

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**Course Curriculum**

**MANUFACTURING ENGINEERING - I  
(Code: 3331901)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Mechanical Engineering	3 <sup>rd</sup> Semester

**1. RATIONALE**

This subject of Manufacturing Engineering provides knowledge regarding different types of manufacturing processes used to produce variety of metal products used in automobile and other machines and equipment. It also develops understanding that can be used to suggest and manipulate vital process parameters related to different manufacturing processes so that the high quality component may be produced at low cost and in minimum time, this is important if we want to compete in today's global market. It also provides information about behavior of metal and change in it during different manufacturing process.

As a technician the knowledge and practical skills in different manufacturing processes are essential and hence emphasis is also given in this course towards skills development. Further the technician should be able to handle machine, equipment, tools and accessories in the recommended manner and also follow safety precautions.

This subject is divided in two courses i.e. Manufacturing Engineering –I and Manufacturing Engineering-II. This course of Manufacturing-I deals with some of the above contents.

**2. COMPETENCY (Programme Outcome as per NBA Terminology)**

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency.

- **Produce the job as per given specification by selecting and applying appropriate manufacturing processes like Casting, Forming, Joining, using optimum process parameters and safe working procedures.**

**3. TEACHING AND EXAMINATION SCHEME**

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	200
3	0	4	7	70	30	40	60	

**Legends:** L -Lecture; T -Tutorial/Teacher Guided Student Activity; P -Practical; C - Credit; ESE-End Semester Examination; PA -Progressive Assessment

#### 4. COURSE DETAILS

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA Terminology)	Topics and Sub-topics
<b>Unit – I Introduction to manufacturing processes</b>	1.a Explain the basic manufacturing processes. 1.b Describe various mechanical properties involved.	1.1 Nature, role and scope of manufacturing processes. 1.2 Role of machining, forming, casting and joining processes in manufacturing of industrial components. 1.3 Recall mechanical properties of material.
<b>Unit – II Metal working processes</b>	2.a Compare the principles of hot and cold working Process. 2.b Identify and explain various metal working processes. 2.c Suggest appropriate metal working process and basic parameters for a given industrial component.	2.1 Concept, principles and differences of hot and cold working processes. 2.2 Classification of forming processes. 2.3 Rolling, Forging, Spinning, Drawing, Extrusion, Swaging. <ol style="list-style-type: none"> <li>i. Types.</li> <li>ii. Working principle.</li> <li>iii. Equipments used and their specifications.</li> <li>iv. Major parts of equipments and their construction of materials and functions.</li> <li>v. Process parameters.</li> <li>vi. Applications.</li> </ol>
<b>Unit – III Metal casting processes</b>	3.a Appreciate the need of casting process. 3.b Calculate pattern allowances. 3.c Interpret the standard color coding on pattern as well as core. 3.d Suggest appropriate casting method suitable for a given industrial component. 3.e Identify casting defects, their causes and suggest remedies.	3.1 Basic concept of foundry process. 3.2 Types of foundries. 3.3 Pattern: <ol style="list-style-type: none"> <li>i. Importance.</li> <li>ii. Types and materials of construction.</li> <li>iii. Allowances, their need and normal values.</li> <li>iv. Drawings and color codes.</li> <li>v. Making process.</li> <li>vi. Applications.</li> </ol> 3.4 Cores: <ol style="list-style-type: none"> <li>i. Need.</li> <li>ii. Types.</li> <li>iii. Making materials and its properties.</li> <li>iv. Testing methods.</li> <li>v. Sintering.</li> <li>vi. Applications.</li> </ol> 3.5 Types, working and applications of furnaces. 3.6 Molding sand: <ol style="list-style-type: none"> <li>i. Sand properties.</li> <li>ii. Sand mixing.</li> <li>iii. Sand binders.</li> </ol>

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA Terminology)	Topics and Sub-topics
		3.7 Molding equipments, their major specifications and applications. 3.8 Types of mould, mould making, mould sintering and applications of mould. 3.9 Salvage techniques. 3.10 Recovery of sand. 3.11 Casting processes: basic principle, working, process parameters and applications. <ol style="list-style-type: none"> <li>i. Centrifugal.</li> <li>ii. Die.</li> <li>iii. Investment.</li> <li>iv. Shell molding.</li> </ol> 3.12 Casting defects -types, causes, effects and remedies. 3.13 Safety precautions in foundry.
<b>Unit – IV</b>  <b>Non metal moulding processes</b>	4.a Suggest appropriate moulding method suitable for a given non metal industrial component.	4.1 Concept, basic principle, major parts, working and their materials of construction, process parameters and applications of: <ol style="list-style-type: none"> <li>i. Injection moulding.</li> <li>ii. Blow moulding.</li> <li>iii. Extrusion process.</li> </ol> 4.2 Safety precautions.
<b>Unit – V</b>  <b>Metal joining processes</b>	5.a Appreciate the need of joining process to reduce cost and time. 5.b Explain different welding processes. 5.c Identify the area of applications of a particular joining process. 5.d Suggest appropriate process and process parameters based on given joining situation. 5.e Practice standard safety norms during any joining process.	5.1 Introduction and classification. 5.2 Welding: working principle, setup sketch, specifications of equipment and consumables, functions of each element, process parameters for various materials, applications and safety precautions for: <ol style="list-style-type: none"> <li>i. Gas welding (Oxy-acetylene, Air-acetylene, oxy-hydrogen and LPG (Liquid Petroleum Gas)- oxygen.</li> <li>ii. Arc welding (Carbon arc, metal arc, MIG (Metal Inert Gas), TIG (Tungsten Inert Gas), flux coated arc and submerged arc).</li> <li>iii. Resistance welding (butt, spot, seam, projection and percussion).</li> <li>iv. Thermit welding.</li> <li>v. Forged welding.</li> </ol> 5.3 Welding defects -types, causes, effects and remedies. 5.4 Working principle, setup sketch, specifications of equipment, tools and consumables, functions of each element, process parameters for various materials, applications and safety precautions for:

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA Terminology)	Topics and Sub-topics
		i. Soldering. ii. Brazing. 5.5 Adhesive joining - process, applications. 5.6 Fastening process - process, applications.

## 5 SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to manufacturing processes.	03	03	02	00	05
II	Metal working processes.	12	05	07	08	20
III	Metal casting processes.	12	05	07	08	20
IV	Non metal moulding processes.	03	02	03	00	05
V	Metal Joining Processes.	12	05	07	08	20
<b>Total</b>		<b>42</b>	<b>20</b>	<b>26</b>	<b>24</b>	<b>70</b>

### Notes:

- This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.
- If midsem test is part of continuous evaluation, unit numbers I, II (2.1 and 2.2-only rolling, forging and spinning), III (Up to 3.6) and IV are to be considered. It is also compulsory for student to complete experiment.no.1 to 6 to eligible for midsem test.
- Ask the questions from each topic as per marks weightage. Numerical questions are to be asked only if it is specified. Optional questions must be asked from the same topic.

## 6. SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of practical skills (**Course Outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies (Programme outcomes). Following is the list of practical exercises for guidance.

**Note:** Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme. Faculty should refer to that common list and should ensure that students also acquire those programme outcomes/course outcomes related to affective domain.

S. No.	Unit Number	Practical/Exercise (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Hours
1	II	Prepare two jobs using hot forging/hot smithy process. This includes cutting of raw material and preparation of pre forged parts.	06
2	II	Demonstration of spinning process with preparation of a job.	04
3	II	Visit a nearby Rolling mill/Hot-Cold material processes, allied manufacturing processes industry and prepare a two page report comprises of details(type, material, process, etc) of items produced, quantities, different sections, equipments used with specification, process parameters being used and consumables.	--
4	III	Demonstration of metal melting, metal pouring, metal casting and casting finishing. Also demonstrate and prepare a report on casting defects. (Use wax in place of molten metal for the purpose of demonstration.)	04
5	III	Prepare a pattern drawing, pattern and core from the given component/drawing.	06
6	III	Prepare a mould using prepared pattern, core and moulding sand. Also pour molten metal and get the casting.	06
7	III	Visit a nearby foundry and prepare a two page report comprises of details (type, material, process, etc) of items produced, quantities, different sections, equipments used with specification, process parameters being used and consumables.	--
8	IV	Prepare at least two jobs containing minimum 4 parts in each using arc welding. This includes cutting of raw material and preparation of pre-weld parts and use tacks and continuous welding in each job.	08
9	IV	Prepare at least two jobs using gas cutting and gas welding. This includes cutting of raw material and preparation of pre-weld parts. Minimum 3 parts for each job should be taken and should include tacks and continuous welding.	06
10	IV	Prepare a job using spot/seam resistance welding. This also includes cutting of raw material and preparation of pre-weld parts.	04
11	IV	Prepare two jobs, one using soldering and another using brazing. This also includes cutting of raw material and preparation of pre weld parts.	06
12	IV	Visit a nearby fabrication industry and prepare a two page report comprises of types of item produced, quantities, different sections, equipments used with specification and consumables.	--
13	ALL	SCHOOL WITHIN SCHOOL: Each student will present and will prepare report on: a. His/her observation for the jobs made. b. His/her experience during industrial visits. c. Process parameters and their effects.	06
<b>TOTAL</b>			<b>56</b>

**Notes:**

- a. It is compulsory to prepare log book of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by teacher.
- b. Student activities are compulsory and are also required to be performed and noted in logbook.
- c. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.
- d. Term work report content of each experience should also include following.
  - i. Experience description / data and objectives.
  - ii. Drawing of experience / setup with labels/nomenclature to carry out the experience.
  - iii. The specifications of machines / equipments / devices / tools /instruments /items/elements which is / are used to carry out and to check experience.
  - iv. Process parameters / setup settings' values applied to carry out experience.
  - v. Steps / Process description to execute experience.
- e. For 40 marks ESE, students are to be assessed for competencies achieved. They should be given following tasks( minimum two):
  - ii. Prepare pattern drawing and pattern from given component/component drawing.
  - iii. Prepare weld joint job from given drawing.
  - iv. Prepare job from given drawing using gas welding/gas cutting.
  - v. Prepare job from given drawing using any one resistance welding method.
  - vi. Competency based questions and answers.

**7. SUGGESTED LIST OF STUDENT ACTIVITIES**

Sr. No.	Activity.
1	Select four industrial components (approved by teacher) and list various methods of manufacturing used to produce these components.
2	Select at least two components which are made by casting only. Also state the type of casting method used.
3	Prepare a list of household items which are prepared by joining processes.
4	Prepare a list of plastic items which are produced using different types of molding methods. Also name the process used.
5	Prepare a list of industries/workshops in the nearby area which are producing components by machining, casting and forming.
6	Identify the type of manufacturing process used in making main component of a car engine.

**8. SPECIAL INSTRUCTIONAL STRATEGIES (If ANY)**

Sr. No.	Unit	Unit Title	Strategies
1	I	Introduction to manufacturing processes.	Share the experience. Show various movies.
2	II	Metal working processes.	Demonstration. Movies. Live examples with suitable components. Industrial visits. Show effect of process parameters.
3	III	Metal casting processes.	
4	IV	Non metal casting processes.	
5	V	Metal Joining Processes.	

**9. SUGGESTED LEARNING RESOURCES****(A) List of Books:**

Sr no.	Title of Books	Author	Publication
1.	Workshop Technology I & II	J. A. Schey	Tata MacGraw Hill Education
2.	Workshop Technology I & II	Raghuwanshi	Dhanpat Rai and Sons
3.	Workshop Technology I, II & III	W. A. J. Chapman	Arnold
4.	Manufacturing Processes	M. L. Begman	Wiley India
5.	Production Technology	R.K. Jain and S.C. Gupta	Khanna publication
6.	Welding Engineering	B.E. Rossi	Jefferson Publications
7.	Audles Welding Guide	F.D. Graham	Wiley India
8.	Foundry Engineering	P.L. Jain	Tata MacGraw Hill Education
9.	Principle of Foundry	Jain & Gupta	National Book Trust, India
10.	Manufacturing Processes	S.E. Rusinoff	Times of India Press
11.	Production Technology	H.H. Marshall	Machinery Publishing Company

**(B) List of Software/Learning Websites:**

- a: [www.youtube.com/watch?v=k6iODHla6qY](http://www.youtube.com/watch?v=k6iODHla6qY)
- b: [http://web.iitd.ac.in/~pmpandey/MEL120\\_html/Metal%20Forming%20Processes.pdf](http://web.iitd.ac.in/~pmpandey/MEL120_html/Metal%20Forming%20Processes.pdf)
- c: [http://thelibraryofmanufacturing.com/forming\\_basics.html](http://thelibraryofmanufacturing.com/forming_basics.html)
- d: [http://www3.nd.edu/~manufact/MPEM%20pdf\\_files/Ch07.pdf](http://www3.nd.edu/~manufact/MPEM%20pdf_files/Ch07.pdf)
- e: [www.ielm.ust.hk/dfaculty/ajay/courses/ieem215/lecs/3\\_forming.pdf](http://www.ielm.ust.hk/dfaculty/ajay/courses/ieem215/lecs/3_forming.pdf)
- f: [www.youtube.com/watch?v=HkjdMdp9KVU](http://www.youtube.com/watch?v=HkjdMdp9KVU)
- g: <http://www-old.me.gatech.edu/jonathan.colton/me4210/casting.pdf>
- h: <http://www.mccannsales.com/book/sandcasting.pdf>
- i: <http://me.emu.edu.tr/me364/2.pdf>
- j: [http://www.ielm.ust.hk/dfaculty/ajay/courses/ieem215/lecs/8\\_joining.pdf](http://www.ielm.ust.hk/dfaculty/ajay/courses/ieem215/lecs/8_joining.pdf)
- k: [http://www.tech.plym.ac.uk/sme/mats116/Materialsjoiningprocesseslecturenotes\\_docx.pdf](http://www.tech.plym.ac.uk/sme/mats116/Materialsjoiningprocesseslecturenotes_docx.pdf)
- l: <http://www.aws.org/w/a/>
- m: [www.youtube.com/watch?v=H3Qb9I03FCk](http://www.youtube.com/watch?v=H3Qb9I03FCk)
- n: [www.youtube.com/watch?v=JqFp5kCeTA0](http://www.youtube.com/watch?v=JqFp5kCeTA0)

- o: [www.youtube.com/watch?v=7F0ypF6IdrU](http://www.youtube.com/watch?v=7F0ypF6IdrU)
- p: <http://www.flamingfurnace.com/>
- q: <http://www.sme.org>
- r: <http://www.youtube.com/watch?v=IrcNSgLZuFs> (Metal Casting)
- s: <http://www.youtube.com/watch?v=Yk1JOYzwRP4> (Loose piece Pattern)
- t: [http://www.youtube.com/watch?v=khEvhjhlh\\_SM](http://www.youtube.com/watch?v=khEvhjhlh_SM) (Foundry Pattern making)
- u: <http://www.youtube.com/watch?v=f7FXtnXVqzY> (Aluminium Casting)
- v: <http://www.youtube.com/watch?v=dOw624I9FDQ> (Investment Casting)
- w: <http://www.youtube.com/watch?v=bzSSfBgkWfc&NR=1&feature=endscreen> (Hot Chamber Die Casting Process)
- x: <http://www.youtube.com/watch?v=UI00-KoC1Oc> (Shell Moulding)
- y: <http://www.youtube.com/watch?v=pTTap4WiEAU> (Gravity Die Casting)
- z: <http://www.youtube.com/watch?v=eUthHS3MTdA> (Plastic Injection Moulding)
- aa: [http://www.youtube.com/watch?v=6xnKmt\\_gsLs](http://www.youtube.com/watch?v=6xnKmt_gsLs) (Hot Rolling)
- bb: [http://www.youtube.com/watch?v=9MU0vSN\\_w-A](http://www.youtube.com/watch?v=9MU0vSN_w-A) (Cold roll forming)
- cc: <http://www.youtube.com/user/IGEJohannesen?feature=watch> (Channel For welding videos)
- dd: <http://www.youtube.com/watch?v=SDJdiNeDXto> (Introduction to Welding)
- ee: <http://www.youtube.com/watch?v=CJ42scaWFnw> (Brazing video)

**(C) List of equipments:**

- a. Pattern Making:
  - i. Wood cutting planer machine/Wood jack plane
  - ii. Carpentry vice
  - iii. Flat file
  - iv. Hammer
  - v. Steel rule
  - vi. Right angle
  - vii. Saw
- b. Molding
  - i. Cope and drag Boxes
  - ii. Molding sand with additives and binder
  - iii. Vent wire
  - iv. Furnace or Oven
  - v. Consumable (Wax)
- c. Smith forging
  - i. Anvil
  - ii. Furnace
  - iii. Hammer
  - iv. Tong
  - v. Steel rule
  - vi. Air blower
  - vii. Swage block
- d. Spot/Resistance welding
  - i. Spot welding machine
  - ii. Plier cutter
  - iii. Hammer
  - iv. Steel rule



- v. Anvil
- e. Arc welding
  - i. Arc welding Machine with electrode holder
  - ii. Tong
  - iii. Chipping hammer
  - iv. Wire brush
  - v. Hand gloves
  - vi. Hand screen
  - vii. Safety goggles
- f. Gas welding
  - i. Oxy acetylene gas cylinders with regulators
  - ii. Welding torch
  - iii. Tong
  - iv. Chipping Hammer
  - v. Steel rule
  - vi. Hand gloves
  - vii. Safety goggles
- g. Gas Cutting
  - i. Oxy acetylene gas cylinders
  - ii. Cutting torch
  - iii. Tong
  - iv. Steel rule
- h. Brazing
  - i. Brazing torch
  - ii. Consumables
  - iii. Tong
  - iv. Hammer
  - v. Anvil
  - vi. Wire brush
- i. Spinning
  - i. Hand shearing Machine/ cutter Plier
  - ii. Hammer
  - iii. Steel rule
  - iv. Lathe Machine
  - v. Spinning tool

## 10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. M. M. Jikar**, HOD, Department of Mechanical Engineering, N. G. Patel Polytechnic, Bardoli.
- **Prof. M. K. Patel**, Lecturer, Department of Mechanical Engineering, M. L. Institute of Diploma Studies, Bhandu.

### Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. S.K.Pradhan**, Associate Professor and Head Department of Mechanical Engineering
- **Dr. Vandana Somkuwar** Associate Professor, Department of Mechanical Engineering