

Courses of Study

Open Electives

B.Tech Mechanical Engineering
(Batch 2023 Onwards)



Department of Mechanical Engineering

Islamic University of Science and Technology, Kashmir

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Open Electives

S.No	Course Code	Course Title	L	T	P	S	Hours Per Week	Credits
1	MEC009	Sketch and Build Your Prototype	1	0	2	0	3	2
2	MEC010	Engineering Materials in Daily Use	2	0	0	0	2	2
3	MEC011	Fluids and Us	2	0	0	0	2	2
4	MEC012	World of Manufacturing	2	0	0	0	2	2

Notes:

Open Electives are offered to the students of all the departments of the university other than the Department of Mechanical Engineering. The students of the Department of Mechanical Engineering have to choose Open Electives offered by departments other than the Department of Mechanical Engineering.

MEC009

Sketch and Build Your Prototype

1-0-2-0

Course Objectives: The objective of this course is to introduce CAD as a sketching and drafting tool to the students of non-mechanical engineering backgrounds. The course is designed to make students comfortable with using CAD to model their prototype and learn the basics of 3D printing technology to convert the model to the real physical prototype.

Course Outcomes: At the end of this course, a student will be able to:

1. Select and use appropriate geometric modelling techniques for engineering applications.
 2. Create the sketches by using sketching tools.
 3. Apply display tools, geometric relations and dimensions to the sketch.
 4. Create base features like extrude, revolve etc. for a solid model.
 5. Use 3D printers for part building.
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Module I:

Introduction to CAD: Popular CAD software used in industry, solid modeling, feature based solid modeling; Input and output devices.

Module II:

Introduction to 3D Printing:: Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages of AM; Classification of AM processes; Key steps in AM. overview of Liquid, Solid, Powder State-based AM Processes.

Module III:

Practical on CAD: Drawing Sketches for Solid Models: sketching environment, various terms used in the sketching environment, sketching planes, sketching tools - line, rectangle, circle, arc etc.; Editing Sketches for Solid Models, Base Features: Solid base extrude, thin base extrude, solid base revolve, rotate the view to display the model, apply material to the model, change the appearance of models.

Module IV:

Practical on 3D Printing: Creating 3D CAD models, Data exchange, and slicing, building parts on 3D printers.

Module V:

Projects: Students would be required to take a project that involves developing CAD models and 3D printing the same having some utility.

Pre-requisites: NA

Text Books:

1. SOLIDWORKS: A Power Guide for Beginners and Intermediate Users by CADArtifex
2. A. Reyes, Beginner's Guide to SOLIDWORKS: Level 1 MSME, CSWE.
3. M. Srivastava, S. Rathee, S. Maheshwari and T. K Kundra, Additive Manufacturing: Fundamentals and Advancements, CRC Press.

Reference Books:

1. Venuvinod, K. Patri., and W. Ma, Rapid prototyping: laser-based and other technologies. Springer Science & Business Media, 2013.
 2. I. Gibson, D. Rosen, and B. Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, New York, NY, 2015.
 3. Kumar, L. Jyothish, P. M. Pandey and D. I. Wimpenny, eds. 3D printing and additive manufacturing technologies. Singapore: Springer, 2019.
 4. Jacobs, F. Paul, Fundamentals of stereolithography. In 1992 International Solid Freeform Fabrication Symposium. 1992.
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Online Resources:

1. Engineering drawing and computer graphics by Prof. Rajaram Lakkaraju (IIT Kharagpur), NPTEL Course (<https://nptel.ac.in/courses/112105294>).
 2. Fundamentals of Additive Manufacturing Technologies by Prof. Sajan Kapil (IIT Guwahati), NPTEL Course (https://onlinecourses.nptel.ac.in/noc22_me122/preview).
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MEC010C

Engineering Materials in Daily Use

2-0-0-0

Course Objectives: This course will enable students to:

1. Broad understanding of different types of engineering materials and their applications.
2. Interpretation of equilibrium phase diagrams of alloys.
3. Correlation between the internal structure of materials and their mechanical properties

Course Outcomes: At the end of this course, a student will be able to:

1. Explain the classification of ceramics on the basis of structure and applications
2. Understand the historical developments of polymers and their classifications
3. Explain the biomaterials and their types
4. Understand the basic structure and functioning of smart materials

Module I

Ceramics: Definition & scope of ceramics and ceramic materials, Classification of ceramic materials – conventional and advanced, Areas of applications, Ceramic crystal structures - Corundum, Wurtzite, Zinc blende, Rocksalt Perovskite and Spinel structure etc., Raw material for ceramics: The range and scope of various natural minerals and inorganic nonmetallic materials to be used as raw materials for ceramic products, General ideas about the characterization of natural and synthetic materials.

Module II

Polymers: Historical developments in polymeric materials, Basic concepts & definitions, Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins etc.

Module III

Biomaterials: Introduction to biomaterials for biomedical applications, Chemical structure and property of biomaterials, Degradation of biomaterials, Polymeric biomaterials: Introduction, preparation, hydrogel biomaterials, Bioconjugation techniques, Biomaterials for drug delivery application (small molecules, gene and protein) Biocompatibility, Biomaterials implantation, Evaluation of biomaterials, Nanobiomaterials.

Module IV

Smart Materials: Introduction to Smart Materials, Principles of Piezoelectricity, Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magnetorheological Fluids

Pre-requisites: NA

Text Books:

1. F Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1994
2. Barsoum, Michel and M. W. Barsoum. Fundamentals of ceramics. CRC press, 2002
3. J. B. Park and R.S. Lakes Biomaterials: An Introduction, Plenum Press: New York.
4. J.C. Brian , Smart Structures and Materials, Artech House, 2000.

Reference Books: NA

Online Resources:

1. Material Science by Prof. Satish V. Kailash (IISC Bangalore), NPTEL Course (<https://archive.nptel.ac.in/courses/112/108/112108150/>)
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MEC011

Fluids and Us

2-0-0-0

Course Objectives: This course will enable students to:

1. Learn about physical properties of fluids and the history of their study.
 2. Know about fluid phenomena governing various aspects of human life.
 3. Learn about measurement of fluid properties.
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Course Outcomes: At the end of this course, a student will be able to:

1. Describe the properties of fluids.
 2. Connect fluid properties with their applications.
 3. Describe the processes undergoing in the human body from a fluid mechanics perspective.
 4. Describe measurement techniques of fluid properties.
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Module I

Introduction to Fluids: definition, properties, flow classification, fluid studies throughout history: ships, harnessing fluid power through turbines- wind and water; construction of dams, Archimedes principle.

Module II

Fluid Phenomena in Daily Life: weather changes- the implications of pressure; water transport- the implications of buoyancy, the implications of skin friction and drag; jams, jellies and sunscreens- the implications of viscosity, cooking gas and deodorants- the implications of compressibility; air and land transport- the implications of skin friction, lift and drag.

Module III

Fluids and the Human Body: heart – the archetype of a pump, cardio-vascular system – a mechanical engineering perspective, introduction to hemodynamics: blood, composition of blood, properties of blood, fluid transport phenomena in the human body including water and electrolytes.

Module IV

Measurement of Fluid Properties: viscosity, density, temperature, pressure, surface tension, flow rate; flow visualization techniques.

Pre-requisites: NA

Text Books:

1. Y. A. Cengel and J. M. Cimbala, Fluid Mechanics: Fundamentals and Applications, McGraw Hill

Reference Books:

1. F. M. White, Fundamentals of Fluid Mechanics, McGraw Hill Education
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Online Resources:

1. Fluid Mechanics by Prof John Biddle (California State Polytechnic University, Pomona) (https://www.cpp.edu/meonline/fluid-mechanics.shtml?gclid=CjwKCAjwzo2mBhAUEiwAf7wjkJD8bCq158MT7UmAWp2LvrCbRbI8xPcp1RvCjwAVPoCyV3yprO3BBocTmUQAvD_BwE).
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MEC012

World of Manufacturing

2-0-0-0

Course Objectives: This course will enable students to:

1. Get introduced to the world of manufacturing.
2. Gain knowledge on classification and principles of different manufacturing processes.
3. Understand the concepts of additive manufacturing and its applications.

Course Outcomes: At the end of this course, a student will be able to:

1. Explain different types of manufacturing processes and their applications.
2. Describe the metal casting process and equipment used.
3. Explain the principles and operations of welding processes.
4. Identify the tool geometry of a single point cutting tool and principles of metal cutting.
5. Differentiate between additive and subtractive manufacturing processes.

Module I

Introduction of Manufacturing Processes: An introduction to the scope and significance of manufacturing worldwide, need of manufacturing processes in making of computers, electronics and electrical devices etc.

Module II

Metal Casting Processes: Patterns, Types of patterns, molding materials, molding sands, properties and sand testing: Grain fineness, moisture content, clay content, Core materials and core making, Chaplets. Casting defects.

Module III

Welding Processes: Principle of welding, Classification of welding and allied processes. Capabilities and applications; welding parameters, Gas welding and gas cutting, Arc welding, Power sources and consumables, TIG, MIG, friction welding. Defects of welding and remedial actions.

Module IV

Machining: Basics of Metal Cutting: Principles of metal cutting, classification of Metal cutting/machining processes: Orthogonal and oblique cutting, Effect of tool geometry and other cutting parameters, Mechanisms of formation of chips, types of chips formed, chip Breaker

Module V

Additive Manufacturing: Introduction to Additive Manufacturing: Rapid Prototyping Technology (SLS), 3D Printing Technology (FDM, etc.)

Pre-requisites: NA

Text Books:

1. S. Kalpakjian and S. R. Schmid, Manufacturing engineering and technology, 7th edition of Pearson publication.
2. Reference Books:
3. P. N. Rao Manufacturing technology volume-II, 3rd edition of TMH publication.
4. P. N. Rao Manufacturing technology volume-I, 3rd edition of TMH publication.

Reference Books: NA

Online Resources:

1. Fundamentals of Manufacturing processes by Prof. D K Dwivedi IIT Roorkee NPTEL course (https://onlinecourses.nptel.ac.in/noc20_me67/preview)
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