COURSE PROSPECTUS

Name of the Group: *CAD/CAM*
Name of the Course: *P.G. Diploma Course on 3D Printing/ Additive Manufacturing*
Course Code: *CAD 500*
Starting Date: 19th Sep 2022
Duration: *24 Weeks – 720 Hours (@6 hours/day)*
Course Coordinator: *Harikrishnan KR, Project Engineer, Mob: 9633890696*
No. of Seats: *12*

Preamble: 3D Printing/ Additive Manufacturing is an emerging technology which could develop Physical Products directly from a CAD Model. This technology has variety of applications in Engineering, Medicine, Fashion, etc. This PG Diploma Program will provide the complete insight about this technology. On completion of this program, the candidate can choose the best technology based on its application and could comply with all the works related with the process chain.

Objective of the Course: The course is aimed to create a skilled manpower in the field of 3D Printing/ Additive Manufacturing with knowledge about various additive manufacturing technologies, Design for Additive Manufacturing, Post Processing and Reverse Engineering. The course is structured in a way to create a skilled man power as required by "National Strategy for Additive Manufacturing" document.

Outcome of the Course: By the end of this course, the learner will be able to
  ➤ Create designs using CAD software or reverse engineering which is required for 3D Printing/ Additive Manufacturing.
  ➤ Conduct slicing operation and develop the numerical codes required for performing the build operation.
  ➤ Implement various Design for Additive Manufacturing Tools to generate a part which has better performance.
  ➤ Choose the best technology to build a part based on the application.
  ➤ Conduct various post processing operations on a part to get the required specifications.

Expected Job Roles:

  • Application Engineer (3DP/AM)
  • Product Engineer (3DP/AM)
  • DfAM Engineer (3DP/AM)
  • Manager/ Deputy Manager/ Sr. Manager (3DP/AM)
  • Engineer/ Sr Engineer/ Lead Engineer/ Project Engineer (3DP/AM)
  • Consultant/ Senior Consultant (3DP/AM)

National Institute of Electronics and Information Technology, Calicut

Course Structure:

S. No.	Module Title	Duration			Credits	
		Theory	Practical	Total	Theory	Practical
1	Introduction to Additive Manufacturing and CAD Modeling	15	45	60	0.63	0.94
2	Additive Manufacturing Technologies	45	0	45	1.88	0
3	Material Extrusion in Detail	30	45	75	1.25	0.94
4	Powder Bed Fusion in Detail	30	45	75	1.25	0.94
5	Vat Photo Polymerization in Detail	30	45	75	1.25	0.94
6	Design for Additive Manufacturing	15	45	60	0.63	0.94
7	Practical Topology Optimization for Additive Manufacturing	15	60	75	0.63	1.25
8	Post Processing and Applications	30	30	60	1.25	0.63
9	Reverse Engineering	30	45	75	1.25	0.94
10	Project Work	18	72	90	0.75	1.50
11	Interpersonal skills	30	0	30	1.25	0
	Total Duration/Credits	**288**	**432**	**720**	**21**	

Other Contents

I. Course Fees:

General Candidates: Course fee is Rs. 60,000/- + all taxes as applicable

SC/ST Candidates :**Limited seats are reserved for SC/ST candidates as per Govt. of India norms on merit basis, and tuition fee is waived for these candidates.**

However they are required to remit an amount of **Rs. 6,000/- as Advance caution/security deposit**. This amount will be considered as caution/security deposit and will be refunded after successful completion of the course. If the student fails to complete the course successfully, this amount along with any other caution/security deposits by the student will be forfeited.

Module wise Course Fee:

Modular admission is also possible

Module & Course Code		Module Name	Duration (Weeks)	Fees (for Other candidates)	Payable by SC/ST candidates admitted under reservation quota	Prerequisite
CAD 500: P.G. Diploma Course on 3D Printing/ Additive Manufacturing						
Module I	*AM 001*	*Introduction to Additive Manufacturing and CAD Modeling*	*2 Weeks – 60 Hours (@6 hours/day)*	*Rs.5000/- + all taxes as applicable*	*Rs.500/-* (refundable after successful completion of course)	*Nil*
Module II	*AM 002*	*Additive Manufacturing Technologies*	*1.5 Weeks – 45 Hours (@6 hours/day)*	*Rs.3750/-+ all taxes as applicable*	*Rs.375/-* (refundable after successful completion of course)	AM001
Module III	*AM 003*	*Material Extrusion in Detail*	*2.5 Weeks – 75 Hours (@6 hours/day)*	*Rs.6250/-+ all taxes as applicable*	*Rs.625/-* (refundable after successful completion course)	AM001
Module IV	*AM 004*	*Powder Bed Fusion in Detail*	*2.5 Weeks – 75 Hours (@6 hours/day)*	*Rs. 6250/-+ all taxes as applicable*	*Rs.625/-* (refundable after successful completion of course)	AM001
Module V	*AM 005*	*Vat Photo Polymerization in Detail*	*2.5 Weeks – 75 Hours (@6 hours/day)*	*Rs. 6250/-+ all taxes as applicable*	*Rs.625/-* (refundable after successful completion of course)	AM001
Module VI	*AM 006*	*Design for Additive Manufacturing*	*2 Weeks – 60 Hours (@6 hours/day)*	*Rs.5000/-+ all taxes as applicable*	*Rs.500/-* (refundable after successful completion of course)	AM001, AM002
Module VII	*AM007*	*Practical Topology Optimization for Additive Manufacturing*	*2.5 Weeks – 75 Hours (@6 hours/day)*	*Rs. 6250/-+ all taxes as applicable*	*Rs.625/-* (refundable after successful completion of course)	AM001
Module VIII	*AM008*	*Post Processing*	*2 Weeks – 60 Hours*	*Rs. 5000/-+ all taxes as*	*Rs.500/-* (refundable after	AM001, AM002

		and Applications	*(@6 hours/day)*	*applicable*	successful completion of course)	
Module IX	*AM009*	*Reverse Engineering*	*2.5 Weeks – 75 Hours (@6 hours/day)*	*Rs. 6250/-+ all taxes as applicable*	*Rs.625/-* (refundable after successful completion of course)	Nil
Module X	*AM010*	*Project Work*	*3 Weeks – 90 Hours (@6 hours/day)*	*Rs. 7500/-+ all taxes as applicable*	*Rs.750/-* (refundable after successful completion of course)	AM001 + AM002 + (AM003/ AM004/ AM005)+ (AM006/ AM007)+ AM008
Module XI	*IS 001*	*Interpersonal skills*	*1 Week – 30 Hours (@6 hours/day)*	*Rs. 2500/-+ all taxes as applicable*	*Rs.250/-* (refundable after successful completion of course)	Nil

II. **Registration Fee:** An amount of Rs.1000/- (includingall taxes as applicable)(nonrefundable) should be paid at the time of registering for the course.

This fee shall be considered as part of course fee, if the student joins the course. If a student register and pay for more than one course and join for any one course, all such amount will be adjusted against the course fee payable.

If the student does not join for the registered course / any of the registered courses, fee paid shall be forfeited.

For SC/ST candidates admitted under reservation quota, the registration fee is Rs.500/- and will be considered as part of caution/security deposit and will be refunded after successful completion of the course. If the candidate does not join or fails to complete the course the amount will be forfeited

For all other candidates the registration fee shall be Rs. 1000/-

However above the registration fee shall be refunded onfewspecial cases as given below

➢ Course postponed and new date is not convenient for the student
➢ Course cancelled in advance, well before the admission date

III. Course Fee Installment Structure:

Students can pay the full fees of *Rs. 70,800/- (Rs.60,000/- + all taxes as applicable*) in advance or as installments as given below

Fees	*Amount for Other Candidates	Amount for SC/ST Candidates admitted under reservation quota (considered as caution/ security deposit)	Due Date (on or before)
Registration Fee	Rs.1000/-	Rs.500/-	During Registration
1st Installment	*Rs. 41,300/-*	*Rs.6,000/-*	*19/09/2022*
2nd Installment	*Rs. 29,500/-*	Nil	*02/11/2022*
Total Fee	*Rs. 70,800/-*	*Rs. 6,000/-* (refundable after successful completion of course)	Nil

*Above fees is inclusive *CGST* 9% and SGST 9% and revision, if any by Government shall be applicable at the time of payment.

Fine will be applicable for late fee payment.

IV. Eligibility:B.E/ B.Tech in Mechanical Engineering/ Equivalent (*Final year students also may apply) *Certificate will be issued only after successful completion of the mentioned Eligibility Criteria.*

V. Number of Seats :*12*

VI. Selection of candidates :The candidates passed in the qualifying examination will be based on their marks obtained, subject to eligibility and availability of seats

VII. Test/Interview: *Not Applicable*

VIII. Counseling/Admission :Starting date of the course

IX. Important Dates (if applicable) :

Starting date:	**19.09.22**
Last date to submit application form:	**11.09.22**
Selection intimation in website:	**13.09.22**
Counseling/Admission	**19.09.22**
Commencement of class work:	**19.09.22**
Payment of Fee	**19.09.22**

X. Course Timings :10:00 Hrs to 17:00 Hrs (13:00 Hrs to 14:00 Hrs Lunch break) (Excl Saturdays, Sundays and National Holidays)

XI. Placement :Support shall be provided

XII. Lab Facilities: Air-conditioned lab consists of Ultimaker 3-D Printer, Formlabs SLA Printer and Accessory units, 3-D Scanner, PCs, Classroom Facilities, Basic Workshop facilities, 3-D Experience, CURA, Preform, EIGER, Free CAD, Netfabb, ANSYS.

XIII. Course Contents :

Course Brief – CAD500 P. G. Diploma Course on 3D Printing/ Additive Manufacturing

3D printing/ Additive Manufacturing (3DP/AM) is an emerging technology in the next generation manufacturing. This course on 3DP/AM is going to deal from the basic principles, various technologies to current research trends in the technology. 3DP/AM produces objects layer by layer by using the design data created either by Computer Aided Design software or Reverse Engineering. This technology has a higher potential when compared to the existing technologies like, design freedom, minimal lead time and reducing gap between supply and demand.

American Society for Testing Machines (ASTM) - F2792-12a has classified 3DP/AM in to 7 main classifications; they are Material Extrusion, Vat Photo polymerization, Sheet Lamination, Binder Jetting, Material Jetting, Powder Bed Fusion and Direct Energy Deposition. This course will give the learner, a wide range of knowledge on all the 3DP/AM technologies and its applications. Also it will give a detailed knowledge about advanced slicing setting, machine maintenance, calibration, etc. on technologies like Material Extrusion, Vat Photo Polymerization and Powder Bed Fusion.

This 3DP/AM technology requires effective skill in the area of Design for Additive Manufacturing (DfAM) which consists of various tools like Topology Optimization, Generative Design etc., to develop designs which can improve the performance and efficiency of the part in its end use.

Apart from building the part, there is a step called Post Processing, which is used to convert the part into a usable one. Here the part undergoes various post processing steps like removal of support structure, surface texture improvements, aesthetic improvements, etc.

3D PRINTING/ ADDITIVE MANUFACTURING
The contents of the modules are listed below:

Introduction to Additive Manufacturing and Process Chain – 60 Hrs
"Introduction: Introduction to the Basic Principles of Additive Manufacturing, AM evolution, Distinction between AM & CNC machining, Advantages of AM, AM around the world.
AM Process Chain: Conceptualization and CAD, Conversion to STL, Slicing, Transfer to AM Machine, Machine Setup, Build, Removal and Cleanup, Post Processing, Application.
CAD Modeling: Sketching, Part Design, Assembly Design, Drafting.

Additive Manufacturing Technologies – 45 Hrs
ASTM Classification: Material Extrusion, VAT Photopolymerization, Sheet Lamination, Binder Jetting, Material Jetting, Powder Bed Fusion, Direct Energy Deposition. Construction, Working, Materials Used, Process Chain, Slicing, Accuracy, Speed, Applications, Limitations

Material Extrusion in Detail – 75 Hrs

Introduction, Basic Principles, Various Constructions, Configuration of Electronic Components, Firmware Installation, Printer Settings and Calibration, Print settings and calibration, Dual Extrusion, Bio Extrusion.

Powder Bed Fusion in Detail – 75 Hrs

Introduction, Materials, Powder Fusion Mechanisms, Process Parameter and Modeling, Powder Handling, Process variants and Commercial Machines, Process Benefits and Limitations.

Vat Photo Polymerization in Detail – 75 Hrs

Introduction, Materials, Reaction Rates, Laser Scan, Process Modeling, Vector Scan VP Machines, Scan Patterns, Vector Scan Micro Vat Photopolymerization, Mask Projection VP Technologies and Processes, Two Photon Vat Photopolymerization, Process Benefits and Limitations.

Design for Additive Manufacturing – 60 Hrs

Introduction: Motivation, Design for Manufacturing and Assembly, AM Unique Capabilities, Core DFAM Concepts and Objectives, Exploring Design Freedom, Topology Optimization, Optimal Light Weight Structures. General DFAM Methods: Part Orientation, Removal of Support, Hollowing out Parts, Inclusion of Undercuts and other Manufacturing constraining Features, Interlocking Features, Reduction of Part count in an Assembly, Identification Markings/ Numbers. Guidelines for Process Selection: Introduction, Selection method for a part, Challenges of Selection, Preliminary Selection, Production Planning and Control.

Practical Topology Optimization for Additive Manufacturing – 75 Hrs

Overview of homogenization method Indicator function, SIMP, and other parameterization methods for topology optimization. Numerical methods used to solve topology optimization problems including optimality criteria method, convex linearization, method of moving asymptotes, etc. Sensitivity analysis including parameter and shape derivatives; Material and spatial derivatives Multiphysics problems in topology optimization

Post Processing and Applications – 60 Hrs

Post Processing: Introduction, Support Material Removal, Surface Texture Improvements, Accuracy Improvements, Aesthetic Improvements, Preparation for use as a pattern, Property enhancement using non thermal techniques, Property enhancement using thermal techniques. Applications: Functional Testing Models, Rapid Tooling, Surgical and Diagnostic Aids, Prosthetics Development, Medical Model Manufacturing, Tissue Engineering and Organ Printing, Aerospace Applications, Dental Applications, Automotive Applications, Remanufacturing.

Reverse Engineering – 75 Hrs

Objectives and common application fields, Existing technologies, Contact systems, Non-contact systems (3D Scanners, Blue light, white light etc,), CT for scan of medical and industrial applications, Principles of scanning, scanning devices, and scanning techniques, Manipulation of acquired data, Practical experiences, Introduction to the Basic Principles of Additive Manufacturing.

Interpersonal Skills and Entrepreneurship – 30 Hrs

Effective Communication, Development competency, Proficiency in English, Self & time management, Motivation techniques, interpersonal Skill development, Computer literacy, Life skills, Entrepreneurship, Occupational safety, Health and Environment- Education.

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