

## GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

### Course Curriculum

#### METAL FORMING AND POWDER METALLURGY (CODE: 3332102)

Diploma Programmes in which this course is offered	Semester in which offered
Metallurgy Engineering	3 <sup>rd</sup> Semester

### 1. RATIONALE

A number of metallic engineering products are used in construction, fabrication and transportation industries. Most of the metallic products can be manufactured by various methods such as metal forming processes, rolling, forging, extrusion, drawing, powder metallurgy etc. Products of metals having high melting points, metal and nonmetallic combinations can be economically produced by powder metallurgy process. A Diploma engineer pass out is expected to work at supervisory level in various production units. Therefore a diploma engineering student must be conversant with metallurgical aspects of metal forming processes and powder metallurgy, along with the basic knowledge of equipment and production of various components by suitable process. This course aims to equip the student with the knowledge of various metal working and powder metallurgy operations that leads to get the best metallurgical qualities and economic products.

### 2. COMPETENCY (Programme Outcome according to 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 products with powder technology and metal forming skills.**

### 3. TEACHING AND EXAMINATION SCHEME

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

**Legends:** L-Lecture; T – Tutorial/Teacher Guided Theory Practice; 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 Metal Shaping Techniques and Properties of Metals</b>	1a. Define the terms related to metal properties 1b. Describe the various metal shaping processes 1c. Explain properties of metals involved in mechanical working processes. 1d. Select the materials based on the properties required for particular metal working process.	1.1. Properties of metals like recovery, Recrystallization, ductility, malleability, strength, toughness, creep, fatigue, elastic and plastic deformation, strain hardening. 1.2. Metal shaping processes like casting, welding, powder metallurgy, mechanical working processes like rolling, forging, extrusion drawing etc. 1.3. Types of loading involved in mechanical working
<b>Unit- II Rolling and Forging</b>	2a. Describe rolling as a mechanical working process. 2b. Enlist the products of rolling 2c. Explain construction and working of rolling mills. 2d. Classify rolling mills. 2e. Select the relevant rolling mill for the given application  2f. Explain forging 2g. Describe forging equipment 2h. Describe products and its production methods 2i. Describe forging defects and their remedies. 2j. Select the relevant forging press for the given application	2.1 Schematic representation of Rolling 2.2 Products of rolling. 2.3 Theory of rolling. 2.4 Construction and working of rolling mills 2.5 Classification of rolling mills.  2.6 Forging- processes, operations, classification, and uses. 2.7 Forging equipment. 2.8 Products of forging. 2.9 Defects and remedies in forged products.
<b>Unit – III Extrusion and Drawing</b>	3a. Differentiate between direct and indirect extrusion. 3b. Describe various extrusion products and their production 3c. Describe equipment used for extrusion. 3d. Select the relevant extrusion process and dies for the given application  3e. List the products obtained by drawing 3f. Describe equipment and procedure for production of rods, wires and tubes by drawing.	4.1 Direct and indirect extrusion 4.2 Products of extrusion and their production by various extrusion methods. 4.3 Variables in extrusion. 4.4 Dies and their materials  4.5 Drawing- Process and Products. 4.6 Equipment and production of rods by drawing. 4.7 Production of wires by drawing 4.8 Patenting of wires.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	3g. Select the relevant load to be applied drawing wires and tubes	4.9 Methods of tube drawing.
<b>Unit-IV Diverse Metal Working Processes</b>	4a. Describe diverse metal working processes 4b. Select the relevant metal working process for the given application	4.1 Shearing, Bending, Forming (hydro rubber), Deep drawing, Punching and piercing, Spinning, Coining and Embossing. 4.2 Selection criteria for the above metal working processes.
<b>Unit-V Powder Metallurgy and Production</b>	5a. Explain powder metallurgy as a method of metal shaping compared to other processes. 5b. List the advantages, limitations and applications of powder metallurgy. 5c. State the criteria for producing the component for powder metallurgy	5.1 Powder metallurgy-process and products 5.2 Comparison of Powder metallurgy and other metal shaping processes. 5.3 Advantages and limitations of powder metallurgy. 5.4 Applications of powder metallurgy.
	5d. Describe method of powder metallurgy for a product. 5e. Describe metal powders preparation. 5f. Describe properties of metal powders. 5g. Sketch the flowchart for production of different components. 5h. Compare the production of porous bearing and sintered carbide	5.5 Powder metallurgy method- powder making, mixing, blending, compaction and sintering. 5.6 Powder preparation by grinding, atomization and electrolysis 5.7 Metal powder properties. 5.8 Flow diagram showing production of component through powder metallurgy route. 5.9 Production of porous bearing and sintered carbides through powder metallurgy.

## 5. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1.	Introduction to Metal Shaping Techniques and Properties of Metals Involved Therein	02	02	02	01	05
2.	Rolling and Forging	14	10	05	05	20
3.	Extrusion and Drawing	12	05	07	05	17
4.	Miscellaneous metal working processes	04	02	03	03	08
5.	Powder Metallurgy and Production	10	08	06	06	20
	Total	42	27	23	20	70

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's Revised taxonomy)

**Note:** 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.

## 6. SUGGESTED LIST OF EXERCISES/PRACTICAL/EXPERIMENTS

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 No.	Practicals/ Exercises (Course Outcomes in Psychomotor Domain according to NBA Terminology)	Approx no of Hours required
1	II	Demonstrate the construction and working of a rolling mill	08
2	II	Study of different types of models of rolling mills according to the roll arrangements	08
3	III	Demonstrate forging operations manually.	06
4	III	Watch a video on the steps for production of connecting rod by close die forging and production of bolt by upset forging and write a report.	08
5	IV	Explain the types of extrusion processes through industrial visit/video programs	06
6	V	Visit to drawing unit of industry and write a report on production of rods, wires and tubes by drawing	08
7	VI	Explain various processes of cold working of sheet metals through videos.	06
8	VII	Watch video on metal powders and write a report the powder properties , powder production processes and production of product .	06
Total			56

## 7. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Prepare assignment
- ii. Group discussion./Quiz

## 8. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Arranging expert lectures from Industry
- ii. Arranging Industrial visits
- iii. Demonstration of Videos
- iv. Asking students to visit relevant websites

## 9. SUGGESTED LEARNING ACTIVITIES

### A) List of Books

S. No.	Title of Book	Author	Publication
1.	Metal process Engineering	Polukins,	Mir Publications, Moscow
2.	Engg. Metallurgy Vol.- II	Higgins, R.A.	ELBS, New Delhi
3.	Mechanical metallurgy	George, E. Dieter	McGraw Hill, New Delhi
4.	Powder Metallurgy	Sinha, A.K.	Dhanpat-rai-Publications, New Delhi

### B. List of Major Equipment/ Instrument with Broad Specifications

- i. Rolling Mill Model
- ii. Hammer , Anvil
- iii. Heating unit
- iv. Extrusion unit model
- v. Specimen objects made through powder metallurgy route
- vi. Videos

### C. List of Software/Learning Websites

- i. [en.wikipedia.org/wiki/Metalworking](http://en.wikipedia.org/wiki/Metalworking)
- ii. [www.youtube.com/watch?v=XBg5iXGjhVY](http://www.youtube.com/watch?v=XBg5iXGjhVY)
- iii. [en.wikipedia.org/wiki/Extrusion](http://en.wikipedia.org/wiki/Extrusion)
- iv. [en.wikipedia.org/wiki/Powder metallurgy](http://en.wikipedia.org/wiki/Powder_metallurgy)

## 10. COURSE CURRICULUM DEVELOPMENT COMMITTEE

### Faculty Members from Polytechnics

- **Prof. Smt B. H. Goyal**, Lecturer, Department of Metallurgy, Dr S and S.S Ghandhy college of Engg. and Technology
- **Dr. I. B. Dave**, Head, Department of Metallurgy Engineering, Dr. S and S S Ghandhy Engg. College, Surat.

### Co-ordinator and Faculty Members from NITTTR Bhopal

- **Dr. C.K Chugh**, Professor, Department of Mechanical Engineering
- **Dr. Vandana Somkuwar**, Associate Professor, Department of Mechanical Engineering