CURRICULUM & SYLLABI

Minor in Innovation, Design & Entrepreneurship

Effective from AY: 2026-27



Department of Mechanical Engineering and Department of Management Studies

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

WARANGAL, TELANGANA

Minor Degree in Innovation, Design and Entrepreneurship (IDE)

Code	Course Title	L-T-P	Credits	Sem
ME2M01	Human-Centred Innovation	2-0-2	3	III
ME2M02	Product Design Methods	2-0-2	3	IV
ME2M03	Product Realization, Fabrication and Prototyping	1-0-4	3	V
MS2M01	Foundations of Entrepreneurship	2-0-2	3	VI
MS2M02	Innovation Management, Markets & IPR	2-0-2	3	VII
		Total	15	

Program Philosophy for Minor in IDE: Designing Responsible and Sustainable Solutions for Society

Pedagogical Tool for Minor in IDE: Learning by Doing & Experiential Progression

This interdisciplinary minor program is open for all eligible UG students including B.Tech (Mech) students. This Minor program requires student teams to work on a single, continuous project across all five courses. Students discover a true societal or environmental need in Course 1 and progressively turn it into an engineered product concept (Course 2), a physical operating prototype (Course 3), a validated business plan (Course 4), and a responsible go-to-market rollout strategy (Course 5). As approved by the Senate, traditional final written exams are completely replaced with interactive project milestones, prototype reviews, presentations and stakeholder pitches, etc.

SYLLABI

Minor in Innovation, Design and Entrepreneurship

ME2M01 **2-0-2 (3)**

Human-Centred Innovation

Pre-Requisites: **None**

Course Outcomes:

CO1	Find and frame meaningful societal problems using primary field research and user empathy.
CO2	Map chosen problems directly to UN Sustainable Development Goals and Indian national priorities.
CO3	Analyze problem root causes cleanly using basic systems thinking and fishbone diagrams.
CO4	Formulate and screen initial project criteria with a clear design requirement specification.

Syllabus:

Introduction to Innovation and Design Thinking: Foundations of human-centric innovation, Design thinking frameworks and agile mindsets, Case Studies

Human-Centred Design: Empathy mapping and ethnography methods, User observation techniques, Stakeholder mapping and identification, User journey mapping and analysis

Problem Framing: Root cause analysis tools (5-Whys, Fishbone diagrams), Systems thinking principles for complex environments, Problem definition and bounding

Societal Challenges and Sustainable Development: Global sustainability challenges (Climate change, resource scarcity, urbanization), UN Sustainable Development Goals (SDG) framework overview, Indian development priorities (Viksit Bharat 2047, Atmanirbhar Bharat, Swachh Bharat etc)

Opportunity Identification & Project Selection: Need-finding consolidation & filtering, SDG + National Priority multi-layer mapping, Impact assessment and final team project selection, Mandatory 1-Page project alignment filter submission

Problem Formulation and Concept Generation: Framing a problem statement neutrally using adequate checks. Case studies.

Activities*:* Field Visit to interact with users, Group discussions, Presentations and Reviews. *Experiential Project Work*: Teams go into the field to locate a true user friction point, mapping it directly into a brief 1-Page Project Filter Dashboard that binds the problem to an active Indian National Mission and a UN SDG.

Learning Resources:

Text Books:

1. David Kelley and Tom Kelley, Creative Confidence: Unleashing the Creative Potential Within Us All, Crown Business, 2013.

2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperBusiness, 2009.

Reference Books:

1. Donella H. Meadows, Thinking in Systems: A Primer, Chelsea Green Publishing, 2008.

2. Vijay Kumar, 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, John Wiley & Sons, 2012.

ME2M02 **2-0-2 (3)**

Product Design Methods

Pre-Requisites: **None**

Course Outcomes:

CO1	Translate field requirements into systematic functional engineering layouts.
CO2	Generate diverse product concepts using morphological charts, TRIZ, and biomimicry.
CO3	Evaluate and rank engineering alternatives objectively using Pugh selection matrices.
CO4	Apply design rules for circular economy, repairability, and material efficiency.

Syllabus:

Product Development Process & Practical Reverse Engineering: Phases of systematic engineering design and stage-gate engineering execution paths, Hands-on Reverse Engineering Exercise: Dismantling common systems (Mixer-grinders, domestic water purifiers, bicycle gear mechanisms, consumer appliances), Documenting product architecture, layout configurations, bill of materials, engineering fits, and eco-features discovered during disassembly

Functional Modelling: Functional decomposition methodologies, Function structures mapping boundary flows (Energy, Material, Signal)

Concept Generation: Structured brainstorming and morphological charts, TRIZ (Theory of Inventive Problem Solving) contradiction matrix basics, Biomimicry principles (learning from durable ecosystems)

Concept Evaluation: Pugh selection matrix tracking, Technical feasibility filters and economic viability checks, Sustainability screening methodologies

Human Factors and Product Experience: Ergonomics and anthropometric datasets, Usability, product semantics, and user interface logic

Design for Sustainability: Energy-efficient and material-efficient design principles, Circular design foundations: repairability, reusability, and modularity

Experiential Project Work:

Teams take their Course 1 problem and create three distinct engineering concept layout variants, proving technical feasibility and utilizing a Pugh Matrix to select the best architecture.

Activities*:* Field Visit for benchmarking, Skill sessions, Ideate sessions, Group discussions, Presentations and Reviews.

Learning Resources:

Text Books**:**

1. Karl T. Ulrich and Steven D. Eppinger, Product Design and Development, 7th Edition, McGraw-Hill, 2020.

2. Kevin Otto and Kristin Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson Education, 2001.

Reference Books:

1. G. Pahl, W. Beitz, J. Feldhusen, and K.H. Grote, Engineering Design: A Systematic Approach, 3rd Edition, Springer, 2007.

2. William McDonough and Michael Braungart, Cradle to Cradle: Remaking the Way We Make Things, North Point Press, 2002.

ME2M03 **1-0-4 (3)**

Product Realization, Fabrication and Prototyping

Pre-Requisites: **None**

Course Outcomes:

CO1	Develop parameterised 3D CAD assemblies and standard engineering drawing sheets.
CO2	Apply Design for Manufacturing and Assembly (DFMA) guidelines to lower layout complexity.
CO3	Fabricate physical engineering parts using additive and subtractive tooling methods.
CO4	Integrate baseline electronic sensors, actuators, and microcontroller logic safely.

Syllabus:

Embodiment Design: Layout configuration and assembly scaling, Material selection metrics and environmental data, Component pairing and geometric standard fits

Design for X (DFX): Design for Manufacturing (DFM) basics, Design for Assembly (DFA) efficiency indexes, Design for Reliability and straightforward Disassembly

Digital Product Development: Parametric 3D CAD assembly modeling, Engineering drawing standards and tolerancing, Hierarchical Bill of Materials (BOM) development

Rapid Prototyping: Additive manufacturing (3D printing parameters), Subtractive CNC machining basics, Electronics integration: sensor circuits and embedded programming

Sustainable Manufacturing: Resource efficiency in workshop operations, Waste minimization and scrap management tracking

Crucial Engineering Testing, Verification and Validation: Functional testing protocols: benchmarking physical hardware against design parameters, Verification vs. Validation workflows: Did we build the product correctly? Did we build the correct product? User Acceptance Testing (UAT) models with targeted field stakeholders, Reliability basics, failure mode tracking, and closing the loop via iterative design refinement sprints

Activities and Skilling Sessions: Skill sessions on sketching, 3D printing, Tinkering related to electrical and electronics, Power tools training, word and metal processing techniques, Prototype building, Presentations and Reviews.

Learning Resources:

Text Books:

1. Geoffrey Boothroyd, Peter Dewhurst, and Winston A. Knight, Product Design for Manufacture and Assembly, 3rd Edition, CRC Press, 2010.

2. Chua Chee Kai and Leong Kah Fai, 3D Printing and Additive Manufacturing: Principles and Applications, 5th Edition, World Scientific, 2017.

Reference Books:

1. David G. Ullman, The Mechanical Design Process, 6th Edition, McGraw-Hill, 2018.
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing Engineering and Technology, 8th Edition, Pearson, 2020.

MS2M01 **2-0-2 (3)**

Foundations of Entrepreneurship

Pre-Requisites: **None**

Course Outcomes:

CO-1	Develop and articulate entrepreneurial mindset
CO-2	Validate business opportunities through evidence-based customer discovery and experimentation
CO-3	Design viable business models
CO-4	Plan realistic go-to-market and resource strategies aligned with actual constraints
CO-5	Communicate business ideas persuasively and demonstrate adaptive learning

Syllabus:

Entrepreneurial Mindset: Entrepreneurial vs. Managerial Thinking; Mindset Dimensions; Entrepreneurial Lifestyle and Practices; Risk Tolerance; Resilience and Growth Mindset

Prototype to Business Opportunity: From Technical Solution to Customer Problem; Reframing the Prototype; Opportunity Recognition; Problem Validation Frameworks; Testing Over Assuming; Pivot vs. Persevere Decisions; Marketing: TAM, SAM, SOM Analysis; Rapid Experimentation Cycles; Safe-to-Fail Experiments

Business Model Development: Business Model Canvas; Revenue Models; Revenue vs. Profit; Pricing Strategies; Unit Economics and Sustainability (Customer Acquisition Cost, Customer Lifetime Value); Revenue Stream Diversity and Planning

Go-to-Market and Resource Planning: Go-to-Market Strategy; Market Feasibility Assessment; Customer Readiness; Financial Planning; Bootstrapping; Government Grants and Schemes; Angel Investment; Venture Capital; Accelerators/Incubators; Legal and Regulatory Issues; Operational Planning and Milestones

Pitching and Launch: Pitching and Investor Communication; Business Plan as a Strategic Document; Learning from Failures and Pivots; Post-Launch Challenges

Activities: Elevator & Investor Pitch; Role Plays; Team Projects; Surveys and Field Visits; Case Studies; Simulation; Brainstorming Discussion; Group Discussion; Debates and Quiz; Video case studies (Founder Talks); Business Plan writing ; Poster Presentations.

Learning Resources:

Text Books:

1. Heidi M. Neck, Christopher P. Neck and Emma L. Murray, Entrepreneurship: The Practice and Mindset, Sage Publications, 2020, 2nd Edition
2. Alexander Osterwalder, Yves Pigneur, Fred Etiemble, and Alan Smith ,Testing Business Ideas: A Field Guide for Rapid Experimentation John Wiley & Sons 2020

Reference Books:

1. Kuratko, D. F. (2024). *Entrepreneurship: Theory, process, and practice* (12th ed.). Cengage Learning.

MS2M02 **2-0-2 (3)**

Innovation Management, Markets & IPR

Pre-Requisites: **None**

Course Outcomes:

CO-1	Develop an innovation strategy aligned with their product, competitive positioning, and market context
CO-2	Understand intellectual property as a strategic tool for value capture and competitive advantage
CO-3	Evaluate technology transfer mechanisms and technology absorption pathways
CO-4	Validate market adoption through rigorous market research and diffusion analysis
CO-5	Build a comprehensive innovation and commercialization strategy document that guides long-term innovation positioning

Syllabus:

Innovation Management: Innovation strategy frameworks; Types of Innovation; Strategic positioning; First-mover vs. fast-follower; Scalability dimensions; Diffusion of innovation

Technology Management: TRL (Technology Readiness Levels); Digital technologies; Digital Business Models; Data Privacy and Ethics; Technology transfer mechanisms, Technology Absorption; Ecosystem orchestration

Intellectual Property Fundamentals: IP Fundamentals; Patents; Trademarks; Copyrights; Trade Secrets; Industrial Designs; IP Strategy and Business Alignment; IP Strategy Development; Trademark and IP Branding Strategy

Market Validation and Product-Market Fit: Assessing Product-Market Fit; Market Research Methods for Validation; Quantitative Methods; Willingness-to-Pay Studies; Qualitative Methods; Competitive Benchmarking

Innovation Strategy Synthesis and Capstone Presentation: Synthesise all prior modules; Identify synergies and any misalignments; Develop coherent ‘go-forward’ strategy; Capstone presentation

Activities: Elevator & Investor Pitch; Role Plays; Team Projects; Surveys and Field Visits; Case Studies; Simulation; Brainstorming Discussion; Group Discussion; Debates and Quiz; Video case studies (Founder Talks); Business Plan writing ; Poster Presentations.

Learning Resources:

Text Books:

1. Joe Tidd, John Bessant, Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley, 2021, Seventh Edition
2. Paul Trott, Innovation Management and New Product Development, Pearson, 2017, Sixth Edition

Reference Books:

1. Clayton Christensen, The Innovator's Dilemma, Harvard Business Review Press, 2013, Sixth Edition
2. Renée Mauborgne, W. Chan Kim, Blue Ocean Strategy, Harvard Business Review Press, 2004.