1-year Diploma in 3D Printing and Design

1. Course Title: **1-year Diploma in 3D Printing and Design**
2. Nodal Department: **ME (UIET)**
3. Duration: 1 Year
4. Eligibility: Senior secondary examination/ 10+2
5. Timing: Weekend/Saturdays, Sundays and Public holidays
6. Mode**:** Offline
7. Assessment and Evaluation mode
8. Fee structure: 10000 per semester

Course Description

Course Objectives:

- The objective of this course on 3D Printing and design to the diploma students is to make the students aware of rapidly evolving and widely used fabrication technology.
- It is aimed to make the students aware of the technology for conceptual modelling, prototyping and rapid manufacturing. It is also aimed to introduce reverse engineering (RE).
- It is aimed to impart detailed knowledge of wide applications of Additive Manufacturing (AM) in industry and society; and in particular, key applications of AM such as rapid tooling, medical AM and rapid manufacturing.
- Give students an understanding of 3D printers
- Provide training to operate 3D printer.

Course outcome

Upon the completion of this course

- Students will understand the basics of engineering graphics and design
- Students will able to understand the principle of fused deposition modeling 3D Printing
- Students will know about the designing and drafting in Autocad software
- Students will able to study about various additive manufacturing techniques
- Students will understand about design technology and innovation
- Students can model and fabricate their own 3D parts using advanced CAD software and 3D printing

M.D. UNIVERSITY, ROHTAK
SCHEME OF STUDIES AND EXAMINATION
1-year Diploma in 3D Printing and Design

Scheme and Syllabus

1st Semester

Course Code	Course Name	Hours/ week	No. of Credits	Internal Assess.	Theory	Practical	Max. marks	Duration of Exam
21D3DP-101	Engineering Graphics and Design	4	4	10	40	-	50	3 Hrs
21D3DP-102	Fundamentals of Fused Deposition Modeling (FDM) printing	4	4	10	40	-	50	3 Hrs
21D3DP-103	Basics of CAD Lab	2	2	25	-	25	50	3 Hrs
21D3DP-104	Additive Manufacturing Lab-I	2	2	25	-	25	50	3 Hrs
Total			12	70	80	50	200	

2nd Semester

Course Code	Course Name	Hours/ week	No. of Credits	Internal Assess.	Theory	Practical	Max. marks	Duration of Exam
21D3DP-201	Additive Manufacturing	4	4	10	40	-	50	3 Hrs
21D3DP-202	Design, Technology and Innovation (MOOC)	4	4	10	40		50	3 Hrs
21D3DP-203	Advance CAD Lab	2	2	25	-	25	50	3 Hrs
21D3DP-204	Additive Manufacturing Lab-II	2	2	25	-	25	50	3 Hrs
Total			12	70	80	50	200	

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Engineering Graphics and Design**	**Course Code**	**21D3DP-101**
Credits	**4**	**No. of hours/Week**	**4**
Duration of End term examination	**03 hrs**	**Max. marks**	**Th: 40** **IA: 10**

Note: Examiner will set nine questions in total. Question one will have 4 parts of 2 marks each from all units and remaining eight questions of 8 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

This course mainly used to develop in students, graphic skills for communication of concepts, ideas and design of engineering products. To expose them to existing national standards related to technical drawings. This course used to introduces students to reading, understanding, and creating engineering drawings.

Course Outcomes:

After learning the course the students should be able to know and understand the conventions and the method of engineering drawing. Interpret engineering drawings using fundamental technical mathematics. Construct basic and intermediate geometry

Unit 1: Introduction to Engineering Drawing

Principles of engineering graphics and their significance – drawing instruments and their use – conventions in drawing – lettering – BIS conventions. Dimensioning rules, geometrical construction.

Unit 2: **Orthographic Projection in First Angle Projection Only**

Principles of orthographic projections – conventions – first and third angle projections. Projections of points and lines inclined to both the planes

Unit 3: Projections of Planes and Solids

Projections of regular planes, inclined to both planes. Projections of regular solids inclined to both planes.

Development of Surfaces

Development of surfaces of right, regular solids – development of prisms, cylinders, pyramids, cones and their parts.

Unit 4: Isometric Projections

Principles of Isometric Projections-Isometric Scale- Isometric Views Conventions-Plane Figures, Simple and Compound Solids. TRANSFORMATION OF PROJECTIONS: Conversion of isometric Views to Orthographic Views. Conversion of orthographic views to isometric projections vice-versa.

References:

1. Engineering Drawing- Basant Agarwal, TMH
2. D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi.

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Fundamentals of Fused Deposition Modeling (FDM) printing**	**Course Code**	**21D3DP - 102**
Credits	**4**	**No. of hours/Week**	**4**
Duration of End term examination	**03 hrs**	**Max. marks**	**Th: 40** **IA: 10**

Note: Examiner will set nine questions in total. Question one will have 4 parts of 2 marks each from all units and remaining eight questions of 8 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

The course will introduce you to the methods and technologies of FDM 3D Printing and its applications such as rapid prototyping, rapid manufacturing, and personal/domestic printing.

Course Outcomes:

The course imparts training in core additive manufacturing technologies Fused deposition modeling (FDM) which is commonly used for modeling, prototyping, and production applications.

Unit 1:

Principle of FDM/FFF printing, Basic steps to perform FDM printing, Significant process parameters of FDM printing, layer height, raster angle, raster width, build temperature, Nozzle temperature, orientation, printing speed etc

Unit 2:

Types of FDM printer

Cartesian, Polar, delta, Robotic (SCARA), continuous

FDM Materials

PLA, ABS, PETG, Nylon, PVA, PC, TPU, Carbon reinforced nylon, ceramics, metals, Dual and multi material etc

Unit 3:

Main Parts and Construction of FDM printer

Frame, Linear rods, Linear motion bearings, Slider/Carriage, V slot extrusion, Pulley, belt, Lead screw Arduino processor, Controller board, Limit Switch, Hot end, Extrusion system: Direct Drive, Bowden type, Power Supply, Heat Beds etc

Unit 4:

Applications of FDM printer in AM, Applications of AM: Aerospace, Biomedical, Automotive, Bio-printing, Tissue & Organ Engineering, Architectural Engineering, Surgical simulation, Art, Health care

Reference Books

1. Ian Gibson, Ian Gibson. "Additive manufacturing technologies 3D printing, rapid prototyping, and direct digital manufacturing." Springer International Publishing
2. Harshit K. Dave, J. Paulo Davim Fused Deposition Modeling Based 3D Printing, Springer International Publishing
3. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari, TK Kundra Additive Manufacturing Fundamentals and Advancements CRC press

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	CAD Lab	**Course Code**	**21D3DP-103**
Credits	**2**	**No. of hours/Week**	**2**
Duration of End term examination	**3hrs**	**Max. marks**	**Prac: 25** **IA: 25**

Course Objectives:

To gain practical experience in handling 2D drafting and 3D modeling software systems. To study the features of CNC Machine Tool. and CNC wire-cut and studying of Rapid prototyping. To give exposure to software tools needed to analyze engineering problems.

Course Outcomes:

Student will learn computer aided design layout and 3D solid modelling definition. Students will also gain the knowledge of design and drafting

Students have to perform the following activities in lab:

1. INTRODUCTION to CAD
2. AutoCAD – BASICS
3. Starting with AutoCAD
4. Layout and sketching
5. Drawing environment
6. Elements of drawing
7. Draw commands
8. 3D functions
9. 2D – FIGURES for practice USING AutoCAD
10. ISOMETRIC DRAWING for practice USING AutoCAD
11. 3-D SOLID FIGURES USING ACAD

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Additive Manufacturing Lab-I**	**Course Code**	**21D3DP-104**
Credits	**2**	**No. of hours/Week**	**2**
Duration of End term examination	**3hrs**	**Max. marks**	**Prac: 25** **IA: 25**

Course Objectives:

Having completed this course, you should be able to: describe additive manufacturing and explain its advantages and disadvantages

Course Outcomes:

1. The student will be able to select between a subtractive and an AM process for a particular application. He or she will be able to select a particular AM process.
2. The student will be able to take a career in research or in advanced manufacturing, the AM being a rapidly evolving area and with wide applications.
3. It is aimed at making the students ready for product development of engineering components and for entrepreneurship. He will be able to employ RE for value addition and reproduction of parts.

Students have to perform the following activities in lab:

Experiments:

1. Make a cube of any dimension using FDM 3D Printer.
2. Slicing Software basics-I. Setting up the build temperature, nozzle temperature, speed, material, layer height
3. Slicing Software basics-II Setting up infill density, infill pattern, orientation of object, support material wall thickness, converting .stl file to .G-code file etc.
4. Download a .stl file of simple object from internet, convert into G-code and print with FDM 3D Printer at 30% infill density.
5. Download a .stl file of simple object which require support material from internet, convert into G-code and print with FDM 3D Printer.

Program Name	1-year Diploma in 3D Printing and Design	Program Code	
Course Name	Additive Manufacturing	Course Code	21D3DP - 201
Credits	4	No. of hours/Week	4
Duration of End term examination	03 hrs	Max. marks	Th: 40 IA: 10

Note: Examiner will set nine questions in total. Question one will have 4 parts of 2 marks each from all units and remaining eight questions of 8 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

The Fundamentals focuses on the basics of additive manufacturing, including a comprehensive overview of additive manufacturing, the various additive manufacturing technologies, and basic safety guidelines.

The Fundamentals course is ideal for individuals working in or seeking to work in additive manufacturing roles in automotive, aerospace, and medical equipment. It is also ideal for high schools and colleges as a capstone or stand-alone achievement to increase workforce readiness in additive manufacturing.

Course Outcomes:

The course equips you to use all digital tools and techniques necessary for exploring 3D designs and 3D printing.

Unit 1

Introduction and Basic Principles, What is Additive Manufacturing? What Are AM Parts Used For The Generic AM Process Step 1: CAD

Step 2: Conversion to STL Step 3: Transfer to AM Machine and STL File Manipulation Step 4: Machine Setup Step 5: Build Step 6: Removal Step 7: Postprocessing Step 8: Application

Why Use the Term Additive Manufacturing? 1 Automated Fabrication (Autofab) 2 Freeform Fabrication or Solid Freeform Fabrication 3 Additive Manufacturing or Layer-based Manufacturing 4 Stereolithography or 3D Printing 5 Rapid Prototyping, The Benefits of AM

Unit 2:

Comparison of Additive Manufacturing with Conventional Manufacturing Processes

Introduction, Comparison between AM and Conventional Manufacturing: Comparison between AM and Deformation Process, Comparison between AM and Primary or Shaping Processes; Pros and Cons of AM with Respect to conventional Manufacturing: Part flexibility, Waste prevention, Production flexibility, Process Running cost, Probability of change, Start-up investment Mass production, Raw material.

Unit 3:

Additive Manufacturing Techniques

Vat photopolymerisation, Material Extrusion, Material Jetting, Binder Jetting, Powder bed fusion, Direct energy deposition and Sheet lamination., Selective Laser Sintering, Direct Metal Selective laser Sintering

Unit 4

Medical Applications for Additive Manufacture

Introduction, The Use of AM to Support Medical Applications 1. Surgical and Diagnostic Aids 2. Prosthetics Development 3. Manufacturing 4. Tissue Engineering and Organ Printing; Software Support for Medical Applications; Limitations of AM for Medical Applications 1. Speed 2. Cost 3. Accuracy, Materials 1. Ease of Use; Further Development of Medical AM Applications 1. Approvals 2. Insurance 3. Engineering Training 4. Location of the Technology 5. Service Bureaus.

Reference Boooks

1. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer
2. Manu Srivastava, Sandeep Rathee, Sachin Maheshwari, TK Kundra Additive Manufacturing Fundamentals and Advancements CRC press

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Design, Technology and Innovation (mooc)**	**Course Code**	**21D3DP-202**
Credits	**4**	**No. of hours/Week**	**4**
Duration of End term examination	**03 hrs**	**Max. marks**	**Th: 40** **IA: 10**

Note: Examiner will set nine questions in total. Question one will have 4 parts of 2 marks each from all units and remaining eight questions of 8 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

Design is becoming a capability-enhancing skill, equipping people with the ability to deal with uncertainty, complexity and failure. In this course, we demonstrate how you can use design as a way of thinking to provide strategic and innovative advantage within your profession.

Course Outcomes:

Design technology aims to develop internationally-minded people whose enhanced understanding of design and the technological world can facilitate our shared guardianship of the planet and create a better world.

Unit 1:

Jaipur Foot - A classic innovation by Prof. B. K. Chakravarthy; User Centred Helmet Design by Prof. B. K. Chakravarthy

Unit 2:

Challenges of Reaching a Million Users by Prof. Chetan Solanki and Prof Jayendran; Technology to Solution by Prof. Ramesh Singh; A Collaborative Excellence by Prof. B. Ravi & Prof. B. K. Chakravarthy

Unit 3:

Collaborative Innovation Methods by Prof B. K. Chakravarthy; Learnings from Grassroot Innovation by Prof. Anil Gupta

Unit 4:

Systemic Approach to Biomed Innovations by Prof. B. Ravi; Research to Innovation by Prof. Amaresh Chakrabarti; Smartcane for the Blind- A Success Story by Prof. P. V. Madhusudhan Rao

References:

1. https://nptel.ac.in/courses/107/101/107101088/
2. https://drive.google.com/file/d/1-zsHtxKWkIaddBdxJWJgYUGpIrguHyNF/view

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Advance CAD Lab**	**Course Code**	**21D3DP-203**
Credits	**2**	**No. of hours/Week**	**2**
Duration of End term examination	**3hrs**	**Max. marks**	**Prac: 25** **IA: 25**

Course Objectives:

The course is aimed at giving exposure to and enhancing the knowledge and skills of fresh graduate engineers and engineers involved in the operation use of CNC machines, CAD/CAM packages and for those who want to provide training to others in this area.

Course Outcomes:

Students gain and apply knowledge of advanced CAD concepts and techniques by using high-end CAD systems

Students have to perform the following activities in lab:

Introduction to CREO 3.0
Sketching
Learning Different Operations like Threading, Sweep, Swept blend.
Part Modelling
Drawing
Assembling

Program Name	**1-year Diploma in 3D Printing and Design**	**Program Code**	
Course Name	**Additive Manufacturing Lab-II**	**Course Code**	**21D3DP-204**
Credits	**2**	**No. of hours/Week**	**2**
Duration of End term examination	**3hrs**	**Max. marks**	**Prac: 25** **IA: 25**

Course Objectives:

1. The objective of this first course on additive manufacturing (AM) to the diploma students is to make the students aware of rapidly evolving and widely used technology.
2. It is aimed to make the students aware of the technology for conceptual modeling, prototyping and rapid manufacturing. It is also aimed to introduce reverse engineering (RE).
3. It is aimed to impart detailed knowledge of wide applications of AM in industry and society; and in particular, key applications of AM such as rapid tooling, medical AM and rapid manufacturing.

Course Outcomes:

The course imparts hands on training in core additive manufacturing technologies Fused deposition modeling (FDM) which is commonly used for modeling, prototyping, and production applications. Persons trained in the digital fabrication (3D Printing, 3D Scanning will have the following new skills which are directly relevant to industry.

Students have to perform the following activities in lab :

1. Design and print objects containing moving parts without assembly.
2. Design the Coupling in Creo software and print it using PLA material.
3. Design the Key ring of your own name in Creo software and print it using multi-material.
4. Make a model of own name and print it.
5. Emboss / engrave your name on a 3D object and print it with ABS material.
6. Reverse engineering- Scan your own face by 3D Scanner and then 3D print it.