

COURSE FILE

Academic year : 2022-23

Department : ME

Course Name : B.Tech

Student's Batch : 2022-23

Regulation : R20

Year and Semester : <u>I</u> B.Tech <u>Semester</u>

Name of the Subject : MANU FACTURING TECHNOLOGY

Subject Code : R20ME2903

Faculty In charge : DY D SUNEEL

Signature of Faculty

Head of the Department

Dept. of Mechanical Engineering NARASARAOPETA ENGINEERING COLLEGE NARASARAOPET - 522 601, Guntur (Dt), A.P.



COURSE FILE CONTENTS

S. NO:	CONTENTS
1	Institute Vision and Mission
2	Department Vision and Mission
3	Program Educational Objectives (PEOs) and Program Specific Outcomes (PSOs)
4	Program Outcomes (POs)
5	Bloom's Taxonomy Levels
6	Course Outcomes (COs)
7	Course Information Sheet
8	Academic Calendar
9	Time Table
10	Syllabus Copy
11	Lesson Plan
12	CO-POs & CO-PSOs Mapping (Course Articulation Matrix)
13	Web References
14	Student's Roll List
15	Hand Written/Printed Lecture Notes
16	Mid & Assignment Examination Question Papers with Scheme and Solutions
17	Unit Wise Important Questions
18	Previous Question Papers
19	CO-POs & CO-PSOs Attainment



INSTITUTE VISION AND MISSION



INSTITUTE VISION AND MISSION

VISION:

To emerge as a Centre of excellence in technical education with a blend of effective student centric teaching learning practices as well as research for the transformation of lives and community.

MISSION:

- 1. Provide the best class infrastructure to explore the field of engineering and research.
- 2. Build a passionate and a determined team of faculty with student centric teaching, imbibing experiential and innovative skills.
- 3. Imbibe lifelong learning skills, entrepreneurial skills and ethical values in students for addressing societal problems.

PRINCIPAL



DEPARTMENT VISION AND MISSION

Department of Mechanical Engineering

Vision and Mission of the Department

Vision:

To strive for making competent mechanical engineering Professionals to cater the real time needs of Industry and Research Organizations of high repute with entrepreneurial skills and ethical values.

Mission:

Mission 1: To train the students with state of art infrastructure to make them industry ready professionals and to promote them for higher studies and research.

Mission 2: To employ committed faculty for developing competent mechanical engineering graduates to deal with complex problems.

Mission 3: To support the students in developing professionalism and make them socially committed mechanical engineers with morals and ethical values.

Program Specific Objectives (PSOs)

- I. The students will be able to apply knowledge of modern tools in manufacturing enabling to conquer the challenges of Modern Industry.
- II. The students will be able to design various thermal engineering systems by applying the principles of thermal sciences.
- III. The students will be able to design different mechanisms and machine components of transmission of power and automation in modern industry.

Program Educational Objectives (PEOs)

- PEO 1: Excel in profession with sound knowledge in mathematics and applied sciences
- PEO 2: Demonstrate leadership qualities and team spirit in achieving goals
- PEO 3: Pursue higher studies to ace in research and develop as entrepreneurs

Program Outcomes

Engineering Graduates will have

PO1: Ability to use basic knowledge in mathematics, science and engineering and apply them to

PO2: Ability to design and conduct experiments, interprets and analyzes data, and reports the results.

PO3: Ability to design a system to meet desired needs within environmental, economic, political, ethical, health, safety, manufacturability, management knowledge and techniques to estimate time and resources to complete a project (Practical engineering analysis skills).

PO4: Ability to identify, formulate and solve mechanical engineering problems of a complex nature.

PO5: Familiarity in applying software methods and modern computer tools to analyze mechanical

PO6: An open mind and have an understanding of the impact of engineering on society and can create awareness of contemporary issues.

PO7: Ability to understand the impact of the profession engineering solutions in social and environmental contexts and demonstrate the knowledge of and need for sustainable

PO8: An understanding of their professional and ethical responsibilities, and use technology for the benefit of mankind.

PO9: An ability of demonstration to function as a coherent unit in multidisciplinary design teams through a collaborative research.

PO10: An ability to communicate effectively in both verbal and written forms.

PO11: An ability to design a system to meet desired needs with economic, management knowledge and techniques to estimate time and resources to complete a project.

PO12: An ability of self-education and can clearly understand the need of continuous and life-long learning.



PROGRAM EDUCATIONAL OBJECTIVES (PEOs) AND PROGRAM SPECIFIC OUTCOMES (PSOs)



PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1: Excel in profession with sound knowledge in mathematics and applied sciences
- PEO 2: Demonstrate leadership qualities and team spirit in achieving goals
- **PEO 3**: Pursue higher studies to ace in research and develop as entrepreneurs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO1.** The students will be able to apply knowledge of modern tools in manufacturing enabling to conquer the challenges of Modern Industry.
- **PSO2.** The students will be able to design various thermal engineering systems by applying the principles of thermal sciences.
- **PSO3.** The students will be able to design different mechanisms and machine components of transmission of power and automation in modern industry.





PROGRAM OUTCOMES (POs)



PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

- 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **4. Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **8. Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.





BLOOM'S TAXONOMY LEVELS

REVISED Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition /erbs	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas. Classify	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way. Apply	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
	 Define Find How Label List Match Name Omit Recall Relate Select Show Spell Tell What When Where Which Who Why 	Compare Contrast Demonstrate Explain Extend Illustrate Infer Interpret Outline Relate Rephrase Show Translate	 Build Choose Construct Develop Experiment with Identify Interview Make use of Model Organize Plan Select Solve Utilize 	 Assume Categorize Classify Compare Conclusion Contrast Discover Dissect Distinguish Divide Examine Function Inference Inspect List Motive Relationships Simplify Survey Take part in Test for 	 Agree Appraise Assess Award Choose Compare Conclude Criteria Criticize Decide Deduct Defend Determine Disprove Estimate Evaluate Explain Importance Influence Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support 	 Adapt Build Change Choose Combine Compile Compose Construct Create Delete Design Develop Discuss Elaborate Estimate Formulate Happen Improve Invent Make up Maximize Minimize Modify Original Original Originate Plan Predict Propose Solve Suppose Test

derson, L. W., & Krathwohl, D. R. (2001). A taxonomy for learning, teaching, and assessing, Abridged Edition. Boston, MA: Allyn and Bacon.



COURSE OUTCOMES (COs)

Course Code: R20ME2203

MANUFACTURING TECHNOLOGY

II B.Tech -II Semester

COURSE OBJECTIVES:

- To emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes
- To understand the conventional manufacturing processes like casting, metal forming, and welding process.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

- CO 1: Explain various manufacturing processes and fundamentals of casting process
- CO 2: Outline different types of welding process for fabrication of metals
- CO 3: Demonstrate advanced welding processes by make use of sketches
- CO 4: Compare the characteristics of cold and hot working processes of Forming, forging and Rolling
- CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches

Manufacturing Technology - 2018-19 - 2nd Sem

COURSE OBJECTIVES:

- Understand different manufacturing processes and fundamentals of casting.
- Distinguish different types of furnaces and design gating system for preparation of a casting.
- Identify and Recommend appropriate type of welding process for fabrication of metals.
- Distinguish process details of advanced welding processes.
- Demonstrate the characteristics of cold and hot working processes of forging and Rolling.
- Explain principles of Extrusion and Drawing processes

COURSE OUTCOMES:

SNO	Course Outcome Statement
CO1	Understand different manufacturing processes and fundamentals of casting by make use of
001	sketches (K2 & K3)
CO2	Explain different types of furnaces and choose gating system for preparation of a casting. (K2&K3)
CO3	Outline different types of welding process for fabrication of metals(K2)
CO4	Explain process details of advanced welding processes by make use of sketches (K2 & K3)
CO5	Compare the characteristics of cold and hot working processes of forging and Rolling.
003	(K2)
CO6	Explain principles of Extrusion and Drawing processes by make use of sketches (K2 &
	K3)



COURSE INFORMATION SHEET



Narasaraopeta Engineering College (Autonomous)

Yallmanda(Post), Narasaraopet- 522601

Department of Mechanical Engineering

COURSE INFORMATION SHEET

PROGRAMME: B.Tech Mechan	ical Engineering	
COURSE: MANUFACTURING TECHNOLOGY	Semester: IV	CREDITS: 3
COURSE CODE: R20ME2203 REGULATION: Autonomous	COURSE TYPE (COF	RE /ELECTIVE / BREADTH/ S&H): CORE
COURSE AREA/DOMAIN: Basic manufacturing processes	PERIODS: 6 Per Weel	K.

COURSE OUTCOMES:

SNO	Course Outcome Statement
CO1	Explain various manufacturing processes and fundamentals of casting
CO2	Outline different types of welding process for fabrication of metals
CO3	Demonstrate advanced welding processes by make use of sketches
CO4	Compare the characteristics of cold and hot working processes of Forming, forging and Rolling
CO5	Explain principles of Extrusion and Drawing processes by make use of sketches

SYLLABUS:

UNIT	DETAILS
Ι	INTRODUCTION TO MANUFACTURING PROCESSES: Difference between Production and Manufacturing. FOUNDRY: Introduction to casting process, steps involved in making a casting, Advantages of casting and its applications, Electric furnaces. Types of patterns, Materials used for patterns, Pattern allowances, Gating elements and moulding procedure, Moulding materials, Cores, Types of Sand moulding-CO2 Moulding and Shell Moulding. Manufacturing of Plastic components: blow and injection moulding SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting, Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies
П	WELDING: Classification of welding processes, Types of welds and types of joints. GAS WELDING: Equipment, Oxy-Acetylene flame, types, Gas welding procedure, Gas cutting. ARC WELDING: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC Welding, Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects – Causes and Remedies
III	RESISTANCE WELDING: Principle, Butt welding, spot welding and seam welding. Simple problems on resistance welding. OTHER WELDING PROCESSES: Thermit welding, Inert gas welding - TIG and MIG welding, submerged arc welding, plasma arc welding, soldering and brazing. Introduction to advanced welding technologies - laser welding, electron beam welding.
IV	FORMING: Introduction, Elastic & Plastic deformation; Recovery, Recrystallization & grain growth; Hot working & Cold working. Sheet metal working FORGING: Introduction, Hot forging & Cold forging, Open & Closed die forging, Forging defects & remedies.

ROLLING: Introduction, Hot & Cold rolling process, Angle of bite, rolling stand arrangements

EXTRUSION & DRAWING: Extrusion fundamentals, Classification of Extrusion-Forward

Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing:

Wire drawing, Tube drawing..

TEX	T BOOKS
T	BOOK TITLE/AUTHORS/PUBLISHER
T1	Manufacturing technology II, P.N Rao, Tata McGraw hill publishers
T2	Production Technology by P. C. Sharma, S. Chand Publications.
REF	ERENCE BOOKS
R	BOOK TITLE/AUTHORS/PUBLISHER
R1	Welding Technology by Little by Tata McGraw Hill Publications
R2	Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS:

SNO	DESCRIPTION	Associated PO & PSO
1	Advanced manufacturing process	PO1, PO3, PO5 & PSO1
2	Basics of non-conventional machining	PO1, PO3, PO5 & PSO1

WEB SOURCE REFERENCES:

I	https://nptel.ac.in/courses/112107144/1
2	https://nptel.ac.in/courses/112107144/2
3	https://nptel.ac.in/courses/112107144/14
4	https://www.researchgate.net/publication/259800841 Manufacturing Technology Vol 1 Foundry For
	ming and Welding
	https://books.google.com/books/about/Manufacturing Technology.html?id=fSHZAgAAQBAJ
5	

DELIVERY/INSTRUCTIONAL METHODOLOGIES:

☑Chalk & Talk	PPT	☐Active Learning
□Web Resources	☐ Students Seminars	☐Case Study
☐Blended Learning	☐ Quiz	□Tutorials
☐Project based learning	□NPTEL/MOOCS	☐ Simulation
☐Flipped Learning	☐Industrial Visit	Model Demonstration
☐Brain storming	☐Role Play	DVirtual Labs:

MAPPING CO'S WITH PO'S

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
	1	-							ļ						
C311.1	2	2	-	-	-	-	-	-	-	-	-		3	-	_
C311.2	3	-	-	-	-	-	-	-	_	-	-	-	2	-	-
C311.3	3		_	-	-	-	-	-	-	-	-		2	-	2
C311.4	3	2	-	-	-	-	-	-	-	-	-	=	3	-	2
C311.5	3	-	-	-	-	-		-	-	-	-	-	3	-	1
C311.6	3	_		-	-	-	-	-	-	-	-		2	-	-
Average	2.83	2.00	-		-	-	-	-	-	-	-		2.50	-	1.66

MAPPING COURSE WITH POS & PSOS

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C311	2.83	2.00		-	-	•	-	au i	. = 8 €	- L	-		2.50	-	1.66

ASSESMENT TOOL WITH WEIGHTAGE	метнор	ATTAINMENT LEVEL 3 (EXCELLENT)	ATTAINMENT LEVEL 2 (GOOD)	ATTAINMENT LEVEL 1 (AVERAGE)	ATTAINMENT LEVEL 0 (POOR)
Internal tests (40%)	Direct	Student secured ≥ 60% marks of allocated marks for that CO	Student secured ≥ 60% and < 50% marks of allocated marks for that CO	Student secured ≥ 50% and <40% marks of allocated marks for that CO	Student secured < 40% marks of allocated marks for that CO
Assignments (20%)	Direct	Student secured ≥ 80% marks allocated for that CO	Student secured ≥ 70% and <80% marks allocated for that CO	Student secured ≥ 60% and <70% marks allocated for that CO	Student secured < 60% of marks allocated for that CO
End Semester Examination (30%)	Direct	Student secured grades A*&S* in External Exam	Student secured grades C*&B* in External Exam	Student secured grades D*&E* in External Exam	Student secured grades F* in External Exam
Course end Survey (10%)	Indirect	Student selected option	Student selected option	Student selected option	Student selected option

Course Instructor

Course Coordinator

Module Coordinator

Head of the Department

ANNEXURE I:

(A) PROGRAM OUTCOMES (POs) Engineering Graduates will be able to:

- 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1. The students will be able to understand the modern tools of machining which gives them good expertise on advanced manufacturing methods.

PSO2. The students will be able to design different heat transfer devices with emphasis on combustion and power production. PSO3. The students are able to design different mechanisms and machine components suitable to automation industry.

Cognitive levels as per Revised Blooms Taxonomy:

Cognitive Domain	LEVEL	Key words
Remember	K1	Defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls, recognizes, reproduces, selects, states.
Understand	K2	Comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates.
Apply	К3	Applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, selects, shows, solves, uses.
Analyse	К4	Analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates.
Evaluate	K5	Appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports
Create	К6	Categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, write

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

- CO 1: Explain various manufacturing processes and fundamentals of casting process
- CO 2: Outline different types of welding process for fabrication of metals
- CO 3: Demonstrate advanced welding processes by make use of sketches
- CO 4: Compare the characteristics of cold and hot working processes of Forming, forging and Rolling
- CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches

Unit wise Sample assessment questions

	Unit wise Sample assessment questions	KNOWLEDGE	_
S NO	QUESTION		CO
		LEVEL	
	UNIT I		
1	List the advantages and applications of metal casting?	K2	CO
2	Explain the ingradients of moulding sand?	K2	CO
3	Define the production & Manufacturing & Classify the manufacturing processes?	K2	CO
4	Explain the investment casting process step by step with neat sketch	K2	CO
5	Explain Centrifugal casting by make use of sketch	K2	CO
	i UNIT 2		<u> </u>
1	Explain any two types of welding flames with sketches	K2	CO
2	Explain any five weld defects by make use of sketches	K2 & K3	CO
3	Sketch and explain a method used for taper turning of long jobs.	К3	CO
4	Explain Oxy- Acetylene Gas cutting in detail?	K4	CO
5	Draw a diagram showing the classification of welding process.	КЗ	CO
. /	UNIT 3		
1	Explain about thermit welding and plasma welding with neat sketches?	К3	CO
2	Explain TIG welding process variables and enumerate its advantages	K4	CO
3	Describe in detail any two resistance welding processes with neat sketches their advantages, disadvantages and applications	K4	CO
4	Explain any two of the following a) Laser welding b) Electron beam welding.	K4	СО
	UNIT 4	1	
1	Explain about hot working and cold working processes?	КЗ	CO
2	Name the Forging Defects and their Remedies?	K4	CO
3	Explain the Forging process and list out their advantages and applications?	К3	CO

4	What is Metal Forming process and classify the types of deformation processes?	K3	CO4
	UNIT 5		
1	Explain wire drawing operation by make use of a neat sketch.	K4	CO5
2	What are the applications of different extrusion processes?	K4	COS
3	Explain tube drawing by make use of a neat sketch	K4	COS

Model Question Paper-I

Code: R20ME2203

Narasaraopeta Engineering College (Autonomous)

Yallmanda(Post), Narasaraopet- 522601
B. Tech V Semester Regular Examinations
MANUFACTURING TECHNOLOGY
MECHANICAL ENGINEERING
[OUTCOME BASED EDUCATION PATTERN]

MODEL PAPER-I

Time: 3	hoı	Max. Max. Max. Max. Max. Max. Max. Max.	arks: 70			
		Note: Answer All FIVE Questions.				
		All Questions Carry Equal Marks (5 X 12 = 60M)				
Q. No.		Questions	Marks			
		Unit-I				
	a	Explain about the design considerations for casting process?	[7M]			
1	What are the elements involved in the gating system with the help of suitable sketches and explain?					
İ	а	What is Investment casting? What is the main material used for making an Investment Pattern? What are the methods of applying the Investment material to the pattern?	[7M]			
	b	What are the common allowances provided on patterns? Why and how they are provided? Give suitable examples.	[7M]			
		Unit-II	<u> </u>			
2	a Explain Oxy- Acetylene Gas cutting in detail?					
		OR				
	b	Draw a diagram showing the classification of welding process.	[14M]			
		Unit-III				
0	a	Describe in detail any two resistance welding processes with neat sketches, their advantages, disadvantages and applications	[7M]			
	b	Write different types of flames and their uses.	[7M]			
3		OR	, .			
	a	How submerged arc welding process takes place. Describe its advantages and applications	[7M]			
	b	Describe the process and applications of thermit welding.	[7M]			
		Unit-IV				
1	a	Explain about drop Forging and Rotary forging in detail?	[7M]			
4	b	Explain how Forging improves the mechanical properties of the components.	[7M]			
		OR				

	a	[7M]				
	b	b Classify the rolling process and explain any one of rolling process				
		Unit-V				
· - ·	a	Explain about impact extrusion and hydrostatic extrusion?	[14M]			
5		OR				
,	a	Describe the wire drawing & tube drawing process.	[7M]			
	b	Explain about forward extrusion and backward extrusion?	[7M]			

İ



ACADEMIC CALENDAR



ACADEMIC CALENDAR (B.Tech. 2021 Admitted Batch, Academic Year 2022-23)

2021 Batch 2 nd Yea	2021 Batch 2 nd Year 2 nd Semester						
Commencement of Class Work	16-01-2023		Γ				
1st Spell of Instructions	16-01-2023	04-03-2023	7 Weeks				
Assignment Test-I	06-02-2023	11-02-2023	Weeks				
I Mid examinations	06-03-2023	11-03-2023	1 Week				
2 nd Spell of Instructions	13-03-2023	29-04-2023	1 WOOK				
Assignment Test-II	03-04-2023	08-04-2023	7 Weeks				
II Mid examinations	01-05-2023	06-05-2023	1 Week				
Preparation & Practicals	- 08-05-2023	13-05-2023	1 Week				
Semester End Examinations	15-05-2023	27-05-2023	2 Weeks				
Commencement of 3rd Year 1st Sem Class Work	 '	05-06-2023	2 WEEKS				

PRINCIPAL



(AUTONOMOUS)

ACADEMIC CALENDAR FOR II B.TECH II SEMESTER ACADEMIC YEAR 2021-22

II B.TECH II SEMESTER							
Commencement of Class Work	07.03.2022						
1st Spell of Instructions	07.03.2022	23-04-2022					
I Assignment Examination	28-03-2022	02-04-2022	7 Weeks				
I Mid Examination	25-04-2022	30-04-2022	1 Week				
2 nd Spell of Instructions	02-05-2022	18-06-2022					
II Assignment Examination	23-05-2022	28-05-2022	7 Weeks				
II Mid Examination	20-06-2022	25-06-2022	1 Week				
Preparation & Practicals	27-06-2022	02-07-2022	1 Week				
End Examinations	04-07-2022	16-07-2022	2 Weeks				
Commencement of III B. Tech I Sem Class Work	18-07-2022						

PRINCIPAL



Narasaraopeta Engineering College (Autonomous) Kotappakonda Road, Yellamanda (P.O), Narasaraopet-522601, Guntur District, AP.

ACADEMIC CALENDAR :: AY 2018-19 (B.Tech - admitted batches 2016-17)

Date: 07-06-2018.

2016	Batch 3 rd Year 1 st Semester, 201	7 Batch 2 nd Year 1	st Semester	
	Description	From Date	To Date	Duration
Commencement of Cl	ass Work	18-06-2018		<u> </u>
1st Spell of Instruction	ons	18-06-2018	11-08.2018	8 Weeks
I Assignment test		02-07-2018	07-07-2018	
II Assignment test		23-07-2018	28-07-2018	
I Mid examinations		13-08-2018	18-08-2018	1 Week
2 nd Spell of Instructi	ons	20-08-2018	13-10-2018	8 Weeks
III Assignment test		03-09-2018	08-09-2018	
IV Assignment test		24-09-2018	29-09-2018	
II Mid examinations		15-10-2018	20-10-2018	1 Week
Preparation & Practic	als	22-10-2018	03-11-2018	2 Weeks
Semester End Examir	ations	05-11-2018	17-11-2018	2 Weeks
Semester Break		19-11-2018	01-12-2018	2 Weeks
2016	Batch 3 rd Year 2 nd Semester, 201	7 Batch 2 nd Year 2	2 nd Semester	
Description		From Date	To Date	Duration
Commencement of C	lass Work	03-12-2018		
1st Spell of Instructi	ons	03-12-2018	26-01-2019	8 Weeks
I Assignment test		17-12-2018	22-12-2018	
II Assignment test		07-01-2019	12-01-2019	
I Mid examinations		28-01-2019	02-02-2019	1 Week
2 nd Spell of Instruct	ions	04-02-2019	30-03-2019	8 Weeks
III Assignment test		18-02-2019	23-02-2019	
IV Assignment test		11-03-2019	16-03-2019	
II Mid examinations		01-04-2019	06-04-2019	1 Week
Preparation & Practic	als Examinations	08-04-2019	20-04-2019	2 Week
Semester End Exami		22-04-2019	04-05-2019	2 Weeks
Summer Vacation		06-05-2019	08-06-2019	5 Week



TIME TABLE

NARASARAOPETA ENGINEERING COLLEGE: NARASARAOPET (AUTONOMOUS) DEPARTMENT OF MECHANICAL ENGINEERING II B.TECH II SEM TIME TABLE

ROOM N	O:1212
--------	--------

	ROOM NO	D:1212										
	TIMINGS	9.10-10.00	2 10.00-10.50	BREAK 10.50-11.00	3	4		5	Wef: 17/01/	2023		
	MON	TCE-II	КОМ	11.00	11:00=11:50 • M	11.50-12.40	12.40-1.30	1.30-2.20	2.20-3.10	3.10-4.00	8	7
-	TUE-	ATD	٠, ٠٠	ATD/C/	AE LAB	<u> </u>	÷ .	CV	PS	ТСЕ⊋Н	Honors/+	
-	WED	KOM				· .	· L	KC	M	TCE-II	Minors Honors/	
	THU	ATD	KOM	MD/M	LAB		U	AT			Minors	
	FRI	TCE-II			MT	,	N C			Honors	/Minors	7
	SAT	<u>-</u>		ATD/CA	ELAB		H	CV	25		ATD	7
L		KO	M	,	ATD		• '4	TCE-II	CVF	PS	Honors/	1
(CODE		·	<u></u> <u>-</u>		<u>-</u>		· N	D/MT LAB	~ <u>-</u> -	Minors	┨.
A	TD			CITO	?♥ :TEL<:re	_	•					1

Signature of HOD

SUBJECT

Applied Thermodynamics

Complex Variables, Probability& Statistics

Kinematics of Machinery Manufacturing Technology

Technical & Communicative English-II

Machine Drawing Lab

Applied Thermodynamics Lab Manufacturing Technology Lab

Computer Aided Engineering Lab

FACULTY

Mr.K.Johan Babu

Msr.A. Aparna

Mr.T.Ashok kumar

Dr. D. Suneel

Mr.A.Venu Gopal

Mr.R.Chinna Rao / T.N.V.Mahesh Babu

Mr.Y.Suvarna Kumar/A.Pavan Kumar

Dr.M.Sreenivasa Kumar/ T.Ashok Kumar

D.Raghavendra/B.Ajay Kumar

Signature of Principal



SYLLABUS COPY

II B.TECH II SEMESTER	L	Т	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS			
	3	0	0	30	70	100	3			
Code: R20ME2203	MANUFACTURING TECHNOLOGY									

COURSE OBJECTIVES:

- To emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes
- To understand the conventional manufacturing processes like casting, metal forming, and welding process.

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:

- CO 1: Explain various manufacturing processes and fundamentals of casting process
- CO 2: Outline different types of welding process for fabrication of metals
- CO 3: Demonstrate advanced welding processes by make use of sketches
- CO 4: Compare the characteristics of cold and hot working processes of Forming, forging and Rolling
- CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches

UNIT-I

INTRODUCTION TO MANUFACTURING PROCESSES: Difference between Production and Manufacturing.

FOUNDRY: Introduction to casting process, steps involved in making a casting, Advantages of casting and its applications, Electric furnaces. Types of patterns, Materials used for patterns, Pattern allowances, Gating elements and moulding procedure, Moulding materials, Cores, Types of Sand moulding-CO2 Moulding and Shell Moulding. Manufacturing of Plastic components: blow and injection moulding

SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting, Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies.

UNIT-II

WELDING: Classification of welding processes, Types of welds and types of joints.

GAS WELDING: Equipment, Oxy-Acetylene flame, types, Gas welding procedure, Gas cutting.

ARC WELDING: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC

ARC WELDING: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC Welding, Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects – Causes and Remedies.

UNIT-III

RESISTANCE WELDING: Principle, Butt welding, spot welding and seam welding. Simple problems on resistance welding.

OTHER WELDING PROCESSES: Thermit welding, Inert gas welding - TIG and MIG welding, submerged arc welding, plasma arc welding, soldering and brazing. Introduction to advanced welding technologies - laser welding, electron beam welding,



UNIT-IV

FORMING: Introduction, Elastic & Plastic deformation; Recovery, Recrystallization & grain growth; Hot working & Cold working. Sheet metal working

FORGING: Introduction, Hot forging & Cold forging, Open & Closed die forging, Forging defects & remedies.

ROLLING: Introduction, Hot & Cold rolling process, Angle of bite, rolling stand arrangements.

UNIT-V

EXTRUSION & DRAWING: Extrusion fundamentals, Classification of Extrusion- Forward Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing: Wire drawing, Tube drawing.

TEXT BOOKS:

- 1. Manufacturing Technology Vol-I by P.N. Rao, Tata McGraw Hill Publications.
- 2. Production Technology by P. C. Sharma, S. Chand Publications.

REFERENCES:

- 1. Welding Technology by Little by Tata McGraw Hill Publications.
- 2. Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI.

Web References:

- 1. https://nptel.ac.in/courses/112107144/1
- 2. https://nptel.ac.in/courses/112107144/2
- 3. https://nptel.ac.in/courses/112107144/10
- 4. https://nptel.ac.in/courses/112107144/13
- 5. https://nptel.ac.in/courses/112107144/14

1

E-Books:

- 1. https://easyengineering.net/manufacturingbooks/
- 2. https://easyengineering.net/manufacturingbooks/
- 3. https://books.google.com/books/about/Manufacturing_Technology.html?id=fSHZAgAAQBAJ
- 4. https://www.researchgate.net/publication/259800841_Manufacturing_Technology_Vol_1_Foundry_Forming_and_Welding



II B.TECH-II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	ı	1	40	60	100	3

MANUFACTURING TECHNOLOGY

Course Outcomes:

At the end of this course student will acquire ability to

- Understand different manufacturing processes and fundamentals of casting.
- Distinguish different types of furnaces and design gating system for preparation of a casting.
- Identify and Recommend appropriate type of welding process for fabrication of metals.
- Distinguish process details of advanced welding processes.
- Demonstrate the characteristics of cold and hot working processes.
- Explain principles of sheet metal working, plastic injection and blow moulding processes.

UNIT-I

Introduction to Manufacturing Processes, Difference between Production and Manufacturing. Foundry: Introduction to casting process, steps involved in making a casting, Advantages of casting and its applications, Types of patterns, Materials used for patterns, Pattern allowances, sand moulding procedure, Moulding materials, Importance of constituents, Cores, Types of Sand moulding-CO₂ Moulding and Shell Moulding.

UNIT-II

Gating System: Elements of gating system, Gating system design, Calculation of gating system dimensions for simple objects, riser design and its function, Solidification of casting. Special Casting Methods: Permanent Mould Casting, Die Casting, Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies.

UNIT-III

Welding: Classification of welding processes, Types of welds and types of joints.

Gas Welding: Equipment, Oxy-Acetylene flame, types, Gas welding procedure, Gas cutting. Arc Welding: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC Welding, Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects-Causes and Remedies.



UNIT-IV

Resistance Welding: Principle, Butt welding, spot welding and seam welding. Simple problems on resistance welding.

Other welding processes: Thermit welding, Inert gas welding - TIG and MIG weldingSubmerged arc welding, plasma arc welding, soldering and brazing.

UNIT-V

Forming and Forging: Fundamentals, Introduction to metal working process, Hot working, Cold working.

Rolling: Rolling fundamentals, Analysis of rolling process- Derivation of Length of deformation zone, Angle of bite, Maximum reduction possible for one pass, Rolling stand arrangements.

UNIT-VI

Extrusion & Drawing: Extrusion fundamentals, Classification of Extrusion- Forward Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing: Wire drawing, Tube drawing.

TEXT BOOKS:

- 1. Manufacturing Technology Vol-I by P.N. Rao, Tata McGraw Hill Publications.
- 2. Production Technology by P. C. Sharma, S. Chand Publications.

REFERENCES:

- 1. Welding Technology by Little by Tata McGraw Hill Publications.
- 2. Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI.





DEPARTMENT OF MECHANICAL ENGINEERING

LESSON PLAN



Narasaraopeta Engineering College (Autonomous)

Yallmanda(Post), Narasaraopet- 522601

DEPARTMENT OF MECHANICAL ENGINEERING **LESSON PLAN**

Course Code	Course Title (Regulation)	Sem	Branch	Contact Periods/Week	Sections
R20ME2203	Manufacturing technology	IV	Mechanical Engineering	10	A&B

COURSE OUTCOMES:

After successful completion of this course, the students will be able to:
CO 1: Explain various manufacturing processes and fundamentals of casting process

CO 2: Outline different types of welding process for fabrication of metals

CO 3: Demonstrate advanced welding processes by make use of sketches
CO 4: Compare the characteristics of cold and hot working processes of Forming, forging and rolling

CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches

Unit No	Outcome	Topics/Activity	Ref Text Total book Period	Delivery Method
	!	Unit-1. FUNDAMENTALS OF MAC	CHINING	
1	CO 1: Explain various manufacturing processes and fundamentals of	1.1 Introduction to casting process steps involved in making a casting, Advantages of casting and its applications, Electric furnaces		Chalk & Talk, PPT& Demonstration with models.
	casting process	1.2 Types of patterns, Materials us for patterns, Pattern allowance Gating elements and moulding procedure, Moulding materials Cores, Types of Sand mouldin CO2 Moulding and Shell Moulding.	T1, T2, R1 3	Chalk & Talk, PPT& Demonstration with models.
		1.3 Manufacturing of Plastic components: blow and injection moulding Permanent Mould Casting, Die Casting.	on T1, T2, R1 2	Chalk & Talk, PPT& Demonstration with models.
		1.4 Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies	nt T1, T2 3	Chalk & Talk, PPT& Demonstration with models.
		Unit-2. WELDING		
	CO 2: Outline	2.1 Classification of welding processes, Types of welds and types of joints.		Chalk & Talk, PPT Case Study
2	different types of welding	2.2 GAS WELDING: Equipment Oxy-Acetylene flame, types, O welding procedure, Gas cutting	Gas	Chalk & Talk, PPT Case Study
	process for fabrication of metals	2.3 Principle of Arc welding, Equipment, Electrodes, Electro coatings, AC and DC Welding		Chalk & Talk, PPT Case Study
		2.4 Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects – Causes and Remedies	T1, T2, R3 2	Chalk & Talk, PPT Case Study



Narasaraopeta Engineering College (Autonomous) Yallmanda(Post), Narasaraopet- 522601

DEPARTMENT OF MECHANICAL ENGINEERING LESSON PLAN

Course Code	Gourse Title (Regulation)	Sem	Branch	Contact Periods/Week	Sections 3
R20ME2203	Manufacturing technology	IV	Mechanical Engineering	10	A & B

1	T					 		
	3	3.1	Principle, Butt welding, spot welding	T1, T2, R1	2	Chalk & Talk, PPT & Demonstration with models		
	CO 3: Demonst	3.2	Seam welding. Simple problems on resistance welding.	T1, T2, R1	3	Chalk & Talk, PPT & Demonstration with models		
3	rate advanced welding processes by	3.3	Thermit welding, Inert gas welding - TIG and MIG welding	T1, T2, R1	2	Chalk & Talk, PPT & Demonstration with models		
	make use of sketches	3.4	Submerged arc welding, plasma arc welding, soldering and brazing.	T1, T2, R1	3	Chalk & Talk, PPT & Demonstration with models		
		3.5	Introduction to advanced welding technologies	T1, T2	1	PPT & Demonstration with models		
		3.6	Laser welding, electron beam welding.	T1, T2	1	Chalk & Talk, PPT & Demonstration with models		
		Unit-4	FORMING, FORGING & ROLL	ING	-			
	CO 4: Compare	4.1	Introduction, Elastic & Plastic deformation; Recovery, Recrystallization & grain growth	T1, T2, R3	2	Chalk & Talk, PPT & Demonstration with models		
	the characteristi cs of cold	4.2	Hot working & Cold working. Sheet metal working	T1, T2, R3	2	Chalk & Talk, PPT & Demonstration with models		
4	and hot working processes of Forming,	4.3	Introduction, Hot forging & Cold forging, Öpen & Closed die forging	T1, T2, R3	2	Chalk & Talk, PPT & Demonstration with models		
	forging and Rolling	4.4	Forging defects & remedies.	T1, T2, R3	2	Chalk & Talk, PPT & Demonstration with models		
		4.5	Introduction, Hot & Cold rolling process, Angle of bite, rolling stand arrangements.	T1	2	Chalk & Talk, PPT & Demonstration with models		



Narasaraopeta Engineering College (Autonomous)

Yallmanda(Post), Narasaraopet- 522601

DEPARTMENT OF MECHANICAL ENGINEERING LESSON PLAN

Course Code	Course Title (Regulation)	Sem	Branch	Contact Periods/Week	Sections
R20ME2203	Manufacturing technology	IV	Mechanical Engineering	10	A & B

	Unit 5	5. EXTRUSION & DRAWING			
CO 5: Explain	5.1	Extrusion fundamentals, Classification of Extrusion	T1, T2, R3	3	Chalk & Talk, PPT
Extrusion and Drawing	5.2	Forward Extrusion, Backward Extrusion	T1, T2, R3	3	Chalk & Talk, PPT
make use of sketches	5.3	Impact extrusion, Hydrostatic extrusion	T1, T2, R3	2	Chalk & Talk, PPT
	5.4	Types of drawing: Wire drawing, Tube drawing	T1, T2, R1	2	Chalk & Talk, PPT
			Total	60	
	principles of Extrusion and Drawing processes by make use of	CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches	CO 5: Explain principles of Extrusion 5.2 Forward Extrusion, Backward Extrusion processes by make use of sketches 5.1 Extrusion fundamentals, Classification of Extrusion 5.2 Forward Extrusion, Backward Extrusion 5.3 Impact extrusion, Hydrostatic extrusion 5.4 Types of drawing: Wire drawing,	CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches 5.1 Extrusion fundamentals, Classification of Extrusion 5.2 Forward Extrusion, Backward Extrusion 5.3 Impact extrusion, Hydrostatic extrusion 5.4 Types of drawing: Wire drawing, T1, T2, R1 Tube drawing	CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches 5.1 Extrusion fundamentals, Classification of Extrusion 5.2 Forward Extrusion, Backward Extrusion, Backward Extrusion 5.3 Impact extrusion, Hydrostatic extrusion 5.4 Types of drawing: Wire drawing, T1, T2, R1 2

TEXT BOOKS

- 1 Manufacturing technology II, P.N Rao, Tata McGraw hill publishers
- 2 Production Technology by P. C. Sharma, S. Chand Publications.

REFERENCE BOOKS

- 1 Welding Technology by Little by Tata McGraw Hill Publications
- 2 Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI

PPT LINKS

https://slideplayer.com/slide/15310695/

https://www.slideshare.net/divyalattoo/production-technology-ppt

https://www.slideteam.net/production-technology-ppt-powerpoint-presentation-slides-iconscpb.html

https://www.fcusd.org/cms/lib/CA01001934/Centricity/Domain/4529/Fundamentals%20of% 20Modern%20Manufacturing%20Materials%20%20Processes%20and%20Systems%20%20 4th%20Edition.pdf

Faculty

HOD

Principal



Narasaraopeta Engineering College (Autonomous) Yallmanda (Post), Narasaraopet- 522601

DEPARTMENT OF MECHANICAL ENGINEERING LESSON PLAN

Course Code	Course Title (Regulation)	Sem	Branch 4 **	Contact Periods/Week	Sections	
R16ME2205	MANUFACTURING TECHNOLOGY	.II-II	Mechanical Engineering	5	A & B	

COURSE OUTCOMES: Students are able to

SNO	Course Outcome Statement
CO1	Explain various manufacturing processes and fundamentals of casting process (K2)
CO2	Illustrate gating system for preparation of a casting and special casting methods (K2)
CO3	Outline different types of welding process for fabrication of metals(K2)
CO4	Summarize advanced welding processes by make use of sketches (K2 & K3)
CO5	Compare the characteristics of cold and hot working processes of forging and Rolling. (K2)
CO6	Explain principles of Extrusion and Drawing processes by make use of sketches (K2 & K3)

Unit No	Outcome	Topics/Activity	Ref Text book	Tot al Perio ds	Delivery Method
		UNIT –I: Foundry	•		
	CO 1: Explain	1.1 Introduction to Entire subject	T1, T2, R2		
1	various manufacturin g processes	1.2 Introduction of casting process, steps involved in making a casting. Advantages of casting and its applications	T1, T2, R2		Chalk & Talk PPT& Tutorial
1	and fundamentals	1.3 Types of patterns, Materials used for patterns. Pattern allowances. PPT			& Case Study
	of casting process (K2)	1.4 Sand moulding procedure, Moulding materials	T1, T2, R2		Study
	process (K2)	1.5 Importance of constituents, Cores. Types of Sand moulding-CO ₂ Moulding	T1, T2, R2		
		1.6 Shell Moulding & Revision, PPT	T1, T2, R2		
	CO 2: Illustrate	UNIT -II: Gating System & Special Casting N	Iethods		
2	gating system	Elements of gating system, Gating system design	T1, T2, R2	1.2	-
	for preparation of	aration of 2.2 Calculation of gating system dimensions for simple objects		12	

		,	····			
	a casting and	2.3	Riser design and its function. Solidification of	T1, T2, R2		Chalk &
	special	2.4	casting Special Casting Methods: Permanent Mould	T1, T2, R2		Talk, PPT,
	casting	2.4	Casting, Die Casting. Centrifugal Casting,	11, 12, K2		Active
	methods (K2)	2.5	Investment Casting. Continuous Casting, Fettling of	T1, T2, R2		Learning
			Castings. PPT			& Tutorial
		2.6	Casting Defects: causes and remedies & Revision	T1, T2, R2		Tutoriai
		i	UNITIII : Welding	·	L	
	CO 3: Outline	3.1	Classification of welding processes. Types of welds	T1, T2, R1		
	different types		and types of joints			
•	of welding	3.2	Gas Welding: Equipment, Oxy-Acetylene flame,	T1, T2, R1		Chalk &
	process for		types. Gas welding procedure, Gas cutting		12	Talk,
3	fabrication of	3.3	Arc Welding: Principle of Arc welding, Equipment.	T1, T2, R1		PPT Tutorial,
	metals(K2)	3.4	Electrodes, Electrode coatings . AC and DC	T1, T2, R1		Active
			Welding. Arc Blow,	11, 12, 11		Learning
		3.5	. Arc Length Characteristics, Related Simple	T1, T2, R1		& Case
			Problems. PPT			Study
		3.6	Welding defects-Causes and Remedies & Revision	T1, T2, R1		
MID I	<u> </u> EXAMINATIONS	ļ				<u>!</u>
			UNIT - IV: Resistance Welding & Other welding	processes		
	CO 4:	4.1,	Principle, Butt welding, spot welding and seam	T1, T2, R1		
	Summarize advanced	,	welding			
	welding	4.2	Simple problems on resistance welding. Other	T1, T2, R1		
	processes by	4.3	welding processes: Thermit welding TIG and MIG welding	T1, T2, R1		Chalk &
4	make use of		Tio and 1710 wording	,,	10	Talk,
	sketches (K2 & K3)	4.4	-Inert gas welding, Submerged arc welding, plasma	T1, T2, R1	10	PPT
	& K3)		arc welding. PPT	11, 12, 11		Tutorial
		4.5	Soldering and brazing & Revision	T1, T2, R1		
		1	TANE X E			
	CO 5: Compare the	5.1	UNIT -V: Forming, Forging & Rolling Forming and Forging: Fundamentals process,	T1, T2, R2		
	characteristics	3.4	Introduction to metal working	11, 12, 12		
_	of cold and	5.2	Hot working, Cold working. Rolling: Rolling	T1, T2, R2		Chalk &
5	hot working		fundamentals, Analysis of rolling process		10	Talk
	processes of	5.3	Derivation of Length of deformation zone, Angle of	T1, T2, R2		PPT& Tutorial.
	forging and	5.4	bite.	T1, T2, R2		
	Rolling. (K2)	5.5	Maximum reduction possible for one pass. PPT Rolling stand arrangements & Revision	T1, T2, R2		
		,	UNIT -VI: Extrusion & Drawing			
	CO 6. Explain	6.1	Extrusion fundamentals, Classification of Extrusion	T1, T2, R2		
	principles of	6.2	Forward Extrusion, Backward Extrusion, Impact	T1, T2, R2		OL 11. 6
	Extrusion and Drawing		extrusion, Hydrostatic extrusion			Chalk & Talk,
6	processes by	6.3	Types of drawing: Wire drawing, Tube drawing.	T1, T2, R2	6	PPT
	make use of	6.4	PPT & Revision	T1, T2, R2		Tutorial
	sketches (K2	"-	TTI & KEVISIOII	11,14,14		
	& K3)			Total	64	

. .

MID II EXAMINATIONS

END EXAMINATIONS

TEXT	T BOOKS
T	BOOK TITLE/AUTHORS/PUBLISHER
T1	Manufacturing Technology Vol-I by P.N. Rao, Tata McGraw Hill Publications
T2	Production Technology by P. C. Sharma, S. Chand Publications
REFE	CRENCE BOOKS
R	BOOK TIT <mark>LE/AUTHO</mark> RS/PUBLISHER
R1	Welding Technology by Little by Tata McGraw Hill Publications

Faculty

HOD

Principal



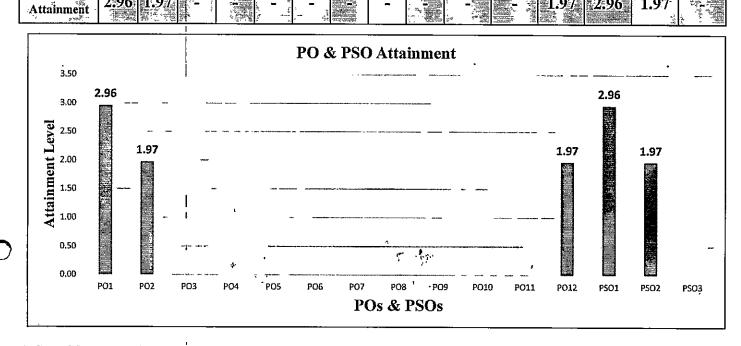
DEPARTMENT OF MECHANICAL ENGINEERING

CO-POs & CO-PSOs MAPPING (COURSE ARTICULATION MATRIX)

Course Code: C224 Course Na				me: MANUFACTURING TECHNOLOGY							Year/Sem: II/II				
					CO-	PO &	& CO	-PSC) Ma	pping	·		•		
COs	POS & PSOS											*			
COS	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11'	PO12	PSO1	PSO2	PSO3
C224.1	3	2	-	-	-	-	-	-		-	_	2	3	2	-
C224.2	3	2	_	_	-	-	-	-	-	-	-	2	3	2	-
C224.3	3	2	-	-	-		-	-	-	-	-	2	3	2	-
C224.4	3	2	-	ı	-		-	-	-	-	-	2	3	2	-
C224.5	3	2	-	-	-	-	-	-	-	_	-	2	3	2	-
C224	3.00	2.00	12.		- -	-	-		† 5	-		2.00	3.00	2.00	

		CC) Atta	inme	nt 	r v	.*				* A. '	· 2.9	5	inte gran	and the second	274
PO & PSO Attainment																
		PO1	PO2	PO3	PQ4	PO5	PO6	PO7	PO8	PO9	PO10	PO11,	PO12	PSO1	PSO2	PSO3

Total CO Attainment through Direct & Indirect Assessment



- 1. Copy CO PO matrix and CO attainment matrix from previous pages and find PO attainment.
- 2. PO attainment is calculated as per the following formula:

PO

POi * Total CO attainment Level / 3 where 'i' ranges from 1 to 12

- 1. Copy CO PSO matrix and CO attainment matrix from previous pages and find PSO attainment.
- 2. PSO attainment is calculated as per the following formula:

PSOi * Total CO attainment Level / 3 where 'i' ranges from 1 to 3



DEPARTMENT OF MECHANICAL ENGINEERING

WEB REFERENCES

Web References

1	https://nptel.ac.in/courses/112107144/1
2	https://npfel.ac.in/courses/112107144/2
3	https://nptel.ac.in/courses/112107144/10
4	https://nptel.ac.in/courses/112107144/13
5	https://nptel.ac.in/courses/112107144/14
6	https://nptel.ac.in/courses/112107144/27
7	https://nptel.ac.in/courses/112107145/
8	http://www.dphu.org/uploads/attachements/books/books_3017_0.pdf
9	http://home.iitk.ac.in/~nsinha/Introduction.pdf



DEPARTMENT OF MECHANICAL ENGINEERING

STUDENT'S ROLL LIST



(AUTONOMOUS)

DEPARTMENT OF MECHANICAL ENGINEERING

21 BATCH II-II STUDENT LIST

S.No	HT No.	Student Name						
I	21471A0301	ANGIREKULA VEERANJANEYULU						
2	214 <mark>71A0302</mark>	BATTULA YUVA RAJU						
3	21471A0303	BOMMIREDDY VENU						
4	21471A0304	JEEDIMALLA SRI LAKSHMI NILENDRA						
5	21471A0305	KONATHAM VENKATA NARAYANA						
6	21471A0306	KUNCHALA ANKA RAO						
7	21471A0307	PATHAN RIYAZ						
8	21471A0309	SASAPU SAI SANTOSH						
9	21471A0310	SOUBHAGYAPU SAI RAM						
10	21471A0311	MUNAGA RAMANJANEYULU						
11	21471A0312	YELCHURI HEMALATHA MEGHANA						
12	21471A0314	ALLAM TIRUMALA RAJU						
13	22475A0301	LUKALAPU RAMBABU						
14	22475A0302	THUNUGUNTLA NAGA THARUN						
15	22475A0303	MAILAVARAPU PAVAN KALYAN						
16	22475A0304	KOLLI GOWRI SANKARA RAO						
17	22475A0305	VANTAKU GANAPATHI LAKSHMI NAIDU						
18	22475A0306	SYED HUSSAIN						
19	22475A0307	BEHERA SANJAY KUMAR						
20	22475A0308	YASAM MANIKANTA						
21	22475A0309	MALLADI GOPI PURNA						
22	22475A0310	UNGATI LOKESH						

		
23	22475A0311	RAMAVATH VASU DEVA NAIK
24	22475A0312	PASALA SYAM KUMAR
25	22475A0313	THURIMELLA VAMSI GANESH
26	22475A0314	KUKKAMALLA KARTHIK
27	22475A0315	VUTLA KISHORE
28	22475A0316	DHARMANA APPALA NAIDU
29	22475A0317	NIKKU SURESH
30	22475A0318	GORANTLA SIVA KOTESWARA RAO
31	22475A0319	POGUNOLLA KARUN KUMAR
32	22475A0321	BANDLAMUDI NAGA RAJU
33	22475A0322	BOJJA SYAM BABU
34	22475A0323	ATHULURI PURNA VENKATA RAMARAO
35	22475A0324	BATTULA LAKSHMI NARAYANA
36	22475A0325	GUDIKANDULA ANJANEYULU
37	22475A0326	AYINAMPUDI KISHORE BABU
38	22475A0327	KETHABOYINA MAHESH
39	22475A0328	SHAIK BABULAL
40	22475A0329	BANDARU VENU GOPAL
41	22475A0330	YADAVALLI LOKESH
42	22475A0331	CHOUDAM VENKATESH
43	22475A0332	CHATTI MURALI KRISHNA
44	22475A0333	DARAM PRUDHVI KRISHNA
45	22475Å0334	SHAIK NAGUR BASHA
46	22475A0335	GOLLAPUDI SARATH KUMAR
47	22475A0336	ADAKA VINOD
48	22475A0337	JANNI ARUN
49	22475A0338	NOWPADA MEGHANADH
50	22475A0339	BALAGA YUGANDHAR
51	22475A0340	NEYYELA KUMAR BEHERA
		·

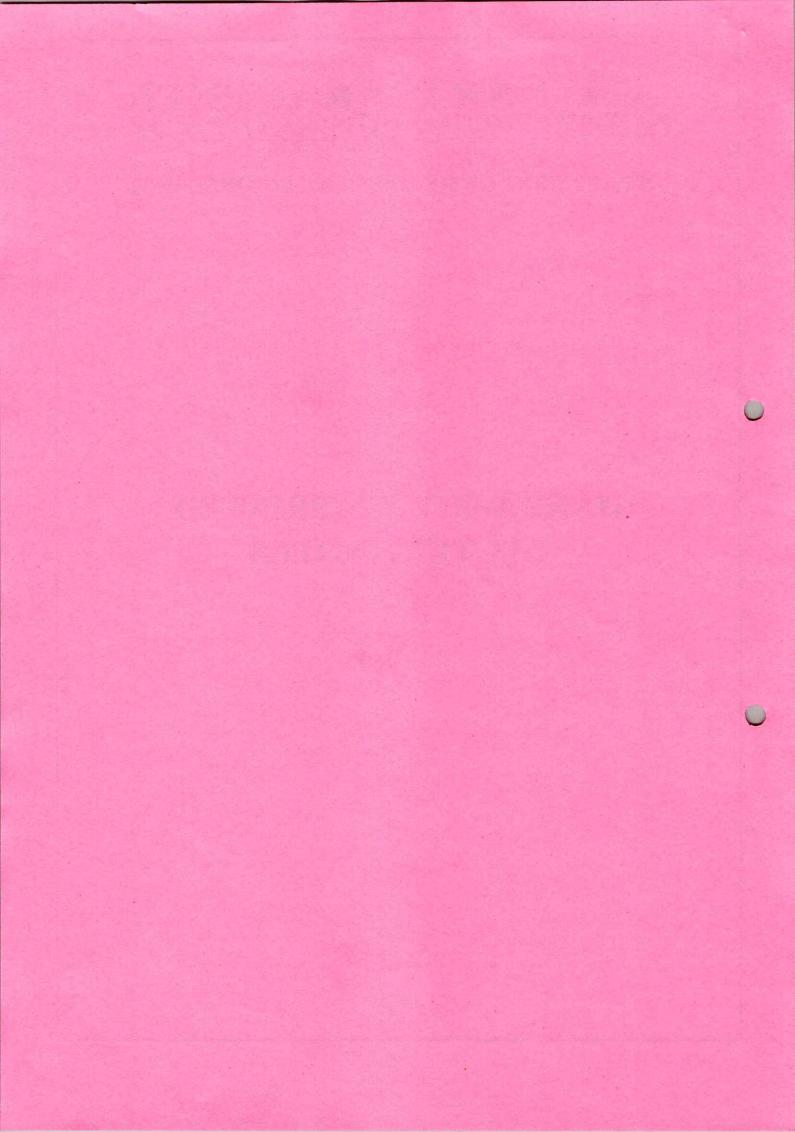
52	22475A0341	KUNITI PAVAN KUMAR	
53	22475A0342	BHUKYA DIWAKAR NAIK	
54	22475A0343	VOONA NARENDRA	
55	22475A0344	CHANDARLAPATI GANESH	
56	22475A0345	BALAGA MOHAN	
57 22475A0346		BOMMALI MAHESH	
58	22475A0347	DUDDETI NAGA SAI	
59	22475A0348	BASWA DILLESWARA RAO	•
60	22475A0349	KORRAPATI MOHAN KRISHNA	
61	22475A0350	NAKKANABOINA NAGA SRIDHAR	
62	22475A0351	GONDU GANESH PAVAN	
63	22475A0352	LINGA SRINIVAS	
•	1		

PRINCIPAL



DEPARTMENT OF MECHANICAL ENGINEERING

HAND WRITTEN/PRINTED LECTURE NOTES

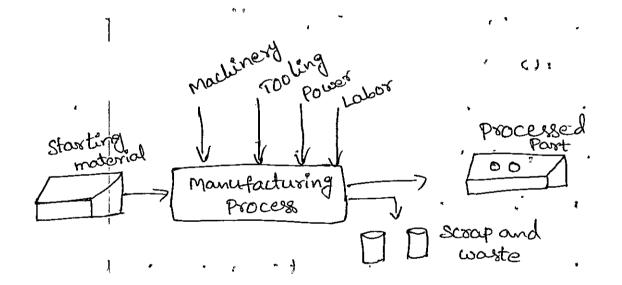


MANUFACTURING TECHNOLOGY

Production: - It is a Process of Converting inputs in to

. ; productivity (which is measure of production) = output/Imput

Manufacturing: It is a process of converting row material in to finished product by using various processes, machines and energy.



Carting Process !-

casting process is one of the earliest metal shaping techniques known to human being. It means Pouring mother metal, into a refront only mould cavity and allows it to solidify. The solidified object is taken out from the mould either by breaking or taking the mould apart. The solidified object is called casting and

the technique followed in method is known as casting process. The casting process was discovered. Probably around 3500 BC in mesopotamia

steps involved in making a casting (or) mouldi-

- (a) Pattern making: make the Pattern of wood, metal (or) plastic.
- (b) sound mixing and Preparation: Select particular sound, test it and prepare the necessary sound mixtures for mould and core making.
- co) core roaking: with the help of patterns prepare the rould and required, cores.
 - d) metting: Mett. the metal or alloy to be cost.
 - (e) Pouring: pour the motten metal or alloy into the rould and remove the Carting from the mould after solidification of metal.
 - (f) Finishing: , clean and finish the casting.
- (9) Testing: Test and insipect the casting and remove the defects, if any.

- (h) Heat treatment: Relieve the casting stresses by using various heat freatments.
- (i) Re-testing: Again inspect the casting and deliver it.

Advantages of metal casting:

- molten metal flows into smallest section in the molten cavity. Hence any complex shape can be easily produced Ex. Gas turbine blades.
- . Practically any matabial can be casted.
 - . I deal method is by producing small quantities.
 - · Due to small cooling rate from all directions, the Properties ob counting are same in all directions,
 - · Any size of cashing can be produced up to 200 tons.
 - . used for mass production of components.
 - · carsting is the cheap comparatively.
 - · Heavy equipment like machine leads, ships propeller, etc. com be madé:

J,

Limitations of casting process:

- . with normal sand costing process, the dimensional accuracies, are less.
- · Low surface finish obtained on castings.
- . Defeats are unavoidable...
- . Sand coesting is more Caborious Process.
 - · Needs, lot of pattern maintenance.

Applications of metal casting:

- 1. Transportation vehicles (in automobile engine and tractors)
- 2. machine tool Structures.
- 3. Turbine vanes and lower generators.
- 4. Pump fitter and valve.
- 5. Railway crossings and aircraft Jet engine blades.
- 6. Agricultural parts and sanitary fittings.
- 7. Construction, communication and atomic energy applications, etc.

Pattern: A pattern is defined as a model or replica of the object to be cast. If one object has to be cast, then also pattern is required. It is a model or form around which sand is packed to give rise called as mould cavity in which motten metal is powed and the casting is produced.

Difference bln Pattern & casting (or) A pottern differ from

- 1. A pattern is slightly larger than the carting because a Pattern carries allowance to compensate for metal shrinkage.
- 2. Also Pattern carries allowances for machining so us to clean and finish the required surfaces.
- 3. Pattern also has the necessary draft for its easy removal from the sand mass.
- 4. Pattern, carries additional projections, called as core prints, to produce seats for the cores.
- 5. A pattern may, not have holes and slots which a casting will have. Such holes and slots make a pattern complicated, hence can be drilled in the casting after it has been made.
- 6. The moterial from which casting and pattern is made, is also different:

Pottern colours and reasons!Reasons for providing colons to Patterns:-

.. To identify quickly the main pattern body and different pattern parts.

- . To indicate the type of the metal to be cast.
- · To identify loose Pieces, core Points, etc.
- . To visualize madined surfaces, etc.

An American colour scheme for pattern and core Loves is as follows:

- 1. cost surfaces to be machined Red.
- 2. Surfaces to be left un machined Black.
- 3. Core Print seats Yellow.
- 4- Loose Piece and Settings- Red Strips on Yellow base.
- 5. Posting surfaces clear or no colours:
- 6. Supports or stop-offs-Black Strips on Yellow base.
- 7. Core prints for madwined costings- Yellow strips on black background.

Factors to be considered while selecting proper of

- 1. The number of casting to be made: Metal.

 Patterns are preferred for large quantity of production and wooden Patterns for lesser quantity.
- 2- Degree of acceptacy in dimensions and the quality of surface finish required on the Casting.
- 3. method of moulding to be used i.e, sand costing, investment casting, etc. i.e, hand or machine.

- 4. Type of casting method to be used i.e., sand casting, investment casting, etc.
- 5- Shape, size and complexity of the Casting.
- 6. Casting design parameters.
- 7. Type of moulding material to be used.

materials used for making Patterns!

The Common materials of which the patterns are

(1) wood [i.e., wooden Patterns)!-

Advantages:

- -) It is cheap and easily available in large quantities.
- -> It can be easily shaped and machined to different configurations and forms.
- -) Good surface finish can be easily obtained
- -) Due to lightness in weight its manipulation is copy and it can also be repaired easily.

bignitations or problems!

- -) wooden patterns are weak as compared to metal patterns.
- They cannot with stand rough handling.
- -> They possess poor wear resistance and hence they are abraded easily by sand action.

-> they absorb modesture, hence get warped and change the shape and size.

Applications: - , wooden Patterns are mostly used where number of costing to be made is small and the Size of pattern is large.

The common woods used in pattern making ares White Pine, Mahogany, Maple, Cherry, Teak, Shisham etc,

2. Metals (ie, metal patterns):- metal patterns one cast from wooden patterns.

Advantages!

- -) They do not absorb moisture.
- They are stronger and accurate, hence more life as compared to wooden patterns.
 - -> They have greater resistance to aborasion and wear.
 - -> They can with stand rough handling-

Limitations?

- -) As compared to wooden pattern's They are more
- ; expensive : -> They are heavier than wooden patterns:
- persons material patterns get rusted is
- they cannot be repaired easily.

Applications: met al patterns are used where large numbers of castings have to be Produced from the same patter.

The common metals and alloys used for making patterns are:-

Aluminium and its alloys, steel, Brass, Cost iron, white metal etc;

(3) Plastic (ie) Plastic Patterns)!-

Advantagles!-

- -> Light weight and high strength.
- -) Resistance to wear and corrosion.
- provides good surface finish.
- -) they are easy to make and less costly also.

Limitations!

- plastic Patterns are fragile, hence light sections may need metal reinforcements.
- -) They may not work well when subjected to. conditions of severe shock.

(4) wax (ie) wax patterns):-

Advantages: They provide good surface finish. After being molded, the wax Pattern is not taken out; souther the molded is invested and heated and the molten wax comes out or gets evaporated, hence there is no chance of the mould cavity getting damaged while removing the pattern. Also, they provide high accuracy to the costings.

Applications: -. wax patterns are exclusively used in investment casting process.

A pattern is always made larger than the final Casting, because it courses cextain allowances (fixen below) due to metallurgical and mechanical reasons.

d) Shrinkage. (or) contraction allowance:

Almost all the metals used in the casting cooking from Pouring work shrink or contract during cooking from Pouring temperature.

Shrinkage allowance for different metals.

metal	Grey cost iron,	Steel	Aluminium	Bronge	Braeg	magnesium
Allowance mm/meter	6.95 to 10.4	20.8	16.5	10.5 to 21	15-4	16.2
			L 			

(2) machining, allowance:

machining allowance, is the amount of.

dimension on a casting which is made oversized

to provide stock for machining. This varies from

1.5 mm to 16 mm.

(3) Draft allowance 1-

Sand without damozing meter on external surfaces and yourn to 65 mm the moulds 1-this viories from 10 mm to 25 mm Per Draft allowance or taper allowanice Pattern 男の per meter on internal surfaces. their easy removal from all vertical faces given to

external Britanon british mathod tapex (6) pathern. Light J Brown ofth drowing. Postern without (8)

led) diroft allowance Figure > Toper

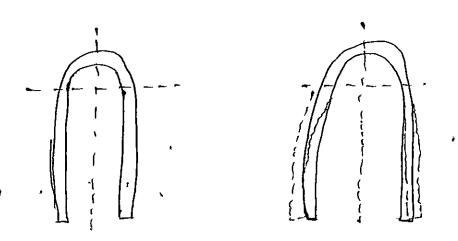


Figure: Distortion (08) comber allowance

(4) Distrottion allowance (cambér allowance):- (see above Af.)

The Casting will distort or warp if it. is obtivities whose, V-shape, the arms howing unequal thickness or one Portion of the Casting cooks at a forter rate than the other. To eliminate this defect, an opposite distortion is provided on the Pattern, so that the effect is balanced and correct shape of the Casting of is produced. The amount of distortion allowance varies from 2 mm to 20mm as per the side, shapeand casting material.

(5) Rapping (Gr) shake allowance:-

when a pattern is to be taken out from the mould. It is first rapped or shaken by striking it with a wooden piece from side to side. This is done so that the pattern sweface becomes free from adjoining sand of the mould. Due to this, three is little increase in the size of the mould cavity. For this purpose, a realize allowance is provided on the Pattern i.e, the dimensions are kept smaller. It is normally provided only to the larger castings and negligible for small and medium sized castings.

•
• · · · • .

MANUFACTURING TECHNOLOGY

1, 2 & 3 Units

....Prepared by P.Suresh Babu

*Casting process: It means pouring molten metal into a pre-shaped cavity (called mould) and allows it to solidify. The solidified object is taken out from the mould either by breaking or taking the mould apart. The solidified object is called casting and the technique followed in method is known as casting process.

*Steps involved in making a casting OR Mould:

- a) Pattern making: Make the pattern of wood, metal or plastic.
- b) Sand mixing and preparation: Select particular sand, test it and prepare the necessary sand mixtures for mould and core making.
- c) Core making: With the help of patterns prepare the mould and required cores.
- d) Melting: Melt the metal or alloy to be cast.
- e) **Pouring**: Pour the molten metal or alloy into the mould and remove the casting from the mould after solidification of metal.
- f) Finishing: Clean and finish the casting.
- g) **Testing**: Test and inspect the casting and remove the defects, if any.
- h) Heat treatment: Relieve the casting stresses by using various heat treatments.
- i) Re-testing: Again inspect the casting and deliver it.

*Advantages of Metal Casting

₹ 4

- Any complex shape can be easily produced
- Practically any material can be casted.
- Ideal method is by producing small quantities
- Any size of casting can be produced up to 200 tons.
- Used for mass production of components
- Casting is the cheap comparatively

Limitations of casting process

- Dimensional accuracies are less
- Low surface finish obtained on castings
- Defects are unavoidable.
- Sand casting is more laborious process

<u>Applications of Metal Casting:</u> Transportation vehicles, Machine tool structures, Turbine vanes and bewer generators, Railway crossings and aircraft jet engine blades etc.,

**A pattern is defined as a model or replica of the object to be cast. If one object has to be cast, then also pattern is required. It is a model or form around which sand is packed to give rise to a cavity called as mould cavity in which molten metal is poured and the casting is produced.

*Factors to be considered while selecting proper material for pattern:

- 1) The number of casting to be made. Metal patterns are preferred for large quantity of production and wooden patterns for lesser quantity.
- 2) Degree of accuracy in dimensions and the quality of surface finish required on thecasting.
- 3) Method of moulding to be used i.e. hand or machine.
- 4) Type of casting method to be used i.e. sand casting, investment casting, etc.
- 5) Shape, size and complexity of the casting.
- 6) Casting design parameters.
- 7) Type of moulding material to be used.

**Materials used for Making Patterns:

1) Wood: Advantages: Cheap, easily available, easily shaped and machined to different forms

<u>Limitations:</u> Wooden patterns are weak, cannot withstand rough handling, possess poor wear resistance, absorb moisture, hence get warped and change the shape and size.

Applications: Used for big patterns and less in quatity

Common woods used: White pine, Mahogany, Cherry, Teak, etc.,

2. Metals: Metal patterns are cast from wooden patterns.

Advantages: They do not absorb moisture. They are stronger and accurate, greater resistance to abrasion and wear.

Limitations: More expensive, heavier, cannot be repaired easily.

Applications: Used where large numbers of castings required .

Common metals and alloys used: Al, Steel, Brass, Cast iron, White metal etc.,

3. Plastic: Advantages: Light weight and high strength, Resistance to wear and corrosion, Provides good surface finish

Limitations: Plastic patterns are fragile; hence light sections may need metal reinforcements.

- They may not work well when subjected to conditions of severe shock.

4. Wax: Advantages: Provide good surface finish,

Applications: Wax patterns are exclusively used in investment casting process.

**Pattern Allowances

A pattern is always made larger than the final casting, because it carries certain allowances (given below) due to metallurgical and mechanical reasons.

- <u>i. Shrinkage or Contraction allowance</u>: Almost all the metals used in the casting work shrink or contract during cooling from pouring temperature to room temperature.
- <u>ii. Machining allowance</u>: Machining allowance is the amount of dimension on a casting whichis made oversized to provide stock for machining. Ferrous metal needs more allowance than the non-ferrous metals and similarly large castings need more allowance than small castings.
- <u>iii. Draft allowance</u>: Draft allowance or taper allowance is given to all vertical faces of a pattern for their easyremoval from sand without damaging the moulds.
- iv. Distortion allowance (Camber allowance): The casting will distort or warp if it is of irregular shape, V-shape, the arms having unequal thickness or one portion of the casting cools at a faster rate than the other. To eliminate this defect, an opposite distortion is provided on the pattern, so that theeffect is balanced and correct shape of the casting is produced.

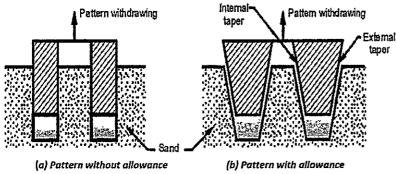


Figure: Taper or draft allowance

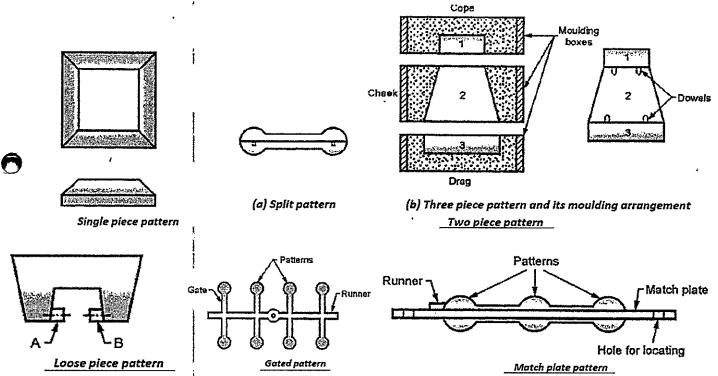
Figure: Distortion or camber allowance

<u>v. Rapping or Shake allowance:</u> When a pattern is to be taken out from the mould there is little increase in the size of the mould cavity. For this purpose, a <u>negative</u> allowance is provided on the pattern i.e. the dimensions are kept smaller. It is normally provided only to the large castings and negligible for small and mediumsized castings.

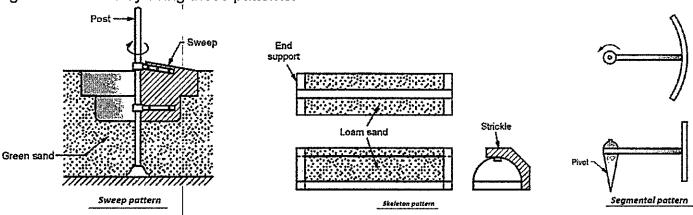
7

Types of patterns:

- 1. Single piece or solid pattern: It is the simplest of all the patterns and it is made in one-piece and does not carry loosepieces or joints. It is generally used for making large sized simple casting, usually made up ofwood or metal.
- 2. Two piece or Split pattern: Pattern upper and lower parts are accommodated in the cope and drag portions of the mould, respectively. For keeping the alignment between the two parts of the pattern, dowel pins are used.
- 3. Loose piece pattern: Some patterns embedded in the moulding sand cannot be withdrawn, hence suchpatterns are made with one or more loose pieces for their easy removal from the moulding box. These patterns are known as loose piece patterns



- Loose pieces like A and B as shown in fig, remain attached with the main body byusing dowel pins. These patterns consume more time for moulding operation and require more labourwork.
- 4. Gated pattern: To increase the strength and reduce the tendency to warp, gated patterns are senerally made of metals. By using gated patterns number of casting can be made at a time, hence are used in mass production system. The sections connecting various patterns serve as a runner and gates. This facilitates filling of the mould with molten metal in better manner and reduces the required time and labour work. These patterns are used for producing small castings.
- **5. Match plate pattern: These patterns are made in two pieces i.e. one piece mounted on one side and the other on the other side of the plate, called as match plate. The plate may carry one pattern or group of patterns mounted in the same way on its two sides. The plate can be of wood, aluminum, magnesium or steel. The match plate has runner and gates attached with it. Piston rings of I. C. engines are made by using these patterns.



- 6. Sweep pattern: Sweep pattern is just a form made on a wooden board which sweeps the casting is shape into the sand all around the circumference. The sweep is rotated about the spindle or post, to form the cavity as shown in Fig.
- <u>7. Skeleton pattern:</u> When the casting size is very large, but easy to shape and few are to be made, then it is not economical to make a large solid pattern of that size. In such cases, a pattern consisting of a wooden frame and strips is made which is called as skeleton pattern.
- 8. Segmental pattern: The pattern is mounted on a central pivot and it completes one portion of the mould and then moves to the next portion. Used for producing large circular casting like big gears, wheel rims etc

Types of Moulding Sands

- 1. Natural sand: Natural sand can be used directly for making moulds as soon as it is received from its source. It contains binding materials (5 to 20% clay) and needs only water (5 to 8 %) to mix before making the mould
- 2. Synthetic sand :Synthetic sand consists of natural sand with or without clay, moisture and binder likebentonite.
- 3. Special sands: These includes the following
- *Green sand: It contains 5% of water and 15 to 30% of clay. Moulds and cores both can be made of green sand. Green sand moulds are poured in the green condition (not dried). It is preferred for producing simple, small and medium sized casting.
- *Loam sand: It contains more amount of clay as compared to other sands i.e. up to 50%. Loam sand dries hard. Its ingredients are fine sand, finely ground refractories, clay, graphite and fibrous reinforcement. It is used for making mould for heavy and large parts.
- *Core sand:Core sand is different from moulding sand as it has very low clay content and their grainsize is large to increase the permeability. It is silica sand mixed with core oil which is composed of linseed oil, resin, light mineraloil and other binding materials. Used for making cores.
- *Parting sand: It consists of dried silica sand, sea sand or burnt sand. It is used to keep the green sand from sticking to the pattern and also to allow the sandon the parting surface of the cope and drag to separate without clinging. Ex. Charcoal, limestone, ground nut shells, etc.
- *Facing sand: It is fresh and specially prepared moulding sand which covers the pattern all around it, thus forms the face of the mould cavity. It comes in direct contact with the molten metal being poured; hence it should possessmuch improved properties than other sands. Its use reduces the mould material cost. Various facing materials are plum bags, graphite, talc, molasses, etc.
- *Backing sand: It is the sand which backs up the facing sand and does not come in direct contaguith the pattern. This sand has black colour and hence, sometimes called as black sand. It should be cleaned off the foreign matter like fins, nails, etc. before use.

*Property of Moulding Sand

- 1. Flowability or plasticity: It is the ability of the moulding sand to get compacted to a uniform density. It assists moulding sand to flow and pack all-around the pattern and take up the desired shape.
- 2. Green strength: It is the strength of the sand in the green or moist condition. A mould which has adequate green strength will retains its shape and does not distort orcollapse, even after the pattern has been removed from the moulding box.
- 3. Dry strength: It is the strength of the moulding sand in the dry state.
- 4. Permeability or porosity: The sand must be porous to allow the gases and steam generated within themoulds to be removed freely.
- <u>5. Refractoriness</u>: It is the ability of moulding sand to withstand high temperatures without fusion, cracking and buckling.
- 6. Adhesiveness: It is the property of moulding sand because of which it is capable of adhering to the surface of other materials.
- 7. Cohesiveness: It is the property of the sand due to which sand particles stick together.

- *8. Thermal stability: To avoid breaking, buckling and flaking off of mould surface at higher temperatures, sand possesses dimensional thermal stability. If not, the casting may have defects like cuts and washes.
- 9. Collapsibility: It is the property due to which the sand mould automatically collapses after freezing of the casting, to allow the free contraction of the metal.

*Ingredient of Moulding Sand & their Purposes or What materials to be added to moulding sand to improve its properties?

- **1. Sand:**The sand which forms the major portion of the moulding sand is essentially a silica grain. The shape and size of these grains greatly affect the properties of the moulding sand. The coarse grains have more void space between the grains which increases permeability, whereas a fine grain lowers the permeability.
- 2. Binder: Binders produce cohesion between the moulding sand grains and give strength to the moulding sand so that it can retain its shape as mould cavity. Ex. Bentonite, Fire clay, Limonite, Ball clay etc.,
- 3. Water: Around 1.5 to 8.0 % of water to be added along with clay. Binders and additives work only when moisture is present. Correct amount of water develops good green strength, edge and scratch hardness, good tensile strength, etc. Excessive amount of moisture adds difficulties in making and king of cores.

Additives: Coal dust, Sea coal, corn flour etc., to improve other properties like strength, surface finish etc..

*Cores & its functions

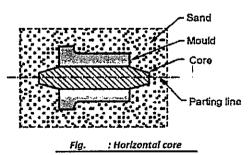
Cores does not permit the molten metal poured to fill the space occupied by the core hence produce hollow casting. Core may be made up of sand, plaster, metal or ceramics. Cores are used as inserts in moulds to form design features which are difficult to be produced by simple moulding.

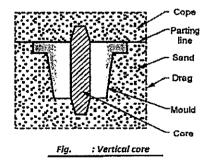
Essential characteristics of Core OR Requirements of Core sand:

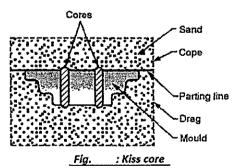
- It should have sufficient strength to support itself without breaking.
- It should have high permeability and high refractoriness.
- It should have smooth surface to ensure a smooth casting.
- It should have high collapsibility, to assist the free contraction of the solidifying metal.
- It should have those ingredients which does not generate mould gases.

Draw and explain any 3 types of Cores? 3M

Prizontal core: A horizontal core is positioned horizontally in the mould and mostly placed at parting line







Vertical core:

- It is similar to horizontal core, except that it is fitted in the mould with its axis vertical. The top end of the core is provided with more amount of taper, to have a smooth fittingof the cope on the core. Kiss core: It does not require core seats for getting support. It is held in position between drag and cope due to the pressure exerted by core on the drag. To obtain a number of holes in a casting, a number of kiss cores can be simultaneouslypositioned.

*Core Print: Core prints are basically extra projections provided on the pattern. They form core seats in the mould when pattern is embedded in the sand for mould making. Core seats are provided to

support all the types of cores. Core prints types are Horizontal core print, Vertical core print, Cover core print, Wing core print, Balance core print etc.,

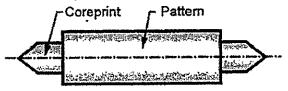
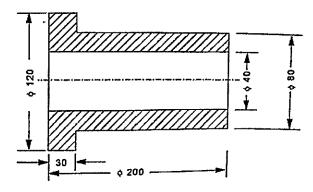


Fig. . :: Core print

<u>Prob.(1)</u>: Design a split pattern for gun metal sleeve (see the below Fig.) assuming shrinkage, draft allowances and machining allowances of 2 mm for hole only



Solution: For gun metal shrinkage allowance is 12 mm/m

Shrinkage allowance for various dimensions:

Dimensions, mm	Allowance, mm	Final size, mm		
200	$200 \times 0.012 = 2.4$	202.4		
120	$120 \times 0.012 = 1.5$	121.5		
80	$80 \times 0.012 = 1$	81.0		
40	$40 \times 0.012 = 0.5$	40.5		
30	$30 \times 0.012 = 0.4$	30.4		

Provide draft allowance of 20 mm/metre.

Draft for 121.5 mm; $\frac{121.5}{2} \times 0.02 = 1.2$ mm on either side of parting line.

Draft for 81 mm; $\frac{81}{2} \times 0.02 = 0.8$ mm on either side of parting line.

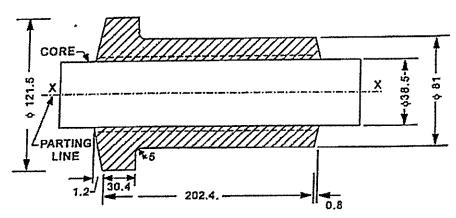


Fig. : SPLIT PATTERN (all dimensions are in mm)

Considering the machining allowance of 2 mm,

The size of hole = 40.5 - 2 = 38.5 mm

Fillet radius of 5 mm is provided at the corners.

Dimensions of split pattern for gun metal sleeve is shown in Fig.

Gating system

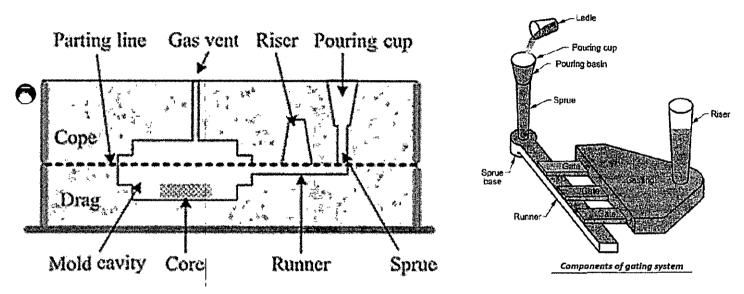
Gating system: A proper method of gating system is that it leads the pure molten metal to flow through a ladle to the casting cavity, which ensures proper and smooth filling of the cavity. This depends on the layout of the gating channels too, such as the direction and the position of the runner, sprue and ingates.

Functions or Objective of the Gating System

- Clean molten metal.
- Smooth filling of the casting cavity.
- Uniform filling of the casting cavity.
- Complete filling of the casting cavity.

Elements of Gating system and explain them in detail

Gating system composed of Flask, Pouring cups and basins, Sprue, Runner, Gates, Riser etc.,



Flak: Flak is the moulding box used for holding the sand. Based on the situation it can be named as cope, drag, cheek, etc.

- Drag: Lower moulding flask is called drag.
- Cope: Upper moulding flask is called cope.

Cheek: The middle moulding flask used in the three-piece pattern is called cheek.

Pattern: The pattern is the replica of the casting to be produced.

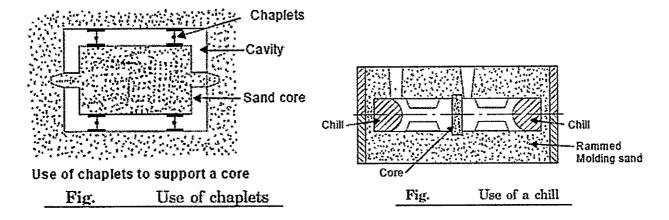
Parting line: The parting line is the dividing line between the two flasks.

**Sprue: Sprue is the connecting passage between the pouring basin and runner. It controls the flow of molten metal. The sprue may be square or round and is generally tapered downwards, to prevent air from entering the castingand metal damage.

Runner: The runner is the passage used for regulating the flow of molten liquid.

Ingate: Ingate is the last point of gating from where the molten metal enters the cavity.

Riser: The riser is the reservoir of molten metal provided in the casting process to compensate the liquid shrinkage's taking place during solidification.



Chill: Chill is the metallic piece used for obtaining directional solidification.

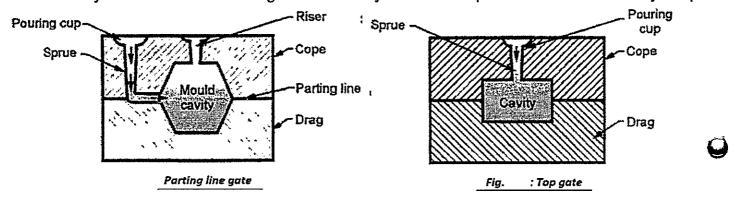
*Chaplets: Chaplets are used for supporting the cores inside the mould cavity to take care of its weight and mould cavity to take care of its weight and overcome the buoyancy forces.

Factors that are to be Controlling Gating Design?

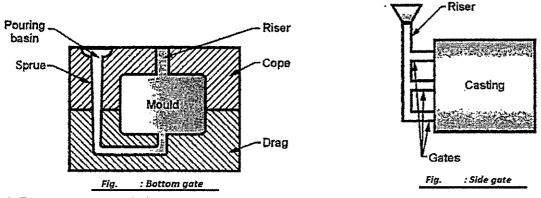
(i) Sharp corners should be avoided (ii) The shape, location and dimensions of runners and type of flow. (iii) Gating ratio should reveal that the total cross-section of sprue, runner and gate decrease towards the mould cavity (iv) Bending of runner if any should be kept away from mould cavity (v) Tapering the sprue, providing radius at sprue entrance and exit and providing a basin instead pouring cup etc.

Major types of gates

a) Parting line gates: These gates enter the mould cavity along the parting line separating the cope and drag portions of the mould. These gates are the simplest in nature and construction. Such gates are commonly used and are found to give satisfactory service except when the mould is very deep.



b) Top gates: The molten metal just drops on the sand in the bottom of the mould. The dropping liquid metal stream erodes the mould surface. It is not favourable for non-ferrous casting.



c) Bottom gates: A bottom gate is provided in the drag half of the mould. In this, liquid metal fills rapidly the bottom portion of the mould cavity and rises steadily and gently up the mould walls.

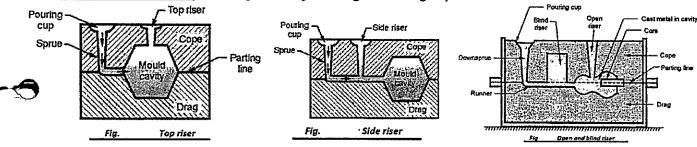
Bottom gates provide less turbulence and erosion in the mould cavity. It is not used in large and deep casting because the metal cools gradually as it rises up.

d) Side gates: Side gates are provided on either left or right side of the casting. Hence, the metal enters into the mould cavity from sides. It enters near the bottom first, and then as the level of the metal rises in the mould the incoming molten metal starts entering near the surface of the rising metal.

Functions of Risers:

- To feed metal to the solidifying casting, so that shrinkage cavities are got rid of.
- It permits the escape of air and mould gases as the mould cavity is being filled with the molten metal.
- It promotes directional solidification.
- Also, it shows that the mould cavity has been completely filled or not.

<u>Classification of Risers (Write by own by seeing the images)</u>



<u>Solidification of casting:</u> Casting is a common metal solidification process which utilized the melting and re-solidification of a metal or alloy within a mould to produce a final desired product. Steps in solidification of metals and alloys in castings is as follows

- 1. Melting: The casting process starts by heating a metal alloy in a crucible until it melts.
- 2. Degassing/Modification: The liquid metal must be degassed prior to pouring.
- **3. Pouring:** The liquid metal is then poured into a sand mould. Inside the hollow cavity of the sand mould is the shape of the desired end product. Sometimes this cavity is only one part and sometimes it is several individual parts.
- **4. Freezing:** Once the molten liquid has been poured into the mould it cools rapidly. When the temperature of the liquid metal changes below the melting point of that particular metal or alloy, the solidification process begins. This usually takes less than a few minutes:
- Solidification: As the temperature drops further, the molten metal loses energy and crystals begin to form. This process starts near the mould walls where it cools first. These crystals eventually become grains within the final structure. If the metal solidifies slowly, the grains are longer. If it cools quickly, the grains are visibly shorter. The crystals (or dendrites) continue to form and harden until the entire melt is solidified. During the solidification process, the metal is shrinking. It is important to feed this shrinking to ensure the castings are free of voids and shrink defects. This is accomplished by the use of risers.
- **6. Casting:** Once hardene'd, the cooled metal is removed or broken from the sand mould to complete the solidification process. This finished piece is also called a casting. The casting is then trimmed, finished and polished based on the specifications of its final application.

Casting / Moulding Processes

Shell Moulding process: Shell moulding is suitable for thin walled articles. It consists of making a mould that has two or more thin shell like parts, made by Silica sand is mixed with synthetic resin

Procedure of making shell mould: Write by own by seeing the below figures

Advantages: Very high surface finish is obtained. Sand handling is minimum. Less floor area is required. Casting defects are minimum.

Limitations: The pattern equipment cost is more. Complicated jobs cannot be moulded.

Hot pattern

Sand resin Mix dumped over a heated pattern

Shell formed over the pattern

Shell stripped from the pattern

Shell joined together

Applications: Automobile casting, casting steel, iron or non-ferrous alloys.

CO₂ Moulding Process

The principle of working of the CO₂ process is that, CO₂ gas is passed through a sand mixture containing sodium silicate. Then the sand immediately becomes extremely strongly bonded as the sodium silicate becomes a stiff gel. This gel is responsible for giving the necessary strength to the mould.

to form a complete mould

Na₂O(x) SiO₂+(x) H₂O+CO₂
$$\rightarrow$$
 Na₂CO₃+SiO₂.(x) H₂O (Sodium silicate) (Sodium (Silica gel) carbonate) where x is 3, 4 or 5, most often $x=2$.

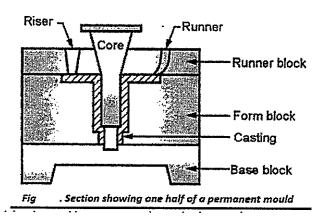
Advantages: 1. Eliminates the need for internal support for cores, and for drag and cope elements 2. Speed in operation, so, suitable for heavy and rush orders 3. Eliminates baking ovens and core driers 4. Requires minimum floor space 5. Semi skilled labour are enough 6. Less labour cost 7. Greater dimensional accuracy

Permanent Mould Casting: The process is also called as gravity die-casting. In this the mould is permanent which is neither destroyed nor remade after each cast. The mould is first preheated, up to a temperature of 400°C. Apply refractory coating on the mould cavity surfaces, runner and riser, etc. After attaining the mould temperature, the casting is poured. As the metal begins to solidify, cores are removed; otherwise it may shrink onto the surface of the metal.

<u>Advantages:</u> It is a very fast process. Moulds pave longer life. Better surface finish can be obtained. Less skilled operator is required. Less floor area is required.

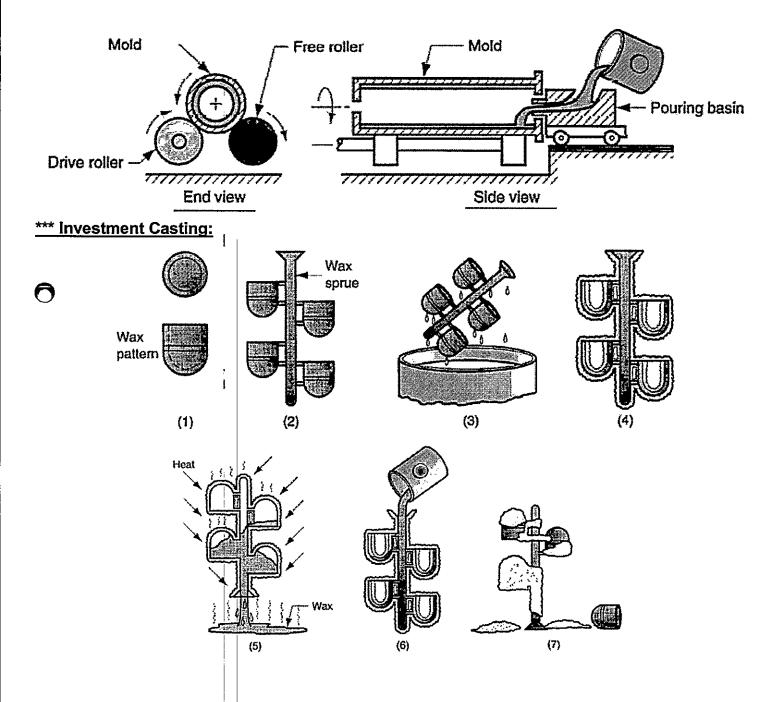
<u>Limitations:</u> Moulds are much costlier. This method is not suitable for small quantity production. Shape and weight of the casting is limited. Gates, runners and risers cannot be shifted.

<u>Applications:</u> Hydraulic brake cylinders, Carburettor bodies, Washing machine gears, Oil pump bodies, Aircraft and missile casting, etc.



<u>Centrifugal Casting process</u>: In this process mould is rotated at high speed and molten metal is poured into it. Due to the centrifugal force, the molten metal is directed outwards from the centre i.e. towards the inner surface of the mould with high pressure. Hence, a uniform thickness of metal is deposited all along the inner surface of the mould, where it solidifies and the impurities being lighter remains nearer to the rotation axis. This process produces casting with greater accuracy and better physical properties. This method is mainly suitable for producing casting of symmetrical shapes.

Applications: This method is used to cast hollow cylindrical objects such as hollow pipes, gun barrels, bushes, etc.



Steps in investment casting:

- (1) Wax patterns are produced
- (2) Several patterns are attached to a sprue to form a pattern tree;
- (3) The pattern tree is coated with a thin layer of refractory material;
- (4) The full mould is formed by covering the coated tree with sufficient refractory material to make it rigid;
- (5) The mould is held in an inverted position and heated to melt the wax and permit it to drip out of the cavity;
- (6) The mould is preheated to a high temperature, pour the molten metal
- (7) After solidification, break and separate the castings

Advantages:

- Better dimensional accuracy with close tolerances can be achieved.
- Complicated shapes and complex contours can be easily cut.
- Extremely thin sections up to 0.75 mm can be cast.
- Surface finish of the casting is very high.

Limitations:

- Suitable only for small sized casting.
- Moulds used are single purpose only.
- Cost of investment material is high.
- It is a time consuming process.

Applications:

- Parts for aerospace industry, aircraft engines, frames, fuel systems, etc.
- Nozzles, buckets, blades, etc. for gas turbines.
- Costume jewellery can be made.

*Continuous Casting: Liquid metal from tundish flow to bottom by gravity which is cooled during down movement to make it to semi solid then by using rollers bending it from vertical to horizontal direction. Then cut into desired lengths by saw

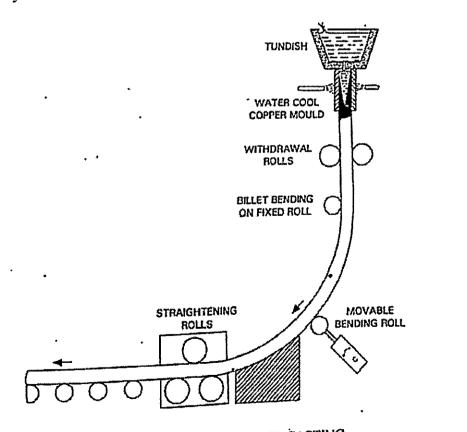


Fig. : CONTINUOUS CASTING

- -The process is cheaper than rolling from ingots.
- -But, Molten metal must be free from slag and poured with minimum turbulence to prevent surface roughness
- Used to produce any shape of uniform cross-section such as rectangular, square, hexagonal etc.,

<u>Fettling:</u> The complete process of cleaning of castings is called fettling. It involves the removal of the cores, gates, sprues, runners, risers and chipping of any of unnecessary projections on the surface of the castings caused by seams and imperfections in the moulds, as well as access ports for pouring material into the moulds.

*Casting Defects with causes and Remedies?

- (a) <u>Misruns</u>, which are castings that solidify before completely filling the mould cavity. Typical causes include (1) fluidity of the molten metal is insufficient, (2) pouring temperature is too low, (3) pouring is done too slowly, and/or (4) cross-section of the mould cavity is too thin.
- (b) <u>Cold Shuts</u>, which occur when two portions of the metal flow together but there is a lack of fusion between them due to premature freezing. Its causes are similar to those of a misrun.
- (c) <u>Cold shots</u>, which result from splattering during pouring, causing the formation of solid globules of metal that become entrapped in the casting. Pouring procedures and gating system designs that avoid splattering can prevent this defect.

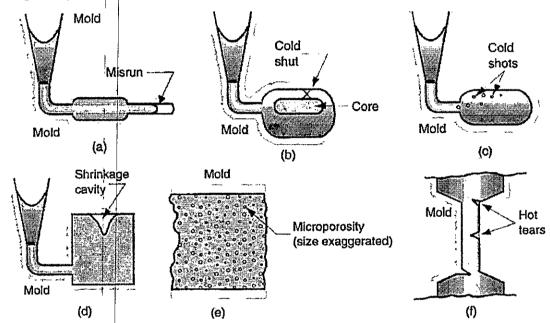


Fig.: Some common defects in castings: (a) misrun, (b) cold shut, (c) cold shot, (d) shrinkage cavity, (e) microporosity, and (f) hot tearing.

- Shrinkage cavity is a depression in the surface or an internal void in the casting, caused by solidification shrinkage that restricts the amount of molten metal available in the last region to freeze. It often occurs near the top of the casting, in which case it is referred to as a "pipe." The problem can often be solved by proper riser design.
- (e) <u>Microporosity</u> consists of a network of small voids distributed throughout the casting caused by localized solidification shrinkage of the final molten metal in the dendritic structure. The defect is usually associated with alloys, because of the protracted manner in which freezing occurs in these metals.
- (f) <u>Hot tearing/hot cracking</u>, occurs when the casting is restrained from contraction by an unyielding mould during the final stages of solidification or early stages of cooling after solidification. The defect is manifested as a separation of the metal (hence, the terms tearing and cracking) at a point of high tensile stress caused by the metal's inability to shrink naturally. In sand casting and other expendable-mould processes, it is prevented by compounding the mould to be collapsible. In permanent-mould processes, hot tearing is reduced by removing the part from the mould immediately after solidification.

Gating ratios of casting process: Gating system refers to the relation between area of the sprue (or choke) to total area of runner total area of Ingates. Mathematically it can be written as

Gating ratio = Sprue area (As): Runner area (Ar): Gate area (Ag)

The gating system completely controls the molten metal flow and depends on the nature of the molten metal. Gating system can be classified as

(i) <u>Pressurized Gating system:</u> Here gate area is smallest, thus maintaining the back pressure throughout the gating system. This backpressure generates turbulence and thereby minimizes the air aspiration even when straight sprue is used. Not good for light alloys, but good for ferrous castings.

In this, Gating ratio =
$$1:2:1$$
 or $1:0.75:0.5$

(ii) Non-pressurized Gating system: It has choke at the bottom of the sprue base, has total runner area and gate areas higher than the sprue area. No pressure is present in the system and hence no turbulence. But chances of air aspiration is possible. Suitable for Al and Mg alloys.

In this, Gating ratio =
$$1:4:4$$
 or $1:2:2$ or $1:3:3$

<u>Pro (1):</u>

The flow rate of liquid metal into the downsprue of a mold = 1 liter/sec. The cross-sectional area at the top of the sprue = 800 mm² and its length = 175 mm. What area should be used at the base of the sprue to avoid aspiration of the molten metal?

Ans: $A = 540 \text{ mm}^2$

Ans: D = 2.4 cm

- convert Q in lit/sec to mm³/sec
- Find $v = \sqrt{2gh}$
- Base area, A = Q/v

<u>Pro (2):</u>

Molten metal can be poured into the pouring cup of a sand mold at a steady rate of 1000 cm^3 /s. The molten metal overflows the pouring cup and flows into the downsprue. The cross-section of the sprue is round, with a diameter at the top = 3.4 cm. If the sprue is 25 cm long, determine the proper diameter at its base so as to maintain the same volume flow rate.

• Find velocity at base,
$$v = \sqrt{2gh}$$

- find area at base, A = Q/v
- Find D = $\sqrt{4A/\pi}$

<u>Pro (3)</u>: A mould sprue is 20 cm long, the cross-sectional area at its base is 2.5 cm². The sprue feeds a horizontal runner leading into a mould cavity whose volume is 1560 cm³. Determine: (a) Velocity of the molten metal at the base of the sprue, (b) Volume rate of flow, and (c) Time to fill the mould.

Solution: (a) The velocity, "v" of the flowing metal at the base of the sprue is given by Eq.: $v = \sqrt{2gh}$

$$v = \sqrt{2(981)(20)} = 198.1 \text{ cm/s}$$

So.

- (b) The volumetric flow rate, "Q" = $v.A = 198.1 \times 2.5 = 495 \text{ cm}^3/\text{s}$
- (c) Given that, Volume of the mould cavity "V" is 1560 cm³.
- So, Time required to fill a mould cavity T=V/Q = 1560/495 = 3.2 s

WELDING

Welding is a process for joining two similar or dissimilar metals/alloys permanently by fusion, by application of heat with or without application of pressure and with or without the use of filler metal.

*Weldability: Defined as property of a metal which indicates the ease with which it can be welded with other similar or dissimilar metals.

Advantages OR Importance Of Welding:

- Welding is more economical and is much faster process as compared to other processes (riveting, bolting, casting etc.)
- Large number of metals and alloys both similar and dissimilar can be joined by welding.
- Portable welding equipment can be easily made available.
- Welding can join welding jobs through spots, as continuous pressure tight seams, end to- end and in a number of other configurations.
- Welding can also be mechanized.

Disadvantages:

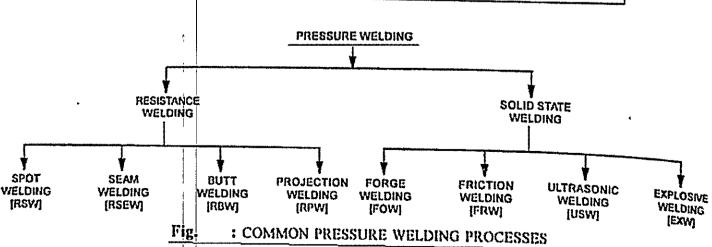
- It results in residual stresses and distortion of the work pieces.
- Welded joint needs stress relieving and heat treatment.
- Welding gives out harmful radiations (light), fumes and spatter.
- Jigs, and fixtures may also be needed to hold and position the parts to be welded
- Edges preparation of the welding jobs are required before welding
- Skilled welder is required for production of good welding

<u>Applications:</u> Manufacturing of machine tools, auto parts, cycle parts, farm machinery & equipment, buildings, bridges & ships, Construction of boilers, furnaces, railways, cars, aeroplanes, rockets and missiles, television sets, refrigerators, kitchen cabinets, etc.

Classification of Welding Process:

They can be classified in to two main groups

	Pressure welding	Fusion welding
0	 Requires heat and pressure Joint heat is heated to plasfic state Requires lower temperature Composition and structure is not much affected 	Requires only heat Joint area is heated to fusion (molten) state Requires higher temperature Composition and structure is affected
	Does not requires filler metal	Generally requires filler metal



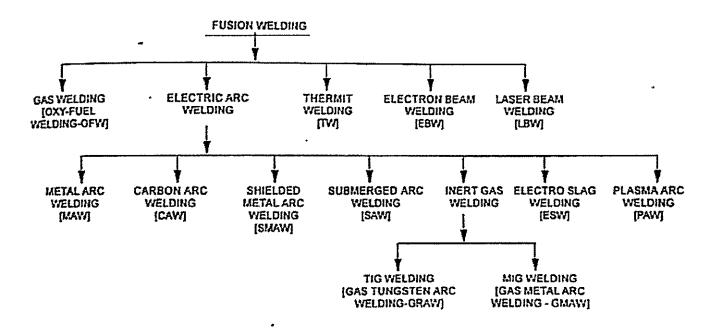
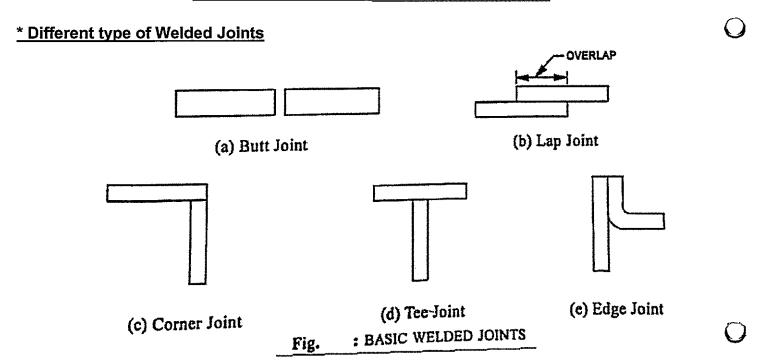


Fig. : COMMON FUSION WELDING PROCESSES



- * (a) <u>Butt Joint</u>: In this type of joint, the edges are welded in the same plane with each other. V or U shape is given to the edges to make the joints strong
- (b) <u>Lap Joint</u>: This type of joint is used in joining two overlapping plates so that the corner of each plate is joined with the surface of other plate.
- (c) <u>T-Joint</u>: When two surfaces are to be welded at right angles, the joint is called T-Joint. The angle betweenthe surfaces is kept 90°.
- (d) <u>Corner Joint</u>: In this joint, the edges of two sheets are joined and their surfaces are kept at right angle to eachother. Such joints are made in frames, steel boxes, etc.
- (e) Edge Joint: In this joint two parallel plates are welded edge to edge.
- (f) Plug Joint: Plug joints are used in holes instead of rivets and bolts.

**** Gas welding Process OR Oxy-acetylene welding:

Gas welding is a fusion welding process which joins metals, using the heat of combustion of an oxygen/air and fuel gas (i.e. acetylene or hydrogen etc.,) mixture

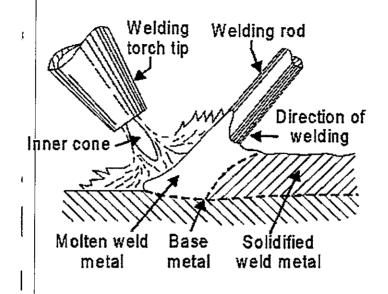


Figure: Gas welding

In this process, acetylene is mixed with oxygen in correct proportions in the welding torch and ignited, which produces temperature of about 3300°C and thus can melt most of the ferrous and non-ferrous metals. A filler metal rod is generally added to the molten metal pool to build up the seam slightly for greater strength.

Advantages of Oxy-acetylene Welding:

- Equipment is cheap as compared to other welding process.
- It can be used for welding of all types of metals.
- Maintenance of equipment is very less.
- It is a portable process.
- It can be used far cutting of metals of small thickness.
- It is specially used for sheet metal work.

<u> Disadvantages:</u>

- It takes long time for heating the job as compared to the arc welding.
- The heat affected area is more.
- This is prone to corrosion and brittleness.
- Gases are expensive and difficult to store.

* Types of flames:

- *(1) Neutral Welding Flame: A neutral flame results when approximately equal volumes of oxygen and acetylene are mixed in the welding torch and burnt at the torch tip. The temperature of the neutral flame is of the order of about 5900°F (3260°C). It has a clear, well defined inner cone, indicating that the combustion is complete. The inner cone is light blue in colour. It is surrounded by an outer flame envelope, produced by the combination of oxygen in the air and superheated carbon monoxide and hydrogen gases from the inner cone. The neutral flame is commonly used for the welding of mild steel, stainless steel, cast Iron, copper, and aluminium.
- *(2) Carburising or Reducing Welding Flame: It has excess of acetylene and can be recognized by acetylene feather, which exists between the inner cone and the outer envelope. The outer flame envelope is longer than that of the neutral flame and is usually much brighter in color. With iron and steel, carburizing flame produces very hard, brittle substance known as iron carbide. Carburizing

flame contains more acetylene than a reducing flame. A reducing flame has an approximate *temperature of 3038°C. A carburizing-flame is used in the welding of lead and for carburizing (surface hardening) purpose. This flame is very well used for welding high carbon steel.

Neutral flame

Oxidizing flame
(Excessive oxygen)

Feather

Carburising flame
(Excessive acetylene)

Fig. Gas welding flames

(3)Oxidising Welding flame: The oxidizing flame has an excess of oxygen over the acetylene. An oxidizing flame can be recognized by the small cone, which is shorter, much bluer in colour and more pointed than that of the neutral flame. The outer flame envelope is much shorter and tends to fan out at the end. Such a flame makes a loud roaring sound. It is the hottest flame (temperature as high as 6300°F) produced by any oxy-fuel gas source. But the excess oxygen especially at high temperatures tends to combine with many metals to form hard, brittle, low strength oxides. A slightly oxidizing flame is helpful when welding (i) Copper-base metals (ii) Zinc-base metals

Flux:

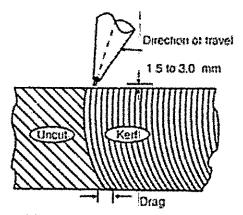
The chemicals which deoxidize the metal surface and provide inert atmosphere around the molter metal are known as fluxes. These are usually employed for gas welding of aluminium, stainless steer, cast iron, brass and silicon bronze. Fluxes are available as liquid, powder, paste and gas. Powder flux is sprinkled on the surfaces to be welded or the filler rod is dipped into the powder. Liquid & paste fluxes are sprayed on the surfaces to be welded. Gas fluxes are used to form inert atmosphere around the joint to be welded

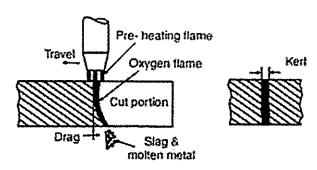
* Gas Cutting:

Apart from using hacksaw, power saw, chisels, etc. for metal cutting operation, gas or oxygen cutting is extensively used now-a-days in industry

The successfulness of gas cutting process depends upon two factors ie.,(i) It employed only when the ignition (oxidation) temperature of the metal being cut is lower than its melting point. (ii) The process involves ensuring that the melting points of the formed oxides are lower than that of the base metal itself.

Although acetylene is commonly used as a fuel in this process, other gases can also be used including butane, methane, propane, natural gas. If the speed of travel of the torch is high, then we will get coarser cut edge. A uniform wide slot, called kerf, is cut by the high pressure stream of oxygen. The marking on the sides of the kerf are called drag as shown in Fig. If the speed of travel of torch is high, the bottom cut lags behind the top cut and the drag lines are curved.





(a) Positioning of cutting torch in oxy-fuel gas cutting.

(b) Gas Flame Cutting.

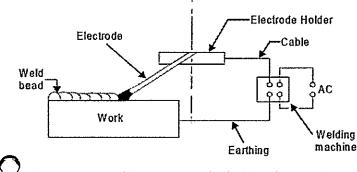
Fig. Gas Cutting Process.

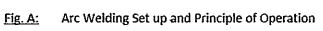
Only 10 – 12% drag is allowed during cutting. Large percentage of drag shows the poor cutting technique, and may result into many cutting defects. This is given by formula.

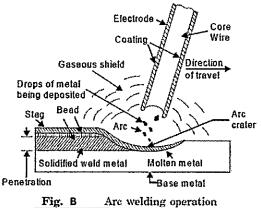
*Arc Welding / Shielded Metal Arc Welding (SMAW) / Manual Metal Arc Welding (MMAW):

Arc Welding is the process, in which an electric arc between an electrode and a work piece or tween two electrodes is utilized to weld base metals, is called an arc welding process.

<u>SMAW</u> is a commonly used arc welding process manually carried by welder. It is an arc welding process in which heat for welding is produced through an electric arc set up between a flux coated electrode and the workpiece. The flux coating of electrode decomposes due to arc heat and serves many functions, like weld metal protection, arc stability etc. Inner core of the electrode supply the filler material for making a weld. The basic setup is shown in Fig.A and the configuration of weld zone is shown Fig. B







Advantages:

- 1. It can be carried out in any position with highest weld quality.
- 2. It is the simplest of all the arc welding processes.
- 3. This welding process finds innumerable applications, because of the availability of a wide variety of electrodes.
- 4. The process can be very well employed for hard facing and metal resistance etc.
- 5 Joints (e.g., between nozzles and shell in a pressure vessel) which because of their position are difficult to be welded by automatic welding machines can be easily done by this
- 6. The welding equipment is portable and the cost is fairly low.

Limitations:

- 1. Due to flux coated electrodes, the chances of slag entrapment and other related defects are more as compared to MIG and TIG welding.
- 2. Duo to fumes and particles of slag, the arc and metal transfer is not very clear and thus welding control in this process is a bit difficult as compared to MIG welding.
- 3. Due to limited length of each electrode and brittle flux coating on it, mechanization is difficult.

4. In welding long joints (e.g., in pressure vessels), as one electrode finishes, the weld is to be progressed with the next electrode. Unless properly cared, a defect (like slag inclusion or insufficient penetration) may occur at the place where welding is restarted with the new electrode 5. The process uses stick electrodes and thus it is slower as compared to MIG welding.

Applications: (a) Building and Bridge construction (b) Automotive and aircraft industry, etc. (c) boiler and pressure vessel fabrication (d) Ship building (e) Pipes and (f) Penstock joining

*What is the difference between Arc welding and Gas Welding?

S. No.	Arc Welding	Gas Welding		
1.	In the arc welding, electricity is used to generate heat.	In gas welding, fuel gases like acetylene, hydrogen are used to generate heat.		
2.	This welding generates higher temperature than gas welding. The temperature is about 6000C.	This welding generates lower temperature than arc welding. The temperature is about 3600C.		
3.	This welding generates stronger joint compare to gas welding.	It gives weaker joint.		
4.	It gives poor surface finish.	This welding gives good surface finish		
5.	In arc welding consumable electrode is used.	In gas welding non consumable electrode is used.		
6.	The electrode is combined with the filler metal.	A filler rod is used separately if required.		
7.	It can be used in welding alone.	It can be used in welding, brazing and soldering.		
8.	There is risk of explosion due to high voltage.	There is risk of explosion due to high pressure.		
9.	It is mostly used to joint similar material.	It is mostly use to join both similar and different metals		
10.	The heat is concentrate in arc welding.	The heat is distributing according to the flame. There is higher loss of energy		
11.	It is more efficient.	It is less efficient.		
12.	Speed of welding is high.	Speed of welding is low.		
13.	The initial cost of arc welding is high.	The setup cost of gas welding is low.		

Explain Carbon Arc Welding Process?

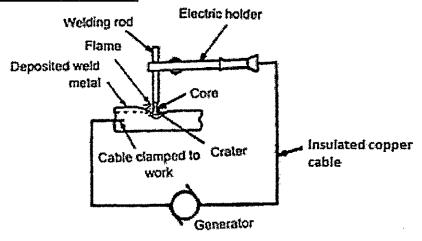


Figure: Carbon Arc Welding

In this process, a pure graphite or baked carbon rod is used as a non-consumable electrode to create an electric arc between it and the workpiece. The electric arc produces heat and weld can be made with or without the addition of filler material.

In single electrode arc welding, an electric arc is struck between a carbon electrode and the workpiece. Welding may be carried out in air or in an inert atmosphere. Direct current straight polarity (DCSP) is preferred to restrict electrode disintegration and the amount of carbon going into the weld metal. This process is mainly used for providing heat source for brazing, braze welding, soldering and heat treating as well as for repairing iron and steel castings. It is also used for welding of galvanized steel and copper.

Arc Welding Equipment:

- 1.Arc welding power source: Both direct current (DC) and alternating current (AC) are used for electric arc welding, each having its particular applications.
- <u>2. Welding cables</u>: These are required for conduction of current from the power source through the electrode holder, the arc, the workpiece and back to the welding power source. These are insulated copper or aluminium cables.
- Electrode holder: It is used for holding the electrode manually and conducting current to it.
- *4. Welding Electrodes: An electrode is a piece of wire or a rod of a metal or alloy, with or without coatings. An arc is set up between electrode and work piece. Welding electrodes are classified into following types.
- (a) Consumable electrode: It is made of different metals and their alloys. The end of this electrode starts melting when arc is struck between the electrode and workpiece. Thus consumable electrode itself acts as a filler metal.
- (i) Bare electrodes: Bare electrodes consist of a metal or alloy wire without any flux coating on them. These produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.
- (ii) Coated electrodes: Coated electrodes have flux coating which starts melting as soon as an electric arc is struck. A metallic core is coated with some suitable material. The material used for core is mild steel, nickel steel, chromium molybdenum steel, etc. One end of the coated core is kept bare holding.

*Functions of Coatings: To prevent oxidation. Forms slags with metal impurities. It stabilizes the arc. Increases deposition of molten metal. Controls depth of penetration. Controls the cooling rate. Adds alloy elements to the joint

Electrode Size: Electrodes are commonly made in lengths 250 mm, 300 mm, 350 mm, 450 mm, and the diameters are 1.6 mm, 2 mm, 2.5 mm, 3.2 mm, 4 mm, 7 mm, 8 mm and 9 mm.

- (b) Non-consumable electrodes: They are made up of high melting point materials like carbon, pure tungsten or alloy tungsten etc. These electrodes do not melt away during welding. But practically, the electrode length goes on decreasing with the passage of time, because of oxidation and vaporization of the electrode material during welding. The materials of non-consumable electrodes are usually copper coated carbon or graphite, pure tungsten, thoriated or zirconiated tungsten.
- 5. Hand Screen: Hand screen used for protection of eyes and supervision of weld bead.
- 6. Chipping hammer: Chipping Hammer is used to remove the slag by striking.
- 7. Wire brush: Wire brush is used to clean the surface to be weld.
- 8. Protective clothing: Operator wears the protective clothing such as apron to keep away the exposure of direct heat to the body.

4

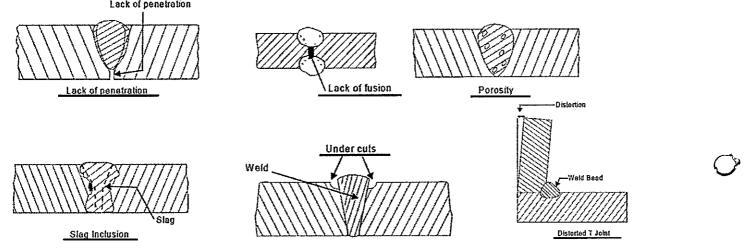
Effect of Arc Length: Arc length is the distance from the tip of the electrode to the bottom of the arc. *It should vary from 3 to 4 mm. In short arc length, the time of contact will be shorter and will make a wide and shallow bead. The penetration is low as compared to long arc lengths.

<u>Arc blow</u>: It is the, usually unwanted, deflection of the arc during arc welding. There are two types of arc blow commonly known in the electric welding industry

- (a) Magnetic arc blow: It is the deflection of welding filler material within an electric arc deposit by a build up of magnetic force surrounding the weld pool. It occur because of Workpiece connection, Joint design, Poor fit-up, Improper settings, Atmospheric conditions etc.,
- (b) Thermal arc blow: It is widely attributed to variations in resistance within the base metal created by the weld pool as it is moved across the workpiece. It occur because of Improper surface preparation, Improper travel speed etc., Thermal arc blow is not as severe as magnetic arc blow, but can still leave undesirable defects in the weld deposit.

* Write the Welding Defects with sketches? Defects in welding joints are given below:

- 1. Lack of Penetration: It is the failure of the filler metal to penetrate into the joint. It is due to (a) Inadequate de-slagging (b) Incorrect edge penetration(c) Incorrect welding technique.
- 2. Lack of Fusion: Lack of fusion is the failure of the filler metal to fuse with the parent metal. It is do to (a) Too fast a travel (b) Incorrect welding technique (c) Insufficient heat
- 3. Porosity: It is a group of small holes throughout the weld metal. It is caused by the trapping of gas during the welding process, due to (a) Chemicals in the metal (b) Dampness (c) Too rapid cooling of the weld.
- 4. Slag Inclusion: It is the entrapment of slag or other impurities in the weld. It is caused by
- (a) Slag from previous runs not being cleaned away,
- (b) Insufficient cleaning and preparation of the base metal before welding commences.

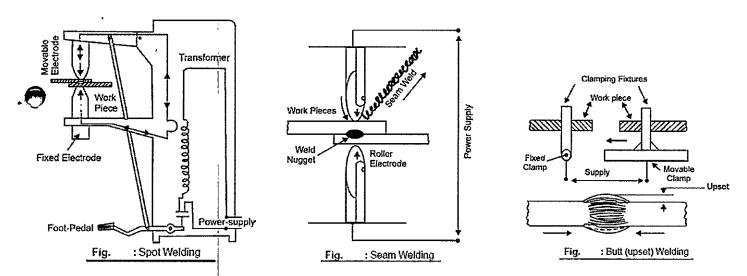


- <u>5.\Undercuts</u>: These are grooves or slots along the edges of the weld caused by (a) Too fast a travel (b) Bad welding technique(c) Too great a heat build-up.
- <u>6. Distortion</u>: Distortion is due to high cooling rate, small diameter electrode, poor clamping and slow arc travel speed

Resistance Welding - Principle: The resistance offered to the flow of current results in raising the temperature of the two metal pieces to melting point at their junction. Mechanical pressure applied at this moment to complete the weld. Types are as follows

*Spot Welding: It is used to lap weld joints in thin metallic plates (up to 12.7 mm thick) for mechanical strength and not for tightness. The metallic plates are overlapped and held between two copper electrodes. A high current, at a very low volt-age (4-12 volts), is passed between the electrodes. The contact resistance of the plates causes to heat rapidly to a plastic state. Mechanical pressure applied. Supply is cut-off for the metal to regain strength. The pressure is released. The processis repeated at another portion of the plates.

<u>Applications</u>: Used in the manufacture of automobile parts, refrigerators, metallic toys, racks, frames, boxes, radio chassis, etc.



*Seam Welding: The metallic plates are held by two copper roller electrodes with one roller driven by motor so that the plates are moved between the rollers at a suitable speed. The high current is passed between the electrodes holding metallic plates pressed together with suitable force and pushes together to travel between the revolving electrodes. The plates between the electrodes get heated to welding (fusion) heat and welded continuously under constant pressure of rotating electrodes. This is a quicker operation than spot welding and gives a stronger joint.

Applications: Pressure tight joints on oil drums, tanks and boiler water pipes,refrigeration parts, motorcar body, utensils, stoves, etc.

Butt Welding (or Upset Welding): The pieces to be welded are held edge to edge in copper clamps. The ends are brought togetherunder a light pressure. A heavy welding current is switched on. The resistance between thecontacting faces causes a rise in temperature to the fusion point. A further mechanical pressure isapplied to obtain a welded joint. The current is switched off.

Applications: Mainly used on non-ferrous materials for joining bars, rods, wires, tubing, etc.

<u>Submerged Arc Welding</u>: In this welding process, a consumable bare electrode is used in combination with a flux feeder tube. The arc, end of the bare electrode and molten pool remain completely submerged under blanket of granular flux. The feed of electrode and tube is automatic and the welding is homogenous in structure. No pressure is applied for welding purposes.

Applications: Used for welding low carbon steel, bronze, nickel and other non-ferrous materials.

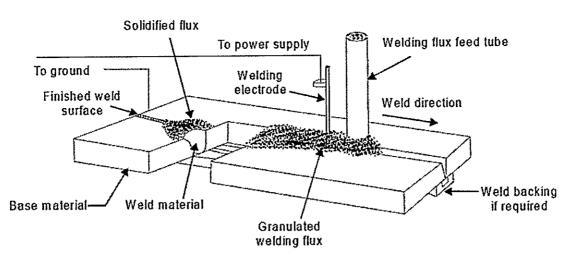


Fig. Schematic submerged arc welding process

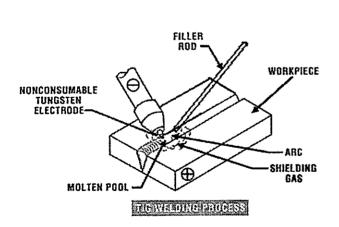
* TIG (Tungsten inert gas) welding or Gas tungsten arc welding (GTAW): In this, an arc is formed between a non-consumable tungsten electrode and the metal being welded. Both AC and DC power source can be used. Shielding gas (Helium or Organ) is fed through the torch to shield the electrode and molten weld pool. Common TIG welds are including the butt joint, lap joint, T-joint, and Fillet weld.

*Advantages of TIG:

- Is easily applied to thin materials,
- Produces very high-quality, superior welds,
- Welds can be made with or without filler metal,
- Welding yields low distortion,
- · Leaves no slag or splatter.
- It can be performed with a wide variety of metals
- The price of TIG welding is Less

Dis-advantages:

- It is a slower process than MIG
- TIG vields lower deposition rates.
- TIG is more costly for welding thick metal sections.

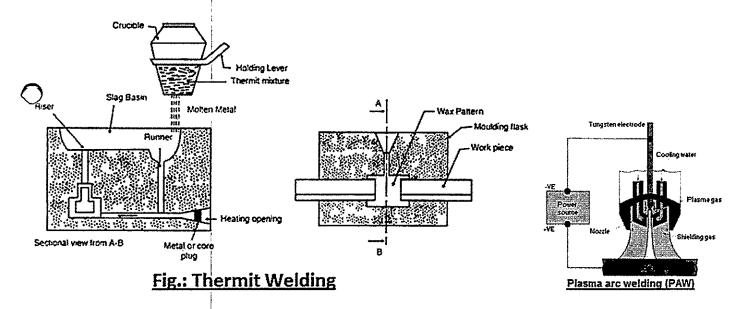




Gas Metal Arc Welding (GMAW) or Metal inert gas arc welding (MIG): It utilizes a consumable electrode and hence, the term metal appears in the title, it is more suitable for thin sheets. When thicker sheets are to be welded, the filler metal requirement makes difficult to use. The consumable electrode is in the form of a wire reel which is fed at a constant rate, through the feed rollers. The welding torch is connected to the gas supply cylinder which provides the necessary inert gas. The electrode and the work-piece are connected to the welding power supply. The power supplies are always of the constant voltage type only. The current from the welding machine is changed by the rate of feeding of the electrode wire. In this process, the filler metal is transferred from the electrode to the joint.

*Thermit welding: Thermit welding is a chemical welding process in which an exothermic chemical reaction is used to supply the essential heat energy. That reaction involves the burning of Thermit, which is a mixture of fine aluminum powder and iron oxide in the ratio of about 1:3 by weight. Although a temperature of 3000°C may be attained as a result of the reaction, which makes the outputs into liquid state. Preheating of the Thermit mixture up to about 1300°C is essential in order to start the reaction.

It consists of welding by using a chemical reaction a volume of molten weld metal which is poured into the joint to be welded. A pattern of wax shaped around the parts to be welded. A sheet – iron box is shaped around the wax pattern and the space between the pattern and box is filled and rammed with sand. Pouring and heating gates, and risers, are cut in the sand and flame is directed into the heating opening. The wax pattern melts & drains out. Heating is continued to raise the temperature. Preheating is done before the liquid metal is poured into the mould. Burner is removed preheating gate is closed with sand. The superheated metal in crucible is poured into the mould surrounding the surfaces to be welded.



The mixture reacts according to the chemical reaction:

 $8 \text{ Al} + 3 \text{ Fe}_3 O_4 \rightarrow 9 \text{ Fe} + 4 \text{ Al}_2 O_3 + \text{heat (3000°C, 35 kJ/kg of mixture)}$

*Application:

- It is mostly used to weld railroad at the site.
- It was used to weld thick plate before introduce electrosiag welding.
- They are used to repair heavy castings.
- It is used to weld cable connectors of copper.
- It is used to make structure joints in large ships etc.

Advantages:

- This process is used for welding of damaged wobblers and large broken crankshafts
- To restore the broken teeth on gears
- Low setup cost.
- Metal joining rate is high.
- Thermite welding can be done at site where casting is impossible.
- This can be used where power supply is not available.

Disadvantages:

- It is used for limited metals like iron and copper.
- It is uneconomical for welding light parts.
- Highly depends on environmental condition like moisture contain, work piece alignment etc.

*Forge welding (FOW) is a solid-state welding process that joins two pieces of metal by heating them to a high temperature and then hammering them together. It may also consist of heating and forcing

the metals together with presses or other means, creating enough pressure to cause plastic deformation at the weld surfaces. The process is one of the simplest methods of joining metals and has been used since ancient times. Forge welding is versatile, being able to join a host of similar and dissimilar metals. With the invention of electrical and gas welding methods during the Industrial Revolution, manual forge-welding has been largely replaced, although automated forge-welding is a common manufacturing process.

*Plasma arc welding (PAW): (See above for Fig.) It is an arc welding process similar to TIG. The electric arc is formed between an tungsten electrode and the work piece. Arc plasma is the temporary state of a gas. The gas gets ionized after passage of electric current through it and it becomes a conductor of electricity. In ionized state atoms break into electrons (-) and cations (+) and the system contains a mixture of ions, electrons and highly excited atoms.

The plasma is forced through a fine-bore copper nozzle which constricts the arc and the plasma exits the orifice at high velocities (approaching the speed of sound) and a temperature approaching 28,000 °C in ordinary electric welding arc.

Applications: Welding thin sheets of 0.1 mm thickness, Keyhole welding etc.,

**Soldering: Soldering is a process of joining two metals by using another low temperature metal alloy called solder (ex. copper, zinc etc.,). The surfaces to be joined are cleaned and are placed each other. A flux is employed to prevent oxidation. Zinc chloride is commonly used for this purpose. The soldering iron is heated either electrically or by some external heat. Then the hot end is dipped into the flux and solder is pressed against the surfaces to be joined. A joint is formed by melting the solder.

Applications: Widely used for sheet metal work and in radio and television work for joining wires.

Advantages:

- 1. Joining cost is low
- 2. Equipment is very simple and cheap
- 3. Good sealing in fabrication as compared to other processes like rivet, spot weld and bolts
- 4. It provides a positive electrical connection
- 5. Due to low operating temperature the properties of base metal are not affected

Disadvantage: Joints formed are weak

**Brazing: The process of joining two metal surfaces by heating and adding a non-ferrous alloy with meltingpoint above 400°C is known as brazing process.

<u>Process</u>: The surfaces to be joined are cleaned from all oil, dirt or oxides. Then both the surfaces are placed in joining position. Flux is sprinkled or placed on it. The heat is given to the surface and the filler metal. The molten filler metal flows to the surfaces to be joined. On cooling, brazing joint isformed.

The filler metals used are copper, copper alloy, silver alloy and aluminium alloys. In brazing, the filler metal melts but the surfaces to be joined remain unmelted.

<u>Applications</u>: Used for electrical items, radiators, heat exchangers, pipes & pipe fittings and tool tips. Advantages:

- 1. It is useful for joining dissimilar metals.
- 2. Thin sections can be easily joined.
- 3. Good finish is obtained on joint.
- 4. Less skill is required.
- 5. Cost of operation is less as compared to other welding processes.

Disadvantages:

- 1. Low strength.
- 2. Not applicable for hardened steel and aluminium alloys.

**Difference Between Soldering And Brazing

Sl. No.	Soldering	Brazing
1	Filler metal has the melting point below 400°C.	Filler metal has the melting point above 400°C.
2	Less stable joints can be made.	More stable joints can be made.
3	Joints are affected by high temperature and pressure	High pressure and temperature do not affect the joint
4	Equipment cost is very low.	Equipment cost is more.

*Why a flux is used in brazing and soldering? Explain

Flux is used in soldering, just as it is in brazing and welding to clean the metal surfaces and make it easy for the solder to flow over the pieces to be joined. Ex. Charcoal, which acts as a reducing agent and helps prevent oxidation during the soldering process. Some fluxes go beyond the simple prevention of oxidation and also provide some form of chemical cleaning (corrosion).

<u>Unit-5</u> <u>Forming and Forging & Rolling</u>

<u>Metal Forming:</u> Metal forming can be defined as a process in which the desired size and shape are obtained through the deformation of metals plastically under the action of externally applied forces. Examples of Metal forming processes are rolling, forging, drawing etc..

deformation. This strengthening occurs because of dislocation movements and dislocation generation within the crystal structure of the material. When a metal is stressed beyond its elastic limit it enters the plastic region. When the load is increased further, 'dislocation density' increases that in turn makes the metal harder and stronger through the resulting plastic deformation. It means, it's more difficult to deform the metal as the strain increases and hence it's called "strain hardening". This tends to increase the strength of the metal and decrease its ductility

* Define the term recrystallization. State its significance in metal forming:

When a metal is cold worked by plastic deformation, a small portion of the mechanical energy spent in deforming the metal is stored in the specimen. This stored energy resides (remains) in the crystals as point defects (vacancies and interstitials), dislocations, and stacking faults in various forms and combinations, depending on the metal. Therefore, a cold-worked specimen, being in a state of higher energy, is thermodynamically unstable. To make it stable, processes like annealing to be done. If the temperature of annealing processes is low called Recovery process or high called Recrystallization process. Further 'annealing' of the recrystallized material can lead to grain sowth.

**Difference between Hot Working and Cold Working:

SI. No.	Cold working	*Hot working		
1	It is done at a temperature below the recrystallization temperature.	Hot working is done at a temperature above recrystallization temperature.		
2	Cold working decreases mechanical properties of metal like elongation, reduction of area and impact values.	It increases mechanical properties.		
3	Crystallization does not take place.	Crystallization takes place.		
4	Material is not uniform after this working.	Material is uniform thought.		
5	There is more risk of cracks.	There is less risk of cracks.		
6	Cold working increases ultimate tensile strength, yield point hardness and fatigue strength but decreases resistance to corrosion.	In hot working, ultimate tensile strength, yield point, corrosion resistance are unaffected.		
7	Internal and residual stresses are produced.	Internal and residual stresses are not produced.		

8		Cold working required more energy for plastic deformation.	It requires less energy for plastic deformation because at higher temperature metal become more ductile and soft.		
		Cold working processes are—cold rolling, cold extrusion, press work (drawing, squeezing, bending, and shearing).	Hot working processes are—hot forging, hot rolling, hot spinning, hot extrusion, hot drawing, and hot piercing, pipe welding.		

FORGING: Forging is the process of shaping heated metal by the application of sudden blows (hammer forging) or steady pressure (press forging) and makes use of the characteristic of plasticity of the material. It is a metal forming process which may be done by hand or by machine. In case of hand forging, hammering is done by hand; whereas forging by machine involves the use of dies and it is mostly used in mass production.

Advantages:

- In forging process, grain flow is continuous and uninterrupted. It gives greater strength and toughness to the forged components.
- The forging process gives the high dimensional accuracy.
- Forged components have better resistance to shock and vibrations.
- Welding of forged parts is easy.

Disadvantages:

- Complicated shapes cannot be forged easily.
- Forging of brittle materials is difficult.
- Forging process is costly.
- More noise and vibrations are produced during the process.

<u>Applications</u>: Car axles, crankshafts, connecting rods, leaf springs, crane hooks, jet engine turbine dies and blades. Levers, flanges, propellers, hollow bodies, railway wheel disks, tank bottoms.

Classification of Forging process:

Open Die Forging: It is the simplest and important forging process. The shapes generated by this process are simple like shafts, disks, rings, etc.. In this a solid workpiece placed between the two flat dies (lower die is fixed and upper die is moving) and reduced in height by compressing it. This process is called as upsetting or flat-die forging.

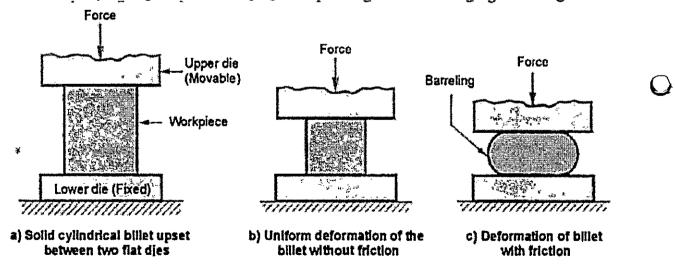


Fig.: Open-die forging

Some of the important operations performed in open-die forging process are as follows:

- 1. Fullering: It is performed to reduce the cross-section and redistribute the metal in a workpiece in preparation for subsequent shape forging. It is performed with dies of convex surfaces.
- 2. Edging: Its working principle is similar to fullering operation, only the difference is that the dies have concave surfaces.

3. Cogging: It consists of a sequence of forging compressions along the length of workpiece to reduce the cross-section and to increase the length.

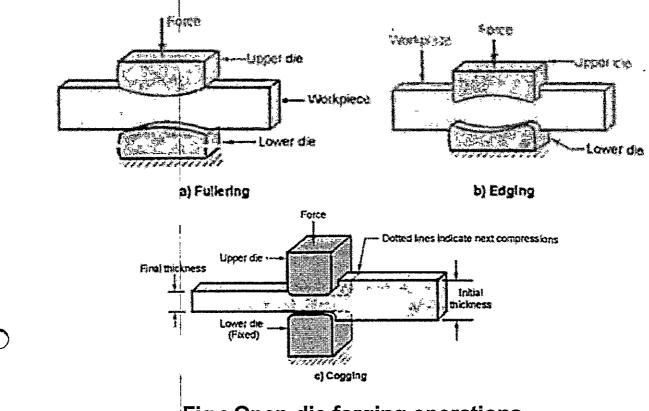


Fig.: Open-die forging operations

<u>Closed Die Forging or Impression Die forging</u>: Impression-die or closed-die forging is performed with dies which contain the inverse of the required shape of the component.

Initially the cast ingot is placed between the two impressed dies. As the die closes to its final position, flash is formed by the metal. This flash flows beyond the die cavity and into the small gap between the die plates. The formed flash must be cut away from the final component in a subsequent trimming operation but it performs an important function that, it increases the resistance to the deformation of the metal.

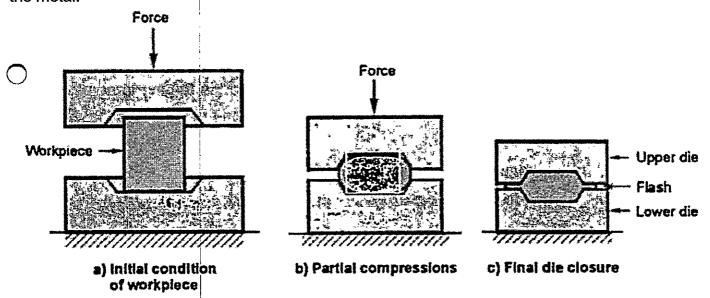


Fig. : Closed or impression dies forging

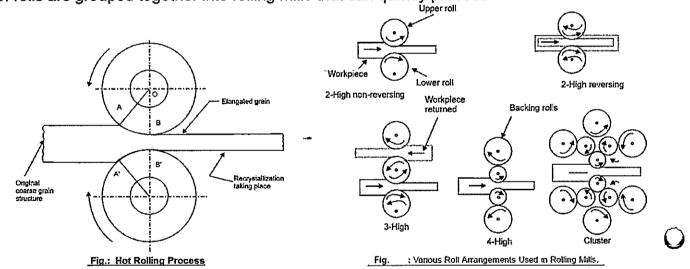
Forging Defects and its Remedies: The common forging defects are:

- 1. Dirt, slag, blow holes: These are defects, resulting from the melting practice.
- 2. Seams, piping, cracks, scales or bad surface and segregation: These are ingot defects.

- 3. Decarburization: These defects results from improper heating of the forging.
- 4. Flakes: These defects results from improper cooling of the forging.
- 5. Fins and rags: These are small projections or loose metal driven into the forging surface.
- 6. Mismatch: This occurs due to improper alignment between the top and bottom forging dies.
- 7. Pitting: These are shallow surface depressions caused by scales which is not removed from dies.
- 8. Cold shut or laps: These are short cracks which usually occur at corners and at right angles to the surface. These are caused when the metal surface folds against itself during forging.
- 9. Dents: These arise due to careless work.
- 10. Unfilled section: It occurs when metal does not completely fill the die cavity. Remedies:
- 1. Shallow cracks and cavities can be removed by chipping out of the cold forging with pneumatic chisel or with hot sets during the forging processes. 2. Surface cracks and decarburized areas are removed from important forgings by grinding on special machines.3. The parting line of a forging should lie in one plane to avoid mismatching. 4. Distorted forgings are straightened in presses, if possible.

ROLLING: Rolling is a metal forming process in which metal stock is passed through one or more pairs of rolls to reduce the thickness by compressive forces and to make the thickness uniform. If the temperature of the metal is above its recrystallization temperature, then the process is known as hot rolling. If the temperature of the metal is below its recrystallization temperature, the process is known as cold rolling.

In terms of usage, hot rolling processes more tonnage than any other manufacturing process, and cold rolling processes the most tonnage out of all cold working processes. Roll stands holding pairs of rolls are grouped together into rolling mills that can quickly process metal



Applications of Rolling:

- (a) Structural shapes or sections: This includes sections like round, square, hexagonal bars, channels, H and I beams and special sections like rail section. Fig. shows some of the rolled structural shapes.
- (b) Plates and sheets: These are produced of varying thickness.
- (c) Special purpose rolled products: These include rings, balls, wheels and ribbed tubes.

Defects in Rolling:

- (1) Surface defects may result from inclusions and impurities in the material, scale, rust, dirt, roll marks and other causes related to the prior treatment and working of the material. In hot rolling blooms, billets and slabs, the surface is usually preconditioned by various means, such as torch to remove scale.
- (2) Structural defects are defects that distort or affect the integrity of the rolled product.
- (3) Wavy edges are caused by bending of the rolls; the edges of the strip are thinner than the centre. Because the edges elongate more than the centre and are restrained from expanding freely, they buckle.
- (4) Zipper cracks are usually caused by low ductility and barreling

(5) Edge cracks are occurs in plates and slabs because of either limited ductility of metal or uneven deformation especially at the edges.

(6) Alligatoring is a complex phenomenon that results from inhomogeneous deformation of the material during rolling or from defects in the original cast ingot, such as piping. The workpiece splits along a horizontal plane on exit from the rolls

<u>Definition of angle of bite:</u> In rolling metals where all the force is transmitted through the rolls, maximum attainable angle between roll radius at the first contact and the roll centers. If the operating angle is less, it is called the contact angle or roll angle.

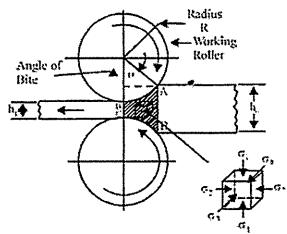


Fig. 2.5. The deformation zone, state of stress, and angle of contact on rolling.

Unit-6

Extrusion & Drawing

[When the metal is forced through the die by a tensile force applied to the metal at the exist of die it is called <u>drawing</u>, while when a compressive force is applied at the entry of the die it is called <u>extruding</u>]

*Extrusion: It is a compression process in which the work metal is forced to flow through a small opening which is called as die to produce a required cross-sectional shape. The extrusion process is similar to squeezing toothpaste or cream from a tube. During the process, a heated cylindrical billet is placed in the container and it is forced out through a steel die with the help of a ram or plunger. Extrusion process is suitable for the non-ferrous alloys, steel alloys, non-ferrous metals, stainless steel, etc.

<u>plications</u>: Tubes, rods, railings for sliding doors, structural and architectural shapes, door and window frames, etc.

Advantages of Extrusion:

- 1. The tooling cost is low
- 2. Intricate cross sectional shapes, hollow shapes and shapes with undercuts can be produced.
- 3. The hardness and the yield strength of the material are increased.
- 4. In most applications, no further machining is necessary.

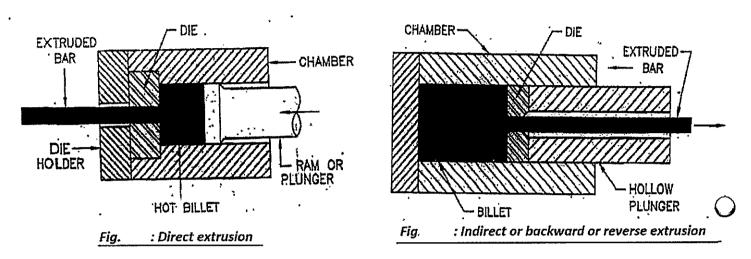
Limitations of Extrusion:

- 1. High tolerances are difficult to achieve.
- 2. The process is limited to ductile materials.
- 3. Extruded products might suffer from surface cracking.
- 4. Internal cracking might also occur. These cracks are attributed to a state of secondary tensile stresses at the centre line of the deformation zone in the die.

Classification:

- 1. According to physical configuration:
 - a). Forward or Direct extrusion b). Backward or Indirect extrusion
- 2. According to working temperature
 - a) Impact Extrusion or Cold Extrusion b). Cold extrusion

*Forward or Direct Extrusion: A billet is heated to its forging temperature and fed into the machine chamber. Pressure is applied to the billet with the help of ram or plunger which forces the material through the die. The length of extruded part will depend on the billet size and cross-section of the die. The extruded part is then cut to the required length. As the ram approaches the die, a small portion of billet remains which cannot be forced through the die opening. This extra portion is known as butt which is separated from the product at the end. Direct extrusion process is also used to produce hollow or semi-hollow sections. To produce hollow sections, by direct extrusion process, a mandrel is used. When the billet is compressed, the material is forced to flow through the gap between the mandrel and die opening. This results in tubular cross-section



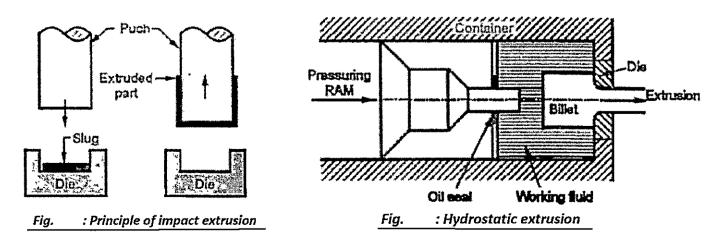
Applications: Bolts, screws or stepped shafts

*Backward or Indirect Extrusion: In this type, the ram or plunger used is hollow and as it presses the billet against the back wall of the closed chamber, the metal is extruded back into the plunger. Refer Fig. It involves no friction between the metal billet and the chamber because the billet does not move inside the chamber.

Applications: Cylindrical shapes such as nuts, sleeves and tubular rivets.

*Impact Extrusion or Cold Extrusion The raw material is in slug form which have been turned from a bar or punched from a strip. By using punch and dies, the operation is performed. The slug is placed in the die and struck from top by the punch operating at high pressure and speed.

The metal flows up along the surface of the punch, forming a cup shaped component. When the punch moves up, to separate the component from the punch compressed air is used. At the same time, a fresh slug is fed into the die. The rate of production is fairly high i.e. 60 components punched. This process is used only for soft and ductile materials such as lead, tin, aluminum, zinc and some of their alloys. The main advantages of this process are its speed, product uniformity and no wastage.



<u>Applications</u>: Tubes for shaving creams, tooth paste and paints, condenser cans and such other thin walled products are impact extruded.

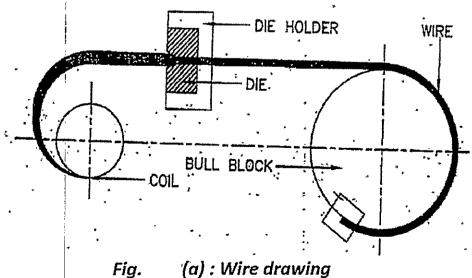
The advantages of cold extrusion are:

- 1. No oxidation takes place. 2. Good mechanical properties
- 3. Good surface finish with the use of proper lubricants.

*Hydrostatic Extrusion: In this type of extrusion process, the billet is surrounded by a working fluid which is pressurised by the ram to apply the extrusion force. In this process, hydraulic fluid remains between the billet and the chamber walls hence eliminating the contact between them. Also, it avoids the friction between the metal billet and the walls of the chamber. Due to absence of wall friction, extrusion of very long billets or even wires and large reductions can be taken. During the process, the ram does not directly act on the billet, instead of that, it acts on the hydraulic fluid which forces the billet through the die and produces the extrusions. The materials which cannot be extruded successfully by conventional methods can be extruded by this process.

Defects in Extrusion:

- (a) <u>Center cracking</u>: It is commonly called as internal breakage, cheveron cracking, arrowhead fracture and center burst. As the workpiece is being extruded from the die, stresses in the work break the material. It causes cracks to form along the central axis of extruded part. This defect occurs due to difference in metal flow of central region and outer region.
- (b) <u>Surface cracking</u>: In this, excessive stresses on the surface of the extruded part cause the breakage on the surface. These cracks usually occur along the grain boundaries. Surface cracking occurs due to high extrusion temperature, friction and speed.
- (c) <u>Piping defect</u>: This is commonly called as tail pipe or fish tailing defect and occurs during direct extrusion at the end opposite to the die. Piping defects results due to improper metal flow during the extrusion operation. A funnel shaped void of material at the end of the work is seen in this defect.
- *Wire Drawing: Drawing is an operation in which the cross-section of a bar, rod or wire is reduced by pulling it through a die opening. During the process, tensile as well as compressive stresses are produced in the material. Wire sizes upto 0.03 mm can be drawn by wire drawing process. The process consists of pulling the hot drawn bar or rod through a die of which the bore size is similar to the finished product size. One end of the rod to be drawn into wire is made pointed, entered through the die and gripped at the other end by using tongs. After pulling a certain length, this end is wound to a reel or draw pulley. When the pulley or reel is rotated, the rod is pulled through the die and its ameter reduces. The die is made of highly wear resistant material like tungsten carbide, which is suitably supported in a die holder which is made of mild steel or brass.



Applications of Wire Drawing: Manufacture of fine wires for electrical and electronic equipments, cables, springs, musical instruments, fencing, bailing, wire baskets and shopping carts, etc

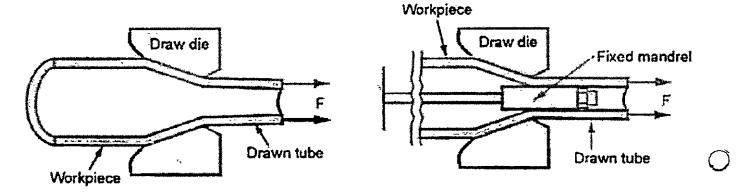
Defects in Wire Drawing::

- 1. Bulge formation: This occurs in front of the die due to low reduction and high die angle.
- 2. <u>Internal cracks</u> (Centre burst or centre-cracking): The tendency of cracking increases with increasing die angle, with decreasing reduction per pass, with friction and with the presence of inclusions in the material.
- 3. <u>Seams</u>: These appear as longitudinal scratches or folds in the material. Such defects can open up during subsequent forming operations by upsetting, heading, thread rolling or bending of the rod or wire.
- 4. <u>Surface defects</u>: Various types of surface defects can also result due to improper selection of process parameters and lubrication.

*Tube Drawing: Tube drawing normally makes tubes from hollow 'tube shells' produced by extrusion to reduce the diameter or wall thickness of seamless tubes and pipes. Tube drawing can be carried out either with mandrel or without mandrel

The simplest method of producing tubes and pipes is shown in Fig. (a) in which mandrel is nused. This method is also called as tube sinking. In tube sinking method there is no control over the inner diameter and wall thickness of tube. To overcome this drawback, mandrels are used in the process.

Fig.(b) shows tube drawing with mandrel. In this method, mandrel is fixed and attached to a long support bar to produce inside diameter and wall thickness during the process



a) Tube drawing without mandrel

b) Tube drawing with mandrel

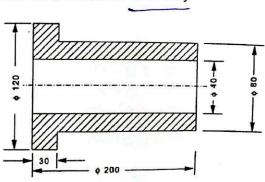
Fig. : Tube drawing

- 5 The low cost of equipment required for Co2.
- 6 Existing pattern making equipment can be used.
- 7 A big plus is that NO unpleasant fumes are given off during the pour. Unlike the EPS or expanded styrene method.
- 8. One of the biggest advantages for the hobby metal caster when using this system, is the total elimination of moisture from the moulding sand (providing it has been stored correctly) The only expense you might encounter is the cost of the Co2 cylinder, regulator, hoses and hand held applicator gun or nozzle. The Co2 system is one of simplicity, which greatly improves casting quality in the home foundry.

Problem on Foundry (Unit-1)

<u>Prob.(1)</u>: Design a split pattern for gun metal sleeve (see the below Fig.) assuming shrinkage, draft allowances and machining allowances of 2 mm for hole only





Solution: For gun metal shrinkage allowance is 12 mm/m

Shrinkage allowance for various dimensions:

Dimensions, mm	Allowance, mm	Final size, mm		
200	$200 \times 0.012 = 2.4$	202.4		
120	$120 \times 0.012 = 1.5$	121.5		
80	$80 \times 0.012 = 1$	81.0		
40	$40 \times 0.012 = 0.5$	40.5		
30	$30 \times 0.012 = 0.4$	30.4		

Provide draft allowance of 20 mm/metre.

Draft for 121.5 mm; $\frac{121.5}{2} \times 0.02 = 1.2$ mm on either side of parting line.

Draft for 81 mm; $\frac{81}{2} \times 0.02 = 0.8$ mm on either side of parting line.

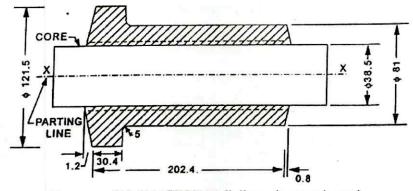


Fig. : SPLIT PATTERN (all dimensions are in mm)

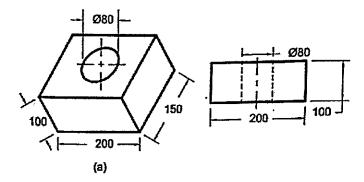
Considering the machining allowance of 2 mm,

The size of hole = 40.5 - 2 = 38.5 mm

Fillet radius of 5 mm is provided at the corners.

Dimensions of split pattern for gun metal sleeve is shown in Fig.

<u>Prob.(2):</u> The casting shown in below fig.(a) is to be made in plain carbon steel using a wooden pattern. Assuming only shrinkage allowance, calculate the dimensions of the pattern.



Sol: For steel the shrinkage allowance is 21 mm/m

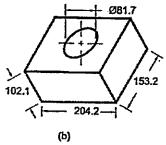
For dimension 200, allowance is $200 \times 21.0 / 1000 = 4.20 \text{ mm}$

For dimension 150, allowance is $150 \times 21.0 / 1000 = 3.15 \approx 3.20 \text{ mm}$

For dimension 100, allowance is $100 \times 21.0 / 1000 = 2.10 \text{ mm}$

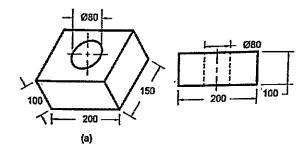
For dimension 80, allowance is $80 \times 21.0 / 1000 = 1.68 \approx 1.70 \text{ mm}$

The pattern drawing with required dimensions taking shrinkage into account is shown below in fig. (b)



Double shrinkage allowance is to be provided on the pattern dimensions, if it is to be used for casting the metallic pattern, which would ultimately be used for moulding to take care of the shrinkage of the actual metal cast as well as the shrinkage of the pattern metal. This is illustrated in the following example.

<u>Prob.3:</u> The casting shown in below fig.(a) is to be made in plain carbon steel using an Aluminum pattern (master pattern), calculate the dimensions of the wooden pattern which is to be used for making the aluminum pattern. What will be the pattern dimensions if all the surfaces of the casting need to be machined?



Solution:

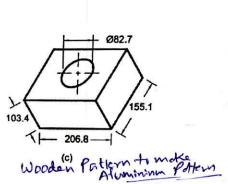
for aluminium the shrinkage allowance is 13.0 mm/m. For plain carbon steel, it is 21.0 mm/m. The total shrinkage = 13.0 + 21.0 = 34.0 mm/m

For dimension 200, allowance is $200 \times 34.0 / 1000 = 6.80 \text{ mm}$ For dimension 150, allowance is $150 \times 34.0 / 1000 = 5.10 \text{ mm}$

For dimension 100, allowance is $100 \times 34.0 / 1000 = 3.40 \text{ mm}$

For dimension 80, allowance is $80 \times 34.0 / 1000 = 2.72 \text{ mm}$

The final dimensions of the wooden pattern for making the aluminium master pattern are shown in Fig. (c). The pattern allowance applied for this wooden pattern is called double shrinkage allowance.



Machining allowance for bore # 3 mm Machining allowance for all surfaces = 3 mm Machining allowance for cope side = 6 mm

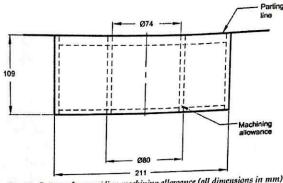


Fig. (d): Pattern after providing machining allowance (all dimensions in mm)

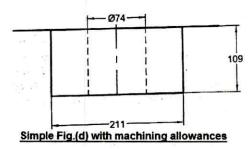
The dimension 80, 80 \pm (2 × 3)= 86 mm The dimension 100, 100 + 3 + 6 = 109 mm The dimension 150, 150 + 3 + 3 = 156 mm

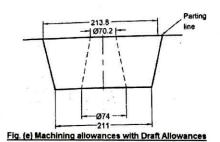
The dimension 200, 200 + 5.5 + 5.5 = 211 mm

The final dimensions are shown in Fig. (d)

Prob.4: For continuation of above problem (3), provide draft allowance to the pattern shown in above Fig.(d) which includes machining allowance.

Sol: The fig. (d) is given below simply





external =
$$109 \times \tan (0.75) = 1.4268 \approx 1.40 \text{ mm}$$

internal =
$$109 \times \tan (1.00) = 1.9026 \approx 1.90 \text{ mm}$$

Based on those dimensions, the sizes are the following

The bore dimension = $74 - 2 \times 1.90 = 70.20$ mm

See the fig. (e), which includes the above dimensions

<u>Objec</u>	ctive Typ	e Questio	ns:						
1.		of the foll of or castin	ıg.						nce, while making a
	(a)	aluminiu		b) brass	_	•	cast iron		plain carbon steel
2.	In solidification of metal during casting, compensation for solid contraction is								
	(a) provided by the oversize pattern ·								
	(b) achieved by proper placed riser (c) obtained by promoting directional solidification								
	(c)	obtained	by promo	ting direct	ional s	olio	dification		
	(d)	made by	provision	of chills		,			
	, ,	-		•		,			
3.			wing mate	rial is use				investm	ent casting mould
	(a) 1	wood		metal	(c)	,	wax	(d)	none of the above
4.	An expe	ndable pa	ttern is use	ed in					
	(a) s	slush casti	ng			•	squeeze caslir	-	
	(c) (centrifuga	casting		(d)	investment ca	sting	
5.	Metal p	atterns are	cast from						
	(a)	Polystyren	Q pattern				•		
6.	(c)	Wax patte	rn		(b) (d)	W	ooden pellern		
u.	tue up	per part of cheek	the mould	ing flask is	called	144	one of the above	iz	
		drag			(b)		ne		
7.	The fol	lowing pat	lern is usec						
			÷444	i ior large :	aise cun	lln	38		'n
	(c)	skeleton p	altern		(6)	lo	ose-plece pallen	n ,	
				-	(0)	Ωē	ted pattern		
8.	in a gree	en sand mo	ulding, unifo				•		
	• •	CHILLICE	3 OI 094 DOW	eli.					
	נסו	unilorm flor	v of molten i	matal tata d	ie moul	سد ار	està		
		D 2000 CHILL	CHSIOHAI SIAI	Millio of the -			vity		
II.	(0)	iess casting the Blanks	delects due :	lo expansió:	n of mor	ıld			
9									
10.		oogse eri	f the mould	ling flask is	called		~*		
11	The	ommon me	tern used fo	r making i	netal p	alle	m is called	 *	
12	. The a	llowance H	star rust ted	uires least	shrinka	ge	allowance is	············•	
13	The a	llowance ti	at lacilitate	easy rem	oval of	a p	allowance is attern from the	mould is _	
14	. A pro-	jection on a	iai is provid	ied by dec	reasing	the	size of the patt	em is	
15	Patter	n is mada :	a pattetti W	nich iorms	a seat	in a	mould for a co	re is called	l
	· · · · · · · · · · · · · · · · · · · ·	m is made	in siz	e inan eas	iting.				
Anou	toro:								
Answ		CL-1 O							
	(1) d	Choice Qu		(4)	1		1		
-	(8) c	(2) a	(3) c	(4) d	[5]	ь	(6) в	(7) c	4
L	(0) 0 1								J
II.	FIII in ti	re Blanks	:						
	9. drag								
		ter pattern							
		cast iron							
	2	t / draft all						•	
		ing allowa print / prit							
	15. large	_					•		

(1) What is the Gating system, its functions and factors that are to be Controlling Gating Design?

A proper method of gating system is that it leads the pure molten metal to flow through a ladle to the casting cavity, which ensures proper and smooth filling of the cavity. This depends on the layout of the gating channels too, such as the direction and the position of the runner, sprue and ingates.

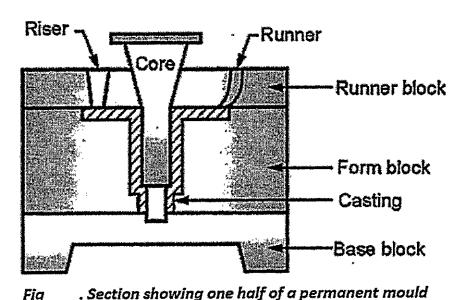
Functions: Clean molten metal, Smooth filling of the casting cavity, Uniform filling of the casting cavity and

Complete filling of the casting cavity.

<u>Factors that are to be Controlling Gating Design:</u> (i) Sharp corners should be avoided (ii) The shape, location and dimensions of runners and type of flow. (iii) Bending of runner if any should be kept away from mould cavity (iv) Tapering the sprue, providing radius at sprue entrance and exit and providing a basin instead pouring cup etc.

(2) Explain Permanent Mould Casting with the help of a sketch along with advantages, limitations and applications?

The process is also called as gravity die-casting. In this the mould is permanent which is neither destroyed nor remade after each cast. The mould is first preheated, up to a temperature of 400°C. Apply refractory coating on the mould cavity surfaces, runner and riser, etc. After attaining the mould temperature, the casting is poured. As the metal begins to solidify, cores are removed; otherwise it may shrink onto the surface of the metal.



<u>Advantages:</u> It is a very fast process. Moulds pave longer life. Better surface finish can be obtained. Less skilled operator is required. Less floor area is required.

<u>Limitations</u>: Moulds are much costlier. This method is not suitable for small quantity production. Shape and weight of the casting is limited. Gates, runners and risers cannot be shifted.

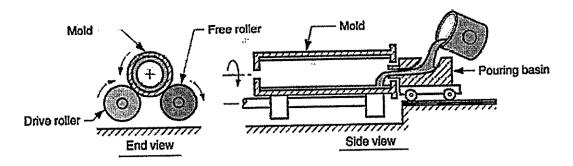
Applications: Hydraulic brake cylinders, Carburettor bodies, Washing machine gears, Oil pump bodies, Aircraft and missile casting, etc.

(3) Explain Centrifugal Casting process and its applications?

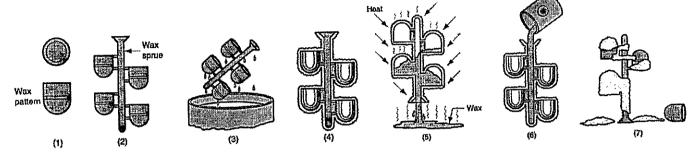
In this process mould is rotated at high speed and molten metal is poured into it. Due to the centrifugal force, the molten metal is directed outwards from the centre i.e. towards the inner surface of the mould with high pressure. Hence, a uniform thickness of metal is deposited all along the inner surface of the mould, where it solidifies and the impurities being lighter remains nearer to the rotation axis. This process produces casting with greater accuracy and better physical properties. This method is mainly suitable for producing casting of symmetrical shapes.

Applications: This method is used to cast hollow cylindrical objects such as hollow pipes, gun barrels,

liner bushes, etc.



(4) Explain Investment Casting step by step with sketch, Advantages & applications?



Steps in investment casting:

(1) Wax patterns are produced

(2) Several patterns are attached to a sprue to form a pattern tree;

(3) The pattern tree is coated with a thin layer of refractory material;

(4) The full mould is formed by covering the coated tree with sufficient refractory material to make it rigid;

(5) The mould is held in an inverted position and heated to melt the wax and permit it to drip out of the cavity;

(6) The mould is preheated to a high temperature, pour the molten metal

(7) After solidification, break and separate the castings

Explain the Continuous Casting along with advantages and applicatoins:

Liquid metal from tundish flow to bottom by gravity which is cooled during down movement to make it to semi solid then by using rollers bending it from vertical to horizontal direction. Then cut into desired lengths by saw

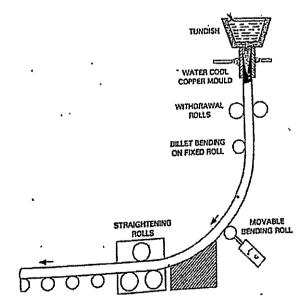


Fig. : CONTINUOUS CASTING

-The process is cheaper than rolling from ingots.

-But, Molten metal must be free from slag and poured with minimum turbulence to prevent surface roughness

- Used to produce any shape of uniform cross-section such as rectangular, square, hexagonal etc.,

MANUFACTURING TECHNOLOGY

Important Questions and Answers

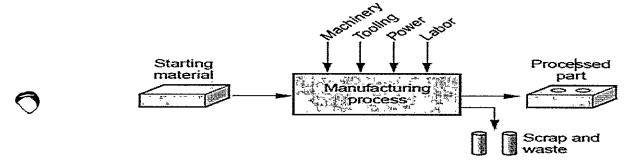
....Prepared by P.Suresh Babu

*Define Production and Manufacturing - 2M

Production: It is a process of converting inputs in to outputs.

Productivity (which is measure of production)= Output / Input

<u>Manufacturing</u>: It is a process of converting raw material in to finished product by using various processes, machines and energy.



*What is the casting process? - 2M

It means pouring molten metal into a refractory mould cavity and allows it to solidify. The solidified object is taken out from the mould either by breaking or taking the mould apart. The solidified object is called casting and the technique followed in method is known as casting process.

*What are the Steps involved in making a casting OR Mould? - 8M

- a) Pattern making: Make the pattern of wood, metal or plastic.
- b) Sand mixing and preparation: Select particular sand, test it and prepare the necessary sand mixtures for mould and core making.
- c) Core making: With the help of patterns prepare the mould and required cores.
- d) Melting: Melt the metal or alloy to be cast.
- e) Pouring: Pour the molten metal or alloy into the mould and remove the casting from the mould after solidification of metal.
- f) Finishing: Clean and finish the casting.
- g) **Testing**: Test and inspect the casting and remove the defects, if any.
- h) Heat treatment: Relieve the casting stresses by using various heat treatments.
- i) Re-testing: Again inspect the casting and deliver it.

**What are the Advantages of Metal Casting? -4M

- Molten metal flows into smallest section in the molten cavity. Hence any complex shape
 can be easily produced Ex. Gas turbine blades
- · Practically any material can be casted.
- Ideal method is by producing small quantities
- Due to small cooling rate from all directions, the properties of casting are same in all directions.
- Any size of casting can be produced up to 200 tons.
- Used for mass production of components
- Casting is the cheapcomparatively
- Heavy equipment like machine leads, ship's propeller, etc. can be made

*Wharare the Limitations of casting process? - 2M

- With normal sand casting process, the dimensional accuracies are less
- Low surface finish obtained on castings
- Defects are unavoidable.
- Sand casting is more laborious process
- Needs lot of pattern maintenance

**What are the Applications of Metal Casting? - 2M

- 1) Transportation vehicles (in automobile engine and tractors)
- 2) Machine tool structures
- 3) Turbine vanes and power generators
- 4) Pump filter and valve
- 5) Railway crossings and aircraft jet engine blades
- 6) Agricultural parts and sanitary fittings
- 7) Construction, communication and atomic energy applications, etc.

*Define Pattern? - 2M

A pattern is defined as a model or replica of the object to be cast. If one object has to be cast, then also pattern is required. It is a model or form around which sand is packed to give rise to a cavity called as mould cavity in which molten metal is poured and the casting is produced.

*What are the Difference between Pattern & Casting (OR) What way a pattern differ from a casting? – 2M

- 1) A pattern is slightly larger than the casting because a pattern carries allowance to Compensate for metal shrinkage.
- 2) Also, pattern carries allowances for machining so as to clean and finish therequired surfaces.
- \bigcirc 3) Pattern also has the necessary draft for its easy removal from the sand mass.
 - 4) Pattern carries additional projections, called as core prints, to produce seats for thecores.
 - 5) A pattern may not have holes and slots which a casting will have. Such holes and slots make a pattern complicated, hence can be drilled in the casting after it hasbeen made.
 - 6) The material from which casting and pattern is made, is also different.

**Factors to be considered while selecting proper material for pattern:

- 1) The number of casting to be made. Metal patterns are preferred for large quantity of production and wooden pattern's for lesser quantity.
- 2) Degree of accuracy in dimensions and the quality of surface finish required on thecasting.
 - 3) Method of moulding to be used i.e. hand or machine.
 - 4) Type of casting method to be used i.e. sand casting, investment casting, etc.
 - 5) Shape, size and complexity of the casting.
 - 6) Casting design parameters.
 - 7) Type of moulding material to be used.

**What Materials used for Making Patterns? 8M

The common materials of which the patterns are made are

1) Wood (ie., wooden patterns):

Advantages:

- It is cheap and easily available in large quantities.
- It can be easily shaped and machined to different configurations and forms.
- Good surface finish can be easily obtained.
- Due to lightness in weight its manipulation is easy and it can also be repaired easily.

Limitations or problems:

- Wooden patterns are weak as compared to metal patterns.
- They cannot withstand rough handling.
- They possess poor wear resistance and hence they are abraded easily by sand action.
- They absorb moisture, hence get warped and change the shape and size.

<u>Applications</u>:Wooden patterns are mostly used where number of casting to be made is small ar thesize of pattern is large.

The common woods used in pattern making are:

White pine, Mahogany, Maple, Cherry, Teak, Shisham etc.,

2. Metals (ie., metal patterns): Metal patterns are cast from wooden patterns.

Advantages:

- They do not absorb moisture.
- They are stronger and accurate, hence more life as compared to wooden patterns.
- They have greater resistance to abrasion and wear.
- They can withstand rough handling.

Limitations:

- As compared to wooden patterns they are more expensive.
- They are heavier than wooden patterns.
- Ferrous material patterns get rusted.
- -- They cannot be repaired easily.

<u>Applications:</u>Metal patterns are used where large numbers of castings have to be produced from thesame patter.

The common metals and alloys used for making patterns are:

Aluminium and its alloys, Steel, Brass, Cast iron, White metal etc.,

3. Plastic (ie., plastic patterns):

Advantages:

- Light weight and high strength.
- Resistance to wear and corrosion.
- Provides good surface finish.
- They are easy to make and less costly also.

Limitations:

- Plastic patterns are fragile; hence light sections may need metal reinforcements.
- They may not work well when subjected to conditions of severe shock.

4. Wax (ie., wax patterns):

Advantages: They provide good surface finish. After being molded, the wax pattern is not taken out; rather the mould is inverted andheated and the molten wax comes out or gets evaporated, hence there is no chance of the mould cavity getting damaged while removing the pattern. Also, they provide high accuracy to the castings.

plications: Wax patterns are exclusively used in investment casting process.

*Explain the Pattern Allowances? - 8M

A pattern is always made larger than the final casting, because it carries certainallowances (given below) due to metallurgical and mechanical reasons.

- i. Shrinkage or Contraction allowance: Almost all the metals used in the casting work shrink or contract during cooling from pouring temperature to room temperature.
- ii. Machining allowance: Machining allowance is the amount of dimension on a casting whichis made oversized to provide stock for machining. Ferrous metal needs more allowance than the non-ferrous metals and similarly large castings need more allowance than small castings.

<u>iii. Draft allowance</u>: Draft allowance or taper allowance is given to all vertical faces of a pattern for their easyremoval from sand without damaging the moulds.

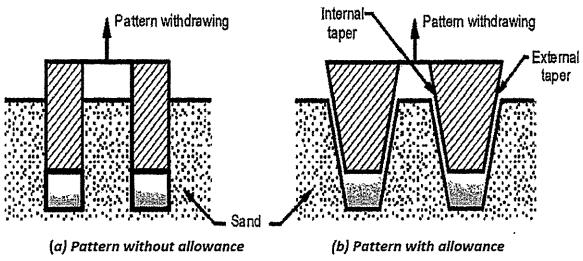


Figure: Taper or draft allowance

<u>iv. Distortion allowance (Camber allowance):</u> The casting will distort or warp if it is of irregular shape, V-shape, the arms having unequal thickness or one portion of the casting cools at a faster rate than the other. To eliminate this defect, an opposite distortion is provided on the pattern, so that theeffect is balanced and correct shape of the casting is produced.

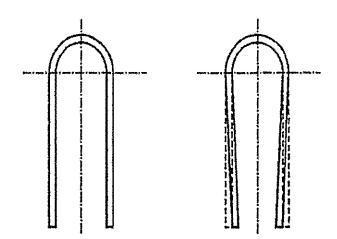


Figure: Distortion or camber allowance

v. Rapping or Shake allowance: When a pattern is to be taken out from the mould there is little increase in the size of the mould cavity. For this purpose, a <u>negative</u> allowance is provided on the

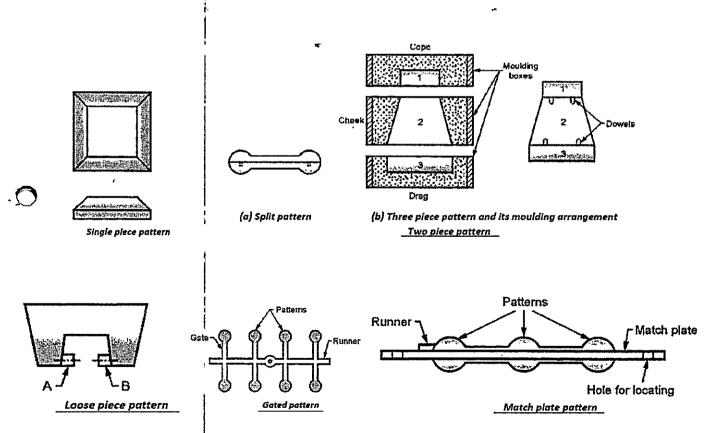
pattern i.e. the dimension's are kept smaller. It is normally provided only to the large castings and negligible for small and mediumsized castings.

*Explain any three types of patterns which are commonly used? - 8M

- 1. Single piece or solid pattern: It is the simplest of all the patterns and it is made in one-piece and does not carry loosepieces or joints. It is generally used for making large sized simple casting, usually made up ofwood or metal.
- 2. Two piece or Split pattern: Pattern upper and lower parts are accommodated in the cope and drag portions of the mould, respectively. For keeping the alignment between the two parts of the pattern, dowel pins are used.

<u>Choose piece pattern</u>:Some patterns embedded in the moulding sand cannot be withdrawn, hence suchpatterns are made with one or more loose pieces for their easy removal from themoulding box.

These patterns are known as loose piece patterns

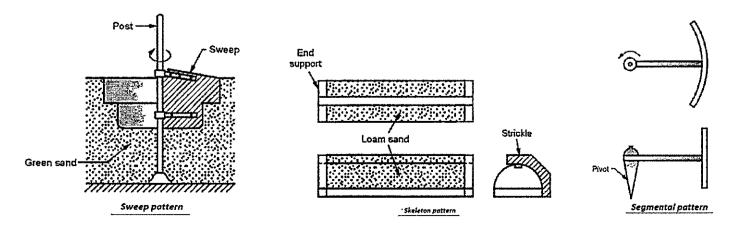


- Loose pieces like A and B as shown in fig, remain attached with the main body byusing dowel pins. These patterns consume more time for moulding operation and require more labourwork.

- 4. Gated pattern: To increase the strength and reduce the tendency to warp, gated patterns are generally made of metals. By using gated patterns number of casting can be made at a time, hence they are used in mass production system. The sections connecting various patterns serve as a runner and gates. This facilitates filling of the mould with molten metal in better manner and reduces the required time and labour work. These patterns are used for producing small castings.
- **5. Match plate pattern: These patterns are made in two pieces i.e. one piece mounted on one side and the other on the other side of the plate, called as match plate. The plate may carry one pattern or group of patterns mounted in the same way on its two sides. The plate can be of wood, aluminum, magnesium or steel. The match plate has runner and gates attached with it. Piston rings of I. C. engines are made by using these patterns.

Advantages:

- They produceaccurate casting at faster rates
- Less required supporting equipment to be purchased and installed
- Requires less floor space comparatively
- · Lower energy costs due to less material handling required;
- Reduced maintenance expenses.
- 6. Sweep pattern: Sweep pattern is just a form made on a wooden board which sweeps the casting shape into the sand all around the circumference. The sweep is rotated about the spindle or post, to form the cavity as shown in Fig.



- <u>7. Skeleton pattern:</u> When the casting size is very large, but easy to shape and few are to be made, then it is not economical to make a large solid pattern of that size. In such cases, a pattern consisting of a wooden frame and strips is made which is called as skeleton pattern.
- 8. Segmental pattern: The pattern is mounted on a central pivot and it completes one portion of the mould and then moves to the next portion. Used for producing large circular casting like big gears, wheel rims etc

* What are the property of Moulding Sand? 8M

- Flowability or plasticity: It is the ability of the moulding sand to get compacted to a uniform density. It assists moulding sand to flow and pack all-around the pattern and take up the desired shape.
- 2. Green strength: It is the strength of the sand in the green or moist condition. A mould which has adequate green strength will retains its shape and does not distort orcollapse, even after the pattern has been removed from the moulding box.
- 3. Dry strength: It is the strength of the moulding sand in the dry state.
- 4. Permeability or porosity: The sand must be porous to allow the gases and steam generated within themoulds to be removed freely.
- <u>5. Refractoriness</u>: It is the ability of moulding sand to withstand high temperatures without fusion, cracking and buckling.
- 6. Adhesiveness: It is the property of moulding sand because of which it is capable of adhering to the surface of other materials.

- 7. Cohesiveness: It is the property of the sand due to which sand particles stick together.
- 8. Thermal stability: To avoid breaking, buckling and flaking off of mould surface at higher temperatures, sand possesses dimensional thermal stability. If not, the casting may have defects like cuts and washes.
- 9. Collapsibility: It is the property due to which the sand mould automatically collapses after freezing of the casting, to allow the free contraction of the metal.

**What are the Ingredient of Moulding Sand& their Purposes or What materials to be added to moulding sand to improve its properties? 8M

- 1. Sand: The sand which forms the major portion of the moulding sand is essentially a silica grain. The shape and size of these grains greatly affect the properties of the moulding sand. The coarse grains have more void space between the grains which increases permeability, whereas a fine grain lowers the permeability.
- 2. Binder:Binders produce cohesion between the moulding sand grains and give strength to the moulding sand so that it can retain its shape as mould cavity.Ex. Bentonite, Fire clay, Limonite, Ball clay etc.,
- 3. Water: Around 1.5 to 8.0 % of water to be added along with clay. Binders and additives work only when moisture is present. Correct amount of water develops good green strength, edge and scratch hardness, good tensile strength, etc. Excessive amount of moisture adds difficulties in making and baking of cores.
- **4. Additives:** Coal dust, Sea coal, corn flour etc., to improve other properties like strength, surface finish etc.,

*What are the Cores& its functions?

Cores does not permit the molten metal poured to fill the space occupied by the core hence produce hollow casting. Core may be made up of sand, plaster, metal or ceramics. Cores are used as inserts in moulds to form design features which are difficult to be produced by simple moulding.

Essential characteristics of Core OR Requirements of Core sand:

- It should have sufficient strength to support itself without breaking.
- It should have high permeability and high refractoriness.
- It should have smooth surface to ensure a smooth casting.
- It should have high collapsibility, to assist the free contraction of the solidifying metal.
- Ot should have those ingredients which does not generate mould gases.

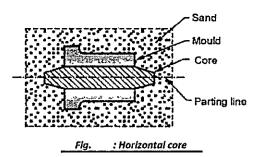
*Core Sand and How it differs from moulding sand: It consists of sand, 1 % core oil, 1 % cereal and 2.5to 6 % of water. Core sand is almost similar to moulding sand but the main difference is that core sand has very low clay content and larger grain size. Large grain size assures higher permeability.

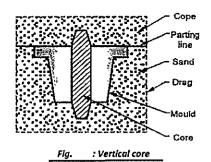
*Core sand Ingredients or core materials are as follows:

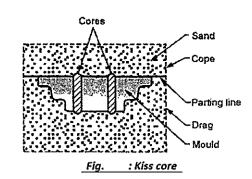
- a) Granular refractories: Some of the commonly used are Dry silica sand, Carbon, Zircon, etc.,
- b) <u>Core binders</u>: A core binder is used to hold sand grains together, give strength to cores, make the cores erosion resistant and impact adequate collapsibility to cores. Ex. Bentonite
- c) Water: Vary from 3 to 7 %.
- d) Additives: Similar to moulding sand

* Draw and explain any 3 types of Cores? 3M

Horizontal core : A horizontal core is positioned horizontally in the mould and mostly placed at parting line







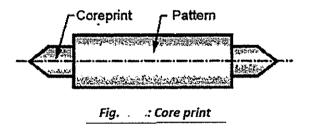
Vertical core:

- It is similar to horizontal core, except that it is fitted in the mould with its axis vertical. The top end of the core is provided with more amount of taper, to have a smooth fitting of the cope on the core.

Kiss core: It does not require core seats for getting support. It is held in position between drag and cope due to the pressure exerted by core on the drag. To obtain a number of holes in a casting, a number of kiss cores can be simultaneouslypositioned.

*What is the function of Core Print in casting process? 4M

Core prints are basically extra projections provided on the pattern. They form core seats in the mould when pattern is embedded in the sand for mould making. Core seats are provided to support all the types of cores. Core prints types are Horizontal core print, Vertical core print, Cover core print, Wing core print, Balance core print etc.,



What is a Mould? 2M

Prepared moulding sand is packed rigidly around the pattern. When the pattern is removed, a cavity corresponding to the shape of the pattern remains in the sand which is known as mould or mould cavity. Hence, mould is a sort of container which when poured with molten metal produces a casting of the mould shape. The process of making the mould is called as mould making.

*What is the Gating system? 2M

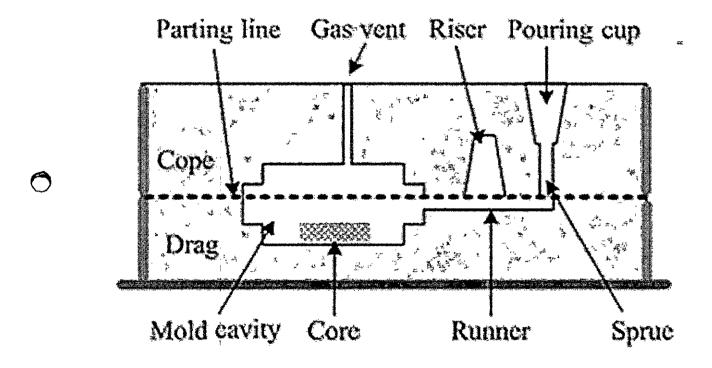
A proper method of gating system is that it leads the pure molten metal to flow through a ladle to the casting cavity, which ensures proper and smooth filling of the cavity. This depends on the layout of the gating channels too, such as the direction and the position of the runner, sprue and ingates.

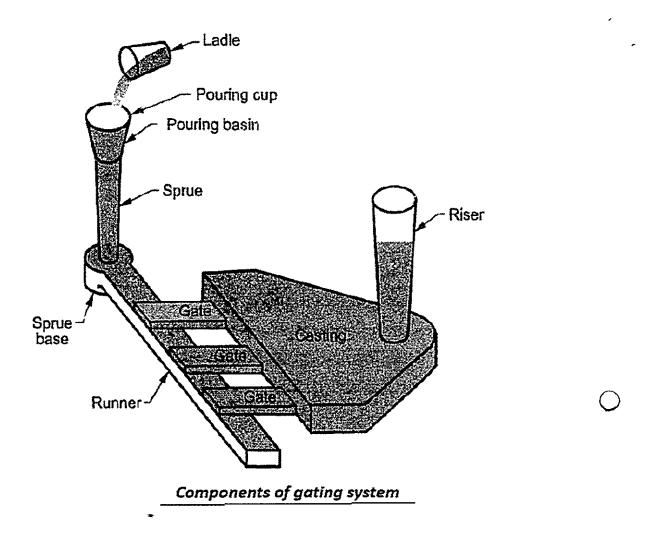
*What are the functions or Objective of the Gating System ? 2M

- Clean molten metal.
- Smooth filling of the casting cavity.
- Uniform filling of the casting cavity.
- Complete filling of the casting cavity.

**What are the elements of Gating system and explain them in detail? 12M

Gating system composed of Flask, Pouring cups and basins, Sprue, Runner, Gates, Riser etc.,





Flak: Flak is the moulding box used for holding the sand. Based on the situation it can be named as cope, drag, cheek, etc.

- Drag: Lower moulding flask is called drag.
- Cope: Upper moulding flask is called cope.
- Cheek: The middle moulding flask used in the three-piece pattern is called cheek.

Pattern: The pattern is the replica of the casting to be produced.

Parting line: The parting line is the dividing line between the two flasks.

**Sprue: Sprue is the connecting passage between the pouring basin and runner. It controls the flow of molten metal. The sprue may be square or round and is generally tapered downwards, to prevent air from entering the castingand metal damage.

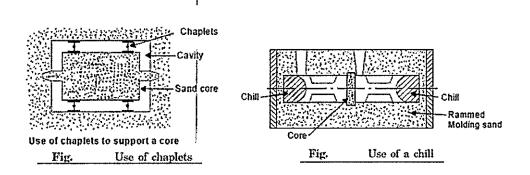
Runner: The runner is the passage used for regulating the flow of molten liquid.

Ingate: Ingate is the last point of gating from where the molten metal enters the cavity.

Riser: The riser is the reservoir of molten metal provided in the casting process to compensate the liquid shrinkage's taking place during solidification.

Chill: Chill is the metallic piece used for obtaining directional solidification.

*Chaplets: Chaplets are used for supporting the cores inside the mould cavity to take care of its weight and mould cavity to take care of its weight and overcome the buoyancy forces.

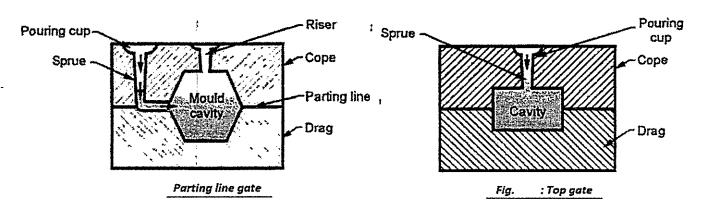


What are the factors that are to be Controlling Gating Design?

(i) Sharp corners should be avoided (ii) The shape, location and dimensions of runners and type of tiow. (iii) Gating ratio should reveal that the total cross-section of sprue, runner and gate decreases towards the mould cavity (iv) Bending of runner if any should be kept away from mould cavity (v) Tapering the sprue, providing radius at sprue entrance and exit and providing a basin instead pouring cup etc.

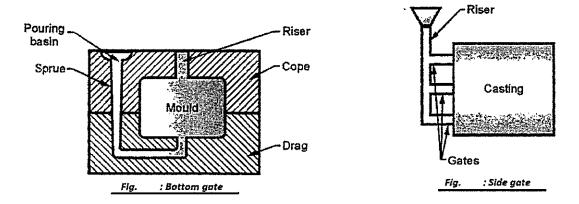
*Explain any 4 major type gates ? 8M

a) Parting line gates: These gates enter the mould cavity along the parting line separating the cope and drag portions of the mould. These gates are the simplest in nature and construction. Such gates commonly used and are found to give satisfactory service except when the mould is very deep.



b) Top gates: The molten metal just drops on the sand in the bottom of the mould. The dropping liquid metal stream erodes the mould surface. It is not favourable for non-ferrous casting.

c) Bottom gates: A bottom gate is provided in the drag half of the mould. In this, liquid metal fills rapidly the bottom portion of the mould cavity and rises steadily and gently up the mould walls. Bottom gates provide less turbulence and erosion in the mould cavity. It is not used in large and deep casting because the metal cools gradually as it rises up.

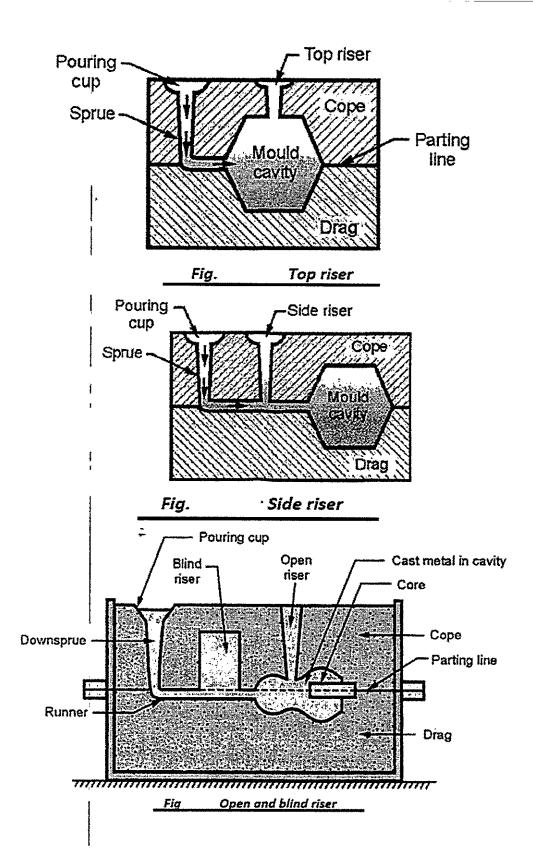


d) Side gates: Side gates are provided on either left or right side of the casting. Hence, the metal enters into the mould cavity from sides. It enters near the bottom first, and then as the level of the metal rises in the mould the incoming molten metal starts entering near the surface of the rising metal.

**What are the Functions of Risers? 2M

- To feed metal to the solidifying casting, so that shrinkage cavities are got rid of.
- It permits the escape of air and mould gases as the mould cavity is being filled with the molten metal.
- It promotes directional solidification.
- Also, it shows that the mould cavity has been completely filled or not.
- A casting solidifying under the liquid metal pressure of the riser is comparatively sound.

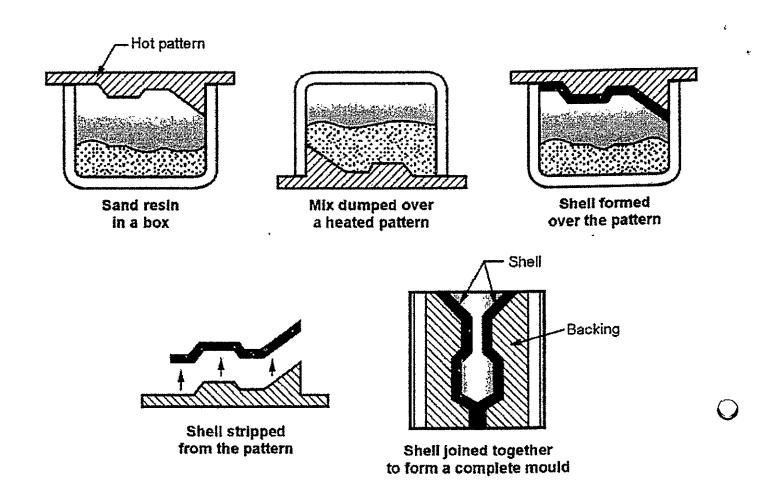
What are the Classification of Risers? Write by own by seeing the images



Explain Shell Moulding process with the help of a neat sketch? 8M

Shell moulding is suitable for thin walled articles. It consists of making a mould that has two or more thin shell like parts, made by Silica sand is mixed with synthetic resin

Procedure of making shell mould: Write by own by seeing the below figures



<u>Advantages</u>: Very high surface finish is obtained. Sand handling is minimum. Less floor area is required. Casting defects are minimum.

<u>Limitations:</u> The pattern equipment cost is more. Complicated jobs cannot be moulded.

Applications: Automobile casting, casting steel, iron or non-ferrous alloys.

Explain CO₂ Moulding Process? 4M

The principle of working of the CO₂ process is that, CO₂ gas is passed through a sand mixture containing sodium silicate. Then the sand immediately becomes extremely strongly bonded as the sodium silicate becomes a stiff gel. This gel is responsible for giving the necessary strength to the mould.

Na₂O(x) SiO₂+(x) H₂O+CO₂
$$\rightarrow$$
 Na₂CO₃+SiO₂(x) H₂O (Sodium silicate) (Sodium (Silica gel) carbonate)

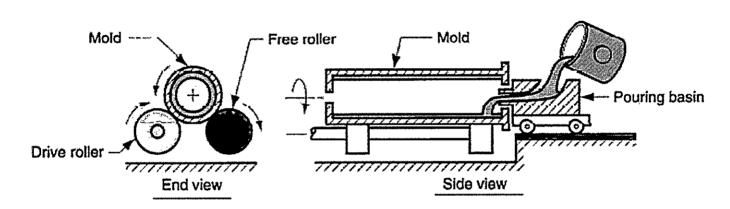
where x is 3, 4 or 5, most often x=2.

Advantages: 1. Eliminates the need for internal support for cores, and for drag and cope elements 2. Speed in operation, so, suitable for heavy and rush orders 3. Eliminates baking ovens and core driers

4. Requires minimum floor space 5.Semi skilled labour are enough 6.Less labour cost 7. Greater dimensional accuracy

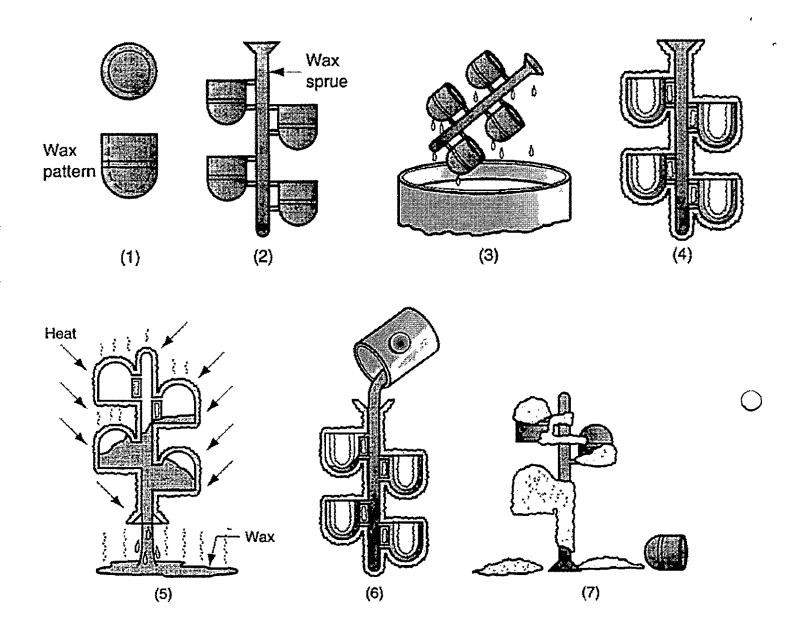
* Explain Centrifugal Casting process step wise, its applications? 12M

In this process mould is rotated at high speed and molten metal is poured into it. Due to the centrifugal force, the molten metal is directed outwards from the centre i.e. towards the inner surface of the mould with high pressure. Hence, a uniform thickness of metal is deposited all along the inner surface of the mould, where it solidifies and the impurities being lighter remains nearer to the rotation axis. This process produces casting with greater accuracy and better physical properties. This method is mainly suitable for producing casting of symmetrical shapes.



Applications: This method is used to cast hollow cylindrical objects such as hollow pipes, gun barrels, liner bushes, etc.

* * * Explain Investment Casting step by step with sketch, Advantages & applications? 12M



Steps in investment casting:

- (1) Wax patterns are produced
- (2) Several patterns are attached to a sprue to form a pattern tree;
- (3) The pattern tree is coated with a thin layer of refractory material;
- (4) The full mould is formed by covering the coated tree with sufficient refractory material to make it rigid;
- (5) The mould is held in an inverted position and heated to melt the wax and permit it to drip out of the cavity;
- (6) The mould is preheated to a high temperature, which ensures that all contaminants are eliminated from the mold; it also permits the liquid metal to flow more easily into the detailed cavity; the molten metal is poured; it solidifies

(7) After solidification, the imould is broken away from the finished casting. Parts are separated from the sprue. The gates, risers, etc. are then chipped off. The castings are then subjected to sand blasting. Then they are inspected through the specified inspection method.

Advantages:

- Better dimensional accuracy with close tolerances can be achieved.
- Complicated shapes and complex contours can be easily cut.
- Extremely thin sections up to 0.75 mm can be cast.

Limitations:

- _Suitable only for small sized casting.
- Moulds used are single purpose only.

Applications:

- Parts for aerospace industry, aircraft engines, frames, fuel systems, etc.
- Nozzles, buckets, blades, etc. for gas turbines.

*What are the advantages of Continuous Casting?

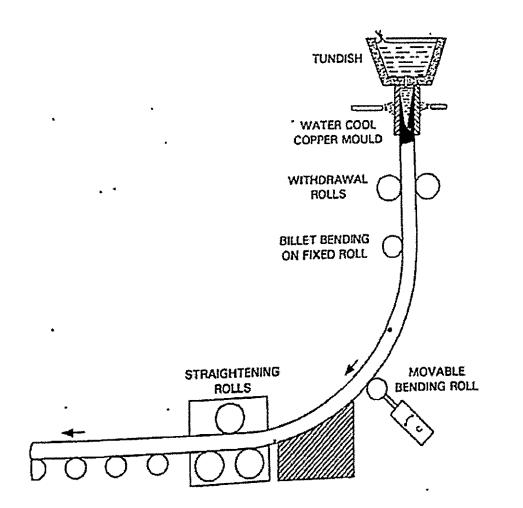


Fig. : CONTINUOUS CASTING

Advantages: The process is cheaper than rolling from ingots. There is no need of rough forming and breakdown rolling operation. Casting surfaces obtained are better than the static ingots. Grain size and structure of the casting can be regulated by controlling cooling rates.

<u>Disadvantages:</u> Molten metal must be free from slag and poured with minimum turbulence to prevent surface roughness. Improper cooling results in centre line shrinkage

<u>Applications:</u> This process can produce any shape of uniform cross-section such as rectangular, square, hexagonal, gear toothed, etc. either solid or hollow. Production of blooms, billets, slabs and sheets. Materials like brass, zinc, copper and its alloys, aluminum and its alloys, alloy steel maybe cast.

What is Fetling?

The complete process of cleaning of castings is called fettling. It involves the removal of the cores, gates, sprues, runners, risers and chipping of any of unnecessary projections on the surface of the castings caused by seams and imperfections in the moulds, as well as access ports for pouring material into the moulds.

* Write the Advantages, Dis-advantages and Applications of Welding? 6M

Advantages OR Importance Of Welding:

- Welding is more economical and is much faster process as compared to other processes (riveting, bolting, casting etc.)
- Welding, if properly controlled results permanent joints having strength equal or sometimes more than base metal.
- Large number of metals and alloys both similar and dissimilar can be joined by welding.
- Portable welding equipment can be easily made available.

Disadvantages:

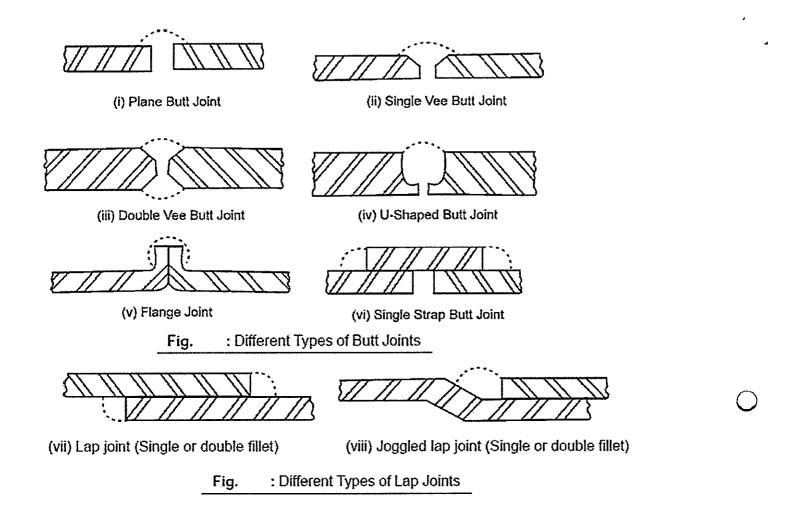
- It results in residual stresses and distortion of the work pieces.
- Welded joint needs stress relieving and heat treatment.
- Welding gives out harmful radiations (light), fumes and spatter.
- Jigs, and fixtures may also be needed to hold and position the parts to be welded
- Edges preparation of the welding jobs are required before welding

Applications:

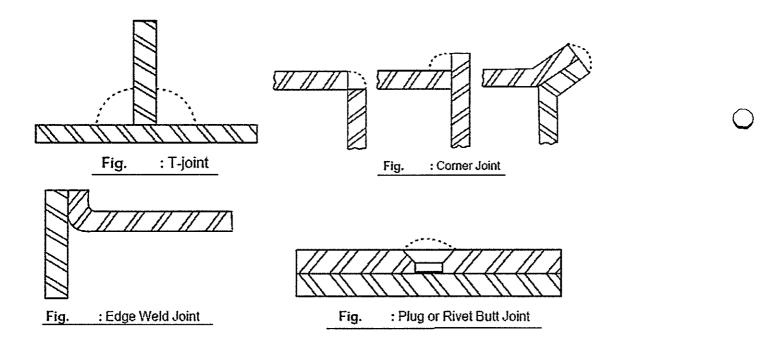
- Manufacturing of machine tools, auto parts, cycle parts, etc.
 - Fabrication of farm machinery & equipment.
 - Fabrication of buildings, bridges & ships.

* Write the different type of Welded Joints? 6M

* (a) **Butt Joint**: In this type of joint, the edges are welded in the same plane with each other. V or U shape is given to the edges to make the joints strong



(b) <u>Lap Joint</u>: This type of joint is used in joining two overlapping plates so that the corner of each plate is joined with the surface of other plate.



- (c) <u>T-Joint</u>: When two surfaces are to be welded at right angles, the joint is called T-Joint. The angle betweenthe surfaces is kept 90°.
- (d) <u>Corner Joint</u>: In this joint, the edges of two sheets are joined and their surfaces are kept at right angle to eachother. Such joints are made in frames, steel boxes, etc.

- (e) Edge Joint: In this joint two parallel plates are welded edge to edge.
- (f) Plug Joint: Plug joints are used in holes instead of rivets and bolts.

Explain Gas welding Process OR Oxy-acetylene welding? 6M

Gas welding is a fusion welding process which joins metals, using the heat of combustion of an oxygen/air and fuel gas (i.e. acetylene or hydrogen etc.,) mixture

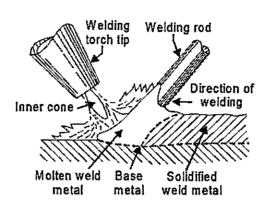


Figure: Gas welding

Oxy-acetylene welding: In this process, acetylene is mixed with oxygen in correct proportions in the welding torch and ignited, which produces temperature of about 3300°C and thus can melt most of the ferrous and non-ferrous metals. A filler metal rod is generally added to the molten metal pool to build up the seam slightly for greater strength.

Advantages of Oxy-acetylene Welding:

- Equipment is cheap as compared to other welding process.
- It can be used for welding of all types of metals.
- Maintenance of equipment is very less.
- It is a portable process.
- It can be used far cutting of metals of small thickness.
- It is specially used for sheet metal work.

Disadvantages:

- It takes long time for heating the job as compared to the arc welding.
- The heat affected area is more.
- This is prone to corrosion and brittleness.
- Gases are expensive and difficult to store.

Write the Gas Welding Equipments? 6M

<u>Gas pressure regulators</u>: These are employed for regulating the supply of acetylene and oxygen gas from cylinders.

<u>Welding torch</u>: It is a tool for mixing oxygen and acetylene in correct proportion and burning the mixture at the end of a tip.

Hose pipes: The hose pipes are used for the supply of gases from the pressure regulators.

Goggles: These are used to protect the eyes from harmful heat and ultraviolet and infrared rays.

Gloves: These are required to protect the hands from any injury due to the heat of welding process.

<u>Spark-lighter:</u> It is used for frequent igniting the welding torch.

<u>Filler rods:</u> It should be held at approximately 90⁰ to the welding tip. Filler rods have the same or nearly the same chemical composition as the base metal.

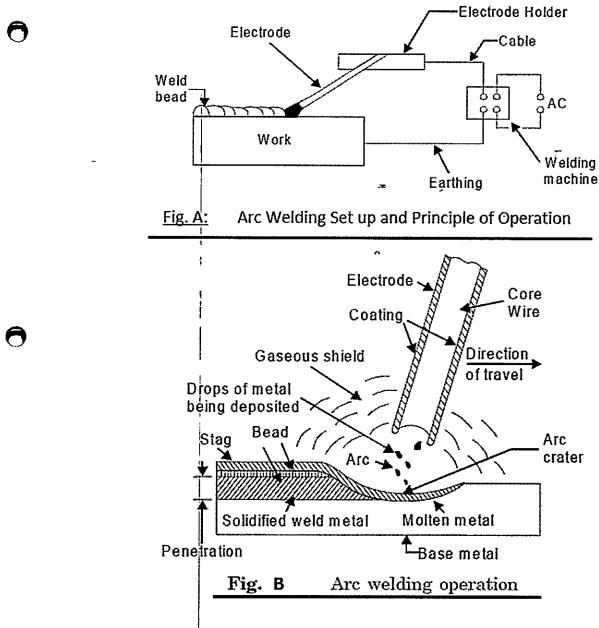
Write about Flux? 2M

The chemicals which deoxidize the metal surface and provide inert atmosphere around the molton metal are known as fluxes. These are usually employed for gas welding of aluminium, stainless steel, cast iron, brass and silicon bronze. Fluxes are available as liquid, powder, paste and gas. Powder flux is sprinkled on the surfaces to be welded or the filler rod is dipped into the powder. Liquid & paste fluxes are sprayed on the surfaces to be welded. Gas fluxes are used to form inert atmosphere around the joint to be welded

*Arc Welding / Shielded Metal Arc Welding (SMAW) / Manual Metal Arc Welding (MMAW)? 6M

Arc Welding is the process, in which an electric arc between an electrode and a work piece or between two electrodes is utilized to weld base metals, is called an arc welding process.

SMAW is a commonly used arc welding process manually carried by welder. It is an arc welding process in which heat for welding is produced through an electric arc set up between a flux coated electrode and the workpiece. The flux coating of electrode decomposes due to arc heat and serves many functions, like weld metal protection, arc stability etc. Inner core of the electrode supply the filler material for making a weld. The basic setup is shown in Fig.A and the configuration of weld zone is shown Fig. B



Advantages:

1. It can be carried out in any position with highest weld quality.

- 2. It is the simplest of all the arc welding processes.
- This welding process finds innumerable applications, because of the availability of a wide variety of electrodes.
- 4. The process can be very well employed for hard facing and metal resistance etc.
- 5 Joints (e.g., between nozzles and shell in a pressure vessel) which because of their position are difficult to be welded by automatic welding machines can be easily done by this
- 6. The welding equipment is portable and the cost is fairly low.

Limitations:

- 1. Due to flux coated electrodes, the chances of slag entrapment and other related defects are more as compared to MIG and TIG welding.
- 2. Duo to fumes and particles of slag, the arc and metal transfer is not very clear and thus welding control in this process is a bit difficult as compared to MIG welding.
- 3. Due to limited length of each electrode and brittle flux coating on it, mechanization is difficult.
- 4. In welding long joints (e.g., in pressure vessels), as one electrode finishes, the weld is to be progressed with the next electrode. Unless properly cared, a defect (like slag inclusion or insufficient penetration) may occur at the place where welding is restarted with the new electrode
- 5. The process uses stick electrodes and thus it is slower as compared to MIG welding.

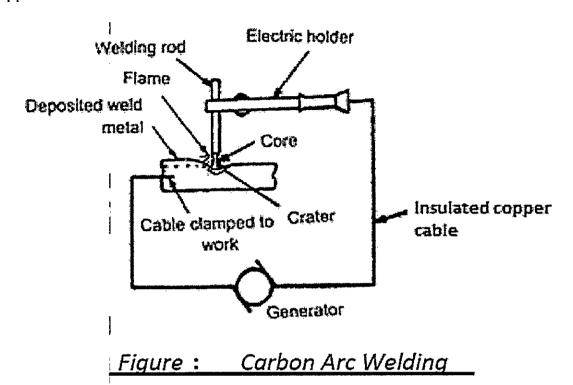
<u>Applications:</u> (a) Building and Bridge construction (b) Automotive and aircraft industry, etc. (c) boiler and pressure vessel fabrication (d) Ship building (e) Pipes and (f) Penstock joining

Explain Carbon Arc Welding Process? 6M

In this process, a pure graphite or baked carbon rod is used as a non-consumable electrode to create an electric arc between it and the workpiece. The electric arc produces heat and weld can be made with or without the addition of filler material.

In single electrode arc welding, an electric arc is struck between a carbon electrode and the workpiece. Welding may be carried out in air or in an inert atmosphere. Direct current straight polarity (DCSP) is preferred to restrict electrode disintegration and the amount of carbon going into the weld

metal. This process is mainly used for providing heat source for brazing, braze welding, soldering and heat treating as well as for repairing iron and steel castings. It is also used for welding of galvanized steel and copper.



Arc Welding Equipment:

1.Arc welding power source: Both direct current (DC) and alternating current (AC) are used for electric arc welding, each having its particular applications.

Welding cables: These are required for conduction of current from the power source through the electrode holder, the arc, the workpiece and back to the welding power source. These are insulated copper or aluminium cables.

- 3. Electrode holder: It is used for holding the electrode manually and conducting current to it.
- *4. Welding Electrodes: An electrode is a piece of wire or a rod of a metal or alloy, with or without coatings. An arc is set up between electrode and work piece. Welding electrodes are classified into following types.

- (a) Consumable electrode: It is made of different metals and their alloys. The end of this electrode starts melting when arc is struck between the electrode and workpiece. Thus consumable electrode itself acts as a filler metal.
- (i) Bare electrodes: Bare electrodes consist of a metal or alloy wire without any flux coating on them. These produce the welding of poor quality. These are cheaper than coated electrodes. These are generally used in modern welding process like MIG welding.
- (ii) Coated electrodes: Coated electrodes have flux coating which starts melting as soon as an electric arc is struck. A metallic core is coated with some suitable material. The material used for core is mild steel, nickel steel, chromium molybdenum steel, etc. One end of the coated core is kept bare for holding.
- *Functions of Coatings: To prevent oxidation. Forms slags with metal impurities. It stabilizes the arc.

 Increases deposition of molten metal. Controls depth of penetration. Controls the cooling rate. Adds alloy elements to the joint

<u>Electrode Size:</u> Electrodes are commonly made in lengths 250 mm, 300 mm, 350 mm, 450 mm, and the diameters are 1.6 mm, 2 mm, 2.5 mm, 3.2 mm, 4 mm, 7 mm, 8 mm and 9 mm.

- (b) Non-consumable electrodes: They are made up of high melting point materials like carbon, pure tungsten or alloy tungsten etc. These electrodes do not melt away during welding. But practically, the electrode length goes on decreasing with the passage of time, because of oxidation and vaporization of the electrode material during welding. The materials of non-consumable electrodes are usually copper coated carbon or graphite, pure tungsten, thoriated or zirconiated tungsten.
- 5. Hand Screen: Hand screen used for protection of eyes and supervision of weld bead.
- 6. Chipping hammer: Chipping Hammer is used to remove the slag by striking.
- 7. Wire brush: Wire brush is used to clean the surface to be weld.

8. Protective clothing: Operator wears the protective clothing such as apron to keep away the exposure of direct heat to the body.

Effect of Arc Length: Arc length is the distance from the tip of the electrode to the bottom of the arc. It should vary from 3 to 4 mm. In short arc length, the time of contact will be shorter and will make a wide and shallow bead. The penetration is low as compared to long arc lengths.

Arc blow: It is the, usually unwanted, deflection of the arc during arc welding. There are two types of arc blow commonly known in the electric welding industry

- (a) Magnetic arc blow: It is the deflection of welding filler material within an electric arc deposit by a build up of magnetic force surrounding the weld pool. It occur because of Workpiece connection, Joint design, Poor fit-up, Improper settings, Atmospheric conditions etc.,
- (b) Thermal arc blow: It is widely attributed to variations in resistance within the base metal created by the weld pool as it is moved across the workpiece. It occur because of Improper surface preparation, Improper travel speed etc., Thermal arc blow is not as severe as magnetic arc blow, but can still leave undesirable defects in the weld deposit.

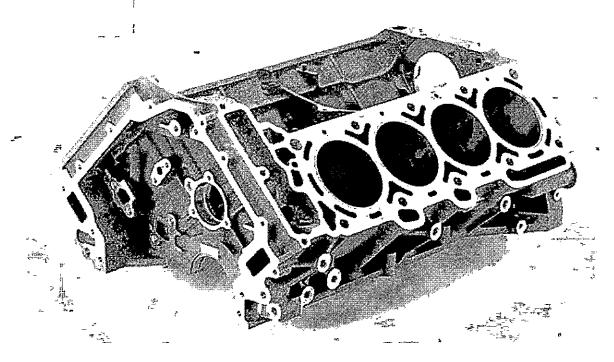
		ş
		0
		0

Topics beyond syllabus

Advance casting process

Ref: https://www.machinemfg.com/types-of-casting/

Lost foam casting

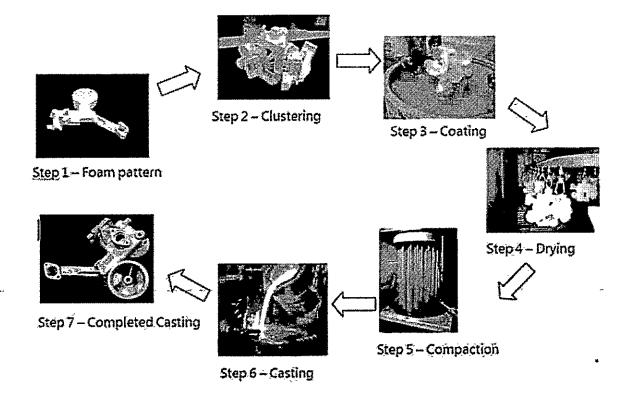


What is lost foam casting (also known as solid casting)

It is a new casting method that a combination of paraffin or foam models similar to the size and shape of the casting to form a model cluster. After brushing and drying the refractory coating, it is buried in dry quartz sand to vibrate. Pouring under negative pressure to vaporize the model, the liquid metal occupies the model position, and is formed after solidification and cooling.

Technological process:

 $Pre-foaming \to Foaming \ molding \to Dip \ coating \to Drying \to Modeling \to Pouring \to Falling \ sand \ \to Cleaning$



Technical characteristics:

- 1. High precision casting, no sand core, reducing processing time.
- 2. No parting surface, flexible design and high degree of freedom.
- 3. Clean production without pollution.
- 4. Reduce investment and production costs.

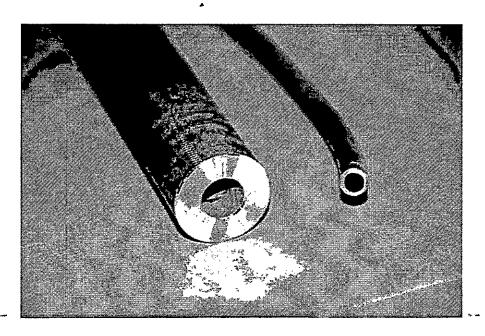
Applications:

It is suitable for the production of various sizes of precision castings with complex structures. There are no restrictions on the types of alloys and the production batches. Such as gray cast iron engine box, high manganese steel elbow and so on.

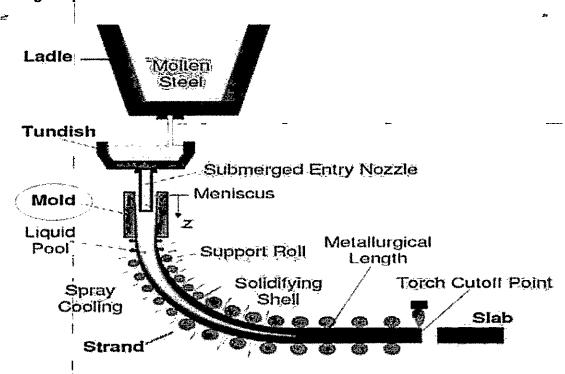
Continual casting

What is continual casting

It is an advanced casting method. Its principle is to continuously pour molten metal into a special metal mold called a crystallizer. The solidified (crusted) casting is continuously pulled out from the other end of the mold, and it can obtain any length or specific length of casting.



Technological process:



Technical characteristics:

- 1. Because the metal is rapidly cooled, the crystals are dense, the structure is uniform, and the mechanical properties are good.
- 2. Save metal and improve yield.
- 3. Simplified procedures, eliminating modeling and other procedures, thus reducing labor intensity and greatly reducing the required production area.
- 4. Continual casting production is easy to realize mechanization and automation and improve production efficiency.

Applications:

Continual casting can be used to cast steel, iron, copper alloys, aluminum alloys, magnesium alloys and other long castings with constant cross-sectional shapes, such as ingots, slabs, rod billets, pipes, etc.

HIGH ENERGY RATE FORMING PROCESSES

In these forming processes large amount of energy is applied for a very short interval of time. \neg Many metals tend to deform more readily under extra - fast application of load which make these processes useful to form large size parts out of most metals including those which are otherwise difficult - to - form.

Parts are formed at a rapid rate, and thus these processes are also called high – velocity forming processes. There are several advantages of using these forming processes, * like die costs are low, * easy maintenance of tolerances, * possibility of forming most metals, * and material does not show spring-back effect. Production cost of components by such processes is low. Limitation of these processes is the need for skilled personnel.

There are three main high energy rate forming processes: 1. Explosive forming 2. Magnetic forming 3. Electro hydraulic forming

Explosive Forming | Explosive forming, is distinguished from conventional forming in that the punch or diaphragm is replaced by an explosive charge. | Explosives used are generally high – explosive chemicals, gaseous mixtures, or propellants.

Factors to be considered while selecting an HERF process:

- · Size of work piece
- · Geometry of deformation
- · Behavior of work material under high strain rates
- Energy requirements/ source
- Cost of tooling / die
- Cycle time
- Overall capital investment
- Safety considerations

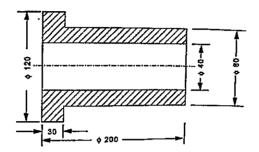
Electro Magnetic Forming Process is also called magnetic pulse forming and is mainly used for swaging type operations, such as fastening fittings on the ends of tubes and crimping terminal ends of cables. Other applications are blanking, forming, embossing, and drawing

Electro Hydraulic Forming θ Electro hydraulic forming (EHF), also known as electro spark forming, is a process in which electrical energy is converted into mechanical energy for the forming of metallic parts. θ A bank of capacitors is first charged to a high voltage and then discharged across a gap between two electrodes, causing explosions inside the hollow work piece, which is filled with some suitable medium, generally water

MANUFACTURING TECHNOLOGY

Problem on Foundry (Unit-1)

Prob.1: Design a split pattern for gun metal sleeve (see the below Fig.) assuming shrinkage, draft allowances and machining allowances of 2 mm for hole only



Solition: For gun metal shrinkage allowance is 12 mm/m

Shrinkage allowance for various dimensions:

Dimensions, mm	Allowance, mm	Final size, mm
200	$200 \times 0.012 = 2.4$	202.4
120	$120 \times 0.012 = 1.5$	121.5
80	$80 \times 0.012 = 1$	81.0
40	$40 \times 0.012 = 0.5$	40.5
30	$30 \times 0.012 = 0.4$	30.4

Provide draft allowance of 20 mm/metre.

Draft for 121.5 mm; $\frac{121.5}{2} \times 0.02 = 1.2$ mm on either side of parting line.

Draft for 81 mm; $\frac{81}{2} \times 0.02 = 0.8$ mm on either side of parting line.

Considering the machining allowance of 2 mm,

The size of hole = 40.5 - 2 = 38.5 mm

Fillet radius of 5 mm is provided at the corners.

Dimensions of split pattern for gun metal sleeve is shown in Fig.

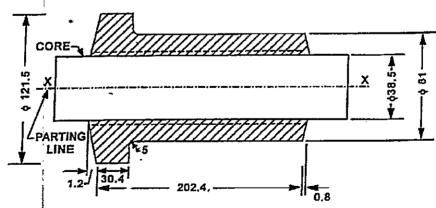
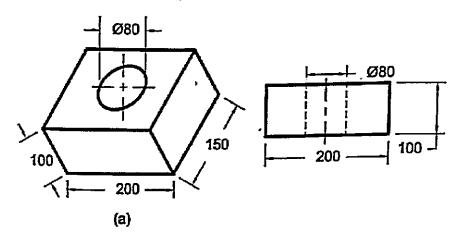


Fig. : SPLIT PATTERN (all dimensions are in mm)

Prob.2: The casting shown in below fig.(a) is to be made in plain carbon steel using a wooden pattern. Assuming only shrinkage allowance, calculate the dimensions of the pattern.



Sol: For steel the shrinkage allowance is 21 mm/m

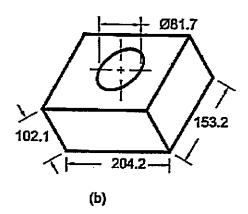
For dimension 200, allowance is $200 \times 21.0 / 1000 = 4.20 \text{ mm}$

For dimension 150, allowance is $150 \times 21.0 / 1000 = 3.15 \approx 3.20 \text{ mm}$

For dimension 100, allowance is $100 \times 21.0 / 1000 = 2.10 \text{ mm}$

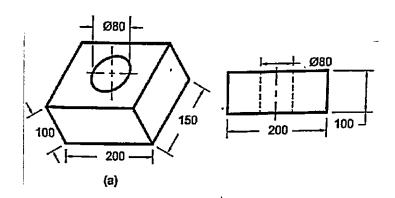
For dimension 80, allowance is $80 \times 21.0 / 1000 = 1.68 \approx 1.70 \text{ mm}$

The pattern drawing with required dimensions taking shrinkage into account is shown below in fig. (b)



Double shrinkage allowance is to be provided on the pattern dimensions, if it is to be used for casting the metallic pattern, which would ultimately be used for moulding to take care of the shrinkage of the actual metal cast as well as the shrinkage of the pattern metal. This is illustrated in the following example.

Prob.3: The casting shown in below fig.(a) is to be made in plain carbon steel using an Aluminum pattern (master pattern), calculate the dimensions of the wooden pattern which is to be used for making the aluminum pattern. What will be the pattern dimensions if all the surfaces of the casting need to be machined?



Sol:

for aluminium the shrinkage allowance is 13.0 mm/m. For plain carbon steel, it is 21.0 mm/m. The total shrinkage = $13.0 \pm 21.0 = 34.0 \text{ mm/m}$

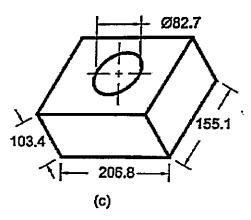
For dimension 200, allowance is $200 \times 34.0 / 1000 = 6.80 \text{ mm}$

For dimension 150, allowance is $150 \times 34.0 / 1000 = 5.10 \text{ mm}$

For dimension 100, allowance is $100 \times 34.0 / 1000 = 5.10 \text{ mm}$

For dimension 80, allowance is $80 \times 34.0 / 1000 = 2.72 \text{ mm}$

The final dimensions of the wooden pattern for making the aluminium master pattern are shown in Fig. (c). The pattern allowance applied for this wooden pattern is called double shrinkage allowance.



Machining allowance for bore $\frac{1}{ii}$ 3 mm Machining allowance for all surfaces = 3 mm Machining allowance for cope side = 6 mm The dimension 80, $80 + 2 \times 3 = 86$ mm The dimension 100, 100 + 3 + 6 = 109 mm. The dimension 150, 150 + 3 + 3 = 156 mm

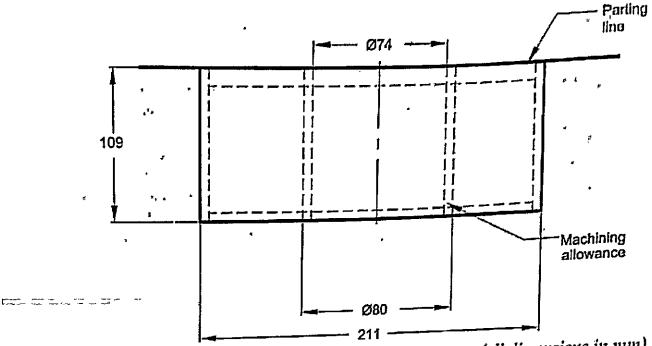


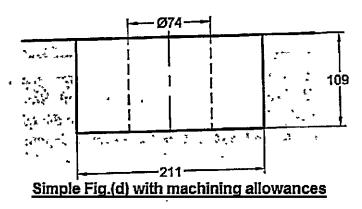
Fig. (d): Pattern after providing machining allowance (all dimensions in num)

The dimension 200, 200 + 5.5 + 5.5 = 211 mm

The final dimensions are shown in Fig. (d)

Prob.4: For continuation of above problem (3), provide draft allowance to the pattern shown in above Fig.(d) which includes machining allowance.

Sol: The fig. (d) is given below simply



The draft angle is 0.75° for external details and 1° for internal details.

Draft need to be provided only for the dimensions that are perpendicular to the parting line. Hence, for a 109-mm size the taper required is

external = $109 \times \tan (0.75) = 1.4268 \approx 1.40 \text{ mm}$

internal = $109 \times \tan (1.00) = 1.9026 \approx 1.90 \text{ mm}$

Based on those dimensions, the sizes are the following

The bore dimension = $74 - 2 \times 1.90 = 70.20 \text{ mm}$

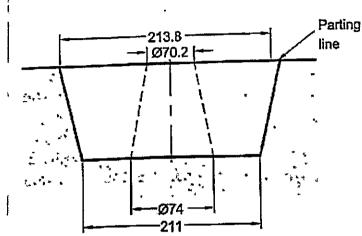
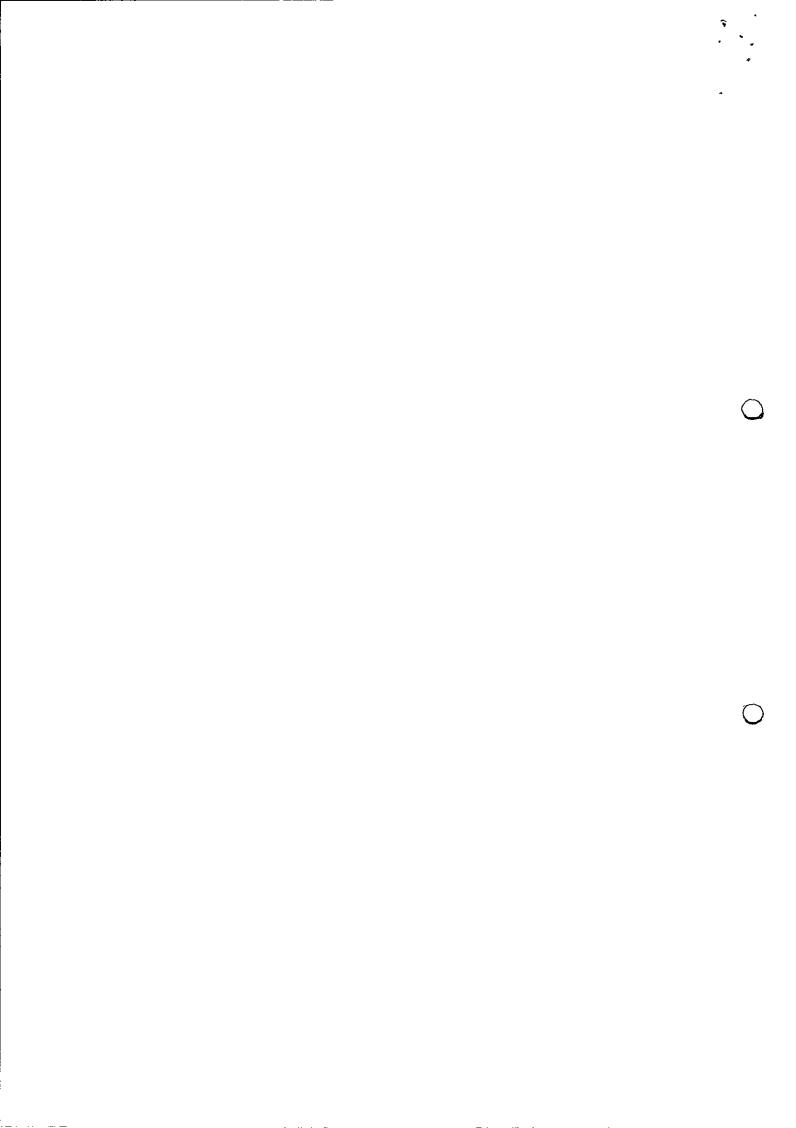


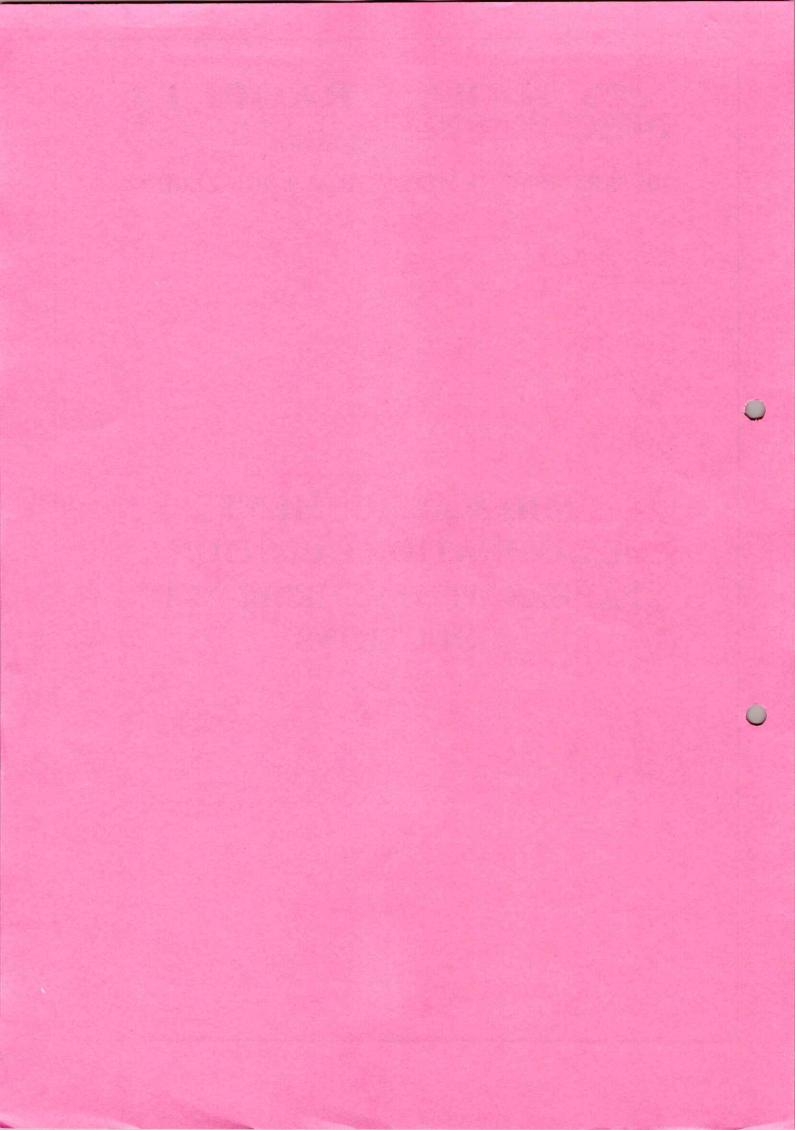
Fig. (e) Machining allowances with Draft Allowances





DEPARTMENT OF MECHANICAL ENGINEERING

MID & ASSIGNMENT EXAMINATION QUESTION PAPERS WITH SCHEME AND SOLUTIONS



NARASARAOPET ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET DEPARTMENT OF MECHANICAL ENGINEERING

II B.TECH II - SEMESTER ASSIGNMENT TEST – I, MARCH- 2022

SUBJECT: Manufacturing Technology DATE: 30-03-2022

Q.No.	Questions	Course Outcome (CO)	Knowledge level as per Bloom's Taxonomy	Marks
1	Rephrase casting process and Outline the steps involved in making a casting	1	Understanding (K2)	5
2.	List the advantages, limitations and Applications of Metal Casting process	1	Analyzing (K4)	5
3	List the materials used for making patterns and also give advantages, limitations and applications of each one.	1	Analyzing (K4)	5
4.	Explain different pattern allowances and explain any three types of patterns which are commonly used.	1	Evaluating (K4)	5
5	What are the elements of Gating system and Explain them in detail?	1	Understanding (K2)	5
6	Explain Investment Casting step by step with neat sketches, Advantages & Earn; applications	1	Analyzing (K4)	5

1	Rephrase casting process and Outline the steps involved in making a casting	1	Understanding (K2)	5
	List the advantages, limitations and	1	Analyzing (K4)	5
2.	Applications of Metal Casting process			
	List the advantages, limitations and	1	Analyzing (K4)	5
2.	Applications of Metal Casting process			
3	List the materials used for making patterns and also give advantages, limitations and applications of each one.	1	Analyzing (K4)	5
3	List the materials used for making patterns and also give advantages, limitations and applications of each one.	1	Analyzing (K4)	5
4.	Explain different pattern allowances and explain any three types of patterns which are commonly used.	1	Evaluating (K4)	5
4.	Explain different pattern allowances and explain any three types of patterns which are commonly used.	1	Evaluating (K4)	5
5	What are the elements of Gating system and Explain them in detail?	1	Understanding (K2)	5
5	What are the elements of Gating system and Explain them in detail?	1	Understanding (K2)	5
6	Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step by step with neat sketches, Advantages & Explain Investment Casting step step in the sketches	1	Analyzing (K4)	5
1	Rephrase casting process and Outline the steps involved in making a casting	1	Understanding (K2)	5
6	Explain Investment Casting step by step with neat sketches, Advantages & Samp;	1	Analyzing (K4)	5

 \bigcirc

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET DEPARTMENT OF MECHANICAL ENGINEERING II B.TECH II-SEMESTER I-MID EXAMINATION, APRIL-2022

Subject: MANUFACTURING TECHNOLOGY

Date 28-04-2022

Duration: 90 Min

Max Marks: 25M

Answer All Questions

Q.No	Questions	Course Outcome (CO)	Knowledge Level as Per Bloom's Taxonomy	Marks
1	 a) Explain any five Casting defects with neat sketches along with their causes and remeadies. b) Explain Shell Moulding process with neat sketches. Also mention advantages, disadvantages and applications. 	CO1	Evaluating (K5)	10
2	 a) The voltage length characteristic of a direct current arc is given by V=20+40L where L is the length of arc in cm. The power source characteristic is approximated by a straight line with an open circuit voltage is 80volts and short circuit current is 1000 Amp. Determine the optimum arc length and the corresponding arc power b) Explain the types of Oxy Acetylene flames in gas welding with neat sketches. 	CO2	Evaluating (K5)	10
3	Explain Spot Welding process with neat sketches. Also mention advantages, disadvantages and applications of Resistance spot welding.	CO3	Evaluating (K5)	5

NARASARAOPET ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET DEPARTMENT OF MECHANICAL ENGINEERING II B.TECH II - SEMESTER ASSIGNMENT TEST – II. MAY- 2022

SUBJECT: Manufacturing Technology	DATE: 25-05-2022
	

Q.No.	Questions	Course Outcome (CO)	Knowledge level as per Bloom's Taxonomy	Marks
1	What is Thermit welding? Explain the process. Also list any Three advantages and limitations.	3	Applying (K3)	5
2	Which welding technology out of TIG/MIG welding uses non consumable electrode? Explain that process with neat diagram.	3	Applying (K3)	5
3	Differentiate between brazing and soldering techniques and give their applications.	3	Evaluating (K4)	5
4	Differentiate between hot working and cold working process	4	Evaluating (K4)	5
5	Explain about forging operations and its principles.	4	Applying (K3)	5

What is Thermit welding? Explain the process. Also list any Three advantages and limitations.	3	Applying (K3)	5
Which welding technology out of TIG/MIG welding uses non consumable electrode? Explain that process with neat diagram.	3	Applying (K3)	5

2	Which welding technology out of TIG/MIG welding uses non consumable electrode? Explain that process with neat diagram.	3	Applying (K3)	5
3	Differentiate between brazing and soldering techniques and give their applications:	3	Evaluating (K4)	5

3	Differentiate between brazing and soldering techniques and give their applications!	3	Evaluating (K4)	5
4	Differentiate between hot working and cold working process	4	Evaluating (K4)	5

4	Differentiate between hot working and cold working process	4	Evaluating (K4)	5
5	Explain about forging operations and its principles.	4	Applying (K3)	5

1	What is Thermit welding? Explain the process. Also list any Three advantages and limitations.	3	Applying (K3)	5
5	Explain about forging operations and its principles.	4	Applying (K3)	5

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET DEPARTMENT OF MECHANICAL ENGINEERING II B.TECH II-SEMESTER II-MID EXAMINATION, JUNE- 2022

Subject: MANUFACTURING TECHNOLOGY

Date 23-06-2022

Duration: 90 Min Section: A& B

Max Marks: 25M

Answer All Questions

Q.No	Questions	Course Outcome (CO)	Knowledge Level as Per Bloom's Taxonomy	Marks
1	Explain principle of Laser Beam Welding with neat sketch. Give its advantages, disadvantages and applications.	CO3	Evaluating (K5)	.5
62	 a) Define term Recrystallization .States its significance in metal forming b) Explain the principle of rolling with a neat sketch 	CO4	Evaluating (K5)	10
3	a) Give the classification of Extrusion process and Explain impact extrusion with a neat sketch b) Explain wire drawing with a neat sketch	CO5	Evaluating (K5)	10

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET DEPARTMENT OF MECHANICAL ENGINEERING II B.TECH II-SEMESTER II-MID EXAMINATION, JUNE- 2022

Subject: MANUFACTURING TECHNOLOGY

Date 23-06-2022

Duration: 90 Min

Max Marks: 25M

Answer All Questions

Q.No	Questions	Course Outcome (CO)	Knowledge Level as Per Bloom's Taxonomy	Marks
1	Explain principle of Laser Beam Welding with neat sketch. Give its advantages, disadvantages and applications.	CO3	Evaluating (K5)	5
2	c) Define term Recrystallization .States its significance in metal forming d) Explain the principle of rolling with a neat sketch	CO4	Evaluating (K5)	10
3	c) Give the classification of Extrusion process and Explain impact extrusion with a neat sketch d) Explain wire drawing with a neat sketch	CO5	Evaluating (K5)	10

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET (R20) 2020 BATCH II B.TECH I SEM ASSIGNMENT TEST-II MARKS - AWARD LIST NOV -2022

Branch: ME

Subject: Nanufacturing Technoly

Date: 12/4/23

			·		Tr. DVC	Q.NO.	со	MARKS	TOTAL	Reduced(5M)
	s.no.	ROLL NO.	Q.NO.	со	MARKS			10	20	ంక్
	1	21471A0301	-3(a.b)	4-13	10	-5,	4	10	20	05
Г	2	21471A0302	9 1	_3	_10	40.p)	4-4-		20	20
	3	21471A0303				Slarp	413	<u></u>	20	05
	4	21471A0304	2_	_3_	10	46.p)	414	70		A
	5	(21471A0305)		Ahur			·	10	20	05
	76	21471A0306	2	<u> 3 </u>	10	darp)	4-14	10	20	05
	7	21471A0307	2	_3_	10	5		_0_	20 -70	20
Γ	8	21471A0309	4619)	14-14-	0		3	10		70
	9	21471A0310	2	_ ?	10	5	4	-10:-	20	r
	10	21471A0311	2_		10	-2-			20	-05
	11	21471A0312	36,6)	413	10	2	-4-	10	20	20
	12	21471A0314	40,6	4-14-	10		2,	10	20	20
	13	22475A0301	300	4-13	10	5	4	10_	50	_ · .
	14	(22475A0302)		Ahir		 			7	A
f	15	22475A0303	2	3	10	yearp	414	10	50	05
	16	22475A0304	9	3	<u> </u>	(digs)	4-14-	10_	20	20_
	17	22475A0305	3(a,b)	43	10	5	1	10	20	50
	18	22475A0306	want	2-14-	10	1	-3	120-	20	0.5
-	19	22475A0307	9	, द्र '	10	2	4	10	50	50
	20	22475A0308	ulabl	11 11	10		3	10	50	05
 	21	22475A0309	a hab	with	10		_3_	10	50	-32
-	22	22475A0310	3(ab)	4.13	10	2	4	10-	50	20_
3 31	23	22475A0311	2	3	10	Hach	وبدردر	10	20	20_
F	24	22475A0312		_3_	10	(dip)	43	10	50	20_
F	25	22475A0313	Scap	14.3	10	2		10	20	02
-	26	22475A0314	9_	3	10	(daib)	414	10	20	20
┢	27	22475A0315	3(a,b)	43	10	S'	4	-0-	50	20
-	28	22475A0316	3(0,6)	0-13	10	_2_	1	10	00	50
	29	22475A0317	2	(3)	10	year	414	10	50	20
Ť	30	22475A0318	9	3	10	dipip	17-14	10	50	20_
-	31	22475A0319	8	3	io	dialis	444	10	120	7.0
上	32	2247 5 A 0320								
+	33	22475A0321	9	3	lo	5	14	10	20	-02
 	34	22475A0322	. (3	10	Nach	413	10	20	05
	35	22475A0323	1	c	10	3(a.b	1413	_ <i>Qj_</i>	20	02
F	36	22475A0324	3(a,b)	دي	10	5	<u> </u>	70	3.0	-02
	37	22475A0325		3	10	Slarp	43	10	20	05
F	38	22475A0326		3.	10	5	14	10	50	50
 	39	22475A0327		413	10	.5	1 4	10	50	05
H	40	22475A0328		1	10		13	10	20	50
ŀ	41	22475A0329	1	6	10	Haip	1 4-14	<u> </u>	20	50
 	42	22475A0330		-73	0)	3	1 4	10	20	05
ŀ	43	22475A0331		3	10	5	<u> </u>	10	20	7.07

" anch: ME

Subject: Manufacturing Technoly

Date: 12/4/23,

S.NO.	ROLL NO.	Q.NO.	CO	MARKS	Q.NO.	CO	MARKS	TOTAL	Reduced(5M)
44	22475A0332	الطيها	دي ديـ	(O	1	N	10	20	70
45	22475A0333			10	, \	C	10	30	2.0
46	22475A0334	(chorp)	-454-	10	Rab	413	10	240	20
47	22475A0335	warb	الله الله	10		3	10	ນ	70
48	22475A0336	6	31	10	5	4	10	20	20
49	22475A0337	40,61	وبات	10	1	3	10	30	05
50	22475A0338	celaib	4114	. (0)	1	3	10	50	20
51	22475A0339	2	6	10	5	4	10	20	20
52	22475A0340	warb)	4.11	10_	1	3	10	50	- 20
53	22475A0341	9_	3	10	2	4	10	20	50
54	22475A0342	3(0/2)	43	<u> </u>	2	<u> </u>	<u> al</u>	20	-02
55	22475A0343		15	10	3/21/2	4/3	10	50	20
56	22475A0344		2	10	Sair	1413	10	50	20
57	22475A0345	9	9	10	2	4	10	30	08
58	22475A0346	300	413	10	5	4	10_	20	20
59	22475A0347	9	े 3	0	(darp)	2-14	10	30	0%
60	22475A0348	1	3_	10	3(9,19)	1-13	w	50	<u>ar</u>
61	22475A0349	<u> </u>	3	10	3(aip)	4-13	10	20	02
62	22475A0350	4 (aub)	<u> </u>	10	1	3	5	15	04_
63	22475A0351	1	3	10	3kub)	4-13	10	80	0)
64	22475A0352	3(216)	43	10	2	14	, J -	17	105

Name of the Staff Member

Signature of the Staff

Signature of the HOD

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS): NARASARAOPET (R20) 2020 BATCH II B.TECH II SEM MID-I MARKS - AWARD LIST MAR -2023

Branch :	ME-A	Subject:	Mans	Laction		Technolog	կ Date:	11/03/201	٠٤٠
		со	1	2	72		Total	Reduced Total	Quiz-II
SNO.	H.T.NO.	Max.Marks	. 10	10	5		25	15	10
		Q.NO	1	2_	3				
1	21471A0301		8	<u>. lo</u>	3		21	13	03
2	21471A0302		10	ક	5		23	14-	02
3	21471A0303		O	8	_5		23	14	20
4	21471 <u>A</u> 0304		구	7	_S		19	12	09
5	21471A0305		6_	2	2_			06	A
-6	21471A0306		7	. 6			14	90	08
7	21471A0307		8	0_	0		90	0.5	10
8	21471A0309	. 1	7	2_	2			-63-	07
9	21471A0310	,	4	2_	3		12_	08	0구
1 0	21471A0311		6	2_	3			Fo	03
11	21471A0312		10_	10_	S		25	12	10
12	21471A0314	į į	6	7-	3		16	10	04
13	22475A0301		10	10	5		25	12	10
14	22475A0302		10	7	5		22	14	10
15	22475A0303		4	8	5		୍ ଥିତ	12	10
16	22475A0304		7	, 2	र		12	-08	.09.
17	22475A0305		8	િન	5	<u> </u>	୍ଥିତ	12	O
18	22475A0306		5	ેલ	3			09	10
19	22475A0307		7	. 2	4		18	11	03
20	22475A0308	4	7	D.	5		19	12	10
21	22475A0309		يو	1	eq.		13	-80-	נס
22	22475A0310		8_	2.	5		15	09	10
23	22475A0311	!	7	l	1		90	06	୍ ଚର୍
24	22475A0312		5	2	3		10	80	09
25	22475A0313		6	7	5		18	II.	0.7
26	22475A0314		7	3	5		19	12	02
27	22475A0315		17		Ī		69	06_	09
28	22475A0316	1	8	7	4		19	12-	10_
29	22475A0317		8	5	4		17	i	- 60
30	22475A0318		8	5	5	,	18	11	10
31	22475A0319		6	13			01	06	04
32	22475A0321		4	2_	4		10	06	80
33	22475A0322	- 	1	5	0		12	_8_	10

34 22475A0323 8 2 0 10 35 22475A0324 7 7 4 4 8 36 22475A0325 8 4 4 15 37 22475A0326 8 4 3 15 38 22475A0327 10 8 5 23 39 22475A0328 8 2 5 15 40 22475A0329 8 4 5 17 41 22475A0330 10 5 0 15 42 22475A0331 10 10 5 27 43 22475A0332 8 2 11	06 11 09 14 09 17 00 17 00 17 00 17 00 17 00 17 00 17 00 17 0	10 08 05 09 09 08 05 10
36 22475A0325	19 14 19 17 19 19 19 19 19 19 19 19 19 19 19 19 19	05 09 08 05 10
36 22475A0325 8 4 4 16 37 22475A0326 8 4 3 15 38 22475A0327 8 2 23 39 22475A0328 8 2 3 15 40 22475A0329 8 4 5 12 41 22475A0330 10 5 0 15 42 22475A0331 10 10 2 43 22475A0332 8 2 11	09 14 09 11 09 15 07	69 09 08 05 10
37 22475A0326 8 4 3 15 38 22475A0327 10 8 5 23 39 22475A0328 8 2 5 15 40 22475A0329 8 4 5 17 41 22475A0330 10 5 0 15 42 22475A0331 10 10 5 25 43 22475A0332 8 2 11	14 09 17 09 15 07	09 08 05 10 04
38 22475A0327 10 8 5 23 39 22475A0328 8 2 5 15 40 22475A0329 8 4 5 12 41 22475A0330 10 5 0 15 42 22475A0331 10 10 2 43 22475A0332 8 2 11	07	08 05 10 04
40 22475A0329 8 5 5 13 41 22475A0330 10 5 0 15 42 22475A0331 10 10 5 25 43 22475A0332 8 2 11	07	05
41 22475A0330 10 5 0 15 42 22475A0331 10 10 2 43 22475A0332 8 2 1	12	10
41 22475A0330 42 22475A0331 43 22475A0332	15	04-
43 22475A0332	60	, -
43 22475A0332 & 2 \ \(\)		
		20
44 22475A0333 6 A 4 1A	- 11	0.3
45 22475A0334 8 8 3 19	12_	05
46 22475A0335 2 5 U	- 11	05
47 22475A0336 4 8 0 12	08	10
48 22475A0337 10 9 5 24	15	10.
49 22475A0338 10 10 5 25	12	10
50 22475A0339 10 10 5 25	15	04
51 22475A0340 8 7 3 18	111	09
52 2247540341 8 2 0	-06_	Off
53 22475A0342 A 5 2 14	109	03
54 22475A0343 10 10 5 2.5	15	-FO
55 22475A0344 B 1 O O	0600	ÖS
56 22475A0345 10 10 3 2.3	14-	10
57 22475A0346 10 10 S 2.5	15	109
· 58 22475A0347 1D 7 5 21	14-	09
59 22475A0348 7 6 4 17	11	01
60 22475A0349 9 2 16	10	10
61 · 22475A0350 1 10 5 0	09	0೩
62 22475A0351 8 2 5 IS	09	FO
63 22475A0352 9 7 5 21	13	10

Dr.D.Sunud.
Name of the Staff Member

Signature of the HOD

Signature of the Staff Member

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS) : : NARASARAOPET (R20) 2021 BATCH II B.TECH II SEM ASSIGNMENT TEST MARKS - AWARD LIST Feb -2023

	Bran	ch : ME-A	Subje	ect: Man	ufacturin	3 Tea	<u>an</u> alosy	Date:	09/02/2	1023,	
	SNO		Q.NO.	со	MARKS	Q.NO.	со	MARKS	TOTAL MARKS (10M)	MARKS	_ 1
	1	21471A0301	<u> </u>	_	10	6	1	2_	12	03	\dashv
	2	(21471A0302) <		Ab.	Seul-					5
	3	21471A0303	5_		10	6	1	8	18	20	7
	4	21471A0304	3	1	10	5		6	16	04	1
	5	21471A0305	- 3		io	5		8	18	05	-
	6	21471A0306			10	6	1	10	20	02	-
	7	21471A0307	2		10	5	1	6	16	1	┪
	8	21471A0309	2_		10	5	1	10	20	04	\dashv
3	9	21471A0310	2	1	10	~		10	20		┨
ŀ	10	21471A0311	2_	<u> </u>	10	5	1	10	20	20	-
ŀ	11	21471A0312			10	6		10	30	20	1
ŀ	12	21471A0314		1	10	6	1	10	20	105	1
ŀ	13	22475A0301	3		10	5	1	10	20	05	-
ŀ	14	22475A0302	2_		10	5	1	10	20	55	┪
Ļ	15	22475A0303	14	1	10	-6	1	10	20	05	┪
Ļ	16	22475A0304	12	1	10	6	1	B	18	BA-05	1
-	17	22475A0305	2		10	2	1	10	20	05	שו
-	18	22475A0306	1	1	Ŕ	6	1	8	16		1
-	19	22475A0307	4	1	10	6	1	20	20	04	1
Ļ	20	22475A0308	14	i	O	6	1	10	20	20	1
\vdash	21 (22475A0309			-Abc	J.			7.0	05	
L	_22	22475A0310	2_	1	10	-5	1	10	20		
L	23	22475A0311	2	1	10	6		7		-05	
7	24	22475A0312	R	1	0/	-5-	1	8	17-	\$5	
L	25	22475A0313	__\		10	6		6	16	20	
L	26	22475A0314		i	10	6	1	10	20	20	
L	27	22475A0315	3	1	10	5	\	2	12	03	
L		22475A0316	4			est.					
Ļ	29	22475A0317			AbR	ent_					
	30	22475A0318	2_		10	2		10	20		
	31	22475A0319	1		10	6	1	10	20	05	
		22475A0321	4		ी	6	1	10	17	5	
		22475A0322	5		7	6	1	7		20	
		22475A0323	-83	1	10	5	1	2	12	03	
_		22475A0324	<u>i</u>	_	io	6	<u> </u>	4	17		
		22475A0325	- -		GI	5		4	17	25	
_	37	22475A0326	_\$_		0/	6		3_	12	05	

·										
1	38	22475A0327	1	1	10	6	1	8	18	05
7	39	22475A0328	14		10	6		8	18	05
	40	22475A0329	5		<u>+</u>	6		1	14_	04
i	41	22475A0330	<u>.</u> و		10	-		2_	12	03
	42	22475A0331	Ī	ì	10	6	1	7	,	65
	43	22475A0332	L.	1	Ü	6		9	13	1
	44	22475A0333		1	10	6	1	6	13	04
[45	22475A0334	4	1	Ö	6	\	7	13.	04
Į	46	22475A0335	d.	1	10	6		10	20	02
Į	47	22475A0336	ý	1	10	-	1	10	20	20
	48	22475A0337	2	1	10	5		10	20	07
	49	22475A0338	ii	1	10	6		-	15	
L	50	22475A0339	2	\	10	5	1	10	20	04
	51	22475A0340	5	(10	2	1 7	-10	20.	20
	52	22475A0341	5	١	10	0	1	10	20.	20
	53	22475A0342	2_	1	50	6	\	10	20	1 1
•	54	22475A0343	وكر	ŀ	ol.	-	1	9	19	05
	55	22475A0344	5	1	t)	6	1	4	14	_04-
L	56	22475A0345	7	1	2	6		8	100	7
	57	22475A0346	1	_ \	10	Ĝ	1	10	20.	20
L	58	22475A0347	5	\	10	-6	1	10	20	
L	59	22475A0348		1	01	6	1	<u> </u>	17.	05
L	60	22475A0349	5	\	8	6		8	16.	04
L	61	22475A0350	نكر		8	5	1	#	12	04
L	62	22475A0351			10	6	<u>;</u>	10	20	70
L	63	22475A0352	et	i	O)	6	1	9	19	05

Dr.D. Simul.
Name of the Staff Member

Signature of the Staff Member

Signature of the HOD

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS) : NARASARAOPET (R20) 2020 BATCH II B.TECH II SEM MID-II MARKS - AWARD LIST MAY -2023

2. /g	Branch :	ME-A	Subject:	Manu	factury	Techn	aley	 Date:	3/5/202	<u>کی </u>
ŵ.		Style Style Style	co	C03	604	COS		Total	Reduced Total	Quiz-II
		H.T.NO.	Max.Marks	05	21.0	1.0		25	15	10
	a to see the c	S. M. S.	Q.NO	1	Ŋ	M				
-	1. 3	21471A0301		04	40	50		18	1.1	09
, ;	2	(21471A0302)	<u> </u>			becet		 	A	-06_
* 1	3	21471A0303	6.	04	02_	02		 80	05	<u>09</u>
	4	21471A0304		_01	02	02_		 20	03	10
	5,4	21471A0305	1	01	02_	62		20	03	20
(10) (10)	6	21471A0306	<u> </u>	01	01	01		03	OB	
3 V	The s	21471A0307	1	01	02	0		04	02	90
_	8 *	21471A0309		05	02	00		<u>F0</u>	20	LO_
	9	21471A0310		05	- 02_	00		 40	05	10
	10	21471A0311		05	-DE	60		 09	06	10
	11	21471A0312		05	10	Į0		 28	.15	0
	12	21471A0314		20	90	00		 14	69	10
	13	22475A0301	!	05	10	10		28	15	10
,	14	22475A0302		7.0	-FO	60		19	12_	10
	15	22475A0303	sl	20	-Fo	63		15	69	10
	16	22475A0304		-02	80	20		 18	11,	20
	17	22475A0305		05	-80	10		 83	14	10
ر. د دی	18	22475A0306		05	10	(O)		82	12	
	19	22475A0307		20_	10	10		 35	15	-40
	20	22475A0308		20	10	-01		25	15	09
•	21	22475A0309		53	10	~ 10		26	12	09
	22	22475A0310		03	-08	10		81	13	10
	23.	22475A0311	Į	04	60	80		19	12	10
	24	22475A0312	1	05	G	01		12	09	lo
	25	22475A0313	1	04-	50	40		18	",	10
	26	22475A0314		05	60	67		19	12	909
	27	22475A0315	İ	20	60	80		80	12	80
	28	22475A0316		7.0	-50	07		19	\2	90
	29	22475A0317		20	50	08		20	12_	03
	30	22475A0318		03	50	-80		<u> 8</u>	11.	90
	31	22475A0319	:	0.5	06	50		_18	11	10
	32	22475A0321		CA-	80	06		×18	ii.	90
	33	22475A0322		20	07	04		 14_	69	10

		t I							
34	22475A0323		04-	60	60		18	[]	10
35	22475A0324		04	68	<i>6</i> 8		રીજ	10_	05
36	22475A0325	ł	04-	ľO	69		23	14_	10
37 38	22475A0326		02	80	65		13	11	68
38	22475A0327		02	67	80		 13	11	08
39	22475A0328		7.0	6 9	67		21	13	10
40	22475A0329		20	100	69	, s	 28	14-	04
41	22475A0330		20	02_	03		 14-	09	09
42	22475A0331		05	10	10		25	12	<u>७</u> १
43	22475A0332	*-	05	a	08		23	14-	09
44	22475A0333	i	20	-50	06		18	11	-08
45	22475A0334		03	0ने	06		16	اما	10
46	22475A0335	1	02	20	05		12	89	90
47	22475A0336		05	68	02		15	09	109
48	22475A0337	•	05	0 -] -	-88		 ag	12	10
, 49	22475A0338		20_	-80	80		19	19	10
50	22475A0339		05	10	F0		83	14-	10
50 51	22475A0340		04	68	10		88	14	80
(· · · · · · · · · · · · · · · · · · ·	22475A0341		20	90	09		23	14	80
53 54	22475A0342		-05	03	FB		 19	15	90
54	22475A0343		05	80	FO .		20	12	w
55	22475A0344		03_	.07	20		15	09	90
56	22475A0345		20_	(0)	29		84	15	10
57	22475A0346		7.0_	10	80		23	14-	90
58	22475A0347		05	10	10	ļ	25	15	59
59	22475A0348		63	-08	100		30	12	09
60	22475A0349		04	10	6		AR	15	109
61	22475A0350	•	20	80	03		 16	10	90
62	22475A0351		20	82	-50		20	12	o
63	22475A0352	· 	04	<u> </u>	80		132	14	10

Name of the Staff Member

Signature of the Staff Member

Signature of the HOD

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS) : : NARASARAOPET

(R20) 2020 BATCH I B.TECH II SEM I MID MARKS - AWARD LIST APRIL-2022

Branch : ME-A

Branch:	I.IE.A		,		<u></u>
SNO.	H.T.NO.	TOTAL MARKS (25M)	REDUCED TO (15M)	OBJECTIVE (10M)	TOTAL (25M)
1	20471A0301	14	9	8	17
2	20471A0302	15	9	6	15
3	20471A0303	5	3	4	7
4	20471A0304	5	3	9	12
5	20471A0305	0	0	4	4
6	20471A0306	5	3	4	7
7	20471A0307	7	5	5	10
8	20471A0308	7	5	10	15
9	20471A0309	8	5	8	13
10	20471A0310	12	8	5	13
11	20471A0311	1	1	АВ	1
12	20471A0312	10	6	6	12
13	20471A0313	5	3	2	5
14	20471A0314	1	1	3	4
15	20471A0315	11	7	7	14
16	20471A0317	1	1	4	5
17	20471A0318	8	5	6	11
18	20471A0319	3	2	3	5
19	20471A0320	20	12	7	19
20	20471A0321	6	4	4	8
21	20471A0323	7	5	5	10
22	20471A0324	4	3	7	10
23	20471A0325	7	5	8	13
24	20471A0326	3	2	10	12
25	20471A0327	19	12	6	18
26	20471A0328	6	4	1	5
27	20471A0329	10	6	7	13
28	20471A0330	3	2	3	5
29	20471A0331	5	3	5	8
30	20471A0332	5	3	5	8
31	20471A0333	18	11	6	17

36	20471A0339					AB				
37	20471A0341	1	3	5	2	3	5	10	5	
38	20471A0342	4	4	5	5	4	5	10	5	
39	20471A0343	1	3	4	5	4	4	8	4	
40	20471A0344	2	3	5	3	3	5	10	5	
41	20471A0345	4	4	4	5	4	4	8	4	
42	20471A0346	2	3	5	3	3	5	10	5	
43	20471A0347		AB							
44	20471A0348	2	3	5	1	3	5	10	5	
45	20471A0349	1	3	5	2	3	5	10	5	
46	20471A0350	1	3	5	5	4	5	10	5	
47	20471A0351	1	3	5	5	4	5	10	5	
48	20471A0352	4	4	4	5	4	4	8	4	
49	20471A0353	3	3	4	4	4	4	8	4	
50	20471A0354					AB				
51	20471A0356	4	4	5	5	4	5	10	5	

K. John Baby Name of the Staff Member

Signature of the Staff Membe

Signature of the HOD

Branch :	: ME-B	Subject	t: <u> M</u>				Date: 3	0/3/2099
SNO.	H.T.NO.	Q.NO.	со	MARKS	Q.NO.	со	MARKS	TOTAL MARKS (5M)
31	21475A0311	જ	1	2	3	1	ನಿ	7
32	21475A0312	ŋ	1	8.5	4	1	a,5	5
33	21475A0313	_ ଶ୍	1	2.5	3	1	२.८	67
34	21475A0314) t/		0	3	1	0	0
35	21475A0315	5	1	なら	6	1	8.5	5
36	21475A0316	5	1	1	6	İ	24	3.
37	21475A0317	5	1	2.6	6	1	2.5	5
38	21475A0318	1	1	2.5	6	1	2.5	5
39	21475A0319	1	1	2.5	6	1	25	5
40	21475A0320	1	1	2.5	6	1	2.5	.5
41	21475A0321	_4	1	N.	5	١	24	Ч
42	21475A0322	1	1	2.5	6	1	2.5	5
3 43	21475A0323	1	1	2-5	2	1	2.5	5
44	21475A0324		1	2.5	2	1	2.5	8
45	21475A0325	3	1	2	4	_ 1	2_	4
46	21475A0326	4	1	1	_ 5	1	2_	3,
47	21475A0327	1	1	2.5	2	1	2.5	5
48	21475A0328	1	1	2.5	2	1	2.5	3
49	21475A0329		1	4	2_	1	2	3
50	21475A0330	5	1	2.5	6	1	2.5	5
51	21475A0331	3	1	2.5	4	1	૨ -૪	5
52	21475A0332	5_	1	a.5	6	1	2.5	5
53	21475A0333	3	1	ब • 5	4	١	2.5	5
54	21475A0334	3	1	2	И	1	2_	4
55	21475A0335	4	\	1	5	1		2

Name of the Staff Member

Signature of the HOD



DEPARTMENT OF MECHANICAL ENGINEERING

UNIT WISE IMPORTANT QUESTIONS

In unit (second Halt of I unit) - 5 Marks Questions.

- i) hive the differences between TIG & MIG welding.
- 2) what are the differences between soldering & Brazing.
- 3) what are the advantases, disadvantases and applications of IV unit Laser beam welding?
 - 1) Distinguish between Hot working & cold working 5M.
 - 2) Explain Various Sheet metal working Operations 10 M with neat sketches.
 - 3) Explain the Brinciple of rolling with a neat Sketch -5M
 - 4) what are different rolling Stand arrangements. -5M.

 Draw neat sketches also.

V unit

- i) Give the Classification of Extrusion Process and explain Impact Extrusion with a neat sketch.
- 2) Explain wive drawing with a neat Sketch.



DEPARTMENT OF MECHANICAL ENGINEERING

PREVIOUS QUESTION PAPERS

II B. Tech II Semester Regular Examinations, July-2022

Sub Code: R20ME2203

MANUFACTURING TECHNOLOGY

Time: 3 hours

(ME)

Max. Marks: 70

Note: Answer All FIVE Questions.
All Questions Carry Equal Marks (5 X 14 = 70M)

O NI -	All Questions Carry Equal Marks (5 X 14 = 70M)		·	1								
Q.No	Questions	KL	CO	Marks								
	UNIT-I		_									
	i)Why is it important to provide a means of venting gases from the mold cavity.	КЗ	CO1	[7]								
1	ii)What are the different types of patterns. Explain with neat sketch	K2	CO1	[7]								
	OR	-1	·	<u> </u>								
	I) Explain the centrifugal casting process with a neat sketch	K2	CO1	[7]								
	b ii)What are the advantages, limitation and applications of investment casting.	K2	CO1	[7]								
•	UNIT-II											
	i)Describe the oxy-acetylene gas welding technique and give the applications.	K2	CO2	[7]								
∵ -	 ii)What are the kinds of joints that are normally employed for welding processes. Give their sketches. 	K2	CO2	[7]								
2	OR											
•	i)What is arc blow. What are the measures to be taken to avoid arc blow.	K2	CO2	[7]								
	ii)Categorize in detail welding defects and their causes and remedies.	K2	CO2	[7]								
	UNIT-III	,										
	i)Why is cleaning of metal important for successful resistance welding. Explain.	K3	CO3	[7]								
	ii)What is meant by edge preparation. Show neat sketches of various edge preparations.	K2	CO3	[7]								
3	OR		·—	,								
	b 1)Discuss the TIG welding process and its applications.	K2	CO3	[7]								
	ii) With sketch, explain the laser beam welding process . Mention advantages and limitation of laser welding also give application.	K2	CO3	[7]								
	UNIT-IV											
	i)Write a note on (a) Strain hardening (b) Recrystallization.	K2	CO4	[7]								
4	a ii)What are the main characteristics of hot working as compared with cold working Process.	КЗ	CO4	[7]								
•	OR	·										
	i)Explain the concept of theory of rolling.	K2	CO4	[7]								
	ii)Explain the various forging operations and list the forging defects.	_K2	CO4	[7]								
	UNIT-V		<u></u>									
	i)With a neat sketch, explain hydrostatic extrusion.	K2	CO5	[7]								
F	a ii)Write a note on impact extrusion and list the advantages of impact extrusion over other extrusion processes.	K2 .	CO5	[7]								
5	OR											
	i)Illustrate wire drawing and Tube drawing.	K2	CO5	[7]								
	ii)Distinguish between bending and drawing in sheet-metal operations.	K2	CO5	[7]								



Narasaraopeta Engineering College (Autonomous)

Kotappakonda Road, Yellamanda (P.O), Narasaraopet- 522601, Guntur District, AP.

Subject Code: R16ME2205

II B.Tech II Semester Regular Examinations, April-2018. MANUFACTURING TECHNOLOGY (ME)

Time: 3 hours

Max Marks: 60

Question Paper Consists of Part-A and Part-B.

Answering the question in Part-A is Compulsory & Four Questions should be answered from Part-B
All questions carry equal marks of 12.

PART-A

- (a) Write few applications of Casting process
 (b) Define the terms Casting yield and Chill
 (c) What is flux? Why it is essential to use in some welding situations?
 (d) What are the materials used for making Resistance Welding Electrodes?
 (e) List the applications of Forging.
 - (f) What is the difference between bloom and billet?

[2+2+2+2+2+2]

PART-B

	4 X 12 = 48	
2. (a) What is Pattern Allowance? Explain various pattern allowances		[6]
(b) Explain the effect of Ingredients of Moulding sand on the Properties of Mould		[6]
3. (a) Explain Investment Casting method with a suitable sketch		[6]
(b) What are the design considerations of a gating system for Casting?		[6]
4. (a) Describe the Principle of Oxy-fuel gas cutting		[6]
(b) Explain different Welding defects with their Causes and Remedies		[6]
5. (a) What is submerged Arc Welding? Explain with a neat diagram		[6]
(b) Define Resistance welding. Write about Resistance Butt welding		[6]
6. (a) Explain various types of Rolling Mills with suitable diagrams		[6]
(b) Differentiate between hot working and Cold working.		[6]
7. (a) Explain with sketches the Direct and indirect extrusion Processes		[6]
(b) Write about Wire drawing Method in detail.		[6]

II B. Tech II Semester Regular/Supplementary Examinations, April/May-2017 PRODUCTION TECHNOLOGY

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (Part-A and Part-B)

2. Answer ALL the question in Part-A

3. Answer any THREE Questions from Part-B

PART -A

- 1. a) List the basic ingredients of moulding sand and their purpose
 - b) Explain the term weld ability. Give two examples of wieldable metals/alloys
 - c) Define the term forge ability and state the commonly used test for its assessment
 - d) What are the advantages of special casting processes over sand casting process?
 - e) Differentiate between cold working and hot working
 - f) Differentiate between oxy-acetylene and air-acetylene welding (3M+4M+4M+4M+4M+3M)

PART -B

- 2. a) What are the functions of gating and rise ring?
 - b) Describe various materials used for making patterns. What are its merits and demerits
 - c) What are the basic requirements of core sand? How does it differ from the moulding sand?

(5M+6M+5M)

- 3. Explain in detail various process steps in investment casting process giving process details, process capabilities and their applications (16M)
- 4. a) Give a brief account of classification of welding processes?
 - b) Explain TIG welding process variables and enumerate its advantages

(6M+10M)

- 5. Describe in detail any two resistance welding processes with neat sketches their advantages, disadvantages and applications (16M)
- 6. a) Describe the principle of rolling. Write the various kinds of rolling mills along with their applications
 - b) What are the types of power hammers available and explain the pneumatic hammer with a neat sketch

(8M+8M)

- 7. a) What is springback effect in metal beading? Explain.
 - b) Explain blow moulding process with help of sketches

(6M+10M)

WWW.MANARESULTS.CO.IN

]"]""]["[[[

II B. Tech II Semester Regular/Supplementary Examinations, April/May-2017 PRODUCTION TECHNOLOGY

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (Part-A and Part-B)

2. Answer ALL the question in Part-A

3. Answer any THREE Questions from Part-B

PART -A

- 1. a) Differentiate between casting and pattern
 - b) Differentiate between brazing and braze welding
 - c) Define the term spring back
 - d) How hot working is predicted in terms of stress strain in formability
 - e) Discuss in brief open die and closed die forging
 - f) Explain about stretch forming.

(4M+4M+3M+4M+4M+3M)

PART -B.

- 2. a) Classify the types of patterns and sketch any three of them
 - b) What is core and explain how to make a core?

(8M+8M)

- 3. Explain in detail various process steps in investment casting process giving process details, process capabilities and their applications (16M)
- 4. a) Describe metal inert Gas arc welding process with a neat sketch.
 - b) Briefly explain on butt welding process

(8M+8M)

5. Discuss in detail plasma welding and laser welding. Also list their applications.

(16M)

- 6. Explain with sketches impact extrusion and hydrostatic extrusion. Also list out product applications of each process (16M)
- 7. a) Explain the transfer moulding process
 - b) Why screw injection moulding machine is better than a ram type injection moulding machine? (6M+10M)

1 of 1

WWW.MANARESULTS.CO.IN

|"|"||"||"|||<u>|</u>

Code No: RT22033

R13

SET - 1

II B. Tech II Semester Regular Examinations, April/May - 2016 PRODUCTION TECHNOLOGY

(Mechanical Engineering)

Note: 1. Question Paper consists of two parts (Part-A and Part-B)

Time: 3 hours

Max. Marks: 70

		2. Answer ALL the question in Part-A 3. Answer any THREE Questions from Part-B	
		PART -A	
1.	a)b)c)d)e)f)	What are the required properties of good molding sand? Explain solidification of pure metals in casting. List the advantages and disadvantages of gas welding. Define soldering and name the types of soldering operations. Give the causes and remedies of rolling defects. What is spring back effect? How to prevent it? PART -B	(4M) (3M) (4M) (4M) (4M) (3M)
2.	a) b)	Define gating ratio and differentiate between pressurized and un-pressurized gating systems. List out and explain various pattern allowances with sketches.	(8M) (8M)
3.	a) b)	Explain cupola furnace with neat sketch and give the reactions takes place at different stages of the furnace. What will be the solidification time for a 1200 mm diameter and 33 mm thick casting of aluminum if the mould constant is 2.2 sec/mm ² ?	(10M) (6M)
4.	a) b)	Explain the characteristics of welding joints. The arc length characteristic of a D.C arc is given by V=24+4L, where V is the voltage in volts and L is arc length in mm. The static volt-ampere characteristic of the power source is approximated by a straight line with a no load voltage of 80 V and a short circuit current of 600 A.	(7M) (9M)
5.	a) b)	Explain the design guidelines of welded joints. What is brazing? Explain the types of brazing with applications.	(8M) (8M)
6.	a) b)	What is strain hardening? Explain its mechanism. What's extrusion? Discuss the types of extrusion with sketch. Also list the advantages, limitations and application of each type of extrusion process.	(6M) (10M)
7.	a)	What are thermoplastic materials? How do they differ from thermosetting plastics?	(8M) (8M)

1 of 1

WWW.MANARESULTS.CO.IN

b) Explain Stretch forming and hydro forming operation with neat sketch mentioning

their applications.

II B. Tech II Semester Regular Examinations, April/May – 2016 PRODUCTION TECHNOLOGY

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Note: 1. Question Paper consists of two parts (Part-A and Part-B)
2. Answer ALL the question in Part-A
3. Answer any THREE Questions from Part-B

PART –A

1.	a) b)	Discuss briefly the influence of molding sand on sand properties. Give the causes and remedies for the following casting defects: i. Blow hole ii. Misrun	(4M) (4M)
	c) d) e) f)	What is neutral flame? Give the reactions and applications of it. What is brazing? Give the applications of brazing. Give the causes and remedies of forging defects. Explain the following operations i. Nibbling ii. Perforating and iii. Trimming	(4M) (4M) (3M) (3M)
2.	a) b)	Grey Cast Iron block of size 200x100x10 cubic cm is to be cast in a sand mould. Shrinkage allowance for pattern making is 2 %. Find the ratio of volume of the pattern to the volume of the casting. Also for the same problem, find the ratio if the block is steel. Give your comment on the problem. List out and explain various pattern materials with applications.	(9M) (7M)
3.	a)	Briefly explain investment casting with neat sketch. Also give its limitations and	(8M)
	•	applications. Compare the solidification times for castings of three different shapes of same volume: Cube, cylindrical (with h=d) and spherical.	(8M)
4.	a) b)	List the advantages and limitations of D.C and A.C power sources in arc welding. How to designate an electrode? Explain in detail.	(8M) (8M)
5.	a) b)	List out and explain the causes and remedies for welding defects. Explain the principle, limitations and applications of explosive welding.	(8M) (8M)
6.	a)	technique. Give the advantages, limitations and applications of powder metallurgy	(10M)
	b)	technique. Enumerate the differences between hot working and cold working processes.	(6M)
7.	a) b)	1. The state of th	(8M) (8M)

WWW.MANARESULTS.CO.IN

II B. Tech II Semester Regular Examinations, May/June - 2015 PRODUCTION TECHNOLOGY (Comm. to ME,AME)

Tim	e· 3 l	nours · Ma	x. Marks: 70
		Note: 1. Question Paper consists of two parts (Part-A and Part-B) 2. Answer ALL the question in Part-A 3. Answer any THREE Questions from Part-B	
		PART -A	
1	a)	List of different types of pattern used for casting?	(3M)
	b)	What is the function of risers in casting?	(4M)
	c)	Classify the welding processes?	(4M)
	d)	Define the term weldability with example?	(4M)
	e)	Explain hot working process?	(4M)
	f)	Define the process of blanking with a neat sketch?	(3M)
	,	PART -B	
2	a)	Give in detail the flow chart followed in preparation of sand casting?	(8M)
_	b)	Define gating ratio? Illustrate the steps involved in designing a gating system	1? (8M)
3	a)	Define freezing ratio. Calculate the pouring time required for complete fillin of mould?	
	b)	Calculate the size of a cylindrical riser(height and diameter equal) necessary feed a steel slab casting 25 x 25 x 5cm with a side riser, casting poured horizontally in the mould. Use caine's equation and take constants a=0.1, b=0.03, c=1.0	to (8M)
4	a)	Define welding. What are different welding joints and their characteristics?	(8M)
_	b)	List out the advantages, limitations and applications of welding?	(8M)
5	a)	With neat sketch explain explosive welding and electron beam welding.	(8M)
J	b)	What are the destructive and nondestructive methods of testing the welded joints with examples?	(8M)
6	a)	Explain briefly the mechanism of plastic deformation in metals and alloys?	(8M)
	b)	c and a rolling process	(8M)
-		in which presses can be classified? Explain one	(8M)
7	a) b)	press work in detail.	ss. (8M)
		www.manaresttts.co.in	

'II B. Tech II Semester Regular Examinations, May/June - 2015 PRODUCTION TECHNOLOGY (Comm. to ME, AME)

		(Comm. to ME, AME)	Iax. Marks: 70
Tim	ie: 3 l	nouis	lax. Marks: 70
		Note: 1. Question Paper consists of two parts (Part-A and Part-B) 2. Answer ALL the question in Part-A 3. Answer any THREE Questions from Part-B	
		PART -A	
1	a)	List out materials used for pattern making.	(3M)
	b)	Illustrate with example the functioning of core prints in casting process.	(4M)
	c)	What are different types of flames?	(4M)
	d)	What are the defects in welding?	(4M)
	e)	Explain extrusion process?	(4M)
	f)	Define the process of coining?	(3M)
		PART -B	
2	a)	How many types of patterns are there? Explain them with neat sketches.	(M8)
	b)	Define gating ratio? Illustrate the steps involved in designing a gating syste	em. (8M)
3	a)	With neat sketch explain the principle and working of cupola furnace.	(8M)
	b)	Illustrate with example the solidification process of pure metals and alloys.	. (8M)
4	a)	Describe in detail all the types of arc welding with figures.	(8M)
	b)	List out the advantages, limitations and applications of welding.	(8M)
5	a)	Explain different types of resistant welding. Explain with neat sketch any	one (8M)
	b)	type! What are the destructive and nondestructive methods of testing the welded joints with examples?	(8M)
6	a)	Distinguish between hot working and cold working processes with suitable	e (8M)
	b)	examples and figures. What is meant by bulk deformation? Explain different types of forgings we neat sketches.	vith (8M)
7	a)	Derive an expression for forces and power required for piercing process.	(8M)
	b)	and the second managing methods of plastics	(8M)

1 of 1

WWW.MANARESULTS.CO.IN



DEPARTMEMNT OF MECHANICAL ENGINEERING (R20) 2020 BATCH II B.TECH II SEMESTER RESULTS AFTER REVALUATION JULY - 2022

BRANCH: ME

anch / s	s SubCode							SECTION-B
	Subject Wise		Regtd.	Attnd.	Pass	Fail	Pass %	Engulfre Name
	R20CC2201	TECHNICAL AND COMMUNICATIVE ENGLISH - III				 	1 433 70,	Faculty Name
	R20CC2202	COMPLEX VARIABLES PROBABILITY AND STATISTICS	54	54	54	<u> </u>	100 00	A.Aparna
	R20ME2203	MANUFACTURING TECHNOLOGY	54	54	54	ø	100.00	Dr.N. Ravi Babu
	<u> R20ME2204 </u>	APPLIED THERMODYNAMICS	54	54	54	0	100.00	Dr.M.Sreenivása Kumar
	R20ME2205	KINEMATICS OF MACHINERY	54	54	52	2	96.30	P.Sravani
	R20ME22L1	MACHINE DRAWING LAB	54	54	52	3	96.30	T.Ashok Kumar
	R20ME22L2	APPLIED THERMODYNAMICS LAR	54	54	53	1	98.15	A.Pavan Kumar
]	RZ0ME21L2	MANUFACTURING TECHNOLOGY LAD	54	54	54	0	100.00	R.Chinna Rao
	_ KZUME22L3	METROLOGY AND INSTRUMENTATION LAB	54	54	54	0		T. Ashok Kumar
	R20ME22SC1	COMPUTER AIDED ENGINEERING LAB	54	54	54	0		T.Ashok Kumar
			54	54	54	0		P.Sravani

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS) :: NARASARAOPET (R16) 17 BATCH II B.TECH II SEMESTER EXAMINATIONS APRIL, / MAY 2019 - RESULT ANALYSIS AFTER REVALUATION

Branch : II B.TECH II SEM ME - A SECTION

ch/Se	Subject Code	Subject Name	Regtd.	Attnd.	Pass	Fail	Pass %	
:h : I	CI B.TECH II SE	EM ME - A SECTION	52	51		23	54.9	Faculty Name
		Subject wise	Regtd.	Attnd.	Pass	Fail	Pass %	
	R16CC2201	BUSINESS MANAGEMENT CONCEPTS FOR ENGINEERS	52	52	52	0	100	T.MALLIKHAJUNA RAO
	R16CC22MNC1	QUANTITATIVE APTITUDE AND REASONING-I (NON-CREDIT MANADATORY COURSE)	52	52	52	Ø	100	M.PAVAN KUMAR
	R16ME2202	THEORY OF MACHINES-I	52	52	46	6	88.46	T.ASHOK KUMAR
	R16ME2203	APPLIED THERMODYNAMICS	52	52	29	23	55.77	J.pavanu sai
	R16ME2204	HYDRAULIC MACHINERY AND PNEUMATIC SYSTEMS	52	52	49	3		M.VENKANNA BABU
	R16ME2205	MANUFACTURING TECHNOLOGY	52	51	46	5,		P.SURESH BABU
	R16ME22L1	APPLIED THERMODYNAMICS LAB	52	52	52	0	100	J.pavanu sai
	R16ME22L2	MANUFACTURING TECHNOLOGY LAB	52	52	52	0		T.ASHOK KUMAR
F	R16ME22L3 FM AND HM LAB		52	52	52	0		M.VENKANNA BABU
F	R16ME22MPW	MINI PROJECT-I	52	52	52	ø	. 100	CH.SEKHAR

NARASARAOPETA ENGINEERING COLLEGE (AUTONOMOUS) :: NARASARAOPET

(R16) 17 BATCH II B.TECH II SEMESTER EXAMINATIONS APRIL / MAY 2019 - RESULT ANALYSIS

AFTER REVALUATION

Branch : II B.TECH II SEM ME - B SECTION

O Subject Cod		Regtd.	Attnd.	Pass	Fail	Pass %	
ch : II B.TECH II	SEM ME - B SECTION	51	51	34	17	66:67	Faculty Name
	Subject wise	Regtd.	Attnd.	Pass	Fail	Pass %	
R16CC2201	BUSINESS MANAGEMENT CONCEPTS FOR ENGINEERS	51	51	51	0	100	DR.Y.SIVA REDDY
R16CC22MNC1	QUANTITATIVE APTITUDE AND REASONING-I (NON-CREDIT MANADATORY COURSE)	51	51	51	0	100	M.PAVAN KUMAR
R16ME2202	THEORY OF MACHINES-I	51	51:	43	<i>l</i> ≥ 8	84.31	CH. SEKHAR
R16ME2203	APPLIED THERMODYNAMICS	51	51	37	14	72.55	J.PAVANU SÄI
R16ME2204	HYDRAULIC MACHINERY AND PNEUMATIC SYSTEMS	51	51	48	3	94.12	P.KRISHNA SUDHAKAR
R16ME2205	MANUFACTURING TECHNOLOGY	51	51,	50 1	1	98.04	P.SURESH BABU
R16ME22L1	APPLIED THERMODYNAMICS LAB	51	51	51,	0	100	J.PAVANU SAI
R16ME22L2	MANUFACTURING TECHNOLOGY LAB	51	51	51	0	100	CH.SEKHAR
R16ME22L3	FM AND HM LAB	51	51	51	0	100	P.KRISHNA SUDHAKAR
R16ME22MPW	MINI PROJECT-I	51	51	51	0	100	CH.SEKHAR



(R20) 2021 BATCH II B.TECH II SEM - REGULAR RESULTS - AFTER REVALUATION - MAY - 2023

BRANCH: ME

Branch / sec E11 : Overall	SubCode	SubName	Regtd.	Attnd.	Pass	Fail	Pass %	T # 1
			63	63				Faculty Name
E11 : Subject	<u>Wis</u> e		 	- 65	55	8	87.30	
	R20CC2201	TECHNICAL AND COMMUNICATIVE ENGLISH -	——————————————————————————————————————	63	61 1		96.83	Mr.A.Venu Gopal
	R20CC2202	COMPLEX VARIABLES PROBABILITY AND STATISTICS	63	63	 59	4	93.65	A. Aparna
	R20ME2203	MÁNUFACTURING TECHNOLOGY	63	63	61	- 2		
	<u> </u>	APPLIED THERMODYNAMICS	63	63				Dr. D. Suneel
ļ	R20ME2205	KINEMATICS OF MACHINERY		`	55	8	87.30	K.Johan Babu
	R20ME22L1		63	63	62	1]	98.41	T.Ashok kumar
	R20ME22L2	MACHINE DRAWING LAB	63	63	63	0	100.00	R.Chinna Rao / T.N.V.Mahesh Babu
		APPLIED THERMODYNAMICS LAB	63	63	63	0		Y.Suvarna Kumar/A.Pavan Kumar
	R20ME22L3	MANUFACTURING TECHNOLOGY LAB	63	63	63	a		
	R20ME22SC1	COMPUTER AIDED ENGINEERING LAB		 -			100.00	Dr.M.Sreenivasa Kumar/ T.Ashok Ku
	-	THE THE THE LABOR LAB	63	63	63	0	100.00	D.Raghavendra/ B.Ajay Kumar



DEPARTMENNT OF MECHANICAL ENGINEERING (R20) 2020 BATCH II B.TECH II SEMESTER RESULTS AFTER REVALUATION JULY - 2022

BRANCH: ME

SECTION-A

nch / s SubCode subName ME20 : Sübject Wise	Regtd.	Attnd.	Pass	Fail	Pass %	Food to the
· · · · · · · · · · · · · · · · · · ·					F 433 78	Faculty Name
R20CC2201 TECHNICAL AND COMMUNICATIVE ENGLISH - II	52	52	51	 	00.00	
R20CC2202 COMPLEX VARIABLES PROBABILITY AND STATISTICS	52			<u> </u>		A. Venugopal
R20ME2203 MANUFACTURING TECHNOLOGY		50	50	ğ	100.00	Dr.N. Ravi Babu
R20ME2204 APPLIED THERMODYNAMICS	52	52	51	1		Dr.D.Suneel
R20ME2205 KINEMATICS OF MACHINERY	52	51	50	1.		Dr. Babu.R
R20ME22L1 MACHINE DRAWING LAB	52	51	48	3		M.Venkanna Babu
R20ME22L2 APPLIED THERMODYNAMICS LAB	52	52	52	Ø	100 00	T.Devarajulu Reddy
R20ME2112 MANUFACTURATE THERMODYNAMICS LAB	52	52	52	e	100.00	CH.Sekhar
R20ME21L2 MANUFACTURING TECHNOLOGY LAB	52	52	52	0		
R20ME22L3 METROLOGY AND INSTRUMENTATION LAB	52	52	52			.M.D.Taju
R20ME22SC1 COMPUTER AIDED ENGINEERING LAB	52	52		0		T.Ashok Kumar
			52	0	100.00	Mr.M.Srinivasa Rao

CONTROLLER OF EXAMINATIONS

HIEF CONTROLLER OF EXAMINATIONS



DEPARTMENT OF MECHANICAL ENGINEERING

CO-POs & CO-PSOs ATTAINMENT

C		Course Name: MANUFACTURING TECHNOLOGY															Year/Sem: II/II							
Adda, X. Sum.				External Examination Assessment																				
				Aprel	1	1	-1	2 =	2	2	2	3		3	3	3 3	4	4	7 3 4	4	5 6000	-1.	· 1000000 c	
_	Q:No	ta de la compa	x	<u></u> a.,	- FEE	₩b.	ta i	a		T I)	Boon.	a		b 🔻		5 a		-b	1 000004	a`		5 5 b	
#0.110#	COs		j.	ii							ii		ii			i,	#ii#		ž Sii				ii.	
32 Vince	Max: Marl				2075.						П		III		*III		¥ IV.	IV	_		V	V	V	
1	Separation of the separation o			See TRIAL	7****			7 🔻	7,40° 1 Annie 2	_		7	7	7.	7	7	^当 逢7.	7	<u>.</u>	7	7	7	7	
2		+	-	╁	$\frac{17}{3}$	-	$\frac{6}{4}$, -	_	5	6	5	<u> . 5</u>	<u> </u>	<u> </u>							5	4	
3		┼──	5	1 4		' +-		_	3 4			3	[_3_	<u> </u>	<u> </u>	3	4				3		 	
4			5	5	-	╁			$\frac{7}{3}$		_	4	 _	5	4	4	3	<u> </u>	 	4	4			
_5				1	╁╴	1	-		2	┰		-4	3	2.	 ,	4	3	<u> </u>	 	3	4			
6		$oxed{\Box}$			$oxed{T}$		<u> </u>			2	3		 	2.	$\frac{1}{2}$	 -	├	1 2	2	—	<u> </u>			
7			7	5		\perp		5 (5	\neg		6	6	 _	-	7	7	3	3	 _	_	3	3	
<u>8</u> 9	<u> </u>	 	7	6	<u> </u>			 :	5					5	5	一	 	 	┼─	5	5	<u> </u>	<u> </u>	
10		 	4	4	┼	\bot	4			\Box				4	4			4	4	 	-	4	4	
11		╂──┤	6	3	┼	-	1 3				\prod	4	4			5	5	Ė	广	4	5	-7	-4	
12		├─┤	2	3	┼-	+-	+-7	' 6	-	_	_	6	7							7	7			
3		 	$\frac{2}{7}$	7	+-	╁	- 6	1 7		5	3	<u>_</u>		4_	3			4	3			4	3	
14		 	İ	ΙŤ	3	+4		+-		+	3	6	7_					7	7					
15			5	4	Ť	 	5	+3		╁	3.	4	4	4	4	_2_	3		<u> </u>	4	4			
16			6	6		\vdash	6		 -	┰	<u></u>	╌┼		6	6	4	4					4	4	
17			5	4 ,			5	4	十	_	╅	*		5	4			<u>6</u> 3	6					
18 19			7	6			6	5						5	5		-		4	4	5	4	4	
20					7	<u> </u>	6	<u> </u>	_	\perp		7	6		$\neg \uparrow$	一十			6			—-{		
21			4	2		├_	$\frac{1}{2}$	2	_ _	4	_ _									$\neg +$	-	2	$\overline{1}$	
22			4	3		├	3	3	-	+	_ _			4	2	[3	4		$\neg \uparrow$	4	4	
23	·		5	4	-:	├	5	$\frac{4}{3}$	╁	╬	- <u>-</u>	1	- 	4	4			4	4			4	4	
24			5	4	_	一	5	$\frac{3}{4}$	+-	╁		4	$\frac{4}{4}$	-+	-	4	4					4	4	
25			6	7		 	6	1 7	+-	╁		7	6					4	4		_ _	4	4	
26			4	4			4	4	┰	╅╴	╁	' +	. 	4	4	\dashv	∤	, 		-	6	$\overline{}$	_	
27 28			3	3					3	12	2	\dashv	`	3	3	4	3	4	4	3		4	4	
29			, 	_	4	3			3	3				3	4	- 	- 	\dashv	4	$\frac{3}{3}$	$-\!\!\!+$	-		
30	 -		2 5	3			5	1 3	_		\bot	4	3			_	\dashv	4	3	- 	-	4	3	
			-	6 7			5	5	┼	_	4	_ _			6			7	6	十	_	· +	-	
32			╧┼	╧	7	6	6	 7	5	+-	+	_		6	7	\bot					_	6	\dashv	
33			_	_	5	5	 	┼-	3	6		5	5	1		4	5	\coprod	\Box		\perp			
34			4	4.			4	4	╁	+-3	-			_	3	-		_	3		_		4	
35			1	4 °				 	6	6			-	*		6'	6	4	4		_	4	4	
36			丌	7	\Box		6	6		╁		. .	-		-	}	6	-+-	-		6	_		
37 38		_	4		6	5			6	6	5		5	+	_	∸┼-		7	6	6	6	\dashv	_	
39			4	5			6	6			$oldsymbol{oldsymbol{oldsymbol{oldsymbol{\Box}}}$			6	6	+	\dashv	-		5	5			
40		- -	+		7	5		<u> </u>	6	6		\perp	\perp		\prod	6	6	\dashv	_	- '	——	5 6	5	
11		6	<u>'</u>	7	5	3		<u> </u>	6	7	_	\bot	\perp		I			7	6	١.			5	
12		5	+	4	'	2	6	4		├-	 _	4-		<u> </u>	_		4	\Box		4 4		<u> </u>	\exists	
13		2		╁	_	-+	4	3		 	5			4	_		5	\bot		5 6				
4			1	_	3	3	7	-	4	4	3	4		,		3	3			3 3				
5		4		3	_	_	4	4	 -	┍╤	+-	┰	$\frac{3}{4}$			- -	_ 4		4	4	_ 5		_	
								<u> </u>					(4	1 4	<u>' </u>		4	-1-	4		4	4		

5 6

46		<u> </u>	T -	$\overline{}$	Τ 4	1 5	-	т—	1 .	т-			, .		<u>. </u>							
47		 	3	4	4	5	+-	+_	14	5	 	—	5	4	<u>L</u>		3	4	T	T	4	4
48		 	$\frac{1}{4}$		+-	-	4	3	 _	+-	4	4					4	4		T^{-}	2	3
49	 -		6	6	+-	╂—	┵	+_	4	4	4	4_	<u> </u>				4	4	T-	<u> </u>	4	4
50	 	 	6	5	╁	+	7	6	╀—	 	6	7		<u> </u>					7	7	 	†
51			1-	+-	+3	+-	7	17	┼	╄—	<u> </u>	<u> </u>	7	7					7	7	\vdash	
52	 		7	6	13	4	4	3	 -	╀	3	3	<u> </u>	<u> </u>	3	4		Τ	\vdash	3		\top
53	 		2	1.3	╫	┼	6	5	 	↓		<u> </u>	5	5	<u> </u>				4	5		
54			7	7	┼─	┿	3	3		 	4	4		<u> </u>	5	5			4	5		
55			 	 	4	+-	6	 7	 _	├	6	7	<u> </u>	<u> </u>			7	7		T-		
56	 		 	┼-	3	3	-	 -	3	3		<u> </u>	3	4				4	3			
57	 	_	 	1 :	5	. 4	├	<u> </u>	4	4	 ,	<u> </u>	3	4	<u> </u>		4	4		\vdash	5	4
58	1		7	6	1-	4	 _	 _ _	6	4		ļ	5_	5	<u> </u>		5	5			5	6
59			' -	۳	 	5	6	5	<u> </u>	<u> </u>		<u> </u>	5	5	<u> </u>				4	5		
60			4	4	├		4	5			_5	_5_	<u> </u>		6	6					7	7
61			- 5	6	├—	_	 _ _	<u> </u>	6	6					6	6			6	6		
62			6	6	 - -	-	5	5	<u> </u>				6	6			7	6				
63	· -				4	 _	6	6					5	6			5	6	5	5		
ENo.	of Students answered		42	40	_	4 . 18	6	6		William Vol. 2	6	6								•	6	6
	50% of Max Marks	Suren	_	3:5			44 3.5		*19	19	25	25	32	32	集20	20	- 27	30	2 4	<u>23</u>	26	26
	of Students crossed					:5.5	*3.5	3.5	"3.5 "	3:5	3.5	3:5	3.5	3.5	3.5	3.5.	3:5	3.5	3.5.	3.5		3,5
5	0% of Max Marks		35	33	12	13		. 31		12	22	THE STREET	25	26	16	15	22		A STORY	1 July 1906		
1 %	of Students crossed		CONTRACT :	Opinio 4	* W27	175	® ' '	a Jack and					- A		10.		22	25	19	20		21
<u>.</u> 5	of Students crossed 0% of Max Marks		83.	79	71	72	86	70.	74	637	88	84	78	81	ะลก	75	\$Q.13	- 00 m	70	87		81
in the state of th	Attainment Level		3				34			2		mode at the		X	TORICANO.	724	-01	03		Jane		81
	Course Outcome			11	īv	V	- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		·**-J*	<u> </u>		<u>√3 </u>	3	3	3,	3 🗐	3	3	3_	‱3∷à ,	35	3_*
No.	of Times Co repeated		4	4	4	4																
Final	CO Attainment Leve	el ,	3	3	3	3																
			_ 1		- 1	-																

Rubrics:

If 50% of the students crossed 50% of the marks: Attainment Level 1 If 60% of the students crossed 50% of the marks: Attainment Level 2 If 70% of the students crossed 50% of the marks: Attainment Level 3

- 1. Enter the question wise marks.
- 2. Identify the CO of each question.
- 3. Calculate the maximum marks of each CO.
- 4. Calculate the CO wise marks obtained by each student.
- 5. Calculate 50% of maximum marks of each CO.
- 6. and number of students crossed 50% of maximum marks for each CO.
- 7. Find percentage of students crossed 50% of maximum marks for each CO.
- 8. Find the attainment level of each CO as per the above Rubrics.

Course Code: C224 Course Name: MANUFACTURING TECHNOLOGY Year/Sem: II/II **Internal Examination Assessment** Test Mid1 Quiz Mid2 A2 CO **EO** .CO CO CO ***2**. **A1**: ĩ Ouiz 2 ΪŤ īV Q.No Ш V 1.a 1.b 2.a 2.b 3.a 1.a 2.a 2.b 3.a 3.b S.No Roll. No Max. Max. Max. Max. Max. COs-III III I III- -IV- -IV- --V--.V -Marks Marks Marks Marks Marks. Max. 5. Marks 3.. 14. 5-6... ...9" 10 W . 12 **~10** 25. . 10 2 . 11. 20° 5. 30% . 17 18. 2. ..15 17. .* :34 23: 20.5 **'33** .20 ∌ 15" 19 ** 16 h . 24

_																				-			
	23	224750311			2	3	1	4	Т	T 5	2	T 3	4	T 5	T 4	7 4		1 70	5. 72	7			
	24	224750312		_	$\frac{\overline{2}}{2}$		1	4	3	5	2	4	3	$\frac{3}{2}$	4	4	5	10	<u> 12</u>	7	20	24	
Γ	25	224750313	<u> </u>		4	3	3	3	5	4	5	4	3		4	2	5	10	9	. 7d.	* 24	20	16
ſ	26	224750314			3	4	5	4	4	5	2	5	+	4		2	5	10	16	11	29		上海
	27	224750315		_	$\frac{2}{2}$	3	1	4	+-	3	$\frac{2}{9}$	5	4	3		4	5	9	14	11.	25_	21	17
	28	224750316			4	3	4	5	4	-	10	5	+	+	4	4	5	8	17.	14	27	20	16
	29	224750317		_	4	3	5	3	3	 	9	5	4	3	4	4	5	9	17	19	33 -	21	17
	30	224750318		_	4	5	3	3	3	5	10	5-	3-	- -	4	4	5	3	F 16.	17	. 25	15	11 * 3
Γ	31	224750319				3	4	$\frac{3}{2}$	1	5	4	+	+	4-		-2-	5	-9-	24-	16	 	-21	15
Ī	32	224750321	 	<u>.</u>	2	.3	1	4		5	8	4	4	3	5	2	5	10	12	10	24	22	17
	33	224750322	 	 }		2	-	$\frac{7}{2}$	2	4		4	3 -	+	5.	2	5	9 '	, 18 ⁻	13	26	21	16
ı	34	224750323	 - : -			3	2	4	1	3	10	5	3	2	3	2	5	10_	19	16	32	20	15
ſ	35	224750324	 	_	-	$\frac{3}{3}$	5	3	3	5	10	4	4	3	5	2	5	10	_ 16.	16	30	22	17.
┌	36	224750325				3	3	3	4	5	8	4	5	3	4	4	_ 5	7	20	16	27	20	15 J
	37	224750326			 !-	4	3	3	-4	<u> </u>	5	5	5	3	5	5	5	10	175	11	29	23	20
F	38	224750327				5	5	5	3	<u> </u>	9	_4	3	4	5	2	_ 5	8	23	× 15	26	å. 20	15
	39	224750328	 		 -	$\frac{3}{4}$	3	3	3	5	9	4	3	3	5	3	5	8	24	19 °	29	19	16
r	40	224750329			_	4	3	3	3	4	<u>8</u> 5	5_	3	4	5	5	5	10	22	11	31	22	20
	41	224750330				4	3	3				5	4	4	5	5	5	4	18	11	22 i	17	14
	42	224750331	-			5	5	5		3	10	4_	3	12	4	2	5	9	i: 22	16	28	19	15
上	43	224750332		 	1	-	2	3	3	5	4	5	⁻ 5	₂ -5	5	5	5	9	19	14	3-28	24	19
	44	224750333			_	3	5	$\frac{3}{4}$	$\frac{3}{3}$	4	_5	5_	5	. 3	_5	5	5	_ 9	<u> 13 </u>	10 5	27	22)	₩" 19> "*
	45	224750334				4	5	 -		4	2	4	3	4	5	2	5	8	12	11 .	22	20	15
r	46	224750335		+ 7	_	3	$\frac{3}{5}$	4 3	3	5	5	3	4_	3	4	_3	5	10	18	i14 i§	26	22	
	47	224750336		$\frac{1}{2}$		2	4	2		5	5	2	4	3	_2	2	_5	9	17°	13	24	21	13
	48	224750337		. - 5	 1		5	5	3	5	10	3	4	2	4	2	_ 5	9	19	16	" , 30 . 🖟	20	15
	49	224750338		5		_	5		5	5	10	5	4 -	3	4	4	5	10	. 25 🖓	20	35	22	18
上	50	224750339		$-\frac{3}{5}$			5	5	5	4	10	5	4	_3_	4	4	_5	10	24	20	35	22	18
	51	224750340		$\frac{1}{4}$		——		5	5	5	4	5	4	4	5	5	5	10	. 19	14	29	23-	20
卜	52	224750341		$\frac{1}{2}$			5	3	3	5	9	5	5	3	5	5	_5	8	21	17 🎚	30.	21.	18
\vdash	53	224750341		$\frac{2}{5}$			1 -	4		5	10	4	4	5	5	5	5	8	20	15	27	22	18
_		227130372		1 2	4	<u> </u>	3	3	L	5	3	3_	4	5	4	4	5	9	17.	9	20	23	217
																					^^		M MEN TO SEE

.

•

77.5

•

_54	224750343		T 5	T 5	T 5	T 5	7 5	-	T =	-	, .	·				_					•
55	224750344	 	2	┼-	1 1	1 3	1 3	1. 3	1 7	5	4	3	4	4	5	10	22	17	32	22	* 10 * *
56	224750345	 	1 4	5	5	 -	3	4	5	4	3	4	2	2	5	9	*11	10.	26	21	18
57	224750346	<u> </u>	5	5	5	5	4	4	10	5	5	5	5	5	5	10	23	20	34	25	19 19 3 §
58	224750347		5	5	-	5	5	5	9	5	5	3	_ 5	5	5	9	24	19	33	22	20
59	224750348		4	3	3	5	13	5	9	5	5	5	5	5	5	9	-24	17	33		19
60	224750349		 	<u> </u>	3	5	3	5	1	4	5	_3	4	4	5	9	13.	9	22	24	19
61	224750350		4	3	3	3	4	4_	10	5	5	5	5	5	5	9	21	16	33	22	17
62	224750351		_ 5		4	3	3	4	2	_3_	-4 -	3	4	3	4	- '0	11	9		.24	19
63	224750352			4	3	3	_5_	5	7	4	4	3	5	4	5	10	16	·	21	20	16
	This was a second		5	5	4	4	4	_ 5	<i>₹</i> 10	5 .	5	4	4	5	5	$\frac{10}{10}$	25	13	31	22	19
4 20 40		4 223 -450 61		50%	o of	ma	ximi	im m	arksi	į y	4		16.1	4 .1		10 白雪龙科·用		18	34	24	19
443	Er Aller and	No. o	f Stu	iden	ts c	rošs	ed.5	.0°/, 0	fma	30 13/10 30 13/10	مراز مرازم	180 -41	20, 428	AND ALL			12.5	10"	17.5	12.5	10//
		% o	fstn	lent	S CF	O C C C	A 50	10/ 12/ 0	· Zhair a z	7. III	äi.K2	i di					<u>* 55</u>	56	62	62	60
. A. W. F	PARKER.		f 1	r W I		ပ္သည္လင္	30 <u>20</u>	1/0(01	max		rks.	国量		型旗		FAS	87	89	- 98	98	C OE S
- 2014 \$'48' THE	· · · · · · · · · · · · · · · · · · ·	歌 鄉 雅 葛 :	1.0		Atta	inm	ient	Level									3.4	300	3		
														Control Control	MIN AND EMP	ST. IN Th.	<u> </u>	3		3	3

Rubrics:

If 50% of the students crossed 50% of the marks: Attainment Level 1 If 60% of the students crossed 50% of the marks: Attainment-Level 2 If 70% of the students crossed 50% of the marks: Attainment Level 3

- 1. Enter the question wise marks for mid examinations, assignments & quiz.
- 2. Identify the CO of each question.
- 3. Calculate the maximum marks of each CO based mid exams, assignments and quiz.
- 4. Calculate the CO wise marks obtained by each student.
- 5. Calculate 50% of maximum marks of each CO.
- 6. Find number of students crossed 50% of maximum marks for each CO.
- 7. Find percentage of students crossed 50% of maximum marks for each CO.
- 8. Find the attainment level of each CO as per the above Rubrics.

Cours	e Code: C224										
Cours		Course Name: N	Year/Sem: II/II								
	CO Attainment										
СО	CO Attainment Level (Mid)	CO Attainment Level (External)	Direct CO Attainment Level (Internal * 30%) + (External * 70%)	Indirect CO Attainment Level	Total CO Attainment Level (Direct CO Attainment * 90% + Indirect CO						
C214.1	3	3. North	3.00	2.75	Attainment * 10%)						
C214.2	3	3.	3:00	2.68	2:97						
C214.3	-3	· · · · · · · · · · · · · · · · · · ·	3:00	2.54	2.95 ************************************						
C214.4	3	3	3.00	2.57	2.96						
C214.5	3	3	3.00	2.52	2.95						
		C214			2:96						

^{1.} Copy the Direct CO Attainment Level (Internal) and Direct CO Attainment Level (External) from the previous sheets and then find the Direct CO Attainment Level.

^{2.} Find Direct CO attainment level using the formula: CO Attainment Level (Internal) * 30% + CO Attainment Level (External) * 70%

^{3.} Copy Indirect CO Attainment Level.

^{4.} Find the CO attainment level using the formula:

Direct CO Attainment Level *90% + Indirect CO Attainment Level * 10%