

# INDIAN INSTITUTE OF TECHNOLOGY KANPUR

## 2022-2023 SEM-I

**Course** : TA201A Manufacturing Processes I  
**Credits** : (1-0-3-0) 6  
**Instructor** : Dr. Niraj Mohan Chawake  
**Lecture Hours** : Lectures will be synchronous  
**Lecture Discussion** : Tuesday 9:00 am – 10:00 am  
**Venue** : L-20

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**Contact** : Faculty Building 412 A // Ph: 2181 // email: [nchawake@iitk.ac.in](mailto:nchawake@iitk.ac.in)  
**Course Webpage** : <https://hello.iitk.ac.in/node/3242>

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**Lab Hours:** Monday to Friday (02:00 pm to 05:00 pm). For first lab five turns, E-1 to E-5, lab staff members will show you various manufacturing techniques (Starts 2<sup>nd</sup> Aug, Tuesday). Lab exam will be conducted on the 6<sup>th</sup> turn (will inform about it in the lab).

**Venue :** TA201(Engineering Metallurgy Lab)

### GRADING SCHEME:

#### **Theory: 40 % weightage of the total**

#Midsem Exam : 40 % of Theory  
\*Endsem Exam : 60 % of Theory

#### **Lab: 60% weightage of the total**

Weekly lab quiz : 10% of lab  
Weekly Job : 10% of lab  
Lab examination : 20% of lab  
Project Report : 10% of lab  
Project evaluation : 50% of lab

### IMPORTANT NOTES:

- There will be a total of 11 lectures starting from 02 August 2022
- Anyone attending 9 lectures or more will awarded 5% extra marks to theory component (unless scored 100%)
- Those attending all the labs will earn 5% extra marks in the lab component.
- No make-up lab will be provided for cultural/ sports activities or casual leaves.
- If you attend less than 10 labs, you will be deregistered from the course or will be awarded 'F' if the last date for deregistration is over.

- All the lab turns from E1 to E6 are mandatory. The only exception is medical emergency which must be approved by SUGC.
- Only SUGC approved medical cases will be given a makeup lab and any other kind of absence will automatically result in deregistration from the course.
- Absence from project turns (P1-P6) will invite a penalty of 10 marks in the project assuming that project is of 60 Marks (will be prorated appropriately).

**Pass Percentage : 40%**

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

[# No makeup for the midsem exam]

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## THEORY COMPONENT

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**Lectures:** The lectures will be synchronous. The lecture hours will be conducted on every Tuesday at 9:00 am- 10:00 am and venue of all the lecture will be L-20.

**Attendance and Discussion:** Attendance during lecture discussion and lab discussion session is compulsory. Please join lecture session by 9.00 am. Lab attendance is compulsory (except for genuine medical reasons).

**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.

**Midsem and Endsem:** Exams will be conducted as per the DOAA schedule. The exam will be conducted in offline mode. If the evaluation mechanism is changed due to some reasons, an announcement will be made in advance.

### OBJECTIVES OF THE COURSE:

- To discuss and demonstrate fundamental manufacturing processes:
  - casting/ solidification
  - metal working/ metal forming
  - welding/Joining process
  - Brazing/Joining process
  - Object fabrication

- 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 Books

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

Topics
<b>Introduction to Manufacturing:</b>
Classification; Historical Perspective
<b>Engineering Materials:</b>
Engineering Materials – Classification
Structure of Materials
Types of Materials
Properties of Materials
Microstructure-property inter-relationship
<b>Casting / Solidification:</b>
Classifications of casting processes
Patterns, core making,
Sprue and Riser design, Fluidity, Shrinkage
Casting defects
Other types of casting
<b>Joining Processes:</b>
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
<b>Metal Forming</b>
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
Powder Metallurgy
Plastic Injection Moulding

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## Laboratory Component

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**INSTRUCTOR:** DR. NIRAJ MOHAN CHAWAKE (2181/ *nchawake@*)

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

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

**SAFETY FIRST:** To avoid injury, the student must take the permission of the laboratory staff before handling any machine. Careless handling of machines may result in serious injury. Students must ensure that their work areas are clean and dry to avoid slipping. A leather apron and leather hand gloves will be issued to each student during Welding and Brazing exercises. Students not wearing the apron will not be permitted to work in the laboratory. At the end of each experiment, students must clear off all tools and materials from the work area. During Sheet Metal forming wearing cotton hand gloves must be compulsory. Students must come to the laboratory wearing (i) Trousers, (ii) Full-sleeve shirt/t-shirt and (iii) Closed shoes.

**PLEASE ENSURE SAFETY, AT ALL TIMES. DO NOT TAKE ANYTHING FOR GRANTED.**

### LAB-TURNS AND TASKS

Lab Turn	Experiments	Group Project
E-1	Moulding and Casting	
E-2	Sheet-Metal Forming	Project group formation
E-3	Welding Process	Bring a minimum of three project ideas along with the rough sketch. One project idea will be finalized on this turn
E-4	Brazing	Discussion on a finalized project with proper drawing as per engineering norms, including parts drawing (with numbering and materials)
E-5	Object Fabrication	A final discussion on drawing and process (Bring complete report)
LE-1	Lab Exam (Students will be given a task that need perform on the same day)	Final drawing submission.
P-1		Projects
P-2		Projects
P-3		Projects
P-4		Projects
P-5		Projects
P-6		Projects
P-7		Project Evaluation

## ABOUT GROUP PROJECT

**About Group formation:** This is a group project. The groups would be formed by the Instructor. The groups would be numbered MG1, MG2.... MG20 (for Monday), TG1, TG2....TG20 (for Tuesday), WG1, WG2.... WG20 (for Wednesday), ThG1, ThG2.... ThG20 (for Thursday), and FG1, FG2...FG20 (for Friday).

**Objective of the group project:** The goal of the group project is to showcase your understanding of the various manufacturing techniques taught to you in the lab. The idea is to fabricate the live project 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 group projects can be static or dynamic model. Some sample of the group projects, from previous semesters, is available in the lab.
2. One project 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:**

- Size of the project: 40 cm × 40 cm × 40 cm (to be strictly followed) and the total weight of the casting objects should not exceed 500 g (of aluminium) per project. Oversize/overweight projects will invite penalty in the project evaluation.
- Total project weight should not exceed 5 Kg.
- External colour/paint should not be used.
- Do not polish/grind cast component used in your project.
- 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.

**Evaluation:**

The group project evaluation will be done on Turn 13. Each group must bring the group project report.

## Outline of project report:

S. No.	Description	Page no.
1	Project name	1
2	Tutor name	
3	Staff supervisor	
4	Group No.:	
5	S No.      Roll no.      Name      Signature's	
6	Contents	2
7	Certificate about plagiarism (format to be obtained from the lab or course website.	3
8	Acknowledgement	4
9	Introduction	5
10	Motivation	6
11	Group member work distribution	7
12	Materials List	8
13	Isometric Drawing with numbering	9
14	Part Drawing (mm, page no.)	10.....
15	Cost estimation	.... xyz

## Point to be used in the project:

- The manufacturing process involve in each component of the final group project.
- You would learn basic of manufacturing techniques in this lab for example metal forming, casting, welding and brazing. Out of these, you must involve minimum three techniques in your project.
- Proper drawing should be made and submitted in consultation with tutor and lab staff.
- The part drawing should be made with appropriate dimensions.
- You must make isometric and part drawing with appropriate dimensions on A-4sheet.

## Project size:

- Size of the project: 40 cm × 40 cm × 40 cm (to be strictly followed) the total weight of the casting objects should not exceed 500 g (of aluminum) per project. Oversize/overweight projects will invite penalty in the project evaluation.
- Total project weight should not exceed 5 Kg.
- External colour/paint should not be used.
- Do not polish/grind cast component used in your project.



## About the project

1. Plan your project carefully. Do not make it unnecessarily complicated. The project has to be entirely your work. Laboratory staff (Technical guide) will provide only the guidelines. They will not make any part of your project.
2. Your tutor, lab in-charge and the technical staff will advise you on the design of your project.
3. There will be no extra lab turn for project.
4. The project groups will be formed and informed to you by the end of the **second lab turn**.
5. You should come with at least three ideas with the rough sketch on the **third lab turn** for the discussion and to be frozen one idea.
6. On the **fourth and fifth lab turns** you should come with all necessary information such as drawing; manufacturing process for each part etc. The drawing should be as per the engineering norms.
7. The copy of the final project drawing with material list and process plan (complete report) must be submitted on the **sixth lab turn**. You should select materials from the list only. (The list will be displayed on lab notice board).
8. The exact responsibilities of each group member should be specified.
9. Two best projects will be chosen from each day. There will be one overall best project award out of all the shortlisted projects. The certificates will be given to the students (winners) in a common gathering after project evolution.
10. Size of the project: 40 cm. × 40cm. × 40cm. (**to be followed strictly**) and total weight for casting objects should not exceed 500 g (of aluminium) per project. The oversized and over-weighted project will be imposed with negative marking.
11. Do not grind the aluminium parts of the project.
12. At least three operations are to be incorporated in the project. (Welding process, molding, casting, and metal forming process)
13. Moving parts in your project will be given extra credit during evaluation.
14. External colour/paint cannot be used. Polishing/grinding of the cast component used will not allow.

In case of any doubt regarding the above, please contact Mr. Anil Kumar Verma & Mr. Indra Pal Singh.

## TA201A LABORATORY SCHEDULE (2022-2023, SEMESTER-I)

<div style="text-align: center;"> <b>Experiment</b>  </div> <div style="text-align: center;"> <b>Turn</b>  </div>	1 <sup>st</sup> E 1	2 <sup>nd</sup> E 2	3 <sup>rd</sup> E 3	4 <sup>th</sup> E4	5 <sup>th</sup> E5	6 <sup>th</sup> Lab Exam +Drawing Submission	7 <sup>th</sup> P 1	8 <sup>th</sup> P 2	9 <sup>th</sup> P3	10 <sup>th</sup> P4	11 <sup>th</sup> P5	12 <sup>th</sup> P6	13 <sup>th</sup> Project Evaluation
Day & Section													
Monday	6/8*	8/8	22/8	29/8	3/9@	5/9	12/9	26/9	10/10	17/10	31/10	7/11	14/11
Tuesday	2/8	16/8	20/8**	23/8	30/8	3/9***	6/9	13/9	27/9	11/10	18/10	25/10	1/11
Wednesday	3/8	10/8	17/8	24/8	31/8	7/9	14/9	28/9	12/10	19/10	26/10	2/11	9/11
Thursday	4/8	11/8	18/8	25/8	1/9	8/9	15/9	29/9	13/10	20/10	27/10	3/11	10/11
Friday	5/8	12/8	26/8	27/8#	2/9	9/9	16/9	30/9	14/10	21/10	28/10	4/11	11/11

Holiday/ Mid &End Examination	Date
Muharram	09 August, 2022 (Tue)
Independence Day	15 August,2022 (Mon)
Janmashtami	19 August, 2022 (Fri)
Mid Semester Examination	19 Sep – 24 Sep, 2022 ( Mon- Sat)
Mid Semester Recess (Dussehra)	01 Oct – 09 Oct, 2022 (Sat - Sun)
Diwali	24 October,2022 (Mon)
Guru Nanak's Birthday	08 Nov, 2022 (Tue)
End Semester Examination	21 Nov – 30 Nov, 2022 ( Mon- Wed)

Make-up lab on Saturday
06/08/2022@10:00 am to 01:00 pm (Monday Batch)*
20/08/2022@10:00 am to 01:00 pm (Tuesday Batch)**
27/08/2022@10:00 am to 01:00 pm (Friday Batch)#
03/09/2022@10:00 am to 01:00 pm (Monday Batch)@
03/09/2022@02:00 pm to 05:00 pm (Tuesday Batch)***

## Appendix-A: Material List for Design Project

Sr. No.	Items	Size	Approx. Rate
1	Mild Steel Flat	25 mm × 3 mm	Rs.65/kg
2	Mild Steel Flat	25 mm × 5 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	10 mm × 10 mm	Rs.63/kg
11	Mild Steel Square Rod	6mm × 6 mm	Rs.65/kg
12	Mild Steel Round Pipe	1 inch dia	Rs 450/20 ft length pipe
13	Mild Steel Round Pipe	3/4 inch 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	25 mm × 25 mm	Rs 450/20 ft length pipe
16	Mild Steel Square Pipe	15 mm × 15 mm	Rs 300/20 ft length pipe
17	Mild Steel Angle	25 mm × 25 mm	Rs 450/20 ft length pipe
18	Mild Steel Discs	20-50 mm dia × 10 mm thick	Avg ~ Rs 20-25/disc
19	Galvanized Iron Sheet	3 ft × 8 ft × 0.35 mm	Rs 756/sheet
20	Galvanized Iron Sheet	3 ft × 8 ft × 0.5 mm	Rs 820/sheet
21	Mild Steel Sheet	4 ft × 8 ft × 0.5 mm	Rs 945/sheet
22	Mild Steel Sheet	4 ft × 8 ft × 0.7 mm	Rs 1058/sheet
23	Mild Steel Sheet	4 ft × 8 ft × 1.0 mm	Rs 1278/sheet
24	Mild Steel Sheet	4 ft × 8 ft × 2.0 mm	Rs 3090/sheet
25	Thermocol	1000 cm × 500 cm × 12 mm	Rs 30/sheet
26	Thermocol	1000 cm × 500 cm × 24 mm	Rs 65/sheet
27	Thermocol	1000 cm × 500 cm × 36 mm	Rs 110/sheet
28	Thermocol	1000 cm × 500 cm × 48 mm	Rs 160/sheet
29	Thermocol	1000 cm × 500 cm × 74 mm	Rs 220/sheet
30	Fevicol	small size tube	Rs 5/tube
31	Sandpaper for thermocol	(9× 11 inch), No. 80	Rs 7/sheet
32	Nut-Bolt Mild steel Washer	all sizes	Avg ~ Rs 10/piece
33	Thin Galvanized Wire	1 mm and 2 mm dia	Rs 20/ meter
34	Aluminium for melting	ingots	Rs 380/kg
35	Cast Iron for melting	ingots	Rs 75/kg