

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

2021-2022 SEM-I

Course	: TA201 Manufacturing Processes I
Credits	: (1-0-3-0) 6
Instructor	: Dr. Shashank Shekhar
Lecture Hours	: Lectures will be asynchronous (1 hr video each week)
Lecture Discussion	: Tuesday 9.00 am – 10.00 am
Lecture Link	: Online (Discussion through Zoom: Click Here)
Contact	: WL304A // Ph: 6528 // email: shashank@iitk.ac.in
Course Webpage	: https://hello.iitk.ac.in/index.php/course/ta201a21

Lab Hours (Online) : Monday to Friday (2pm to 5pm) (Details of sections are given later)

For first three turns, videos related to the particular turn would be uploaded on course website, and students must watch this video before coming to the lab discussion session.
(Starts 9th Aug, Monday)

Lab Discussion Link : Individual Tutors will share the lab discussion link with their section

GRADING SCHEME:

Theory: 50

Assignments	: 15 (1.5 X 10)
Quiz	: 15 (5 X 3)
Lecture Attendance	: 06 (0.5 X 12)
*Endsem Exam	: 14

Lab: 50

Part Fabrication	: 12 (3 X 4)
Lab Attendance	: 11 (1 X 11)
*Group Project (Design)	: 12
Fabrication Project	: 15

Pass Percentage : **40%**

[*Endsem exam and contribution to Group Project are mandatory components of the course]

Quiz Dates: Quiz-1 24th Aug; Quiz-2 21st Sep; Quiz-3 26th Oct;

THEORY COMPONENT

Video Lectures: Video lectures for the coming week would be uploaded after the lecture discussion hour. These video lectures also contain ‘in-video’ questions which students should try to answer based on the content. These questions are only to assess formative learning and do not contribute to the final grade. However, watching all the lectures is important and will help in solving assignments.

Attendance and Discussion: Attendance during lecture discussion and lab discussion session is compulsory. Please join lecture session by 9.00am. Missing more than one lab turns (out of first six turns) would result in automatic Fail grade or de-registration (except for genuine medical reasons). Overall students should not miss more than two lab turns. Other things to keep in mind for the online discussion session:

- *Login using IITK email ID*
- *Students must be present for most of the session to get their attendance counted*
- *Change your name on the zoom to “S#_Gr#_Name” (where S and Gr represent Section and Gr and # represents respective no.)*

Unfair Means: Any use of unfair means (in project or assignment or exam) would lead to automatic ‘F’ grade. It is individual’s responsibility to ensure that other students do not copy from them. If unfair means is found, then all parties involved will be penalized.

Assignments: Assignments would be given on weekly basis for assessment of formative learning. Students are encouraged to discuss concepts and theories with other students, but assignments must be completed individually and with due diligence. It must be completed and submitted before the end of the corresponding week. These assignments will not be available beyond the deadline. Assignments will be checked automatically (for objective type questions) and marks would be released at the end of week.

Quizzes: Three quizzes would be conducted through the semester. These quizzes will be conducted on [Codetantra](#) platform. All the contents covered since previous quiz will form the syllabus of these quizzes. These quizzes ensure continuous evaluation of the learning process.

Endsem: Endsem exam will be conducted as per the DOAA schedule. This will be the summative learning evaluation, based on the overall contents covered in the course. This exam will also be conducted on [Codetantra](#) platform. If the evaluation mechanism is changed due to some reasons, an announcement will be made at least two weeks in advance.

OBJECTIVES OF THE COURSE:

- ✓ To discuss and demonstrate fundamental manufacturing processes:
 - casting/ solidification
 - metal working/ metal forming
 - welding and heat treatment
 - powder metallurgical processes
 - plastic injection moulding
- ✓ At the end of the course, whenever you look at a component, you should be able to answer questions like:
 - What are the primary techniques used in the manufacture of this component
 - What material was used for this product
 - What process was used
- ✓ Hands-on experience
- ✓ Craftsmanship

References

1. Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Mikell P. Groover (**Main Reference Book**)
2. Manufacturing Engineering and Technology, S. Kalpakjian (e-book available from IITK Library website) (access using VPN)

COURSE CONTENTS AND WEEK-WISE DISTRIBUTION:

Lecture No.	Topics
1/ 2	Introduction to Manufacturing:
	Classification; Historical Perspective
3/ 4/ 5	Engineering Materials:
	Engineering Materials – Classification
	Structure of Materials
	Types of Materials
	Properties of Materials
	Microstructure-property inter-relationship
6/ 7	Casting / Solidification:
	Classifications of casting processes
	Patterns, core making,
	Sprue and Riser design, Fluidity, Shrinkage
	Casting defects
	Other types of casting
8/ 9	Joining Processes:
	Fusion welding: Arc (MMAW, SAW, SMAW), Gas welding and resistance welding, Other fusion welding techniques
	Fusion zone, Heat affected zone (HAZ)
	Brazing and Soldering
	Adhesive joining
	Mechanical fastening
10/ 11	Metal Forming
	Bulk deformation, Sheet metalworking
	Strain and flow stress
	Temperature in metal forming, Effect of strain-rate
	Rolling – classification, roll camber, defects
	Forging (open and closed-die), Extrusion
	Defects
Shearing, blanking, punching	
12/ 13	Powder Metallurgy
	Plastic Injection Moulding

Laboratory Component

INSTRUCTOR: DR. SHASHANK SHEKHAR (6528/ *shashank*)

COURSE STAFF-IN-CHARGE: MR. INDRA PAL SINGH (7978/ *indraps*)

LAB IN-CHARGE: MR. ANIL KUMAR VERMA (7978/ *akumarv*)

TUTOR AND TAs FOR VARIOUS SECTIONS

		Tutor	TA1	TA2
Monday	S1	Shashank Shekhar (shashank/ 6528)	Akash Yadav (ayadav20)	Jhili Sen (jhisen20)
	S2	Niraj Chawake (nchawake/ 2181)	Sandeep Sahni (ssahni)	Ankush Ghosh (ankush20)
Tuesday	S3	Kantesh Balani (Kbalani/ 6194)	Arijit Samaddar (arijit20)	Shalini Kushwaha (shalinih)
	S4	Sourav Ghosh (gsourav)	Pratik Pradhan (pratik20)	Rajesh Behera (rajeshkb20)
Wednesday	S5	Vivek Verma (vverma/ 6527)	Anant Srivastava (anantsr)	Shruti Srivastava (shrutis20)
	S6	Shikhar Jha (skjha/ 2094)	Sushrita Dash (sushdash20)	Md Redad Mehdi (mohommadm20)
Thursday	S7	Navindra (navindra/ 7342)	Kaushal Rajendra (kashakya)	Pritam Ghosh (pritamg20)
	S8	Nilesh Badwe (nbadwe/ 2205)	Gulnaz Parween (gulnazp20)	Sudipta Maity (diptamars20)
Friday	S9	Krishanu Biswas (kbiswas/ 6184)	Nimish Khandelwal (nimishk20)	Hima Shankar Anagani (himasiva20)
	S10	Sushanshu S. Singh (sudhanss/ 6908)	Abhinav Garg (abhinavg20)	Amit Tiwari (amittiwari20)
		Instructor	Nadeem Bhat (nadeemb)	Ajay Singh (ajaysgh)

STAFF MEMBERS:

Sections	Staff Members
S1, S3, S5, S7, S9	A K Verma + Gaurav Mishra
S2, S4, S6, S8, S10	IP Singh + Rakesh Dixit

Safety First: Safety is paramount when working at home. While working on the project from home, please ensure that you have worn gloves and taken other safety measures. Ensure not to wear loosely hanging clothes, while fabricating these components. Strictly, do not perform operations which need strict supervision, like welding and brazing, on your own. PLEASE ENSURE SAFETY, AT ALL TIMES. Do not take anything for granted.

LAB-TURNS AND TASKS

	Process Demo	Fabrication demo	Group Project	Fabrication Project
Lab-1	1a: Casting; 1b: Welding;	1a: Wax casting; 1b: Adhesive joining;		
Lab-2	2a: Sheet-Metal Working; 2b: Forging;	2a: Object fabrication; 2b: Shaping of hemisphere;	Idea Discussion	
Lab-3	3: Brazing	3a: Riveting; 3b: Hinge making;	Idea Finalization	
Lab-4			Isometric drawing of the assembly with list of parts and processes	
Lab-5			Isometric drawing and engineering drawing of all the parts	
Lab-6			Short presentation to the group and final submission	Initial discussion of idea
Lab-7				Finalization of idea/ Major part fabrication
Lab-8				Major/ Minor part fabrication
Lab-9				Minor part fabrication
Lab-10				Assembly / Engineering Drawing
Lab-11				Short presentation to the group and final submission
evaluation				2 to 2.30 minute video of each project evaluation by 5 member Tutor team

Materials and Tools: Some of the materials and tools which will come in handy for the course are listed below. It is advised that you arrange these before the start of the lab.

Materials:

1. Spoke of cycle or mild steel rod of 2-3 mm diameter (3-4 no.)
2. Aluminum foil (available at grocery store)
3. Coca-cola or pepsi can (to be used as sheet metal)
4. Small plastic bottle (to be used for making mould)
5. River sand and yellow clay (if not able to arrange, then use mud from backyard)
6. Nuts, bolts
7. Adhesives (Fevi-quick and M-Seal OR similar) (included on 4th Aug 2021)

Tools:

1. Scale/ Ruler
2. Sketch pen or permanent marker
3. Normal Scissor
4. Normal Gloves
5. Pliers
6. Light weight ball pen hammer

Lab Discussion Link

All the zoom links are put up in Resource on course website.

ABOUT DESIGN PROJECT

About Group formation: This is a group project, with about 7-9 students in each group. The groups would be formed by Instructor. The groups would be numbered M1G1, M1G2.... M1G8 (for Monday Section-1), M2G1, M2G2.... M2G8 (for Monday Section-2), T3G1, T3G2....T3G8 (for Tuesday Section-3) and F10G1, F10G2...F10G8 (for Friday Section-10), etc.

Objective of the project: The goal of the project is to showcase your understanding of the various manufacturing techniques taught to you in the lab in the form of a design project. The idea is to design models of things which can be fabricated in the lab using materials available in the lab. The list of the materials available in the lab, would be provided to you, so that you can accordingly select appropriate materials for various parts. The processes should also be simple which can be carried out in the lab. This project is NOT about exploring the actual manufacturing techniques of things like Automobile, Refrigerator, Washing Machine etc. These are contents for courses on advanced manufacturing techniques.

Task:

1. Each group is expected to come up with at least three designs, based on their internal discussion amongst their group members. These design projects can be static or dynamic model. Some sample design projects, from summer course, would be made available in the resource section of the course website
2. One design idea would be finalized based on discussion with Tutor + Lab staff + Tas
3. Groups need to prepare an isometric drawing of the overall assembly (of the project) and identify various parts or components of the assembly
4. Engineering drawing of all components have to be prepared
5. Select material and process for manufacturing of each component and also identify the joining techniques to be employed

Participation:

It is expected that all members would contribute to the project. Tutors will identify in the group discussion if some members are not actively participating. Such students will be penalized in terms of marks or can even be de-registered for not participating in the course.

Complexity:

The project should have sufficient complexity in terms of number of parts, so that each member can contribute significantly. At the same time, it is advisable to not to aim for too difficult things, and ensure that the project can be completed in time.

Constraints:

- The overall dimensions of the project should be such that it can fit inside a cuboid of 50cm X 50cm X 50cm.
- The overall weight of the project, if fabricated, should not exceed 10 Kgs.
- At least three manufacturing operations should be incorporated in the project

Material List:

The list of materials that students can assume to be available, is attached as Appendix-A. Parts must be designed using only these materials. Non-metallic material parts should not exceed 5%.

Plagiarism:

Plagiarised reports or drawings will be dealt with severely. You are encouraged to get inspiration and ideas from real things and also from internet. However, do not copy and present those things as your own.

Project Report Expectation: The project report should contain following details:

- Isometric drawing of the overall assembly with individual parts clearly marked
- Table of contents
- Engineering drawing with dimensions for important components
- Exploded view of complex parts
- Materials being used for each component
- Processes and the joining technique being used for each component
- Turn-wise work distribution
- Member-wise work distribution
- Cost analysis
- Sustainability and environmental impact analysis

Evaluation:

A short presentation (about 5 minutes) is to be made to the Tutor + TA + Staff member in 6th turn. After incorporating their suggestions, the report is to be submitted by midnight of the same day. There will be 50% weightage on the weekly progress of your project, which will be evaluated by your Tutor. Remaining 50% weightage will be evaluated by a panel of Tutors who will go through your project report (doc or PPT file). You are also allowed to include any supplementary material like animation of your project, only if it is created by you.

Images of sample project which were fabricated by students in the earlier lab sessions:



ABOUT FABRICATION PROJECT:

Objective: The objective of this project is to bring out creativity and craftsmanship of the students, while utilizing the understanding of manufacturing techniques. In this project, students are expected to utilize scrap materials at home or elsewhere that they can find, and use them to fabricate a model on their own. It can be a static model, as well as, a dynamic model.

Constraints: Since the course is about metallurgical manufacturing techniques, use primarily metal parts. The project should not have more than 10% non-metallic components in it. Additionally, wax components made by casting can also be included, upto 20% of the project. The size constraint for this project is liberal and left to the students. It is suggested that the project should neither be too large, nor too small.

Safety First: Safety is paramount when working at home. While working on the project from home, please ensure that you have worn gloves and taken other safety measures. Ensure not to wear loosely hanging clothes, while fabricating some of these components. Strictly, do not perform operations which need **experienced operators, like welding, brazing and soldering, on your own.** Even if someone else is performing these tasks for you, make sure that you stay at safe distance while these operations are being carried out. PLEASE ENSURE SAFETY AT ALL TIMES. Do not take anything for granted.

Report: Students have to create a 2 to 2:30 minute video to showcase their work. The video should include pictures of important stages of the project fabrication, and highlight the challenges that you overcame in finishing the project.

Evaluation: A short presentation is to be made to the Tutor + TA + Staff member in 11th turn. After incorporating their suggestions, the video report (2 to 2:30 minutes) is to be submitted by midnight of the same day. There will be 50% weightage on the weekly progress of your project, which will be evaluated by your Tutor. Remaining 50% weightage will be evaluated by a panel of Tutors who will go through your video presentation.

Sources for Inspiration:

<https://iitk->

my.sharepoint.com/:f:/g/personal/shashank_iitk_ac_in/ErUxq2GeDu5Ehk_Ctc_gi-

oBW9LoRihpAAanzJlNXc6MILg?e=PK8R2E

[Scrap Art in Chennai](#)

[Do-it-your project ideas](#)

[Metal Art](#)

Expected Timeline of the project:

Turn #7: Finalization of Idea

Turn #8: Major part fabrication

Turn #9: Minor part fabrication

Turn #10: Assembly/ Engineering Drawing

Turn #11: Short presentation to the Tutor + TA + Staff members. Final video report to be submitted by midnight of the same day.

Regarding help from outside:

- a. The project should not have more than 20% help from outside
- b. The final video presentation must clearly highlight the work of the student, and distinguish it from the work done by outside help
- c. Project will be scored primarily only on the amount of work done by students and not for the work done by outside help
- d. It is suggested that the outside help is limited to joining of parts, (eg. Welding, brazing, soldering) which cannot be done by students at home

TA201 LABORATORY SCHEDULE (2021-2022, SEMESTER-I)

Turn	1 Turn	2 Turn	3 Turn	4 Turn	5 Turn	6 Turn	7 Turn	8 Turn	9 Turn	10 Turn	11 Turn	12 Turn
Day	Casting/ Welding (Wax Casting)	Metal working (Fabrication)	Brazing (Joining)									Evaluation of Fabrication project
		Idea Discussion	Idea Finalization	Isometric drawing of assembly	Isometric drawing of all parts	Short presentation/ submission						
						Initial Idea discussion	Finalization of idea/ Major part	Major/ Minor part fabrication	Minor part fabrication	Assembly/ Engineering Drawing	Short presentation/ submission	
Monday	9 Aug	16 Aug	23 Aug	6 Sep	20 Sep	27 Sep	4 Oct	18 Oct	25 Oct	1 Nov	8 Nov	15 Nov
Tuesday	10 Aug	17 Aug	24 Aug	31 Aug	7 Sep	21 Sep	28 Sep	5 Oct	26 Oct	2 Nov	9 Nov	16 Nov
Wednesday	11 Aug	18 Aug	25 Aug	1 Sep	8 Sep	22 Sep	29 Sep	6 Oct	20 Oct	27 Oct	3 Nov	17 Nov
Thursday	12 Aug	21 Aug	26 Aug	2 Sep	9 Sep	23 Sep	30 Sep	7 Oct	21 Oct	28 Oct	11 Nov	18 Nov
Friday	13 Aug	20 Aug	27 Aug	3 Sep	10 Sep	24 Sep	1 Oct	8 Oct	22 Oct	29 Oct	5 Nov	12 Nov

Make-up Lab for Thursday: 21st Aug (Saturday)

Independence Day	15 th August 2021	Id	19 th October 2021
Muharram	19 th August 2021	Deepavali	4 th November 2021
Janmashtami	30 th August 2021	Midsem Exam	13 th Sep to 18 th Sep
Dussehra	15 th October 2021	Semester Break	9 th Oct to 17 th Oct

Appendix-A: Material List for Design Project

Sr. No.	Items	Size	Cost
1	Mild Steel Flat	25x3 mm	Rs.65/kg
2	Mild Steel Flat	25x5 mm	Rs.63/kg
3	Mild Steel Round Rod	25 mm dia	Rs.65/kg
4	Mild Steel Round Rod	10 mm dia	Rs.68/kg
5	Mild Steel Round Rod	8 mm dia	Rs.68/kg
6	Mild Steel Round Rod	6 mm dia	Rs.70/kg
7	Mild Steel Round Rod	5 mm dia	Rs.70/kg
8	Mild Steel Round Rod	4 mm dia	Rs.70/kg
9	Mild Steel Round Rod	3 mm dia	Rs.80/kg
10	Mild Steel Square Rod	10x10 mm	Rs.63/kg
11	Mild Steel Square Rod	6x6 mm	Rs.65/kg
12	Mild Steel Round Pipe	25 mm dia (1" dia)	Rs 450/20 ft length pipe
13	Mild Steel Round Pipe	18 mm dia (3/4" dia)	Rs 425/20 ft length pipe
14	Mild Steel Round Pipe	10 mm dia	Rs 300/20 ft length pipe
15	Mild Steel Square Pipe	25x25 mm	Rs 450/20 ft length pipe
16	Mild Steel Square Pipe	15x15 mm	Rs 300/20 ft length pipe
17	Mild Steel Angle	25x25 mm	Rs 450/20 ft length pipe
18	Mild Steel Disks	20,30,40,50,60,70mm dia x8-10mm Thick	Avg ~ Rs 20-25/disc
19	Galvanized Iron Sheet	0.35 mm	Rs 756/sheet
20	Galvanized Iron Sheet	0.5 mm	Rs 820/sheet
21	Mild Steel Sheet	0.5 mm	Rs 945/sheet
22	Mild Steel Sheet	0.7 mm	Rs 1058/sheet
23	Mild Steel Sheet	1.0 mm	Rs 1278/sheet
24	Mild Steel Sheet	2.0 mm	Rs 3090/sheet
25	Thermocol	1/2 inch	Rs 30/sheet
26	Thermocol	1 inch	Rs 65/sheet
27	Thermocol	1.5 inch	Rs 110/sheet
28	Thermocol	2 inch	Rs 160/sheet
29	Thermocol	3 inch	Rs 220/sheet
30	Fevicol	small size tube	Rs 5/tube
31	Sandpaper for thermocol	No. 80	Rs 7/sheet
32	Small Nut-Bolt with Mild steel Washer	-----	Avg ~ Rs 10/piece
33	Thin Galvanized Wire	1 mm and 2 mm dia	Rs 20/ meter
34	Aluminium & Cast iron	For casting	Rs 380/kg
35	Cast Iron for melting	Ingots	Rs. 75/ kg