Certificate ProgramIn Design and 3D printing

(To be launched from Jan 2023)

Course Curriculum Structure

DEPARTMENTOFMECHANICALENGINEERING

GIRIJANANDACHOWDHURYUNIVERSITY

Hathkhowapara,Azara,Guwahati781017,Assam

SemesterI

Course Code	Course Name	Hours per week			No. of Credits	Evaluation criteria * Proposed Ratio: 30:70 (*or as per your course demands*)		
		L	T	P	C	Continuous Evaluation (30)	End term (70)	Max marks
C3DP-101	Engineering Graphics and Design	4	0	0	4	30	70	100
C3DP -102	Fundamentals of Fused Deposition Modeling (FDM) printing	4	0	0	4	30	70	100
C3DP -103	Basics of CAD Lab	0	0	2	2	15	35	50
C3DP-104	AdditiveManufacturingLab-I	0	0	2	2	15	35	50
Total		**8**	**0**	**4**	**12**	**90**	**210**	**300**

L: Lecture, T: Tutorial, P: Practical, C: Credit

*Evaluation process can be flexible as per the course demands. If necessary, you may alter the table content for evaluation process depending on theory, practical or project domain.

SemesterII

Course Code	Course Name	Hours per week			No. of Credits	Evaluation criteria * Proposed Ratio: 30:70 (*or as per the course demands*)		
		L	T	P	C	Continuous Evaluation (30)	External Assessment (70)	Max marks
C3DP-201	AdditiveManufacturing	4	0	0	4	30	70	100
C3DP-202	Design, Technology and Innovation(MOOC)	4	0	0	4	30	70	100
C3DP-203	Advance CADLab	0	0	2	2	15	35	50
C3DP -204	Additive Manufacturing Lab-II	0	0	2	2	15	35	50
Total		**8**	**0**	**4**	**12**	**90**	**210**	**300**

Details of Syllabus

Program Name	1-year Certificate Course in Design and 3D printing	Program Code	GCUMEC3DP
Course Name	Engineering Graphics and Design	Course Code	C3DP-101
Credits	4	No.of hours/Week	4
Duration of End term examination	03 hrs	Max. marks	Th: 70 IA: 30

Note: Examiner will set seven questions in total. Question one will have 10 parts of 1 mark each from all units and remaining six questions of 15 marks each to be set 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 is primarily used to develop students' graphic skills to communicate engineering product concepts, ideas, and designs. Students will be exposed to existing international standards relating to technical drawings. This course will introduce students to reading, understanding and creating technical drawings.

Course Outcomes:

At the end of this course, students should be able to recognize and understand the conventions and methods of technical drawing. Interpret engineering drawings using fundamental engineering mathematics. Build 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: 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 3: Orthographic Projection

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

Unit 4: Isometric Projections

Principles of Isometric Projections-Isometric Scale, Isometric Views; Conventions; Isometric views of Lines, Planes, Simple and Compound Solids; Conversion of isometric Views to Orthographic Views and vice-versa.

References:

Engineering Drawing-N. D. Bhatt, Charotar Publishing

HouseEngineering Drawing- Basant Agarwal, TMH

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 Certificate Course in Design and 3D printing	Program Code	GCUMEC3DP
Course Name	Fundamentals of FusedDeposition Modeling (FDM) Printing	Course Code	C3DP -102
Credits	4	No. of hours/ Week	4
Duration of End term examination	03 hrs	Max. marks	Th: 70 IA: 30

Note: Examiner will set seven questions in total. Question one will have 10 parts of 1 mark each from all units and remaining six questions of 15 marks each to be set 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 FDM 3D printing methods and techniques and its applicationsin rapid prototyping, rapid manufacturing, and personal/home printing.

Course Outcomes:

The course provides training in basic additive manufacturing techniques, 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, Nozzletemperature, orientation, printing speed etc.

Unit 2:

Types of FDM printer: Cartesian, Polar, delta,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:

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

Program Name	1-year Certificate Course inDesign and 3D printing	Program Code	GCUMEC3DP
Course Name	CAD Lab	Course Code	C3DP-103
Credits	2	No. of hours/ Week	2
Duration of Endterm examination	3hrs	Max. marks	Prac: 35 IA: 15

Course Objectives:
- Gain hands-on experience working with 2D drafting and 3D modeling software systems.
- Exposure to software tools needed to analyze engineering problems.

Course Outcomes:

Students will learn the definition of computer-aided design layout and 3D solid modeling.
Students will also acquire knowledge of design and drawing.

Students have to perform the following activities in lab:
Introduction to
CADCAD – Basics
Starting with CAD
SoftwareLayout and
sketching Drawing
environment Elements of
drawing
Draw
commands3D
functions
2D – Figures for practice using CAD Software
Isometric Drawing for practice using CAD
Software3-D Solid Figures using CAD Software

Program Name	1-year Certificate Course inDesign and 3D printing	Program Code	GCUMEC3DP
Course Name	Additive Manufacturing Lab-I	Course Code	C3DP-104
Credits	2	No. of hours/ Week	2
Duration of Endterm examination	3 hrs	Max. marks	Prac: 35 IA: 15

Course Objectives:

After completing this course, students should be able to describe additive manufacturing andexplain its advantages and disadvantages

Course Outcomes:
- Students will be able to choose between subtractive and additive manufacturing processes for specific applications. He or she may choose a specific AM process.
- Students will be able to pursue careers in research or advanced manufacturing, a rapidlygrowing and widely applied field.
- Designed to train students in engineering product development Components and entrepreneurship. He will be able to use RE for added value and coin duplication.

Students have to perform the following activities in lab:

Slicing Software basics-I. Setting up the build temperature, nozzle temperature, speed, material,layer height

Slicing Software basics-II Setting up infill density, infill pattern, orientation of object, supportmaterial wall thickness, converting .stl file to G-code file etc.

Download a .stl file of simple object from internet, convert into G- code and print with FDM 3D Printer at 30% infill density.

Download a .stl file of simple object which require support material from internet, convert intoG-code and print with FDM 3D Printer.

Make a cube of any dimension using FDM 3D Printer.

Semester- II

Program Name	1-year Certificate Course in Design and 3D printing	Program Code	GCUMEC3DP
Course Name	Additive Manufacturing	Course Code	C3DP -201
Credits	4	No. of hours/Week	4
Duration of End term examination	03 hrs	Max. marks	Th: 70 IA: 30

Note: Examiner will set seven questions in total. Question one will have 10 parts of 1 mark each from all units and remaining six questions of 15 marks each to be set from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

Fundamentals focuses on the basics of additive manufacturing, including a comprehensive overview of additive manufacturing, various additive manufacturing techniques, and basic safety guidelines. The foundation course is ideal for people working or looking to work in additive manufacturing in industries. It is also ideal for high school and college as a cornerstone or standalone achievement in workforce preparation.

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 of Additive Manufacturing; 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; Automated Fabrication, Freeform Fabrication or Solid Free form Fabrication, Additive Manufacturing or Layer-based Manufacturing , Stereolithography or 3D Printing, Rapid Prototyping, The Benefits of AM

Unit 2:

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

Unit 3:

Additive Manufacturing Techniques

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

Reference Books

Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer

Manu Srivastava, Sandeep Rathee, Sachin Maheshwari, TK Kundra, Additive Manufacturing Fundamentals and Advancements CRC press

Program Name	1-year Certificate Course in Design and 3D printing	Program Code	GCUMEC3DP
Course Name	Design, Technology and Innovation (MOOC)	Course Code	C3DP-202
Credits	4	No. of hours/ Week	4
Duration of End term examination	03 hrs	Max. marks	Th: 70 IA: 30

Note: Examiner will set seven questions in total. Question one will have 10 parts of 1 mark each from all units and remaining six questions of 15 marks each to be set from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Course Objectives:

Design becomes an empowering skill, giving people the ability to deal with uncertainty, complexity, and failure. In this course, we show how you can use design as a way of thinking to your strategic advantage and innovate in your business

Course Outcomes:

Design Technology aims to develop internationally minded people whose deep understanding of design and the tech world can facilitate our joint guidance of the planet and creating 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 Certificate Course inDesign and 3D printing	Program Code	GCUMEC3DP
Course Name	Advance CAD Lab	Course Code	C3DP-203
Credits	2	No. of hours/ Week	2
Duration of End term examination	3hrs	Max. marks	Prac: 35 IA: 15

Course Objectives:

The course aims to expose and improve the knowledge and skills of students related to the use ofCNC machines, CAD/CAM packages and for those who want to train others in the field.

Course Outcomes:

Students acquire and apply knowledge of advanced CAD concepts and techniques using advanced CAD systems.

Students have to perform the following activities in lab:

Introduction to Fusion 360/

OnshapeSketching

Learning Different Operations like Revolve, Sweep, Part

ModellingDrawing Assembling

Program Name	1-year Certificate Course inDesign and 3D printing	Program Code	GCUME C3DP
Course Name	Additive Manufacturing Lab-II	Course Code	C3DP-204
Credits	2	No. of hours/Week	2
Duration of End term examination	3 hrs	Max. marks	Prac: 35 IA: 15

Course Objectives:

The goal of this course in additive manufacturing (AM) is to introduce students to a rapidly evolving and widely used technology. It aims to introduce students to the technologies of conceptual modeling, rapid prototyping, and manufacturing. It also aims to introduce reverse engineering (RE). It aims to impart detailed knowledge of the wide applications of AM in industry and society; and especially key AM applications such as rapid instrumentation, medical AM and rapid manufacturing.

Course Outcomes:

The course provides hands-on training in fundamental additive manufacturing technologies.

Fused deposition modeling (FDM) is commonly used for modeling, prototyping, and manufacturing applications. Those trained in digital manufacturing (3D printing, 3D scanning) will have new skills directly related to the following industry.

Students have to perform the following activities in lab:

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