse grain parallelism.

OpenMP: introduction, fork and join, synchronizations, race conditions, compiler directives, heap and stack memory, barriers, overheads, reductions, data dependencies, thread-safe functions, pseudo-random number generators in parallel, example codes, and demonstrations.

MPI: introduction, message passing, domain decomposition, MPI communicators, MPI modules and functions (broadcast, reduce, allreduce, MPI send and receive), master-worker paradigm, example codes, and demonstrations.

Comparison of OpenMP and MPI – numerical integration using adaptive quadratures

Use of HPC clusters for computing **(10 Hours)**

Scientific computing: Solution to the steady-state diffusion problem using the finite difference method, Jacobi method with OpenMP and MPI, numerical integrals using Monte Carlo (MC) method, solution to Poisson problem using MC method **(3 Hours)**

Cloud computing: Cloud computing demonstration using machine images **(1 Hour)**

Laboratory/practical/tutorial Modules: One hour lab following each lecture

Details of labs:

Hours 1 – 2: Introductory heat conduction problem and linear algebra, and Unix shell

Hours 3 – 8: Roots of a polynomial using numerical methods, version control, makefiles

Hours 9 – 12: Python lists and modules using numerical integration, Jupyter notebook, Numpy arrays and timing codes

Hours 13 – 22: Vector normalisation, Approximation of pi, adaptive quadratures, norms of matrices, LU factorisation, iterative methods to solve linear systems, Finite difference method for solving diffusion equation. All problems using OpenMP and MPI.

Hours 23 – 25: Monte Carlo methods to solve a steady-state diffusion problem

Hour 26: Cloud computing exercise

3. Text books:

No text book for this course

4. References:

L. R. Scott, T. Clark, B. Bagheri, *Scientific Parallel Computing*, Princeton University Press, 2005.

C. Lin and L. Snyder, *Principles of Parallel Programming*, Pearson, 2008.

R. Chandra, L. Dagum, et. al., *Parallel Programming in OpenMP*, Academic Press, 2001.

M. Quinn, *Parallel Programming in C with MPI and OpenMP*, McGraw-Hill Education, 2003.

G. Karniadakis, R. Kirby II, *Parallel Scientific Computing in C++ and MPI*, Cambridge University Press, 2003.

W. Gropp, E. Lusk, A. Skjellum, *Using MPI*, The MIT Press, 2014.

LD Fosdick, ER Jessup, CJC Schauble, G Domik *An Introduction to High-performance Scientific Computing*, MIT Pres, 1996.

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.	CS508 (Introduction to Heterogeneous Computing)	OpenMP and MPI theory	23%

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



Course number : PH 528
Course Name : Introduction to General Relativity
Credit Distribution : (3-0-0-3)
Intended for : I-Ph.D., M.Sc., B.Tech 3rd and 4th Year.
Prerequisite : Mathematical Physics (PH511), Classical Physics (PH 512), Electromagnetic Theory (PH 521).
Mutual Exclusion : None

1. Preamble:

General Relativity is one of the main pillars of modern physics. Einstein's discovery of General Relativity revolutionized our understanding of gravity and the universe. Since then, there has been enormous progress in both theoretical and observational fronts. General Relativity is foundational to fields such as cosmology, astrophysics, black hole physics and the physics of gravitational waves. In this course, we introduce students to the theory and applications of General Relativity.

2. Course Modules with quantitative lecture hours:

Special Relativity: Principles of special relativity – Lorentz transformations, Covariant and contravariant vectors, Relativistic Mechanics. **(4 Hours)**

Tensor Algebra and Tensor Calculus: Manifolds and metric, Introduction to tensors – Transformation of coordinates, Lie derivatives – covariant differentiation – Christoffel symbols, The Riemann and Ricci tensors – The Bianchi identities, Geodesics, Isometries – The Killing equation and conserved quantities. **(9 Hours)**

General Relativity: The equivalence principle – The principle of general covariance, The stress-energy tensor, Einstein equations, The equation of geodesic deviation, linearized gravity and idea of gravitational waves. **(9 Hours)**

Schwarzschild solution and Black holes: The Schwarzschild solution, Motion of particles in the Schwarzschild metric – Precession of the perihelion – Bending of light, Black holes – event horizon and singularity, The Kruskal extension – Penrose diagrams. **(10 hours)**

Cosmology: Homogeneity and isotropy – The FRW metric, Friedmann equations – Solutions with different types of matter, Cosmological redshift – standard candles, Dark matter and dark energy, Thermal history of the universe, Horizon problem and Inflation. **(10 hours)**

3. Text books:

1. J. B. Hartle, Gravity: An Introduction to Einstein's General Relativity, Pearson Education, India, 2003
2. B. F. Schutz, A First Course in General Relativity, 2nd Edition, Cambridge University Press, United Kingdom, 2009

4. References:

1. S. Carroll, Spacetime and Geometry, Addison Wesley, USA, 2004)
2. Barbara Ryden, Introduction to Cosmology, 2nd Edition, Addison-Wesley, USA, 2016

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.	Electromagnetic Theory	PH 521	4 lectures	10%

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



Course number	: PH607
Course Name	: Physics of Ultracold Quantum Gases
Credit Distribution	: 3-0-0-3
Intended for	: UG/PG/I-PhD/PhD elective
Prerequisite	: PH301/PH513 (Quantum Mechanics), PH522 (Statistical Mechanics), PH524/EP403(Physics of Atoms and Molecules)
Mutual Exclusion	: None

1. Preamble:

With the expanding interest in harnessing quantum science and technology, the main goal of this course is to introduce the basic concepts and fundamentals related to the recent research directions in the field of ultracold atoms, including the ones that investigate fundamental physical problems and those in which highly controllable superfluids are used as quantum simulators of other complex systems.

Students will learn the basic tools and acquire competence to be able to read and understand scientific papers dealing with these topics and in general with the physics of quantum gases and liquids. At the end of the series of lectures, students are expected to have a broad knowledge on many topics that are currently studied worldwide using quantum gases. They will have a hands-on experience of numerically solving Gross-Pitaevskii equation to obtain equilibrium and non-equilibrium solutions, and interpretation of the results.

2. Course Modules with quantitative lecture hours:

- (a) **The ideal Bose gas** [6 Hours]
The Bose Einstein condensation in ideal Bose gases, Off-diagonal long-range order, Transition temperature and condensate fraction, velocity distribution, Thermodynamic quantities
- (b) **Manipulation of atomic internal and external degrees of freedom** [6 Hours]
Level structure and atomic transitions of alkali-metal atoms, Atom-field interaction, Cooling, trapping and imaging ultracold gases
- (c) **Atom-atom interaction** [4 Hours]
Contact interaction, scattering length, Feshbach resonances, Dipolar long-range interactions
- (d) **Bose-Einstein condensates (BEC)** [12 Hours]
Condensation and Gross-Pitaevskii equation (GPE) for the macroscopic wave function, BEC dynamics in uniform and trapped configurations; Thomas-Fermi approximation, Hydrodynamic equations, Elementary excitations, BEC as simulator of quantum vacuum effects (Hawking radiation and Casimir effect), collapse and supersolidity with dipolar quantum gases

(e) Atomic mixtures

[7 Hours]

Coupled GPE, spin waves, phase diagram, Josephson effect and magnetism, Quantum droplets

(f) Lower dimensional systems as solid-state quantum simulators

[7 Hours]

Phase fluctuations, Mermin-Wagner-Hohenberg theorem, optical lattices, Bose-Hubbard model, Entanglement and correlations.

3. Text books:

1. Atomic Physics; C.J. Foot (Oxford University Press, 2005)
2. Bose-Einstein condensation in dilute gases; C.J. Pethick and H. Smith (Cambridge University Press, 2008)

4. References:

1. M. Ueda, Fundamentals and New Frontiers of Bose-Einstein Condensation, World Scientific Publishing Company 2010.
2. Lev Pitaevskii and Sandro Stringari, Bose-Einstein Condensatio, and Superfluidity, Oxford Science Publication, 2016
3. F. Dalfovo, S. Giorgini, Lev P. Pitaevskii, and S. Stringari, Theory of Bose-Einstein condensation in trapped gases, Rev. Mod. Phys. 71, 463 (1999)

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.	EP403	4 Hours	10%

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



Course number : IC-141
Course Name : Product Realization Technology
Credit : 2-0-4-2
Distribution : L-T-P-C
Intended for : UG
Prerequisite : None
Mutual Exclusion : *(courses with high similarity not allowed to credit by the students after or along with this course)*

1. Preamble:

Product Realization Technology combines market requirements, technological capabilities, and resources to define new products, their designs and the requisite manufacturing and field support processes. This course will cover product realization technology related to metals, ceramics and polymers. Experiments will provide hands on experience w.r.t. various product realization technologies.

2. Course Modules with quantitative lecture hours:

- **Introduction:** Engineering materials, their manufacturability and application (2 Hours)
- **PRT for Structural Applications (Metals & Alloys):** Casting (sand casting, permanent mold casting, investment casting), forming (Rolling, Forging, Extrusion, Sheet metal operations), machining (drilling, lathe, milling), joining, Additive manufacturing (SLS, SLM) (8 Hours)
- **PRT for Light weight applications (Polymers):** Classifications of plastics, blow molding, injection molding, extrusion, compression molding, vacuum forming, Additive manufacturing (FDM, SLM), laser machining, joining methods. (6 Hours)
- **PRT for High Temperature Applications (ceramics and glasses):** Powder manufacturing, mixing and blending, compacting, Sintering (with SPS), hot iso-static pressing (5 Hours)
- **PRT for High Performance Applications (Composites):** Microwave curing,

compression molding, resin infusion microwave curing, pultrusion, filament winding (5 Hours)

- **PRT for Electronic Applications (Semiconductors):** Thin film deposition, photolithography, wet bulk micromachining/etching, screen printing, 3D printing, Fabrication of PCBs. (2 Hours)

Laboratory (2 credit):

S.No.	Equipment	Experiment	Turns
1.	Lathe, milling, shaper machine	Facing, turning and grooving operations on mild steel rod	1
2.	Sintering	To demonstrate sintering process for ceramic/metallic powders	1
3.	Microwave composite processing	To demonstrate manufacturing of composite laminates	1
4.	Fitting	To make fillet, chamfer, drilling and tapping on mild steel flat	1
5.	Welding	To perform arc welding, gas welding and spot welding and FSW	1
6.	Sheet metal	To perform shearing, bending and riveting of galvanised iron sheet	1
7.	Foundry	To sand cast an aluminium rod	1
8.	CNC lathe and milling	To machine objects using CNC machining processes	1
9.	Laser machining	To demonstrate laser machining of an acrylic sheet	1
10.	Advanced Manufacturing	To demonstrate thin film deposition, lithography, screen printing, fabrication of PCBs.	1
11.	Additive manufacturing	To create objects using advanced 3D printing processes	1
12.	Injection molding	To understand the plastic injection molding process	1
			12

3. Text books:

(Relevant and Latest, Only 2)

1. Groover, M.P., 2020. Fundamentals of modern manufacturing: materials, processes, and systems. John Wiley & Sons.
2. Kalpakjian, S. and Schmid, S.R., 2018. Manufacturing engineering and

technology, 2001. New Jersey: Prentice Hall

4. References: None

(No limit on numbers, relevant)

Standard format can be followed, the formats should be similar)

5. Similarity with the existing courses: None

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

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

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

Approvals:

Center on Indian Knowledge System and Mental Health (CIKSMH)

The Indian Institute of Technology Mandi (IIT Mandi) conducted a Workshop on Indian Knowledge System and Mental Health (IKSMH) between 25th and 27th March 2022. The workshop was widely attended by renowned researchers in the Indian Knowledge System (IKS) and Mental Health (MH) from India and abroad. Also, 20+ faculty and staff from IIT Mandi participated in this Workshop. As a part of the deliberations that took place in the Workshop, the following IKS topics emerged: Mind, brain, and consciousness with applications from yoga, meditation, Ayurveda, traditional Indian medicine research, and other Indian performing arts (like dance, music, Indian languages, etc.).

Consequent to the IKSMH Workshop, it is proposed to establish a **Center on Indian Knowledge System and Mental Health (CIKSMH)** at IIT Mandi. The CIKSMH will focus on research in topics concerning IKS, which have several benefits for the human body, mental health, and wellbeing. In fact, IKS has deep roots grounded in Indian history, philosophy, society, arts, languages, science and technology, and life sciences. IKS may incorporate the study of mind, brain, and consciousness and include applications from several areas like yoga, meditation, Ayurveda, traditional Indian medicine research, and other Indian performing arts.

The Center's main objective are:

1. To be a world leader and serve Indian society via research and translation activities concerning IKS and mental health (MH). It plans to do so by banking on state-of-the-art scientific methods in answering questions related to the effectiveness of IKS on the human body, mental health, and wellbeing.
2. To actively engage in skill development and impart education on IKS and mental health (MH) topics to the general public. This skill development program would involve teaching and workshop programs and undergraduate or postgraduate students grounded in IKS.
3. To serve the society with IKS-related research interventions, knowledge, and tools via a retreat center, which would be open to both national and international visitors.
4. To translate research into possible product prototypes for mental health diagnostics, therapy, and general wellbeing.
5. To generate monetary resources via teaching, skill development, clinical research, retreat center, and leasing the bleeding-edge lab equipment and other facilities to eventually become self-sustaining over time.

As shown in Figure 1, the CIKSMH is intended to be designed under the main theme of mind, body, and consciousness.

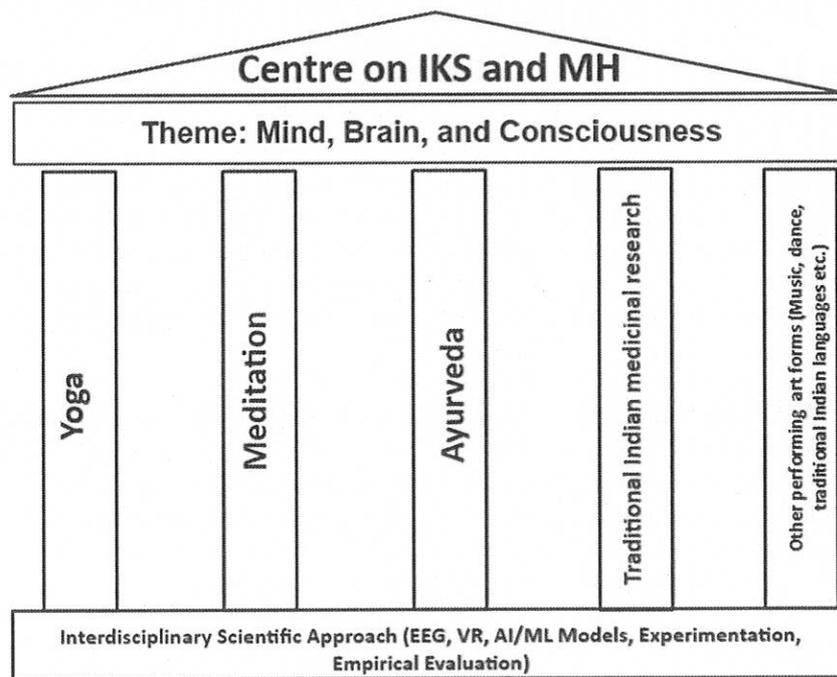


Figure 1. The conceptualization of CIKSMH grounded in mind, brain, and consciousness via applications from yoga, meditation, Ayurveda, traditional Indian medicinal research, and other performing arts.

The research and teaching under the Center would include the following IKS areas: Yoga, meditation, Ayurveda, traditional Indian medicine research, and other Indian performing arts. The Center's research would be grounded in the interdisciplinary scientific methods and it would involve a number of methodologies from cognitive science, neuroscience, computer science, sports science, chemistry, biology, and experiment design.

The Center would establish research labs like EEG/MEG lab, Neurostimulation lab, Eye-tracking lab, AR/VR and Motion lab, Psychology, data collection, and AI/ML lab, Dance and Music lab, Biosensors lab, Cellular, Molecular, and Analytical lab, IKS Retreat Center, and teaching labs. The Center would also cater to a number of degree programs at the undergraduate and postgraduate levels. These programs include B. Tech. in Computer Science (with specializations in Cognitive Science/IKS/MH/neuroscience/AI and ML). Furthermore, some of the postgraduate programs include MH-focused M.Tech. programs in Cognitive Science/IKS/MH/neuroscience/AI and ML. Finally, the Center would also include a Ph.D. program in IKS and MH areas. The teaching programs would be supported via a number of teaching labs.

Master of Business Administration

School of Management



Indian Institute of Technology Mandi

Preamble

The managerial landscape is rapidly changing due to the advancement in ICT and web enabled business platforms. Leadership in an organization are required to make appropriate decisions which is a judicious combination of the context data available and other subjective aspects. Optimal solution is no more the requirement, rather an appropriate solution is the key for success in the context of an organization. Rational decision making driven by the data has now evolved to incorporate tools and techniques of data sciences, artificial intelligence, machine learning etc. To be an impactful leader in the context of an organization, there is a need to combine softer aspects with purely data driven solutions in order to solve problems efficiently and effectively.

The proposed MBA program is a blend of management of contemporary concepts, softer skills towards developing individuals, and relevant applications of data science tools.

More specifically, the program objectives are

- To provide an exposure to fundamentals of business management with special emphasis on contemporary and emerging topics.
- To help the individuals to develop their personality by adequate exposure to soft skills like communication, creativity, and emotional intelligence etc.
- To provide an in-depth exposure to tools and techniques of data science, artificial intelligence, and machine learning etc. with a strong emphasis on problem solving approach.
- Prepare the graduate of the course to evolve as leaders of an organization who can combine rational and subjective skills in the context of an organization to make appropriate decisions.

Description:

The proposed MBA program is a blend of management of contemporary concepts, softer skills towards developing individuals, and relevant applications of data science tools. MBA is a 2-year long full-time Masters programme, distributed in 4 semesters. The credit requirement is 70. The program aims to provide an in-depth exposure on data science tools and techniques like analytics, artificial intelligence machine learning, deep learning, natural language processing, and neural networks with a strong emphasis on problem solving approach.

The course structure has three major components as detailed below:

Discipline Cores (46 credits):

Discipline Cores are designed to give the students appropriate exposure to different thoughts and theories of 'management' and 'Data science'. These include course in managerial competence such as communication skills, Legal aspects of business, HR management, creative thinking problem solving and decision making, organizational behaviour; as well as data science course such as Neural networks fundamentals for business, Mathematical foundations, disruptive technologies for data science, Introduction to AI and automation etc.

Electives (8+4 credits):

A pool of discipline and free elective courses help students to go deeper into selected areas of application of data science and artificial intelligence in business. While discipline cores are more theme oriented and interdisciplinary in nature, the discipline electives have greater disciplinary grounding. The pool of discipline electives courses is dynamic in nature and more courses may be added in the future depending upon suitability. Students also have to take 4 credits offered in the institute from outside the pool of discipline electives for the MBA Programme.

Project and internship (12):

Students would get exposure to real world problems, research methodology and industry experience through the Qualitative research workshop, social immersion project, Industry internship and two semester long Management project.

Curriculum:

The distribution of credits across types of courses is proposed to be the following:

1	Discipline Core	46
2	Discipline Electives	8
3	Free Electives	4
4	Project and Internship	12
Total		70

Sl. No.	Semester I	Break	Semester II	Break	Semester III	Break	Semester IV
1	Communication Skills for Managers	Qualitative Research (2 credits in Workshop mode) Social Immersion (0 credits)	Operations Management	Industry Internship (2 credits)	Legal Aspects of Business		Electives (6 – 10 credits)
2	Financial Statement Analysis		Fundamentals of Data and Analytics		Neural Networks fundamentals for Business		
3	Mathematical Foundations for DS/AI ML		Human Resource Management		Digital Business Strategy, Models and Transformations		
4	Creative Thinking, Problem Solving and Decision Making		Disruptive Technologies for Data Science		Entrepreneurship		
5	Marketing Management		Strategic Management		Electives (2 – 6 credits)		
6	Python Programming		Machine Learning for Business				
7	Decision Analysis		Introduction to AI and Automation		Management Project I (4 credits)		Management Project II (6 credits)
8	Probability and Statistics for Data Science/AI ML		Financial Management				
9	Managerial Economics		Organizational Behavior				
Credits	18	2	18	2	14-18		12 - 16
Summary	18 credits compulsory		18 credits compulsory		12 credits compulsory		6 credits compulsory
Total Credits Completed	18	20	38	40	54-58		70

Discipline Elective Minimum 2 courses each in 3rd and 4th semester

Sl No	Course Title	Credits
1	AI in Marketing	2
2	Causal Analytics	2
3	AI for Finance	2
4	Fintech	2
5	Blockchain for Business	2
6	Deep Learning for Business Application	2
7	Natural Language Processing for Business	2
8	Devops In ML and AI	2
9	Intelligent Automation	2
10	Fuzzy logic for business decision making	2
11	Evolutionary computation for business solutions	2
12	DevOps	2

Free Electives One course each in 3rd and 4th semester

Sl No	Course Title	Credits
1	Product Management	2
2	Design Thinking	2
3	Social Analytics	2
4	Cloud Computing For Business	2
5	Cyber Securities, Ethics and Privacy	2
6	Negotiation Analysis	2
7	Data Strategy	2
8	AI Strategy and Implementation	2
9	Leadership	2

Following are the possible title of the proposed program:

- MBA (Data Science)
- MBA (AI&ML)
- MBA Technology



46.11: Any Other Agenda

Proposed Change in Course Structure of M.Tech. in Fluid and Thermal Engineering

9 May, 2022

Mathematical Core Course (MC)

- ❖ Existing: **Advanced Analytical Techniques for Engineers (ME517)**
- ❖ Proposed Change: Mathematical Core (MC) course
 - Advanced Analytical Techniques for Engineers (ME517)
 - Numerical Methods for Engineering Computation (ME504)
 - Any suitable courses with prior permission of FA

- ❖ The motivation of this suggestion is to effectively handle the teaching load of the faculty of SE given that we are handling many MTech courses now. Note that this modification will not restrict the offering of ME517 or the students from taking it. If a faculty is available for teaching, ME517 the course will be offered.



Entrepreneurship Practicum Proposal

IIT Mandi

Preamble

The proposal intends to introduce an option for the students of the institute by virtue of which they would be able to gain academic credits based on their entrepreneurial work.

Background

IITs have always been the hub of entrepreneurs and job creators. The New Education Policy ([NEP 2020](#)) and National Innovation and Start-up Policy ([NISP 2019](#), section: Components of Guiding Framework, point-5) also have a futuristic vision for radical transformation of job seekers to job creators by promoting students' driven innovations & start-ups in higher educational institutes. In this line, it becomes highly significant to support and foster the entrepreneurial spirit among the students of our institution.

Implementation

- Students may opt for 6-months long entrepreneurship during which they have to initiate a start-up or execute an already set up start-up which must be recognised under an incubator and registered under the name of the students themselves latest by the end of the semester.
- **Approval:** Students willing to opt for this, must pitch the start-up idea to IIT Mandi Catalyst as part of "Exploration program" and get approval. The student will need to share the approval of the catalyst to the academic office to register for the entrepreneurship practicum program.
- **Duration & Credits:** The duration of this practicum will be around 6 months, including a regular semester (13-14 weeks) and a preceding vacation period (8-10 weeks). The initial 2 months will be focused on learning/training through materials and lectures provided by the incubator and will be counted towards 2 months industrial internship (IC010) under the incubator for 2 P/F credits. The next 4 months will be focused on implementation of the start-up idea and prototype. Thus students will get $2 + 9 = 11$ P/F credits and a duration of 6 months for working on the startup.

Thus the 6 months entrepreneurship practicum can be divided as follows -

Period	Objectives	Credits
First 2 months (vacation)	Training (through workshops) and Idea Validation	2
Next 4 months (semester)	Prototype Building and marketing the product	9

- **Evaluation:**

- The student will be mentored and evaluated by industrial mentors from the incubator.
- At the start of the semester, the student must lay out time-bounded goals for his/her entrepreneurial work. These goals, after approval by the mentors, will serve as the basis for the evaluation of the Entrepreneurship Practicum.
- A checkpoint meeting will be held every month by the mentors to assess the progress of the student towards the goals defined above. The students will need to present the details of his/her progress in entrepreneurial work, and the mentors reserves the right to cross verify every detail presented thereof.
- At the end of the semester, a report on the work done during entrepreneurship should be submitted by the student to the FA.
- Subject to satisfaction of the requirements and feedback received from the mentors from the incubator, the student shall be awarded 11 credits. These 11 credits will be considered from the P/F category of the degree program.

- **Exit Option:** The mentor will have an option to ask the team to drop the idea after 2 months, if he/she feels that the idea cannot be pursued further or the team is not working seriously towards the idea. Also, if the mentor accepts the team for the next 4 months, then also the team should have an option to drop the practicum with only 2 credits. These 2 drop options, first for mentor and second for the team, is to ensure that only self-motivated teams with workable ideas work on the idea for the semester as the nature of the entrepreneurial work is mostly self-guided.

- **Semester of eligibility:** 5th semester onwards

Note: IIT Mandi student teams will be required to pay Rs. 4500 to the Catalyst for registering in Catalyst's Exploration program. The amount should be directly paid by the student teams to the incubator.

Similar programs in other IITs

1. **IIT Delhi:** At IIT Delhi, students can also opt for a break in coursework for a semester to initiate or work for his / her start-up, upon successful completion of which students would be eligible for 5 DPE units (Design and Practical Experience P/F credits). Students desiring to opt for semester break for start-up are required to plan well in advance and submit a project proposal in consultation with their faculty mentor. [source - [Academic Handbook IITD](#), section: 9.6.2.5]
2. **IIT Kanpur:** IIT Kanpur allows students to take up and pursue their entrepreneurial aspirations as a part of their academic journey while pursuing their degrees. The policy allows undergraduate students in 3rd year and the postgraduate students immediately after completion of the minimum course work to gain academic credit while pursuing entrepreneurial activities. The students can also avail semester leave to pursue their ideas by using facilities both inside and outside the campus. [source - [Student Entrepreneurship Policy, IITK](#)]
3. **IIT Jodhpur:** At IIT Jodhpur, students can take a break from semester and work on their start-up and earn 20 credits as a part of engineering innovation. Students may opt for Entrepreneurship as a part of the curriculum from the beginning of the 8th Semester. A student would be required to complete a minimum of six months for Minor in Entrepreneurship, and would earn 20 credits on successful completion of a minimum of six months of Entrepreneurship. The students would be exempted from the requirement of 10 open elective credits in lieu of credits earned against Entrepreneurship. However, the remaining coursework is required to be completed by taking extra credits in the earlier semesters or can be completed after completion of Entrepreneurship. A student should have earned minimum required credits with at least 6 CGPA at the end of 7th semester to opt for dual-degree M. Tech. Programme. [source - [IITJ's Exclusive Entrepreneurship Programme](#)]
4. **IIT Palakkad:** UG/PG students can earn co-curricular academic credits for pursuing startup-related activities at any Business Incubator (BI) approved by the I&E (Innovation and Entrepreneurial) council. The exact number of credits awarded will depend on the nature of the activity and as decided by the Senate from time to time. [source - [IIT Palakkad Innovation and Startup Policy](#)]