अड़तीसवीं सिनेट बैठक का कार्यवृत्त

MINUTES OF THE 38th SENATE MEETING OF IIT MANDI

8th February, 2023

भारतीय प्रौद्योगिकी संस्थान मण्डी
कमांद– 175075, हिमाचल प्रदेश

INDIAN INSTITUTE OF TECHNOLOGY MANDI
KAMAND – 175075, HIMACHAL PRADESH

INDIAN INSTITUTE OF TECHNOLOGY MANDI
KAMAND, HIMACHAL PRADESH

38th SENATE MEETING OF IIT MANDI

WEDNESDAY, 8th February, 2023

INDIAN INSTITUTE OF TECHNOLOGY MANDI

Minutes of the 38th Senate Meeting of IIT Mandi held on 8th February, 2023 at 10:00 AM in Conference Room, C.V. Raman Guest House, IIT Mandi, Kamand.

The following were present:

In the Chair

Prof. Laxmidhar Behera, Director, IIT Mandi

Members:

Prof. Siddhartha Mukhopadhyay, Dept. of Electrical Engineering, IIT Kharagpur
Prof. Binay Kumar Pattnaik, Dept. of HSS, IIT Kanpur
Prof. Subrata Ghosh, Professor, SCS, IIT Mandi
Prof. Chayan Kanti Nandi, Professor, SCS and Dean (Resource Gen. and Alumni Relations), IIT Mandi
Prof. Pradeep C. Parameswaran, Professor & Chairperson, SCS, IIT Mandi
Prof. Rajeev Kumar, Professor, SMME and Dean (I&S), IIT Mandi
Prof. Rahul Vaish, Professor, SMME and Dean (Academics), IIT Mandi
Prof. Arti Kashyap, Professor, SPS and SCEE (dual appointment), IIT Mandi
Prof. Manoj Thakur. Professor, SMSS and Chairperson, SoM, IIT Mandi
Prof. Syed Abbas, Professor, SMSS, IIT Mandi
Prof. Rajendra K. Ray, Professor, SMSS, IIT Mandi
Dr. Venkata Krishnan, Dean (SRIC & IR), IIT Mandi
Dr. Sunny Zafar, Dean (Students) I/c, IIT Mandi
Dr. Samar, Chairperson, SCEE, IIT Mandi
Dr. Atul Dhar, Chairperson, SMME, IIT Mandi
Dr. Shyamasree Dasgupta, Chairperson, SHSS, IIT Mandi
Dr. Muslim Malik, Chairperson, SMSS, IIT Mandi
Dr. Shyam Kumar Masakapalli, Chairperson, SBB, IIT Mandi
Dr. Dericks P. Shukla, Chairperson, SCENE, IIT Mandi
Dr. Prosenjit Mondal, Co-ordinator, Bio-X Centre, IIT Mandi
Dr. Varun Dutt, Chairperson, IKSMHA, IIT Mandi
Dr. Amit Shukla, Chairperson, CAIR, IIT Mandi
Dr. Rahul Shrestha, Associate Professor, SCEE, IIT Mandi
Dr. Jinesh Machchar, Assistant Professor, SCEE, IIT Mandi
Dr. Satyajit A. Thakor, Associate Professor, SCEE, IIT Mandi
Dr. Deepak Swami, Associate Professor, SCENE, IIT Mandi
Dr. Kala Venkata Uday, Associate Professor, SCENE, IIT Mandi
Dr. Bhaskar Mondal, Assistant Professor, SCS, IIT Mandi
Dr. Satvasheel R. Powar, Associate Professor, SMME, IIT Mandi
Dr. Amit Prasad, Associate Professor, SBB, IIT Mandi
Dr. Surya Prakash Upadhyay, Assistant Professor, SHSS, IIT Mandi
Dr. Nitu Kumari, Associate Professor, SMSS, IIT Mandi
Dr. Narendra Kumar Dhar, Assistant Professor, SCEE & CAIR, IIT Mandi
Mr. Hemachandra Bhat, General Manager and Practice Head, Robotics Platforms, Wipro
Dr. P. Anil Kishan, Associate Dean (Courses), IIT Mandi
Dr. Amit Jaiswal, Associate Dean (Research), IIT Mandi
Dr. Tushar Jain, Head, CCE, IIT Mandi
Mr. Naresh Singh Bhandari, Deputy Librarian, IIT Mandi
Dr. Tulika Srivastava, Associate Professor, SBB, IIT Mandi
Dr. Devika Sethi, Assistant Professor, SHSS, IIT Mandi
Mr. Suresh Rohilla, Deputy Registrar (Academics), IIT Mandi
Student Research Affairs Secretary, IIT Mandi (Special Invitee)
Student General Secretary, IIT Mandi (Special Invitee)

Student Academic Affairs Secretary, IIT Mandi (Special Invitee)
Prof. Satinder Sharma, Professor, SCEE, Dean (Faculty), Co-ordinator C4DFED, and Registrar I/c & Secretary, Senate IIT Mandi

Following Senate members/Special invitees could not attend the meeting due to prior commitments:

Prof. Siddhartha Mukhopadhyay, Dept. of Electrical Engineering, IIT Kharagpur.
Mr. Hemachandra Bhat, General Manager and Practice Head, Robotics Platforms, Wipro.
Prof. Prem Felix Siril, Professor, SBS, IIT Mandi.
Prof. Bharat Singh Rajpurohit, Professor, SCEE, IIT Mandi.
Dr. Rajeshwari Dutt, Associate Professor, SHSS, IIT Mandi.
Student General Secretary, IIT Mandi (Special Invitee).

Following faculty attended the meeting as an Invitee:

Dr. Pradeep Kumar, Associate Professor, SMME, IIT Mandi

The Chairman Senate extended a warm welcome to all the Senate members and Invitees attending the 38th Senate meeting of the Institute.

Thereafter, following agenda items were taken up.

Item No. 38.1: **To confirm the minutes of the 37th Senate meeting held on 7th October, 2022.**

The minutes of the 37th Senate meeting held on 7th October, 2022 at IIT Mandi were circulated to members of the Senate on 4th November, 2022 (through email) for comments, if any. No comments have been received on the minutes. Therefore, minutes of the 37th Senate meeting held on 7th October, 2022 were confirmed as circulated.

Item No. 38.2: **To receive a report on the actions taken for the decisions taken in the 37th Senate meeting held on 7th October, 2022.**

The Senate noted the actions taken on the decisions taken in its 37th meeting held on 7th October, 2022.

Item No. 38.3: **To consider the proposal of new branch in B.Tech. programme i.e., B.Tech in Materials Science and Engineering.**

Dr. Viswanath Balakrishnan, presented a proposal of new branch in B.Tech. in Materials Science and Engineering under School of Mechanical and Materials Engineering. After discussion, the Senate resolved to approve the proposal as placed at **Annexure – A; Page No. 8 to 25** and the same shall be reported to the BoG.

Item No. 38.4: **To consider the proposal of new branch in B.Tech. programme i.e., B.Tech in General Engineering.**

Dr. Mrityunjay Doddamani, presented a proposal of new branch in B.Tech. in General Engineering. After discussion, the Senate gave the following suggestions:

1. There should not be conventional UG specialization associated with this degree programme.
2. There should be inputs from Industries and placement cell about job prospectus.

3. There should be USP of the programme w.r.t existing similar program in other IITs.
4. Committee may explore specialization in the discipline of Liberal Art, photography, fashion design, film making, product design etc. In this regard collaboration with NIFT, CEPT etc. desirable where students can spend one year.
5. Committee may explore execution of these specialization with sister institutions.

After incorporating the suggestions, the revised proposal be presented for consideration in subsequent meetings of the Senate.

Item No. 38.5: **To consider the proposal of new BS-MS in Chemical Sciences.**

Dr. Bhaskar Mondal, presented a proposal of new BS-MS in Chemical Sciences. After discussion, the Senate suggested to constitute a committee by Dean (Academics) to look into the proposal and to check the other requirements of new O&R etc. for such programmes.

After incorporating the suggestions, the revised proposal will be presented to the Chairman, Senate for approval, and same will be reported in subsequent Senate meeting.

Item No. 38.6: **To consider the proposal of M.Tech./M.A/M.Tech. (Research) with Specialization.**

Prof. Rahul Vaish, Dean (Academics), presented a proposal of M.Tech./M.A./M.Tech (Research) with Specialization. After discussion, the Senate approved the proposal in principle. A committee will be constituted by the Dean (Academics) for proper execution and to recommend for closing the M.Tech. programme which are not running well and it will be presented in subsequent Senate meeting.

1. MA (R) / MS (R)/M.Tech (R) programs

Institute offers M.Tech. (by Res.) in areas of science, technology, humanities, and social sciences. This program is relatively more popular among engineering disciplines due to its professional name. In order to promote master level research programs the following three research programs can be offered by all schools and centres.

Student can be awarded more appropriate degrees as

Engineering	M.Tech (R)
Science	M.S. (R)
Humanities and Social Sciences	M.A.(R)

APC may recommend appropriate degree based on dissertation and courses credited.

These programs will be governed under the existing O & R of M.Tech (Res.).

The Senate approved the proposal.

2. MA (R) / MS(R)/M.Tech (R) programs with specialization

These programs can be only awarded with specialization subject to completion of minimum 15 credits in specific specialization along with dissertation in the same area.

Some of the proposed specializations are as follows:

- M.Tech (Res.) in Engineering Structures / Construction Technology & Management / Geotechnical Engineering / Transportation Engineering / Environmental Engineering / Remote Sensing & GIS / Water Resource Engineering, etc. M.Tech (Res.) in Thermal

Engineering/Manufacturing / Automobile Engineering/Manufacturing Engineering / Material Technology / Product Design and Development / Robotics/Control Systems / Computational Mechanics etc.

- M.S.(Res.) in Data Science, Statistics, Computing and Mathematics, Condensed Matter Physics, etc.

Similarly, MA (Res.) can also be awarded in the specialized area of courses and dissertation opted.

The above-mentioned list is not exhaustive and hence Schools and Center's can decide such specialization based on student's/faculty research interest and based on placement aspects.
These specializations can be decided by the various schools and centres and can be advertised every year with the permission of Dean (Academics).

The Senate has also approved the following:

1. M.Tech (R)/MA (R)/MS (R) will not be counted under HTRA cap of faculty. School/Centre chair may decide number of students /faculty based on research facility and other logistics.
2. There will not be thesis title in case of specialization awarded to the candidate. Both the formats are attached for M.Tech. (R), M.Sc. (R) and M.A. (R) on the degree certificate.
3. Every year specializations may vary and can be pre-decided by schools/centres with the approval of Dean (Academics).
4. These will be advertised and selected as same as present M.Tech course based programs.
5. These programs will be governed under the existing O & R of M.Tech (Res.).
6. Credit Structure for M.Tech (R) can be redefined and may be presented in the subsequent Senate meeting.

Format (Attached Annexure-B; Page No. 26 to 32.)

Execution process:

1. **Dean Academic office will collect schools/centres requirements (Name of Specialization and number of tentative seats) every year.**
2. **The Chairman Senate will approve overall M.Tech (R)/MS (R)/MA (R) seat matrix every year.**
3. **Approved seat matrix will not be specified for proposed specialization.**
4. **Reservation norms will be applicable on overall proposed seats (institute level) in M.Tech (R)/MS (R) /MA (R).**

The Chairman Senate has also raised the concern for need of APC, in this regard. The Dean (Acad) Office will review the case and will present comprehensive report in subsequent Senate meeting.

It was also suggested to have Dissertation credits in these programs so that overall credit should be at par as M.Tech. course-based program.

Item No. 38.7: **To consider the proposal of award of B.Tech. degree with Specialization.**

Prof. Rahul Vaish, Dean (Academics) presented the proposal of award of B.Tech. degree with Specialization. After discussion, the Senate approved the following proposal in principle with a suggestion to finalize all the requirements to float the programme. The Senate also approved that only single degree will be awarded .

All B.Tech degrees have Discipline electives component ranging from 15-20 credits. These electives largely cover all areas of main discipline of UG programme. There is a possibility that these electives can be offered in more specialized area baskets.

Completion of 15 credits from the discipline electives baskets (in same specialization) can be considered for specialization in own discipline.

Some of the possible specializations could be:

Mechanical Engg.	Specialization in "Thermal Engg.", "M/C Design", "Product development & Manufacturing"etc.
Civil Engg.	"Structural Engg.", Environmental Engg." etc.
Electrical Engg.	"VLSI" "High Voltage" etc.
Engg. Physics	Classical Mechanics, Biophysics, Quantum Mechanics, Optics & Atomic & Molecular Physics,

The Schools/centers can decide such provisions in all B.Tech degrees based on student's job prospects, resources, and students interest.

In order to fulfill the requirement of specialization, student should have minimum 7 CGPA in respective basket of specialization.

Item No. 38.8: **To consider the proposal for granting permission to extend degree duration (UG/PG).**

Prof. Rahul Vaish, Dean (Academics) presented the following proposal for granting permission to extend degree duration for UG and PG programmes :

Programme	Minimum Duration	Maximum duration
Under graduate (B.Tech.)	4 yrs.	Can be extended maximum upto 2 more years *(after completion of four years from the date of registration)* based on the recommendation of Faculty advisor and School Chairs. Prior approval of Dean (Academics) is necessary for continuing registration after 4 yrs. *(This approval needs to be obtained every semester with proper plan of completion).*
Postgraduate degrees (course based) (M.Tech, MSc, MBA, MA etc.)	2 yrs.	Can be extended maximum upto 1 more year *(after completion of Two years from the date of registration)* based on the recommendation of Faculty advisor/ supervisor and School Chair. Prior approval of Dean (Academics) is necessary for continuing registration after 2 yrs. *(This approval needs to be obtained every semester with proper plan of completion).*

After brief discussions, this was approved by the Senate.

Item No. 38.9: **To consider the proposal of modification in the programme M.Tech. in Mechanical Engineering with Specialization in Energy Systems.**

Dr. Atul Dhar, Chair SMME presented the following proposal of modification in the programme M.Tech. in Mechanical Engineering with Specialization in Energy Systems.

1.	**Replacing Core Course HS540**: Energy: Environment Policy and Law with Open Elective Courses such as: –ME513 Finite Element Method for Engineers –ME601 Advanced Finite Element Methods –HS540 is suggested to be included in the list of electives –Any other course with sufficient out of discipline exposure
2.	**Replacing ME631**: Heat Transfer and Fluid Flow in Energy Systems with ME604: Experimental Methods in Thermal Engineering

The motivation for this change is to effectively handle the teaching load of the faculty of SMME by replacing the course with similar course content.

After brief discussions, this was approved by the Senate.

Item No. 38.10: **To consider the revision in course curriculum of M.Sc. in Applied Mathematics.**

Dr. Nitu Kumari, presented a proposal of revision in course curriculum of M.Sc. in Applied Mathematics. After discussion, the Senate resolved to approve the proposal as placed at **Annexure – C; Page No. 33 to 37.**

Item No. 38.11: **Any other agenda item with the permission of the Chairman, Senate.**

None.

Item No. 38.12: **To report decisions/action taken by the Chairman, Senate.**

The Senate noted the decisions taken by the Chairman, Senate on behalf of the Senate, as given in the agenda.

Item No. 38.13: **Issues to be discussed by the Senate without Student Members being present.**

None.

The meeting concluded with a vote of thanks to the Chair and to the Members.

31/3/23
Chairman, Senate

31-3-2023
Registrar I/c & Secretary-Senate

Anneuxre-A

Proposal for B. Tech. in

Materials Science and Engineering

School of Mechanical and Materials Engineering (SMME)

Indian Institute of Technology Mandi

Programme Proposal Form

Name of the New Proposed Program: B.Tech. in Materials Science and Engineering (Four Years Undergraduate Program)

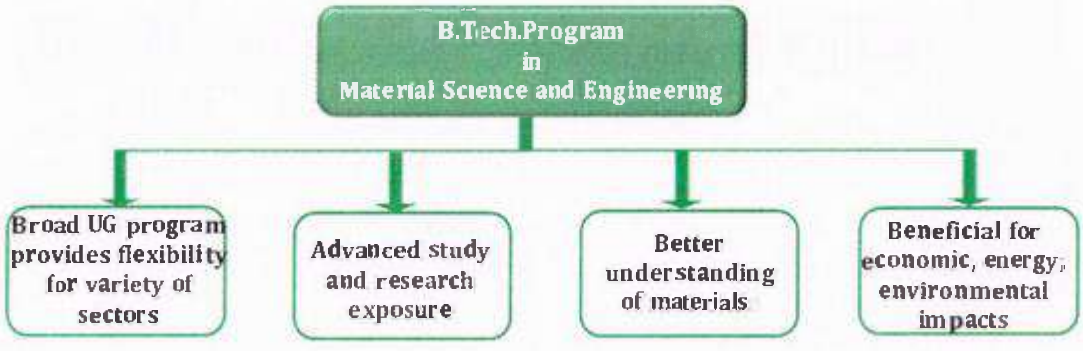
I. General Information:

Name (s) of prosper school: School of Mechanical and Materials Engineering (SMME)

II. Program Description:

A. Provide a justification/rationale for the program. How does the program relate to the mission of the IIT Mandi?

The Bachelor of Technology (B.Tech.) in Materials Science and Engineering program aims to achieve strong foundation in Materials Science with focus on Engineering Applications by offering large number of allied engineering courses and employable skills. The idea is to develop broad B.Tech. Curriculum with a blend of science and engineering covering key elements of materials, advanced processing, additive manufacturing with hands-on training. Further the proposed curriculum will develop an understanding of the structure-properties correlation, processing, and service behavior of engineering materials, including semiconductors for electronic devices, ceramics for energy conversion and storage, and polymers for emerging biotechnologies. This understanding fosters both the development of new materials and the improvement of existing materials to optimize manufactured products and modern tools. This program will give students a strong foundation in both theoretical and practical understanding of the subject. At present scenario, student who specializes in materials science and engineering needs to study and develop solutions in the advanced emerging fields of sustainability and renewable energy, nanotechnology, quantum materials, and devices, artificial intelligence, smart materials, low-power computing, manufacturing, and productivity. We have excellent laboratories/research centers facilities for materials science and engineering at IIT Mandi. The proposed B.Tech. program will help us to bridging the gaps between the research activities and engineering education and our graduates would play a leadership role to future growth and the industry. Materials engineers also offer knowledge of materials for practical applications that serve as the cornerstone of the goods and services provided by numerous sectors. Further, the proposed B.Tech. program will promote the academic and research activities at IIT Mandi and make larger impacts in society by producing high quality engineers.



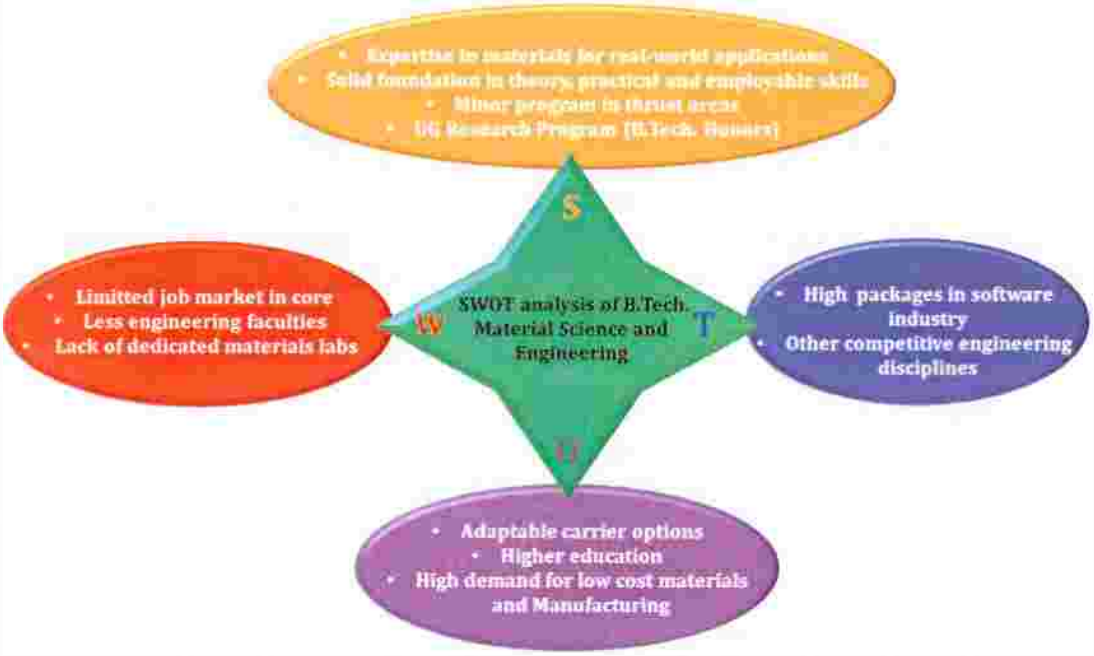
B. SWOT analysis of the program

The purpose of SWOT analysis is to see how Material Science and Engineering can be implemented in the IIT Mandi's education system.

ADVANTAGES (Strengths-Opportunities)	DISADVANTAGES (Weakness – Threats)
The coursework will cover fundamental sciences and mathematics relevant to Materials Science and Engineering, as well as provide an in-depth understanding of key material properties and behaviours.	Lack of dedicated teaching laboratories for providing hands on training to UG students to conduct experiments, familiarize material processes and applications.
This program will educate undergraduate students to tackle grand challenges in sustainability and clean energy, quantum materials and devices, artificial intelligence and smart materials, characterization tools, product design and manufacturing by selected elective courses in different streams.	Less number of faculty members in the core materials engineering area.
Our graduate students will be trained in R&D to become researcher, innovators and entrepreneurs who consistently conduct research, develop novel materials and processes of all kinds towards positive economic and social impact. This will be achieved by attracting highly motivated students in UG research program under B.Tech. Honors program.	Limited job market in the core area of materials as well as high packages in software and other competitive industries.

Some of the weaknesses could be addressed by establishing good UG teaching laboratories that caters the need of large number of UG students. Similarly, hiring few more engineering faculty members in the areas of computational materials, functional materials and metallurgy will strengthen the core discipline and also reduce the teaching dependencies over the associated faculty members from different Schools.

While the limited job market in the core area of materials may not be changeable at our end, the broad UG curriculum with technical skills, elective specializations and UG research program etc will likely to increase the employability of our students in various sectors. Further, more focused efforts are needed to expand the network on identified sectors such as Semiconductors, Manufacturing, Structural Materials/Steels, Automobiles, Energy and Waste Management in order to improve the placements. For example, core industries such as Saint Gobain, Aditya Birla, Applied Materials, Tata Steel, Jindal Steel, 3M, Intel, Global Foundries and Micron might be contacted by faculty advisors to increase our engagements with them for better career opportunities.



C. Justification with respect to New National Education Policy (NEP) mandates

One of the major key points of the new national education policy (NEP) is transformational reforms in school and higher education systems in the country and also to foster interdisciplinary education. In the proposed B.Tech. program, greater emphasis is given to connection between the fundamentals and analytical abilities, critical thinking, and research. As per the recent developments, the rigid boundaries among different disciplines are diminishing, the subject of materials science and engineering interdisciplinary by itself and would provide broad knowledge to UG students. The field of materials science and engineering gives flexibility for work in a variety of sectors. Graduates receive an in-depth understanding of fundamental sciences and engineering due to the program's resilience. Due to the program's integration of the fundamental sciences and engineering, graduates' benefit from having a degree that allows them to be flexible enough to work in a variety of industries while also being highly qualified for advanced study and research.

D. Provide a mission statement for the program. Include educational and learning objectives

The Bachelor of Technology in Materials Science and Engineering program's mission is to prepare graduates with a solid foundation in materials science and engineering to fulfill the demands of business and government as well as to pursue further academic study in fields connected to materials. This will be done by giving students access to up-to-date curricula, state-of-the-art labs, chances to collaborate on cutting-

edge research with eminent faculty mentors, and opportunities to get involved in leadership and service projects.

The educational and learning objectives of the B.Tech.in Materials Science and Engineering program are:

- Our graduates will quickly advance to leadership positions in organizations that deal with materials in the industry, academia, government, and other fields of endeavor.
- With the help of the process-structure-properties-performance paradigm, our graduates will be entrepreneurs who continuously research, develop, and produce novel materials of all kinds, having a beneficial economic and social influence on their industry and society as a whole.
- Our graduates will be trained to become world leaders who integrate cutting-edge engineering and material breakthroughs that are improving society and the state of the human condition while working with diverse, multidisciplinary teams.

E. Credit Structure of the programme.

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

Division	Sub division	Credits
Institute Core	IC Compulsory	39
	IC Baskets	06
	Humanities and Social Sciences (HSS)	12
	Indian Knowledge System (IKS)	03
Discipline	Discipline Core (DC)+ Reverse Engg.	44+1
	Discipline Electives (DE)	21
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, 42 credits will be dedicated to discipline courses in which 12 credits will be reserved for six engineering labs and taught together with theory. Total of 21 credits will be assigned for discipline electives wherein few optional baskets will be introduced for promoting B.Tech. Specialization for 15 credits. Total of 63 credits will be maintained for DC (42 credits) and DE (21 credits) courses while the rest of the credits will be kept for IC and other institute level courses (97 credits). Additional 12 credits will be introduced for UG research program to attract motivated research students towards research career at early stage by offering B.Tech. Honors.

F. List of courses proposed

Core Courses	Discipline Electives	IC Courses/Other
1. Physics of Solids 2. Materials Synthesis and Characterization (2 + 2 credits of Lab) 3. Phase Transformations 4. Thermodynamics and Kinetics of Materials 5. Durability Behavior of Materials (2 + 1 credits of Lab) 6. Quantum Mechanics and Applications 7. Functional Properties of Materials (2 + 2 credits of Lab) 8. Extraction and Materials Processing (2 + 2 credits of Lab) 9. Mechanics of Solids 10. Transport Phenomena 11. Computational Materials Science (2 + 2 credits of Lab) 12. Product Realization Technology (2 + 2 credits of Lab) 13. Materials Science for Engineers (IC 241) (3 credits) 14. Reverse Engineering (1 credit)	1. Smart Materials and Actuators 2. Biomaterials 3. Thin Film Technology 4. Carbon Materials 5. Materials Modelling 6. Ancient Materials 7. Structural Materials ***(See the other discipline elective courses under the specialization baskets below)***	1. Calculus 2. Complex variables and Vector Calculus 3. Linear Algebra 4.ODE 5. Engineering Graphics and Design 6. Introduction to Python and Data Science 7. Applied Chemistry 8. Applied Electronics 9. Applied Electronics Lab 10. Probability and Statistics 11. Materials Science for Engineers 12. Foundations of Design and Practicum 13. Physics Practicum 14. Design Practicum 15. Machine Learning 16. Reverse Engineering 17. MTP-1 and MTP-2 18. HSS courses 19. IKSHMA Course 20. Mechanics of Rigid Bodies

The elective courses are organized under 4 optional specialization baskets as shown below.

B.Tech. in Materials Science and Engineering with Specialization in "X"

ELECTIVE BASKETS

X: Product Design and Manufacturing

1. Fundamentals of Product Design
2. Prototyping methods
3. 3D Printing of Diverse Materials
4. Advanced Manufacturing Processes
5. Nanomanufacturing

X: Quantum Materials and Semiconductor Devices

1. Materials for Quantum Technologies
2. Sensor Materials and Technologies
3. Semiconductor Materials and Devices
4. Quantum Optics and Devices
5. Mesoscopic Physics and Quantum Transport

X: Clean Energy and Sustainable Materials

1. Urban Mining and Sustainability
2. Energy Conversion and Storage Technologies
3. Recycling and Circular Economy
4. Environmental Implication of Materials
5. Green Processes and Decarbonization

X: ICME - Integrated Computational Materials Engineering

1. Artificial Intelligence for Materials Science
2. Modelling and Simulations
3. Finite Element Method in Engineering
4. Density Functional Theory
5. Computational Materials Laboratory

- 5 courses from the proposed four elective baskets will enable specialization in B.Tech.
- It is optional and number of specialization baskets will be operated based on the available resources
- No additional credits are needed for B.Tech. with specialization in "X"

G. Provide a list of any current courses that would be cross-listed with the program:

1. Structure Property Correlations
2. Durability Behavior of Materials
3. Product Realization Technology
4. Functional Materials
5. Quantum Mechanics and Applications
6. Mechanics of Solids

Some of these courses are offered for M.Tech. wherein energy is added and may need to be edited suitably to make it common for both B.Tech. and M.Tech. programs.

H. What, if any, new courses will be required for the program? A separate course proposal is required for each new required course.

Being a new B.Tech. program, around 20 new courses will be proposed with required details. At the same time, some of the existing courses in the subject of Mechanical, Manufacturing, Energy Engineering and Physics will be adopted as per the requirement. Separate course proposals are being prepared and will be submitted in the due course.

I. Provide a sample academic plan for students completing the academic program being proposed.

The overall academic structure of B.Tech. Materials Science and Engineering is being worked out in cognizance with other B. Tech programs such as Mechanical Engineering and Engineering Physics. The semester wise detailed academic structure is shown in the table below for 8 semesters.

B.Tech. (Materials Science and Engineering)–1st Semester

S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	ICXXX	Calculus	2	0	0	2
2	ICXXX	Complex variables and Vector Calculus	2	0	0	2
3	IC140	Engineering Graphics	2	0	3	4
4	IC152	Introduction to Python and Data Science	3	0	2	4
5	IC131	Applied Chemistry for Engineers (basket – 1)	2.5/3	0.5/0	0	3
6	IC241	Materials Science for Engineers (basket-2) (DC)	3	0	0	3
7	YYXXX	Ikshma Course	3	0	0	3

Total Credits: 21

B.Tech. (Materials Science and Engineering)–2nd Semester

S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	ICXXX	Linear Algebra	2	0	0	2
2	ICXXX	ODE & Integral Transforms	2	0	0	2
2	IC161	Applied Electronics	3	0	0	3
3	IC 161P	Applied Electronics Lab	0	0	3	2
4	IC252	Probability and Statistics	3	0	2	4
5	ICXXX	Foundations of Design Practicum	1	0	6	4
6	IC221P	Physics Practicum	0	0	3	2
7	HSXXX	HSS Course	3	0	0	3

Total Credits: 22

B.Tech. (Materials Science and Engineering) –3rd Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	IC201P	Design Practicum	0	0	6	3
2	IC272	Machine Learning	2	0	2	3
3	ICXXX	Mechanics of Rigid Bodies (basket-2)	3	0	0	3
4	DC-1	Physics of Solids	3	0	0	3
5	DC-2	Quantum Mechanics and Applications	3	0	0	3
6	DC-3	Materials Synthesis and Characterization	3	0	2	4
7	HSXXX	HSS Course				3

Total Credits: 22

B.Tech. (Materials Science and Engineering) – 4th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DC-4	Mechanics of Solids	3	0	0	3
2	DC-5	Thermodynamics and Kinetics of Materials	3	0	0	3
3	DC-6	Functional Properties of Materials	3	0	2	4
4	DC-7	Extraction and Materials Processing	3	0	2	4
5	HSXXX	HSS Course				3
6	DE-1	Discipline Elective				3
7	FE-1	Free Elective				2

Total Credits: 22

B.Tech. (Materials Science and Engineering)– 5th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DC-8	Phase Transformations	3	0	0	3
2	DCX-9	Transport Phenomena	3	0	0	3
3	DC-10	Computational Materials Science	3	0	2	4
4	DC-11	Durability Behavior of Materials	3	0	2	4
5	DE-2	Discipline Elective				3
6	DE-3	Discipline Elective				3
7	FE-2	Free Elective				2

Total Credits: 22

B.Tech. (Materials Science and Engineering) – 6th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DC-12	Product Realization Technology	3	0	2	4
2	DE-4	Discipline Elective	0	0	3	3
3	DE-5	Discipline Elective	3	0	0	3
5	FE-3	Free Elective	3	0	0	3
6	HSXXX	HSS Course				3
7	ISTP					4

Total Credits: 20

B.Tech. (Materials Science and Engineering)– 7th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DE-6	Discipline Elective				3
2	FE-4	Free Elective				3
3	FE-5	Free Elective				3
4	MTP-1	MTP-1				4
5	IC010	Internship				2

Total Credits: **15**

B.Tech. (Materials Science and Engineering)–8th Semester						
S.No	Code	Course Name	Lecture	Tutorial	Practical	Credit
1	DE-7	Discipline Elective				3
2	FE-6	Free Elective				3
3	FE-7	Free Elective				3
4	FE-8	Free Elective				3
5		MTP-2				4

Total Credits: **16**

Grand Total: **160 credits for B.Tech. Materials Science and Engineering**

J. If established at other institutions, please submit sample programs from those institutions.

1. In what ways is this proposal consistent with those programs?

UG program in Materials Science and Engineering is a common program in both national and international institutes. At present, 16 out of 23 IITs offer B.Tech. in Materials/Metallurgy branch. Similarly, 15 out of 31 NITs have B.Tech. in Materials/Metallurgy. In addition, many leading private institutes such as VIT, Amirta Vishwa Vidyapeetham, SRM, Amity University, Thapar Institute of Engineering and Technology, BITS Pilani and Sastra University, also have B.Tech. in Materials subject. There is a general trend, moving from metallurgy to materials science and engineering in UG program both nationally and globally as advanced materials are gaining more attention in industry. On this context, the proposed B.Tech. in Materials Science and Engineering consistent with the existing program in other places in terms of core courses and laboratory courses.

2. In what ways is this proposal different from those programs? Please explain those differences.

B.Tech. programs established in some of the older institutes are more oriented towards metallurgy and newly launched programs (for example, B.Tech. in Materials Science and Engineering at IIT Delhi in 2020) are focusing of advanced materials, functional materials, semiconductor devices, polymers, composites and energy etc with core courses in structure, processing and properties of matter etc. Many of the older IITs also revised their curriculum to make it suitable for the present scenario.

In 2020, a national level workshop was organized to develop a model curriculum for Materials Science and Engineering by Indian Academy of Sciences at Coorg (Annexure – I). The report reviewed the existing curriculum and come up with several important aspects to be implemented to make the B.Tech. in Materials Science and Engineering more attractive for students with features of fundamentals, mathematical and computational tools, laboratory sessions, projects to cover broad

spectrum of knowledge. The following guidelines are suggested to improve the B.Tech. Materials Science and Engineering curriculum.

(i) The compulsory department curriculum should adopt a unified approach towards materials education. Fundamental concepts related to structure, properties and processing for different types of materials should be consolidated and taught together, and not as separate courses. For example, 'structure of materials' can be taught together for metals, ceramics, and semiconductors.

(ii) Courses should be quantitative, wherever possible. Emphasis on quantitative correlations between structure, property and process should be encouraged. Excessive memorizing should be discouraged. In fact, concepts should be inculcated through quantitative projects and assignments.

(iii) In manufacturing and extractive metallurgy courses, a unit operation based generalized approach is recommended. This may also minimize the number of courses without sacrificing the content.

(iv) Balancing of lectures, tutorials, and experiments is critical.

(v) Computational and mathematical skills acquired during the core courses should be utilized in making the departmental courses more analytical. Mathematical concepts to be applied in each course should be clearly identified and reinforced during teaching of the course.

(vi) There should be an adequate emphasis on process design in all areas of materials and metallurgy. This implies that students should also have a good understanding of transport phenomena and solid mechanics.

(vii) Teaching methodology should keep pace with changing times. Innovative ideas are necessary to sustain students' interest in courses, for example, by incorporating small projects in the courses wherever possible.

(viii) The concept of modular courses may be implemented. Here, courses can consist of topics around theme that may be taught by multiple instructors. Also, modular course avoids repetition of course contents between similar courses in one domain.

(ix) Laboratories could be conducted in such a way that teaching of key techniques of laboratories is followed by their execution and learning in the form of a capstone project.

The report also suggested a model template for B.Tech. Materials engineering curriculum consisting of 12 core courses, labs and elective courses that are presented in page number 20 of Annexure -I. The proposed B.Tech. in Materials Science and Engineering at IIT Mandi targets to go further in this direction focusing on advanced materials. Some of the uniqueness of the proposed programs are as follows.

- Good balance of core courses in the area of materials and allied engineering courses in mechanical, manufacturing, Physics etc.
- More credits for laborato ry courses in the discipline to provide practical knowledge and employable skills

- Elective courses are chosen in the form of 4 different baskets to cover wider areas of interest in emerging areas such as Manufacturing, Sustainability, Quantum Materials and Integrated Computational Materials.
- UG research program with additional 12 credits to provide early research exposure to the highly motivated students as B.Tech. honors in major research streams (B.Tech. in R&D).

III. Faculty and Governance:

Provide a list of the faculty available to teach courses for this program.

1. Dr. Jaspreet Randwal(SMME)
2. Prof. Rahul Vaish (SMME)
3. Dr. Ranbir Singh (SMME)
4. Dr. Rik Koner (SMME)
5. Dr. Sudhir Pandey (SMME)
6. Dr. Swati Sharma (SMME)
7. Dr. Viswanath Balakrishnan (SMME)
8. Dr. Ravindra (Newly Recruitment, SMME)
9. Dr. Dheeraj (New Recruitment, SMME)
10. Dr. Shivam (New Recruitment, SMME)
11. Dr. Vishal Chauhan (SMME)
12. Dr. Satvasheel Pawar (SMME)
13. Dr. Prateek Saxena (SMME)
14. Dr. Sarthak Nag (SMME)
15. Dr. Sunny Zafar (SMME)
16. Dr. C.S. Yadav (SPS)
17. Dr. Ajay Soni (SPS)
18. Dr. Venkata Krishnan (SCS)
19. Dr. Aditi Halder (SCS)
20. Dr. Bhaskar Mondal (SCS)
21. Prof. Satinder Sharma (SCEE)

In case of interdisciplinary program, mention governances and execution mechanism of the programme:

Materials Science and Engineering program is an interdisciplinary program and good number of the allied courses will be taught by faculty members from Mechanical Engineering, Electrical Engineering, Physics and Chemistry. While the core faculty in SMME will take a lead in governance and overall coordination, the associated faculty members from other streams will be contributing for teaching activities as per the need and their availability to bring out the best in this interdisciplinary program. Recruitment of around 5 more faculty members in the area of Materials Science and Engineering with expertise on computational materials science and other advanced areas are needed in the next few years.

IV. Student interest:

What measures of student interest in the program are there? How/why are the proposers convinced that students would want to take this program of study? (Attach Career and Placement Cell recommendation or any other)

While the conventional and major engineering streams such as Civil, Mechanical, Electrical and Computer would continue to lead the overall engineering education, allied branches such as chemical, materials, bio are gaining interest in the recent past. The proposed B.Tech. in Materials Science and Engineering would be attractive to the students those have inclination towards basic sciences as well as engineering. Being an interdisciplinary program, this also will cater to the students who would like to peruse different fields at the master level. However, the job market in industry for materials core area is relatively limited in India. To address this issue and provide broader expertise, 4 different specialization programs via elective baskets are added as part of the B.Tech. program. With such exposure, the employability of students is expected to be higher considering the developments in semiconductors and manufacturing sectors. Finally, our UG program at IIT Mandi is sufficiently broad covering key elements of general engineering, sciences, humanities and more importantly computer and data sciences that would enable students to get jobs in non-core areas/software sectors as it is a common trend over a decade.

Resources:

Additional requirements of laboratory space with justification (name of the labs)

1. Materials Processing (required space= 100 sqm)
2. Mechanical Testing Laboratory (required space= 100 sqm)
3. Functional Materials Laboratory (required space= 100 sqm)
4. Product Realization Technology (required space= NA)
5. Computational Materials Science (required space= NA)
6. Materials Synthesis and Characterization (required space= NA)

Additional requirements of laboratory fund (recurring and non-recurring) with justification (name of the labs)

1. Materials Processing Lab (Equipment: 1.05 crores)
2. Materials Testing Laboratory (Equipment:1.2 crores)
3. Functional Materials Laboratory (Equipment: 1 crore)
4. Product Realization Technology (Nil)
5. Computational Materials Science (Software packages: 40 lakhs)
6. Materials Synthesis and Characterizations (Nil)
7. Recurring budget (Consumables:20 lakhs)
8. Infrastructure budget for laboratory needs to be worked out by I & S section.

Additional requirements of faculty and non-teaching staff (Numbers and justification)

1. Around 5 more faculty members with engineering background are needed to cater to the broad curriculum with large number of elective courses.

2. For laboratory management, around 2 lab assistants are needed.
3. _____
4. _____
5. _____

V. **Origin and development of the proposal:**

- Please mention name for faculty involve in developing this proposal.
  1. Viswanath Balakrishnan
  2. Sudhir Pandey
  3. Rik Koner
  4. Jaspreet Kaur
  5. Swati Sharma
  6. Ranbir Singh
  7. Rahul Vaish
  8. Prateek Saxena
- Details of external industry experts and their recommendations (please include their evaluation)
  1. Dr. Hemant Kumar Iyer (Aditya Birla Science & Technology)
  2. Dr. Sandip Chatterjee (Meity)
  3. Dr. Chitra Selvaraj (Saint Gobain)
  4. Dr. Debashish Bhattacharjee (Tata Steel Limited)
- Details of external academia experts and their recommendations (please include their evaluation):
  1. Prof. Ashish Garg (IIT Kanpur)
  2. Prof. Prita Pant (IIT Bombay)
  3. Prof. Ranjith Ramadurai (IIT Hyderabad)
  4. Prof. Nityanand Gowsami (IIT Delhi)
  5. Prof. Krishanu Biswas (IIT Kanpur)

- Proposers' faculty name and their signatures:

Name of Faculty members	Signatures
1. Viswanath Balakrishnan	
2. Sudhir Pandey	
3. Rik Koner	
4. Jaspreet Kaur	
5. Swati Sharma	
6. Ranbir Singh	
7. Rahul Vaish	
8. Prateek Saxena	
9.	

Recommendations of Chairperson of School/ Centre Signature with Date:

Dean (Students) recommendations on availability of hostels and other requirements Signature with Date:

Associate Dean (Courses) recommendation on class rooms availability and other academic infrastructure requirements Signature with Date:

Dean Finance recommendation on financial aspects (if any) Signature with Date:

Dean Academics recommendations: Recommended/Not Recommended Signature with Date:

Please enclose additional information if any. ***Final Remarks on Elective Specialization and UG Research Programs***

The employment opportunities and placement aspects are critical for success of the B.Tech. program and the common wisdom is that the core job market in materials science and engineering is relatively less. The proposed broad curriculum addresses this issue by connecting the core materials science with emerging and applied areas that are attractive for industries such as manufacturing, semiconductors and energy etc. Further the computational based courses with blend of AI, machine learning etc would make the students competent in other non-core areas including software industry. As per recent placement records, the core engineering branches such Civil, Mechanical and Electrical also experiences less job offers (less than 40%) in core engineering industries. While the placement trend may be common among many of the B.Tech. programs due to the job market, it is important to educate students in core

branches and specialized areas ensuring the employable skills and knowledge. The proposed B.Tech. specialization with 4 different elective baskets (Product Design and Manufacturing, Clean Energy and Sustainable Materials, Quantum Materials and Devices, and Integrated Computational Materials Engineering is an attempt to train students in targeted areas of industry. Further the proposed B.Tech. Honors with full focus on research program for additional of 12 credits will provide early research exposure to students to increase their opportunities in R&D sector and academics to play a leadership role.

Brief details about the Elective Specializations are shown below.

1. B.Tech. Specialization in Product Design and Manufacturing

To establish a program bridging a gap between industrial product design and its manufacturing. The program minor will be oriented towards conceptualizing and nurturing a design idea by making it progress through various design stages. The outcome of such a practice will be a product prototype that can be upscaled to an industrial level. The students opting for this minor will aim at working in close collaboration with the incubation center (catalyst) to support the technology transfer and/or lead to the establishment of the start-ups. Such a program will be in line with the Make-in-India objective. The engineering students, irrespective of their branch can engage themselves right from the first semester into a design philosophy which they can slowly nurture over the years ending up with a ready to launch a product by the end of their undergraduate degree.

2. B.Tech. Specialization in Clean Energy and Sustainable Materials

Materials that can be produced at a large scale in an eco-friendly manner and a reduced dependence on non-renewable sources are designated as sustainable materials. The idea of sustainable materials and production is an emerging concept in the 21st century that is inspired by the rapid global growth in the production of commercial goods featuring advanced functionalities. Sustainable materials are expected to be compatible with low energy consuming manufacturing processes that generate minimal waste. At the same time, their recyclability is an essential aspect, in order to minimize waste generation. In this specialization, courses on a range of environment-friendly materials, non-hazardous materials, waste-derived materials, recyclable and biodegradable materials, and associated process optimization will be offered. The student will also receive training on designing and developing alternative materials for existing products. In addition, general waste management processes, introduction to energy

management and associated technologies will be covered. Essential energy and environment related policies, both Indian and international, will also be touched upon.

3. B.Tech. Specialization in Quantum Materials and Semiconductor Devices

The advancement of the human civilization has been immensely influenced by the discovery of new materials. Almost all the new technological developments rely on the exotic properties of materials. Materials such as Magnets, Multiferroics, Thermoelectrics, Optical, Piezoelectrics, superconductors, nanomaterial, low dimensional materials etc. whose properties cannot be explained within the pursuit of Newtonian physics, and the principles of quantum mechanics are invoked to understand their behavior, are termed as quantum materials. The technology using new quantum materials would lead to the next level of revolution in technologies for energy, electronic sensors, quantum computers, optical fiber, optical sensors, levitating trains, nano-electronics, information infrastructures etc. The new technology harnessing the quantum properties of materials is expected to be more powerful in comparison to its classical counterparts. In order to harness the quantum properties of materials for the future technology, there is need to understand, explore and tailor the new property of material as well as the fabrication of the suitable devices. The proposed minor in B.Tech. program will give an early exposure to the students to this developing field of advance technology.

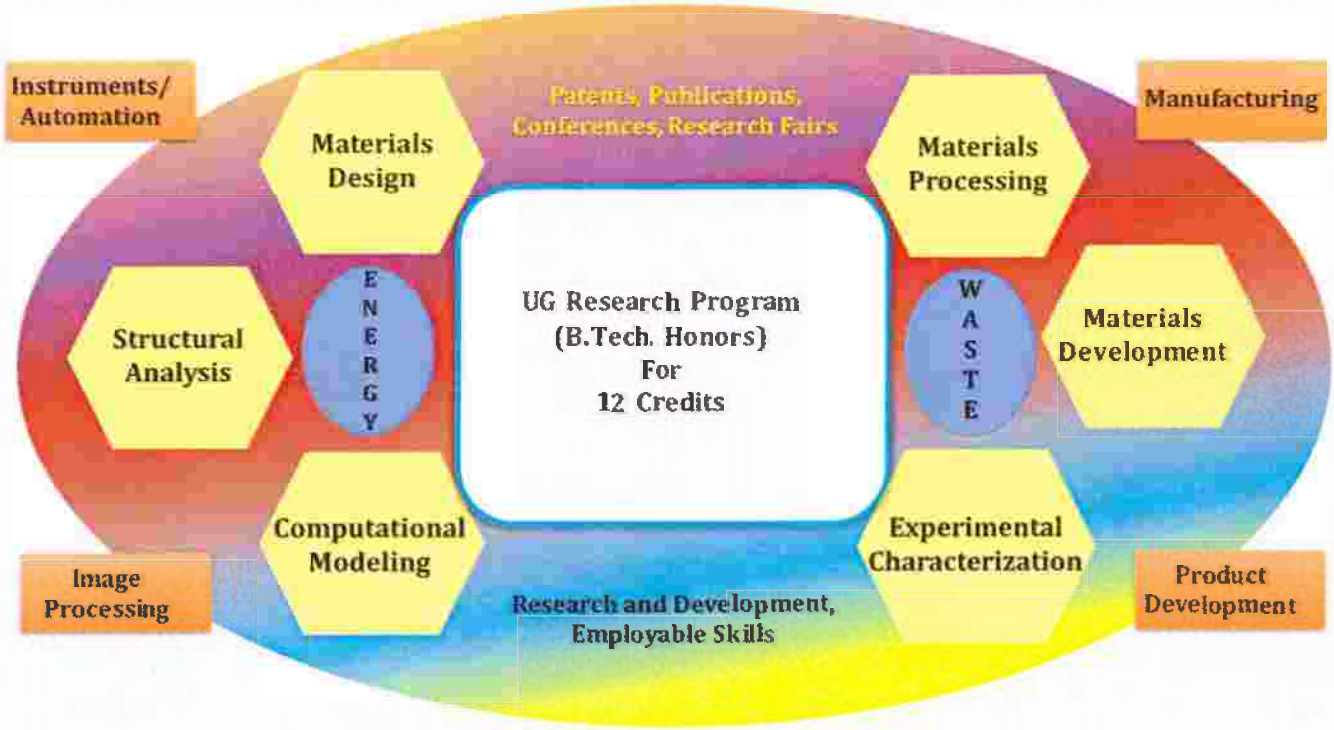
4. B.Tech. Specialization in Integrated Computational Materials Engineering

The integrated computational materials engineering covering variety of theoretical and simulation approaches at different length scales with the use of different computational tools would attract students who are interested to apply their computational skills to scientific problems in Materials Science. In addition to conventional methods such as density functional theory, molecular dynamics, modeling and simulations and finite element methods, emerging subjects like application of AI and machine learning in materials science would be introduced. Materials discovery has always been challenging problem based on its numerous real life target applications. Scientist are trying to accelerate the research with use of artificial intelligence (AI) and machine learning (ML) to adapt the materials fabrication which could meet the demand of current century. tudents will be trained in multiple computational packages to solve materials engineering problems from atomic, molecular scales to macroscopic length scales.

UG Research Program (B.Tech. Honors in Research and Development) (ON HOLO)

B.Tech. specialization can be decided by the school (within approved norms) based on infrastructure, facilities and job prospectus.

Attracting and training B.Tech. students in research are important and much-needed steps at institutes national eminence, considering the available research infrastructure and resources. At present, B.Tech. Honors at IiT Mandi is offered with an additional 12 credits of course work. instead, the prosed B.Tech. Honors in R&D will provide advanced training in the research labs where they can work with research scholars under the supervision of faculty member on cutting edge research areas for 4 semesters.



The student can be assigned a specific guide based on the mutual interest on particular research topic in the end of 3rd semester and carry out the research during 4th, 5th, 6th and 7th semester. The progress may be monitored by the panel chaired by faculty advisor on every semester with weightage of 3 credits per semester. The students are expected to carry out high quality research work on challenging research topics and publish at least one or two research papers or patents for the successful completion of their research project. Since the UG research program is completely optional and meant for engaging highly motivated UG students, suitable criteria, testing the student's interest could be defined based on the "quality of research statement plus presentation" other than CGPA could be defined. in addition to writing research

articles/patents on materials science topics, the students may also be encouraged to develop or use software, develop methodology to analyze data, build instruments, prototypes, enable the automation in existing instruments and demonstrate their applications. The students may also participate in R&D shows, technical completions and conferences.

ANNEXURE -B

क्रम संख्या/Serial No. MAXXXX

क्रमांक संख्या/Roll No. AXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

कला स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

मानविकी एवं सामाजिक विज्ञान अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

शोध प्रबन्धः

Indian Institute of Technology Mandi

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Arts (Research)

on

A B C

School of Humanities and Social Sciences

on

Fifth of December, Two Thousand Twenty Two

Thesis:

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairperson, Senate

कुलसचिव
Registrar

क्रम संख्या/Serial No. MAXXXX

क्रमांक संख्या/Roll No. AXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

व्यावसायिक अर्थशास्त्र/अर्थिक विकास में कला स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

मानविकी एवं सामाजिक विज्ञान अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Arts (Research)

In

Business Economics/Economic Development

on

A B C

School of Humanities and Social Sciences

on

Fifth of December, Two Thousand Twenty Two

अध्यक्ष, अभिशासक परिषद्	निदेशक एवं अध्यक्ष, अभिषद्	कुलसचिव
Chairperson, Board of Governors	Director & Chairperson, Senate	Registrar

क्रम संख्या/Serial No. MVXXXX

क्रमांक संख्या/Roll No. VXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

विज्ञान स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

सामान्य विज्ञान अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

शोध प्रबन्धः

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Science (Research)

on

A B C

School of Basic Sciences

on

Fifth of December, Two Thousand Twenty Two

Thesis:

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairperson, Senate

कुलसचिव
Registrar

28

क्रम संख्या/Serial No. MVXXXX

क्रमांक संख्या/Roll No. VXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

डाटा सांइस/सांख्यिकीय/संघनित पदार्थ भौतिकी में

विज्ञान स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

सामान्य विज्ञान अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

Indian Institute of Technology Mandi

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Science (Research)

in

Data Science/Statistics/Condensed Matter Physics

on

A B C

School of Basic Sciences

on

Fifth of December, Two Thousand Twenty Two

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairperson, Senate

कुलसचिव
Registrar

क्रम संख्या/Serial No. MTXXXX

क्रमांकसंख्या/Roll No. TXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

प्रौद्योगिकी स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

संगणना एवं विद्युत अभियांत्रिकी अनुभाग/अभियांत्रिकी अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

शोध प्रबन्ध:

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Technology (Research)

on

A B C

School of Computing and Electrical Engineering/School of Engineering

on

Fifth of December, Two Thousand Twenty Two

Thesis:

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairperson, Senate

कुलसचिव
Registrar

30

क्रम संख्या/Serial No. MTXXXX

क्रमांक संख्या/Roll No. TXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

डाटा साइंस/थर्मल/पदार्थ/जैव अभियांत्रिकी में

प्रौद्योगिकी स्नातकोत्तर (अनुसंधान)

की उपाधि

अ ब स

संगणना एवं विद्युत अभियांत्रिकी अनुभाग/अभियांत्रिकी अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

Indian Institute of Technology Mandi

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Technology (Research)

in

Data Science/Thermal/Materials/Bio Engineering

on

A B C

School of Computing and Electrical Engineering/School of Engineering

on

Fifth of December, Two Thousand Twenty Two

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairperson, Senate

कुलसचिव
Registrar

क्रम संख्या/Serial No. MSXXXX

क्रमांक संख्या/Roll No. SXXXXX

भारतीय प्रौद्योगिकी संस्थान मण्डी

के अभिषद् द्वारा

विज्ञान अधिस्नातक (अनुसंधान द्वारा)

की उपाधि

अ ब स

संगणना एवं विद्युत अभियांत्रिकी अनुभाग

को

पाँच दिसम्बर दो हज़ार बाईस को प्रदान की गयी।

शोध प्रबन्धः मेडिकल इमेजिंग टेक्निक्स फॉर ट्रांसफॉर्मेशन एंड इनफेरेन्स यूज़िंग डीप लर्निंग

Indian Institute of Technology Mandi

The Senate of the

Indian Institute of Technology Mandi

hereby confers the degree of

Master of Science (by Research)

on

A B C

School of Computing and Electrical Engineering

on

Fifth of December, Two Thousand Twenty Two

Thesis: Medical Imaging Techniques for Transformation and Inference Using Deep Learning

अध्यक्ष, अभिशासक परिषद्
Chairperson, Board of Governors

निदेशक एवं अध्यक्ष, अभिषद्
Director & Chairman, Senate

कुलसचिव
Registrar

32

Master of Science in Applied Mathematics

Programme Level	Post Graduate
Year of Commencement	2016
Minimum Duration	2 Years (4 Semesters)
Maximum Duration	3 Years (6 Semesters)
Senate Meeting Reference	9.3/18.5/20.4

Preamble : M.Sc. in Applied Mathematics programme at IIT Mandi is intended to give the students deep understanding of the principles of Mathematical sciences while expanding their knowledge in the allied areas through elective courses. The curriculum has been designed so as to prepare the students to take up a research career either in academia or in industries on completion of the program. The students will be equally equipped to take up professional career in Industries. The structure of the proposed programme has been designed drastically amended from the conventional M.Sc. (Mathematics) programs across the country by providing a balance among theory, application, and research components. The program is designed in such a way that students will have enough choices to learn their desired subjects by taking number of elective courses from and outside of the discipline. The curriculum focuses on an interdisciplinary approach wherein students learn theory and its applications (through fundamental core courses and engineering open elective courses) those are required for research in applied Mathematics and industry jobs:

- Broad based curriculum by the inclusion of a number of free and discipline electives, without compromising the core subjects.
- Theory and application oriented courses.
- Research oriented curriculum to increase 'thinking power' and 'Problem solving ability'.
- Adequate blend of theory and research.
- Learning of advanced Mathematical tools to solve engineering and real-life problems.
- Generates enough opportunities for industry jobs.

Semester-wise credit distribution :

Semester-I		Semester-II	
Real Analysis(MA-511)	4 Credit	Functional Analysis(MA-521)	4 Credit
Linear Algebra(MA-512)	4 Credit	Partial Differential Equation(MA-522)	4 Credit
Ordinary Differential Equation(MA-513)	4 Credit	Numerical Analysis(MA-523)	4 Credit
Computer Programming(MA-514)	3 Credit	Probability and Statistics(MA-52x)	4 Credit
Computer Programming Lab(MA-514P)	2 Credit	Discipline Elective- I	4 Credit
Applied Mathematical Programming(MA-515)	4 Credit	Technical Communication(HS-541)	1 Credit
Total	21 Credit	Total	21 Credit

Semester-III		Semester-IV	
Discipline Elective - II	3 Credit	Discipline Elective - VII	3 Credit
Discipline Elective - III	3 Credit	Elective - VIII	3 Credit
Elective - IV	3 Credit	Elective - IX	3 Credit
Elective - V	3 Credit	Project (Part-2)	8 Credit
Elective - VI	3 Credit		
Project (Part-I)	6 Credit		
Total	21 Credit	Total	17 Credit

- **Credit Structure:** A student, to be awarded M.Sc. degree, must need to earn 80 credits.
- **Open Electives:** Open electives from outside the discipline of program should be at least of 6 credits.
- **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 are attached herewith.
- **Discipline Elective Courses:** The following existing senate approved courses can be offered as discipline electives. More elective courses will be added time to time as required.

List of Discipline Elective Courses

Course Numbers	Course Titles	Credits
MA-549(3)	Abstract Algebra	3
MA-552(3)	Number Theory	3
MA-780 (3)	Topics in Semigroup Theory	3
MA-550(3)	Statistical Data Analysis	3
MA-553(3)	Mathematical Foundations of Financial Engineering	3
MA-565(3)	Numerical Methods in Quantitative Finance	3
MA-608(3)	Computational Fluid Dynamics	3
MA-609(3)	Numerics of Partial Differential Equation	3
MA-651(3)	Optimization Techniques	3
MA-652(3)	Stability Theory of Differential Equations	3
MA-653(3)	Computational Financial Modelling	3
MA-654(3)	Financial Engineering	3
MA-656(3)	Stochastic Calculus for Financial Engineering	3
MA-704(3)	Dynamical System	3
MA-705(3)	Modeling Population Dynamics	3
MA-709(3)	Numerical Linear Algebra	3
MA-765(4)	Fractional Differential Equations	4
MA-516(4)	Topology	4
MA-611(4)	Statistical tools and Computing	4
MA-5XX(4)	Field Theory	4
MA-5XX(4)	Graph Theory	4
MA-528(4)	Measure Theory and Integration	4

Project: The project focuses on an interdisciplinary approach wherein students learn theory and its applications, those are required for research in Mathematics and industry jobs. Students need to complete 14 credit project in the third and fourth semester. We offer the research projects on the following topics:

1. Differential Equations
2. Mathematical Control Problems
3. Optimization,
4. Soft Computing
5. Machine Learning
6. Financial Mathematics
7. Dynamical Systems
8. Nonlinear Dynamics
9. Harmonic Analysis

10. Wavelet Analysis
11. Computational Fluid Dynamics
12. Numerical Methods for PDEs
13. Topology and Combinatorics
14. Algebraic Topology
15. Classical K-theory, Commutative Algebra
16. Statistical Time Series Analysis
17. Climate Modelling
18. Ecological Modelling
19. Deep Learning
20. Any Interdisciplinary Topics with applications in Mathematics

In project, students are expected to read research papers, advance mathematical courses and to do literary survey about research problems and their application to the real life problems. Also, some motivated students works on new research topic suggested by their project mentor.

Project Evaluation: A continuous evaluation process will be followed to evaluate the project/thesis work progress to award letter grades for the credits assigned to project/thesis component, as mentioned in the institute's Ordinance for M.Sc. programme.

Changes: We have reduced the credits of the final year project from 21 credits to 14 credits and have added two more courses as discipline electives. Adding two more courses as discipline elective will give an exposure to students about different areas of applied mathematics as per their interest. These changes will help the students to qualify the national level exams and get the extra knowledge in courses related to applied mathematics. Changes are highlighted in Blue.