15 MEC 275 DESIGN THINKING 2 0 2 3

Course objectives		Course outcomes	
1.0	To introduce to the students the concept of design thinking	CO1	Students will be able to understand the diverse methods employed in design thinking and establish a workable design thinking framework to use in their practices
		CO2	Students will be able to examine critical theories of design, systems thinking, and design methodologies.
2.0	To make the students as a good designer by imparting creativity and problem solving ability	CO3	Students will be able to produce great designs, be a more effective engineer, and communicate with high emotional and intellectual impact
		CO4	Students will be able to conceive, organize, lead and implement projects in interdisciplinary domain and address social concerns with innovative approaches

Design process: Traditional design, Design thinking, Existing sample design projects, Study on designs around us, Compositions/structure of a design,

Innovative design: Breaking of patterns, Reframe existing design problems, Principles of creativity

Empathy: Customer Needs, Insight-leaving from the lives of others/standing on the shoes of others, Observation

Design team-Team formation, Conceptualization: Visual thinking, Drawing/sketching, New concept thinking, Patents and Intellectual Property, Concept Generation Methodologies, Concept Selection, Concept Testing, Opportunity identification

Prototyping: Principles of prototyping, Prototyping technologies, Prototype using simple things, Wooden model, Clay model, 3D printing; Experimenting/testing.

Sustainable product design, Ergonomics, Semantics, Entrepreneurship/business ideas, Branding, Advertising.

Product Data Specification, Establishing target specifications, Setting the final specifications.

Design projects for teams.

References:

1. *Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers Ltd.*
2. *Idris Mootee, Design Thinking for Strategic Innovation,2013, John Wiley & Sons Inc*
3. *Brenda Laurel Design Research methods and perspectives MIT press 2003*
4. *Terwiesch, C. & Ulrich, K.T., 2009. Innovation Tournaments: creating and identifying Exceptional Opportunities, Harvard business press.*
5. *Ulrich & Eppinger, Product Design and Development, 3rd Edition, McGraw Hill, 2004*
6. *Stuart Pugh, Total Design: Integrated Methods for Successful Product Engineering,*
7. *Bjarki Hallgrimsson, Prototyping and model making for product design, 2012, Laurence King Publishing Ltd*
8. *Kevin Henry, Drawing for Product designers, 2012, Laurence King Publishing*

15 MEC 276 ADDITIVE MANUFACTURING 3 0 2 4

Course objectives		Course outcomes	
1.0	To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials	CO1	Students will be able to demonstrate appropriate levels of understanding on the principles of additive manufacturing processes
		CO2	Students will be able to demonstrate competency in the use of materials for additive manufacturing processes
2.0	To make the students understand the various software tools and techniques that enable advanced/additive manufacturing and personal fabrication.	CO3	Students will be able to demonstrate the methodology of CAD tools and CAD interface with additive manufacturing systems
3.0	To make the students learn to create physical objects that satisfies product development/prototyping requirements, using /additive manufacturing processes.	CO4	Students will be able to identify suitable additive manufacturing process, define optimum process parameters and develop physical prototypes using suitable additive manufacturing systems.

INTRODUCTION: METHODS AND SYSTEMS

Introduction to layered manufacturing, Importance of Additive Manufacturing Additive Manufacturing in Product Development

Classification of additive manufacturing processes, Common additive manufacturing technologies; Fused Deposition Modeling(FDM), Selective Laser Sintering(SLS), Stereo Lithography(SLA), Selection Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM) Capabilities, materials, costs, advantages and limitations of different systems.

MATERIAL AND PROCESS EVALUATION

Material science for additive manufacturing-Mechanisms of material consolidation-FDM, SLS, SLM, 3D printing and jetting technologies.Polymers coalescence and sintering, photopolymerization, solidification rates,Meso and macro structures,

Process evaluation: process-structure relationships, structure property relationships,

Applications: Prototyping, Industrial tooling, Aerospace, Automobive, Medical etc.,

Quality control and reliability: Defects in FDM, SLS and SLM, Critical process parameters:geometry, temperature, composition, phase transformation, Numerical and experimental evaluation: roles of process parameter combination, process optimization.

CAD in Additive Manufacturing

CAD Modelling for 3D printing: , 3D Scanning and digitization,data handling &reduction Methods,

AM Software: data formats and standardization, Slicing algorithms:-uniform flat layer slicing, adaptive slicing,

Process-path generation: Process-path algorithms, rasterisation, part Orientation and support generation.

Laboratory:

CAD Modeling: Introduction to CAD environment, Sketching, Modeling and Editing features, Different file formats, Export/Import geometries, Part orientation, Layer slicing, Process path selection, Printing, Numerical and experimental evaluation.

REFERENCES:

1. *Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.*
2. *Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.*
3. *Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2011.*
4. *Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.*
5. *Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.*