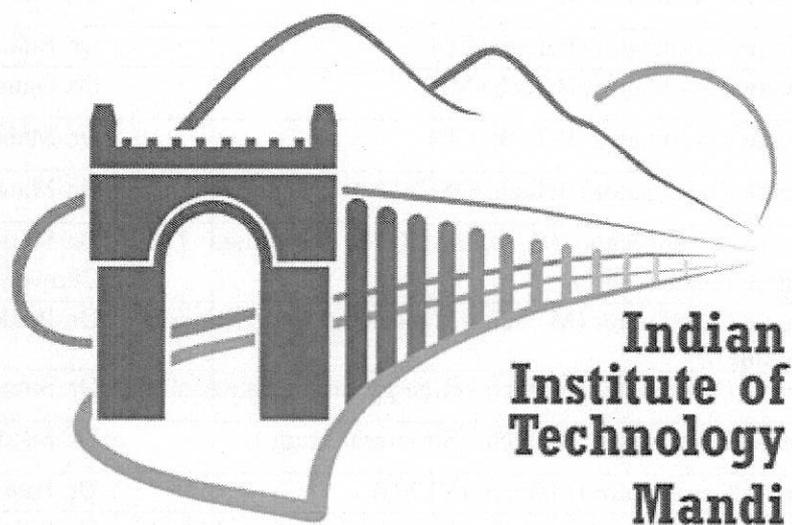


INDIAN INSTITUTE OF TECHNOLOGY MANDI
KAMAND, DISTT. MANDI – 175075 (HIMACHAL PRADESH)



MINUTES OF 39TH BOARD OF ACADEMICS MEETING

VENUE : A-4(SC) and A-10 (NC) CONFERENCE ROOM

DATE : 25TH MARCH, 2021 (THURSDAY)

TIME : 04:00 P.M.

Following members attended the meeting

Sl. No	Responsibilities	Name
1	Dean Academics	Dr. Pradeep Parameswaran
2	Associate Dean (Research)	Dr. Rahul Vaish
3	Associate Dean (Courses)	Dr. Anil K Sao
4	Chairman Library Advisory Committee	Dr. Astrid Kiehn
5	Chairman Course Proposal Committee	Dr. Kunal Ghosh
6	Course Coordinator (IC Courses)	Dr. Aniruddha Chakraborty
7	Course Coordinator (B.Tech.-EE)	Dr. Rahul Shrestha
8	Course Coordinator (B.Tech.-ME)	Dr. Gaurav Bhutani
9	Course Coordinator (B.Tech.-CE)	Dr. Maheshreddy Gade
10	Course Coordinator (B.Tech.-DSE)	Dr. Manoj Thakur
11	Course Coordinator (B.Tech.-M.Tech. Integrated Dual Degree in Bio-Engg.)	Dr. Shubhajit Roy Chowdhury
12	Course Coordinator (M.Tech.-(Mechanical Engg. (Energy Systems))	Dr. Pradeep Kumar
13	Course Coordinator (M.Tech.- (Energy Engg. (Materials))	Dr. Sumit Sinha Ray
14	Course Coordinator (M.Tech.-(Structural Engg.))	Dr. Sandip Kumar Saha
15	Course Coordinator (M.Tech.-(VLSI))	Dr. Hitesh Shrimali
16	Course Coordinator (M.Tech.-(Communication and Signal Processing))	Dr. Siddhartha Sarma
17	Course Coordinator (M.Tech.-(Power Electronics and Drives))	Dr. Narsa Reddy Tummuru
18	Course Coordinator M.Sc. (Chemistry)	Dr. Chayan K Nandi
19	Course Coordinator (M.Sc.-Applied Maths)	Dr. Rajendra K Ray
20	Course Coordinator (MA Dev.Studies)	Dr. Shyamasree Dasgupta
21	Nominee-1: School of Engineering	Dr. Gaurav Bhutani
22	Nominee-1: School of Computing & Electrical Engineering	Dr. Srikant Srinivasan
23	Nominee-2: School of Computing & Electrical Engineering	Dr. Manas Thakur
24	Nominee-2: School of Basic Sciences	Dr. C.S.Yadav
25	Industry Member – 1	Dr. Nadeem Akhtar
26	Research Affairs Secretary	Mr. Pawan Kumar Mandal
27	Academic Affairs Secretary	Mr. Arnav Prasad
28	Assistant Registrar (Academics): Secretary	Mr. Vivek Tiwari

Following members could not attend the meeting

Sl. No.		Name	
1	Course Coordinator (HSS Courses)	Dr. Suman Sigroha	Member
2	Course Coordinator (B.Tech.-CSE)	Dr. Dileep A D	Member
3	Course Coordinator (B.Tech.-EP)	Dr. Pradeep Kumar (SBS)	Member
4	Course Coordinator (M.Tech.-Biotechnology)	Dr. Shyam K Masakapalli	Member
5	Course Coordinator (M.Sc.-Physics) + (I-Ph.D. (Physics))	Dr. Ajay Soni	Member
6	Nominee-2: School of Engineering	Dr. Subhamoy Sen	Member
7	Nominee-1: School of Basic Sciences	Dr. Nitu Kumari	Member
8	Nominee-1: School of Humanities & Social Sciences	Dr. Devika Sethi	Member
9	Nominee-2: School of Humanities & Social Sciences	Dr. Puran Singh	Member

Special Invitee

Sl. No.	Name	
1.	Dr. Parmod Kumar	Asst. Prof., SE
2.	Dr. Srinivasu Bodapati	Asst. Prof., SCEE
3.	Dr. Kaustav Mukherjee	Assoc. Prof., SBS
4.	Dr. Himanshu Pathak	Asst. Prof., SE

PART-A

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

39.1 Confirmation of the minutes of 38th meeting of Board of Academics:

The minutes of the 38th Board of Academics meeting held on 22nd January, 2021 were confirmed.

39.2 To consider the modification in Core Course list for B.Tech. Data Science and Engineering:

Dr. Manoj Thakur, Course Coordinator for B.Tech. Data Science and Engineering presented a proposal to the Board of Academics regarding modification in core course list for B.Tech. Data Science and Engineering branch. After due deliberations, the BoA recommended the proposal with minor changes for consideration of the Senate and its approval. The final modified proposal is placed as **Annexure – A**.

39.3 To consider approval of courses presented by the Course Proposal Committee (CPC):

The Chairperson, Course Proposal Committee (CPC) presented sixteen courses for consideration and approval of the BoA. After due deliberations, the BoA recommended seven courses with minor modifications for consideration of the Senate and its approval, which are placed as **Annexure - B**:

Sl.No.	Course No.	Course Title	Credits (L-T-P-C)
1	ME 310*	System Dynamics and Controls	3-0-0-3
2	ME 514	Fundamentals of Multiphase Flow	3-0-0-3
3	ME 516	Polymer Technology for Engineers	3-0-0-3
4	ME 627	Mesh Independent Computational Techniques	3-0-0-3
5	ME 628	Impact Mechanics	3-0-0-3
6	EE 560	Reconfigurable Computing	3-0-2-4
7	ME 501P	Practicum-I	0-0-6-3

*ME 310 will count towards the additional 3 Discipline Core credits for B.Tech. (Mechanical Engineering) that were created due to IC basket restructuring.

Due to time constraint, the following courses were deferred for consideration in subsequent BoA meeting:

Sl.No.	Course No.	Course Title	Credits (L-T-P-C)
1	ME 502P	Practicum-II	0-0-6-3
2	ME 517	Advanced Analytical Techniques for Engineers	3-1-0-4
3	ME518	Conduction and Radiation	3-0-0-3
4	EP 302	Computational Methods for Engineering	2-0-2-3
5	EP 403	Physics of atoms and molecules	3-0-0-3
6	EE 528	Modelling and Analysis of Electrical Machines	2-0-2-3
7	EN 503	Energy Storage Technologies	3-0-0-3
8	EN 611	Durability Behavior of Energy Materials	3-0-0-3
9	EN 612	Structure-Property Correlations for Energy Applications	1-0-4-3

39.4 Any other item with the permission of the Chair.

-NIL-

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


15/4/2021
Chairman, Board of Academics


15/04/2021
Secretary, Board of Academics

PART-B

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

-NIL-

ANNEXURE A

Revised List of Core Courses in B. Tech. Data Science and Engineering Program at IIT Mandi.

The following changes are proposed in the Core Courses in B. Tech. Data Science and Engineering Program.

1. Mathematical foundations of Data Science I (3-0-0-3) is replaced with CS208 Mathematical Foundations of Computer Science (3-1-0-4).
2. Introduction to Data Structure and Algorithms (2-0-2-3) is replaced with CS202 Data Structures and Algorithms (3-1-0-4).
3. One credit tutorial is added in Mathematical Foundations of Data Science II (3-0-0-3) and the course is renamed as Mathematical Foundations of Data Science (3-0-1-4).

List of Core courses for Data Science and Engineering Program

(Total Credits for discipline core = 33)

S. No.	Course Title	Lecture	Tutorial	Practical	Total Credit	Semester
1	Mathematical Foundations of Computer Science (CS208)	3	1	0	4	III
2	Data Structures and Algorithms (CS202)	3	1	0	4	III
3	Data handling and visualization	2	0	2	3	IV
4	Statistical Foundations of Data Science	3	0	0	3	IV
5	Mathematical Foundations of Data Science	3	1	0	4	V
6	Matrix Computations for Data Science	2	0	2	3	V
7	Information Security and Privacy	3	0	0	3	V
8	Computing Systems for Data Processing	2	0	2	3	VI
9	Introduction to Statistical Learning	2	0	2	3	VI
10	Optimization for Data Science	3	0	0	3	VI



IIT Mandi

Proposal for a New Course

Course Number	: ME 310
Course Name	: System Dynamics and Controls
Credits	: 3-0-0-3
Prerequisites	: Engineering Mathematics (IC110) and Linear Algebra (IC111)
Intended for	: UG
Distribution	: Discipline Core for ME
Elective or Core	: Core

Preamble: The objective of this course is to introduce students with fundamental concepts of modeling, analysis, and design of linear control systems for physical systems. Students will be taught applying modelling techniques to real physical systems and analyzing its performance and stability before building real systems. Performance and stability analysis will be done in time and frequency domain which will allow student to build linear controllers by applying classical and modern control techniques. Matlab/Simulink will be used to create models and design of controllers.

Course Outline: Modeling of mechanical, electrical, and electromechanical systems. Laplace Transform techniques. Time response analysis. Block diagram representation. Feedback systems. Root locus method. Frequency response techniques. State-space representation. Controller design.

Course Modules: In this course the student will develop and/or refine the following areas of knowledge:

- **Introduction [2 hrs]:** Control system examples, historical developments leading to modern day control theory, the basic features and configurations of control systems, control systems analysis and design objectives, control system's design process
- **Modeling in Frequency Domain [3 hrs]:** Mathematical descriptions of systems by differential equations, Laplace transform linear, time-invariant systems (mechanical, electrical, and electromechanical), linearization of a nonlinear system to find the transfer function.
- **Modeling in Time Domain [3 hrs]:** State-space representation a LTI system, conversion of a transfer function to state space and vice-versa, linearization a state-space representation.
- **Time Response [3 hrs]:** Effect of poles and zeros on the time response of a control system, quantitative description of the transient response of first-order systems, general response, damping ratio, settling time, peak time, percent overshoot, and rise time and natural frequency of second-order systems, time response from the state-space representation.
- **Reduction of Multiple Subsystems [2 hrs]:** Reduction of a block diagram of multiple subsystems to a single block, analysis and design of transient response for a system consisting of multiple subsystems, conversion of block diagrams to signal-flow diagrams, Mason's rule.
- **Stability [3 hrs]:** Making and interpreting Routh table to determine the stability of a system, Application of Routh table to determine the stability of a system represented in state space.
- **Steady-State Errors [2 hrs]:** Steady-state error for a unity feedback system, steady-state error performance, design the gain of a closed-loop system to meet a steady-state error



specification, finding the steady-state error for disturbance inputs, steady-state error for systems represented in state space.

- **Root Locus Techniques [4 hrs]:** Properties of a root locus, sketching techniques of a root locus, root locus for systems of order 2 and higher, root locus for positive-feedback systems.
- **Design via Root Locus [4 hrs]:** Use the root locus to design cascade compensators to improve the steady-state error and the transient response, feedback compensators to improve the transient response, realize the designed compensators physically.
- **Frequency Response Techniques [4 hrs]:** Plot of frequency response of a system, Nyquist stability criteria, gain and phase margins, closed-loop frequency response.
- **Design via Frequency Response [5 hrs]:** Use frequency response techniques to adjust the gain to meet a transient response specification, frequency response techniques to design cascade compensators to improve both the steady-state error and the transient response.
- **Design via State Space [5 hrs]:** State-feedback controller using pole placement, controllability, transient response specifications, observability.

Text Books:

- System Dynamics, 4th Edition by Katsuhiko Ogata, Pearson Education, 2013
- *Control Systems Engineering*, 7th Ed. by N. S. Nise, Wiley, 2015
- Control Systems: Principle & Design, 4th Ed. by M. Gopal, McGraw Hill, 2012

Suggested Books:

- Feedback Control Systems, Franklin, Powell
- The Mechatronics Handbook, Robert H. Bishop
- Modeling, Simulation, and Control of Mechatronic Systems, Dean C. Karnopp, Donald L. Margolis and Ronald C. Rosenberg, John Wiley & Sons, Inc.
- Control and Mechatronics, Bogdan M. Wilamowski and J. David Irwin, CRC Press
- Mechatronics Electronic control systems in mechanical and Electrical Engineering, William Bolton, sixth edition, Pearson
- Modern Control Systems, Richard C. Dorf and Robert H. Bishop, Pearson

Note: EE301 cannot be credited if ME310 has already been credited, due to the significant overlap.

Similarity content with existing courses:

S. No.	Course code	Similarity content	Approx. % of content
1	EE 301	Time-domain analysis, Frequency-domain analysis, Stability analysis, Root-locus technique, State-space Analysis	30%-40%

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

In most of the universities around the world including IITs “System Dynamics and Control”, with alternative names such as “Mechatronics and Control” or “Introduction to Control Systems”, is a core course for the students of mechanical engineering. Mechanical engineering students must be familiar with techniques of control systems especially applied in the control of mechanical systems, electromechanical systems, and basic electrical systems for acquiring real proficiency in managing these systems used in industries. Aerospace



engineering and chemical engineering also teach similar control courses specific to their field to their students. Therefore, my proposal is that students of mechanical engineering should also learn this important course oriented to their engineering stream. Many students from mechanical engineering stream, who have not taken any course in control systems hesitate to take-up interest in robotics and related fields. Therefore, this course will not only introduce mechanical engineering students with basic control engineering but also prepare them to take-up further interest and required skill development in automation, mechatronics, robotics, and intelligent systems. Skill of the student with professional outcomes because of this course are listed as follows:

Student Outcomes:

An ability to apply knowledge of mathematics, science, and engineering.

An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

An ability to identify, formulate, and solve engineering problems

An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Professional Outcomes: The most measurable long-term outcome from this course is the student's resulting ability to identify, formulate and organize engineering problems in a conceptual form as well as in terms of mathematical and physical models. Understanding control systems enables students from all branches of engineering to speak a common language and develop an appreciation and working knowledge of the other branches.

Approvals:

Other faculty interested in teaching this course: Dr. Rajeev Kumar, Dr. Gaurav Bhutani, Dr. Arpan Gupta

Proposed by: Dr. Amit Shukla

Signature: _____

Date: _____

Recommended/Not Recommended, with comments:

Date: _____

Chairman, CPC

Approved/Not Approved

Date: _____

Chairman, Senate



IIT Mandi

Proposal for a New Course

Course Number	:	ME514
Course Name	:	Fundamentals of Multiphase Flow
Credits	:	3-0-0-3
Prerequisites	:	ME 210 and ME 303 or equivalent courses
Intended for	:	M.Tech/MS/PhD/UG
Distribution	:	Elective course

1. Preamble:

Multiphase flow is often encountered in a variety of engineering applications such as power generation, nuclear reactor technology, food production, environmental flows, chemical process, aerospace and automotive industries. This course intends to extend the fundamental knowledge of multiphase flow which is a very vast area and has a wide scope in several fields of engineering. The course emphasizes the preliminary introduction and mathematical formulations of various multiphase flow problems. It also attempts to include the flow specific computational theories along with experimental measurement techniques so that students can be benefited to pursue the research in the relevant area. The last module of the course lists special topics in multiphase flow and the instructor is advised to select the topics and lecture distributions as per his/her interest.

2. Course modules with quantitative lecture hours:

- **Introduction and flow regimes [6hrs]**
Introduction to multiphase flows, equations of motion, flow regimes in horizontal and vertical pipes, flow regimes with phase change
- **Modelling techniques for multiphase flow [12hrs]**
Homogeneous flow models, drift flux models, separated flow models, dispersed phase modelling, modelling of annular and stratified flow
- **Computational techniques [10hrs]**
Introduction to computational modelling of multiphase flow, population balance modelling for dispersed phase, interface tracking methods for multiphase flow (Volume of Fluid and Level set), particle methods for multiphase flow (Lagrangian Point Particle and Smoothed Particle Hydrodynamics), molecular dynamics
- **Experimental techniques [7hrs]**
Introduction to experimental techniques, importance of measurement and experimentation, calibration, uncertainty analysis, error propagation, pressure, velocity and temperature measurements, measurement of size distribution for dispersed phase, measurement of void-fraction and interface reconstruction, data acquisition and analysis techniques
- **Special topics in multiphase flow [7hrs]**
Granular flows, slurry transport, lattice Boltzmann method, phase change heat transfer, micro-fluidics, multiphase flow in micro-channels

3. Text books:

- Christopher E. Brennen, Fundamentals of Multiphase Flow, Cambridge University Press; 2005.
- S. Mostafa Ghiaasiaan, Two-Phase Flow, Boiling, and Condensation, Cambridge University Press; 2nd Edition, 2007.

4. References:

- John G. Collier and John R. Thome, Convective Boiling and Condensation, Oxford University Press; 3rd Edition, 1994.
- L. S. Tong and Y. S. Tang. Boiling Heat Transfer and Two-Phase Flow, CRC Press; 2nd Edition, 2010.
- R. Clift, J. R. Grace and M. E. Weber, Bubbles, Drops, and Particles, Dover Publications, Inc.; 2005.
- Mamoru Ishii and Takashi Hibiki, Thermo-Fluid Dynamics of Two-Phase Flow, Springer; 2nd Edition, 2011.
- J. P. Holman, Experimental Methods for Engineers, Tata McGraw-Hill; 7th Edition, 2001.
- Andrea Prosperetti and Grétar Tryggvason, Computational Methods for Multiphase Flow, Cambridge University Press, 2007.
- Grétar Tryggvason, Ruben Scardovelli and Stephane Zaleski, Direct Numerical Simulations of Gas-Liquid Multiphase Flows, Cambridge University Press, 2011.

5. Similarity content declaration with existing courses:

S. No.	Course code	Similarity content	Approx. % of content
1.	ME604	Introduction to experimental techniques, importance of measurement and experimentation, uncertainty analysis	5

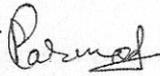
6. Justification for new course proposal if cumulative similarity content is > 30%: NA

Approvals:

Other faculty interested in teaching this course: Dr. Gaurav Bhutani

Proposed by: Dr. Parmod Kumar

School: SE

Signature: 

Date: 18/05/2019

Recommended/Not Recommended, with comments:

Date: _____

Chairman, CPC

Approved/Not Approved

Date: _____

Chairman, Senate



IIT Mandi

Proposal for a New Course

Course Number: ME 516

Course Name: Polymer Technology for Engineers

Credits: 3-0-0-3

Prerequisites: Materials Science for Engineers (IC241) or equivalent material science course

Intended for: UG/PG

Distribution: Elective for UG (ME), M Tech/MSc., MS, and PhD

1. **Preamble:** Polymers or commonly known as plastics as commodity materials have been around for more than 50 years. In the 1950s, plastics were considered to be specialist materials for niche applications or were used by artists. With the greater availability of polymers in the 1960s, a number of engineers started to explore their application in a variety of areas- automobiles to aeroplanes, day- to-day utensils to biomedical implants and many more. Now plastics have found ways to become the most common material in our lives. For engineers to be able to successfully use plastics they need to recognise that, unlike metals, alloys and ceramics, the physical properties of polymers can vary significantly with stresses and temperature. This course will help students to identify the properties of polymers, and thereby engineer them according to the demands following several manufacturing technique.

2. **Course Outline:** The course will highlight different aspects polymer chemistry, mechanical and physical properties of polymers, common and advanced manufacturing techniques followed by several case studies with applications.

3. **Course Modules:**

Module-1: Introduction to Polymer

(3 hrs)

Brief history of polymers; polymer classification; molar mass and molar mass distribution; polyethylene-polymerization process; chemical bonding- primary, secondary and tertiary structure; crystallinity

Module-2: Thermal Transitions in Polymers

(4 hrs)

Glass transition temperature; factor affecting glass transition temperature- molar mass dependence, plasticization, chain entanglement effect; crystalline melting point; differential scanning calorimetry

Module-3: Mechanical Properties of Polymers

(6 hrs)

Stress-strain measurements; dynamic modulus; methods of measurements of polymers- tensile testing, fracture, creep, relaxation time, compression; effect of structural and environmental factors on mechanical properties- molecular weight, cross-linking, crystallinity, strain rate, temperature.

Module-4: Viscoelastic Properties of Polymer

(6hrs)

Simple rheological responses- ideal elastic, pure viscous and rubberlike elastic; viscoelasticity; mechanical models for viscoelastic responses- Maxwell model, Kelvin-Voigt model, Four-parameter model; relaxation time; material response time-Deborah number;

Module-5: Polymer processing- Melt: Thermoplastics and Thermoset

(8 hrs)

Processing thermoplastics- rotational moulding, injection moulding, compression moulding; melt spinning; processing thermosets- hand lay-up process, spray lay-up method, vacuum bagging, resin transfer moulding, resin infusion process; dry spinning, Spun bonding

**Module-6: Polymer processing- Solution: Thermoplastics****(3 hrs)**

Electrospinning; centrifugal spinning; wet spinning

Module-7: Composites**(3 hrs)**

Importance of composites; classification- fiber and particle reinforced; factors affecting composite performance; failure

Module-8: Case Studies**(4 hrs)**

Application of polymers in special cases-vibration damping; energy; adhesives; bio-medical-drug delivery, tissue engineering; water and air purification; electronics

Module-9: Recycling of Plastics and Environmental Issues**(3 hrs)**

Need of recycling: degradation-thermal, chemical, hydrolysis, mechanical; incineration; bioplastics; issues with recycling

4. Text Books:

- Robert O. Ebewe, 2000, Polymer Science and Technology, CRC press.
- Richard A. Pethrick, 2010, Polymer Science and Technology for Scientists and Engineers, Whittles Publishing

5. Similarity Content Declaration with Existing Courses

S.No.	Course Code	Similarity Content	Approx. % of Content
1.	CY 641	Classification, polymerization process (Here limited to one model case – Polyethylene compared to vast polymerization chemistry emphasized in CY 641)	Less than 5%
2	CY 555	History of Polymers, Molecular weight, Glass transition temperature, Physical state of polymers, DSC, Polymer fibers	Less than 10%

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

Other Faculty interested in teaching this course: Dr. Sunny Zafar, Dr. Swati Sharma, Dr. Jaspreet Kaur Randhawa

Proposed by: Dr. Sumit Sinha Ray

School: SE

Signature _____

Date _____

Recommended/Not Recommended, with comments:

Chairman, CPC

Date: _____

*Approved/Not Approved*_____
Chairman, Senate

Date: _____



IIT Mandi

Proposal for a New Course

Course Number	:	ME627
Course Name	:	Mesh Independent Computational Techniques
Credits	:	3-0-0-3
Prerequisites	:	FEM in Engineering (ME 513)/Advanced FEM (ME 601)
Intended for	:	M.Tech/MS/PhD/UG
Distribution	:	Elective course

1. Preamble:

In recent years, many mesh independent numerical methods have been developed to simulate problems with geometrical discontinuities or moving boundaries and highly oscillatory systems. Many challenging engineering problems such as solidification, microstructure modelling, material interfaces, bio-mechanics, fracture and fatigue, and asymptotic field problems can be solved much more easily with improved accuracy using the mesh independent methodology. This course describes the need and scope of mesh independent methods like meshfree methods and eXtended finite element method. The course emphasizes the preliminary introduction and mathematical formulations of various mesh independent computational techniques. It also attempts to include the implementation to specific engineering problems so that students can be benefited to pursue the research in the relevant area. This course focuses on various aspects with particular reference to application and implementation of methodology by using computer programming.

2. Course modules with quantitative lecture hours:

- **Scope and Need of Mesh Independent Methods [9 hrs]**
Equations for two-dimensional and three-dimensional solids, Strong-forms and weak-forms, Weighted residual method, Need of Mesh free methods, Solution procedure of MeshFree methods, Classification according to the formulation procedures, Classification according to the function approximation schemes.
- **Shape function construction [6 hrs]**
Meshfree shape function construction, Point interpolation methods, Moving least squares shape functions, Interpolation error using Meshfree shape functions.
- **Methods based on global weak-forms [8 hrs]**
Meshfree radial point interpolation method and formulation, Integration issues in RPI method, Imposition of essential BC in RPI method, Element Free Galerkin method formulation and shape function, Implementation issues and application examples in EFGM, Integration techniques and enforcement of BC in EFGM.
- **Methods based on local weak-forms [4 hrs]**
Meshless Local Petrov-Galerkin method, Implementation issues and application examples.
- **eXtended Finite Element Method [6 hrs]**
Difference between FEM and XFEM, Partition of Unity and Level set function, Intrinsic enrichment and Extrinsic enrichment, Numerical integration, Implementation and case studies.
- **Computer Implementation and Case Studies [9 hrs]**



FEM implementation with computer programming platform.

Implementation of meshfree EFGM using computer programming for analysis of (i) solid mechanics problem (ii) heat transfer problem. Enforcement of essential boundary condition will be implemented using Lagrange multiplier method.

Implementation of XFEM with extrinsic enrichment techniques for material discontinuity and crack discontinuity.

3. Text books:

- An Introduction to Meshfree Methods and their Programming, *G.R. LIU and Y.T. GU*, ISBN-13 978-1-4020-3468-8 Springer Dordrecht, Berlin, Heidelberg, New York. 2005.
- Extended Finite Element and Meshfree Methods, Timon Rabczuk, Jeong-Hoon Song, Xiaoying Zhuang, Cosmin Anitescu, ISBN: 9780128141069, Academic Press Elsevier, USA. 2019.

4. References:

- Meshfree Methods: Moving Beyond the Finite Element Method, *G.R. LIU*, ISBN 9781420082098 CRC Press Taylor and Francis Group, USA. 2018.
- Meshfree Methods for Partial Differential Equations, Lecture Notes in Computational Science and Engineering book series, Springer, Berlin, Heidelberg. 2017.
- Meshless Methods in Solid Mechanics, Youping Chen, James Lee, Azim Eskandarian, ISBN 978-0-387-30736-7, Springer, New York, USA. 2006.
- Meshless Methods and Their Numerical Properties, Hua Li, Shantanu S. Mulay, ISBN 9781138072312, CRC Press, Boca Raton, Florida, USA. 2013.
- Extended finite element method for Fracture Analysis of Structures, Soheil Mohammadi, ISBN: 978-1-4051-7060-4 Blackwell Publishing Inc., USA. 2008.
- Extended Finite Element Method: Theory and Applications, Amir R. Khoei, ISBN: 9781118457689, John Wiley & Sons. 2014.

5. Similarity content declaration with existing courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	ME352	Strong-forms and weak-forms, Weighted residual methods	5 %

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

Approvals:

Other faculty interested in teaching this course: Dr. Rajeev Kumar, Dr. Rajesh Ghosh

Proposed by: Dr. Himanshu Pathak

School: School of Engineering (SE)

Signature:

Date:

Recommended/Not Recommended, with comments:

Date: _____

Chairman, CPC

Approved/Not Approved

Date: _____

Chairman, Senate



IIT Mandi

Proposal for a New Course

Course Number	:	ME628
Course Name	:	Impact Mechanics
Credits	:	3-0-0-3
Prerequisites	:	Mechanics of Solids (ME206) & FEM in Engineering (ME513) or Advanced FEM (ME601)
Intended for	:	M.Tech/MS/PhD/UG
Distribution	:	Elective course

1. Preamble:

Impact Mechanics is an advanced course under mechanical engineering for students with specialization in machine design. The course covers theories for materials and structures subjected to transient dynamic loads such as impact, penetration and explosion. A key part of the course will be devoted to applied use of analytical methods in combination with explicit non-linear finite element analysis for solving this kind of problems. The course introduces principles, theory and techniques for analysis of impacts of particles and rigid bodies. Applications will be taken from vehicular crash mechanics to ballistic impact.

2. Course modules with quantitative lecture hours:

- **Introduction [4 hrs]**
Impact Mechanics – Appreciating Impact Problems in Engineering, Historical Background, Low velocity impact, Principle of dynamics, Percussion, Concussion, Collision and Explosion.
- **Rigid Body Impact Mechanics [5 hrs]**
Impulse – Momentum Equations, Measurement of Coefficient of Restitution, Kinetic Coefficient of Restitution, Energy Coefficient of Restitution, Oblique Impact – Role of Friction.
- **Impact Mechanics of Deformable Bodies [8 hrs]**
One-Dimensional Impact Mechanics of Deformable Bodies: Single Degree of Freedom Idealization of Impact Process, 1-D Wave Propagation in Solids Induced by Impact, Governing Equation for Flexural Waves in Rods, D'Alembert's Solution for Wave Equation.
Multi-Dimensional Impact Mechanics of Deformable Bodies: Analysis of Stress and Strain, Linearised Stress-Strain Relations.
- **Experimental Impact Mechanics [10 hrs]**
Quasi-Static Material Tests, Pendulum Impact Tests, High Strain Rate Testing of elastoplastic and visco-elastic materials, Split Hopkinson's Pressure Bar Test, Taylor Cylinder Impact Test, Drop Impact Test.
- **Impact Modeling [6 hrs]**
Modeling Deformation and Failure Under Impact: Equation of State, Gruneisen Parameter and Murnaghan Equation of State, Constitutive Models for Material Deformation and Plasticity, Johnson-Cook Material Model, Determination of Parameters in Johnson-Cook Model, Implementation of Damage, Implementation of penetration and bulging.



- **Computational Impact Mechanics [3 hrs]**

Lagrangian Formulation, Eulerian Formulation, Computational Aspects in Numerical Simulation, Shockwaves.

- **Case Studies [7 hrs]**

low-velocity impact properties of composite materials, Simulation of Ballistic Impact of a Steel Bullet, Mechanics of Vehicle Collision, Case studies of vehicle crash impact test, Case studies of explosive impact test.

3. Text Books:

- Applied Impact Mechanics, C. Lakshmana Rao, V. Narayanamurthy, K. R. Y. Simha, ISBN: 978-1-119-24180-5, John Wiley & Sons Ltd United Kingdom. 2016.
- Impact Mechanics, W. J. Stronge, ISBN: 9780511626432, Cambridge University Press United Kingdom. 2018.

4. References:

- Computational Contact and Impact Mechanics, Laursen, Tod A, ISBN 978-3-662-04864-1 Springer. 2003.
- The Science of Armour Materials, Ian G. Crouch, ISBN: 978-0-08-100711-2 Elsevier. 2016.
- Wave Motion in Elastic Solids, Karl F. Graff, ISBN: 978-0486667454, Dover Publications. 2003.
- Terminal Ballistics, Zvi Rosenberg and Erez Dekel, ISBN: 978-981-10-0393-6, Spinger. 2012.
- High Velocity Impact Dynamics, Jonas A Zukas, ISBN: 978-0471514442, John Wiley & Sons. 1990.

5. Similarity content declaration with existing courses:

Sl. No.	Course Code	Similarity Content	Approximate % of Content
1	IC240	Impulse – Momentum Equations	2%
2	CE511	Dynamic equilibrium equations	1%
3	ME614	Shockwaves	1%

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

Approvals:

Other faculty interested in teaching this course: Dr. Rajesh Ghosh, Dr. Mohammad Talha

Proposed by: Dr. Himanshu Pathak
Signature:

School: School of Engineering (SE)
Date:

Recommended/Not Recommended, with comments:

Date: _____

Chairman, CPC

Approved/Not Approved

Date: _____

Chairman, Senate



IIT Mandi

Proposal for a New Course

Course Number: EE560

Course Name: Reconfigurable Computing

Credits: 3-0-2-4

Prerequisites: EE 210/201P- Digital System Design & Practicum, CS 201/201P- Computer Organization & Practicum.

Intended for: PG/UG

Distribution: Elective for M. Tech (VLSI), UG and other PG courses

1. Preamble: Application level parallelism in the new age computer architecture is gaining much attention with the recent achievements in the VLSI technology. Reconfigurable computers offer the advantage of configuring hardware and programming the interconnections as per the application in comparison to the fixed hardware elements (and interconnections) in a general purpose microprocessor. The aim of this course is to investigate the state-of-the-art in reconfigurable computing and motivating hardware-software co-design on FPGA. The concepts of reconfigurable computing will be validated with experiments on various numerical, signal processing and cryptographic algorithms.

2. Course Modules with Quantitative Lecture Hours: This course has three hour lecture session accompanied by two hours of laboratory session per week. List of course modules are provided below.

- 1. Introduction to reconfigurable computing :** [3 Hours]
Reconfigurable computing, history and survey, fixed Vs reconfigurable computing, applications of reconfigurable computing
- 2. FPGA Design :** [6 Hours]
Introduction to FPGA, LUT devices and mapping, partitioning, placement and routing algorithms. A case study on ALU design
- 3. Reconfigurable computing architectures:** [5 Hours]
Performance evaluation, Coarse grained and fine grained reconfigurable computing, a case study on coarse grained reconfigurable computing, Multi-FPGA architectures, Dynamic reconfiguration, total versus partial reconfiguration
- 4. Reconfigurable computing :** [2 Hours]
Power Reduction techniques for FPGA
- 5. Reconfigurable computing applications** [6 Hours]
Distributed Arithmetic, CORDIC algorithm on FPGA
- 6. Reconfigurable computing – Security to FPGA** [4 Hours]
Physical Unclonable Functions-Introduction and implementation on FPGA, on-chip authentication of FPGA-based devices
- 7. Hardware-Software Co-design** [4 Hours]
Introduction, Partitioning, Scheduling, Synthesis, Retiming, Pipelining. Unfolding, analysis and Estimation
- 8. Finite State Machine with Datapath** [3 Hours]
Introduction, finite state machines, finite state machine with datapath (FSMD), a case study on FSMD
- 9. Hardware –Software Interfaces** [3 Hours]



Hardware software Communication, one way and two way handshake, blocking and non-blocking data transfer, On-chip Bus, Bus transfer and topologies

10. Case study

[6 Hours]

Decoders, Crypto processor, CORDIC processor.

Experiments: The practicum of this course implements the FPGA based implementation of the algorithms and architectures discussed during the course. Experiments such as UART interfacing with FPGA, CORDIC algorithm, interfacing camera with FPGA, image compression and cryptographic algorithm on FPGA.

3. Textbooks:

1. Scott Hauck André DeHon, Reconfigurable Computing, The theory and practice of FPGA based Computation, 1st edition, Morgan Kaufmann, 2008.
2. F. Vahid and T. Givargis, "Embedded Systems: A Unified Hardware Software Introduction", John Wiley and Sons, 2011.

4. References:

1. Patrick Schaumont, "A Practical Introduction to Hardware/Software Co design", Springer, 2010, ISBN 978-1-4614-3736-9 and ISBN 978-1-4614-3737-6.
2. **Bobda**, Christophe, Introduction to Reconfigurable Computing: Architectures, algorithms and applications, Springer, 2007.
3. I. Koren, "Computer Arithmetic Algorithms". A.K. Peters Ltd., 2002.
4. Behrooz Parhami, "Computer Arithmetic- Algorithms and Hardware Designs", Oxford university press, 2nd Edition. 2010.
5. Peter J. Ashenden, "The designer's guide top VHDL", Morgan Kaufmann, 2008.
6. IEEE research papers on relevant topics.

Similarity Content Declaration with Existing Courses:

S.No	Course Code	Similarity content	Approximate %
1.	EE 529	Introduction to FPGA, Hardware Software co-design	< 20 %
2.	EE208P	Introduction to FPGA	< 5 %
3.	EE 523	CORDIC Based Architecture	< 10 %

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

Approvals:

Other faculty interested in teaching this course: Dr. Rahul Shrestha, Dr. Shubhajit Roy Chowdhury

Proposed By: Dr. Srinivasu Bodapati

Signature:

Date:

Recommended/Not Recommended, with comments:

Chairman, CPC

Approved/Not Approved

Chairman, Senate

School: SCEE



IIT Mandi

Proposal for a New Course

Course Number : ME 501P
Course Name : Practicum-I
Credits : 0-0-6-3
Prerequisites : None
Intended for : Only for M.Tech.
Distribution : Core for M.Tech in Fluid and Thermal Engineering
Semester : Winter Break

Preamble - After completing one semester of course work at IIT Mandi, the students will be exposed to hands-on which will help to develop useful skills, through this course. This skill can include, performing numerical/experiment work in a laboratory, developing some models/products, literature survey, venturing into a new domain, testing the validity of a new idea through experimentation and/or numerical simulations etc. A laboratory will be allotted to every student. This course will end at the start of the even semester. **The Faculty Advisor (FA) will form a committee according to M.Tech. ordinance and conduct presentations to evaluate the work performed in this course.**

Course Modules with Quantitative Lecture Hours:

There are no regular lecture hours or practical classes for this course. It is expected that a student should meet laboratory coordinator regularly and perform the work as per mutual understanding between them.

The assigned work should provide exposure to students. It should help them in choosing relevant problems and defining its objectives. Students should perform small scale work for understanding the current level of development in the area of problem. Based on this they should make some effort for solving a few objectives by applying the learned numerical or experimental skills. Learning of any new skill before applying them should also be counted in the effort of the students.

3. Text Book:

There is no text book for this course.

4. Reference Books: N.A.

5: Similarity Content Declaration with Existing Course: N.A.

S.N	Course Code	Similarity Content	Approx. % of Content
1			

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

Not Applicable

Other Faculty interested in teaching this course: Pradeep Kumar



Proposed by: School: School of Engineering

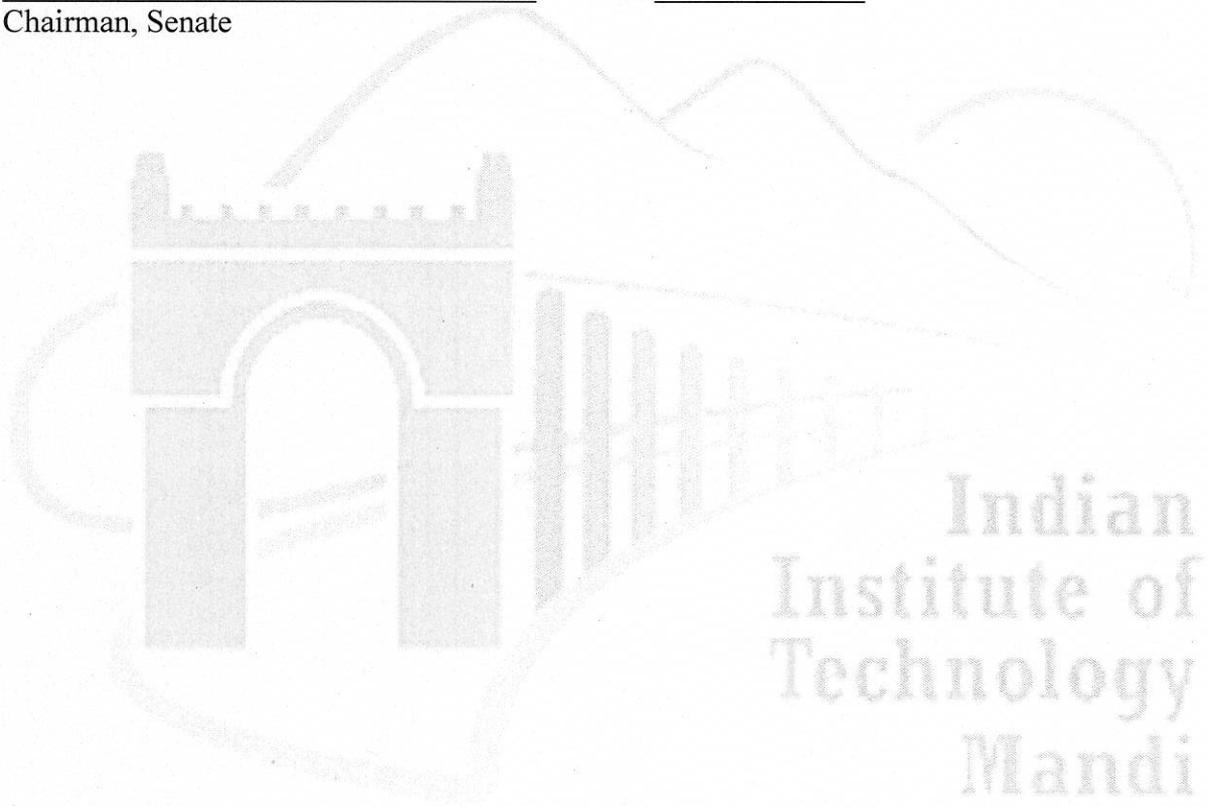
Signature _____ Date _____

Recommended/Not Recommended, with Comments:

_____ Date: _____
Chairman, CPC

Approved / Not Approved

_____ Date: _____
Chairman, Senate



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