

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**

**COURSE CURRICULUM**  
**COURSE TITLE: MANUFACTURING ENGINEERING - II**  
**Code: (3341901)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
<b>MECHANICAL ENGINEERING</b>	<b>4<sup>th</sup> Semester</b>

**1. RATIONALE**

Large number of industrial parts undergoes various machining operations for their manufacturing. Appropriate selection and usage of machine tool, work holding devices, cutting tools and process parameters plays very crucial role in obtaining good quality product at optimum cost. This course will make student familiar with fundamentals of cutting mechanics, kinematics, constructional features and selection criterion for various basic machine tools and automates with some basic exposure to conventional work holding devices and cutting tools and tool holders used on the same machines.

**2. COMPETENCY.**

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 part as per given specification by using appropriate machine tools, work holding devices, cutting tools & tool holders along with optimum process parameters and safe working procedures.

**3. COURSE OUTCOMES (CO's).**

1. Explain mechanics of cutting.
2. Classify and explain working of basic machine tools with kinematics.
3. Observe and conclude the effect of varying tool materials, cutting parameters and work piece materials.
4. Interpret and select tool and tool holder designation system.
5. Identify the machine tool and select cutting parameters for given job.
6. Produce the job as per given drawing.

**4. 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.

### 5. COURSE DETAILS.

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – I</b>  <b>Introduction and mechanics of cutting.</b>	1a. Explain mechanics of cutting.	1.1 Need, scope & importance of manufacturing processes in industries. 1.2 Need of attitude, knowledge & skill required for shop floor supervisor in machine tools based industries. 1.3 Differentiate between forming and generating processes. 1.4 Mechanics of cutting action, orthogonal and oblique cutting. (Without derivation).
	1b. Observe and conclude the effect of varying cutting parameters.	1.5 Chip formation, types of chips. 1.6 Forces acting on tool and chip, methods to compute cutting force using dynamometer. 1.7 Concept and definition of cutting speed, feed and depth of cut. 1.8 Cutting fluid- basic need, types, properties and its applications. 1.9 Influence of cutting variables on surface finish, tool life, economy, and mass production. 1.10 Safety precautions in machine tools.
<b>Unit – II</b>  <b>Basic machine tools-I.</b>	2a. Explain classification, working principles, construction and operation of lathe and drilling machines.  2b. Describe mechanism & motion transmission in lathe and drilling machines.  2c. Explain work holding devices for lathe and drilling machines.	2.1 Define and classify basic machine tools. 2.2 Movements of tool, job, slides and work holding devices during cutting operation on various machine tools. 2.3 Lathe machine. <ol style="list-style-type: none"> <li>i. Types.</li> <li>ii. Working principle (using block diagram).</li> </ol> 2.4 All geared head stock centre lathe. <ol style="list-style-type: none"> <li>i. Constructional features.</li> <li>ii. Kinematics-(drive, head stock, feedbox, carriage, cross slide, top slide, swivel, apron, tailstock,) constructional</li> </ol>

Unit	Major Learning Outcomes	Topics and Sub-topics
		<p>sketch, working, and use.</p> <p>iii. Detailed specifications.</p> <p>iv. Operations performed.</p> <p>v. Work holding devices- constructional sketch, working and applications. (3 jaw chuck, 4 jaw chuck, face plate, centers).</p> <p>vi. Lead screw and feed rod mechanisms.</p> <p>vii. Thread cutting setting-concept methods and simple numerical.</p> <p>viii. Accessories- types, constructional sketch, working and applications.</p> <p>2.5 Metal removal rate (MRR) – concept and method to calculate on lathe.</p> <p>2.6 Drilling machine.</p> <p>i. Types.</p> <p>ii. Working principle (using block diagram).</p> <p>2.7 Radial drilling machining.</p> <p>i. Constructional features.</p> <p>ii. Kinematics (drive, spindle speeds, feed mechanism, radial movement, etc.) constructional sketch, working, and use.</p> <p>iii. Detailed specifications.</p> <p>iv. Accessories- types, constructional sketch, working and applications.</p> <p>v. Tool holding and setting methods.</p> <p>vi. Operations performed.</p> <p>vii. Work holding devices- constructional sketch, working and applications.</p> <p>2.8 Metal removal rate (MRR) –method to calculate on drilling machine.</p>

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – III</b>  <b>Basic machine tools- II.</b>	3a. Explain classification, working principles, construction and operation of milling machine.  3b Describe mechanism & motion transmission in milling machine.	3.1 Milling machine. <ol style="list-style-type: none"> <li>i. Types.</li> <li>ii. Working principle (using block diagram).</li> </ol> 3.2 Plain horizontal milling machining. <ol style="list-style-type: none"> <li>i. Constructional features.</li> <li>ii. Kinematics (drive, spindle speeds, feed mechanism, table movement, etc.) constructional sketch, working, and use.</li> <li>iii. Detailed specifications.</li> <li>iv. Operations performed.</li> </ol>
	3c. Select appropriate milling cutter for required milling operation.	3.3 Milling cutters-types and applications. 3.4 Up milling and down milling- concept, advantages, disadvantages and applications.
	3d. Calculate number of revolutions of indexing head for given requirements using appropriate indexing method.	3.5 Indexing-dividing head- constructional sketch, working, and use. 3.6 Simple, differential and compound indexing methods with simple numerical. 3.7 Work holding devices- constructional sketch, working and applications. 3.8 Metal removal rate (MRR) – concept and method to calculate on milling.
<b>Unit – IV</b>  <b>Basic machine tools-III.</b>	4a. Explain types, working principles, construction and operations of shaping, slotting and planning machines.  4b. Describe mechanisms & motion transmission in shaping, slotting and planning machines.	4.1 Shaping machine. <ol style="list-style-type: none"> <li>i. Types.</li> <li>ii. Working principle (using block diagram).</li> <li>iii. Constructional features and detailed specifications.</li> <li>iv. Quick return mechanisms- kinematic sketch, working and advantages.</li> <li>v. Operations performed.</li> <li>vi. Work holding devices- constructional sketch, working and applications.</li> </ol> 4.2 Slotting machine. <ol style="list-style-type: none"> <li>i. Types.</li> </ol>

Unit	Major Learning Outcomes	Topics and Sub-topics
		<ul style="list-style-type: none"> <li>ii. Working principle (using block diagram).</li> <li>iii. Constructional features and detailed specifications.</li> <li>iv. Operations performed.</li> <li>v. Work holding devices- constructional sketch, working and applications.</li> </ul> <p>4.3 Planning machine.</p> <ul style="list-style-type: none"> <li>i. Types.</li> <li>ii. Working principle (using block diagram).</li> <li>iii. Constructional features and detailed specifications of double column planner</li> <li>iv. Operations performed.</li> <li>v. Work holding devices- constructional sketch, working and applications.</li> </ul>
<p><b>Unit – V</b></p> <p><b>Cutting tools and tool holders.</b></p>	<p>5a. select cutting tool material for given work piece material and machining operation.</p> <p>5b. Describe various effect of alloying elements on tool properties.</p>	<p>5.1 Various cutting tool materials, their compositions and properties.</p> <p>5.2 Alloying elements in tool materials and their effects.</p>
	<p>5c. Interpret carbide insert and tool holder designation system.</p> <p>5d. Suggest suitable carbide inserts and tool holder for specified operation.</p>	<p>5.3 Carbide inserts:</p> <ul style="list-style-type: none"> <li>i. Designation method for turning, milling and drilling (As per ISO).</li> <li>ii. Need.</li> <li>iii. Benefits.</li> </ul> <p>5.4 Tool holders for carbide inserts:</p> <ul style="list-style-type: none"> <li>i. Designation method for turning, milling and drilling (As per ISO).</li> <li>ii. Need.</li> <li>iii. Benefits.</li> <li>iv. Mounting and replacement</li> </ul>

Unit	Major Learning Outcomes	Topics and Sub-topics
		<p>methods of carbide insert.</p> <p>5.5 General cutting parameters for various cutting tool materials (HSS and Carbide) and work piece materials.(low carbon steel, high carbon steel, stainless steel, gunmetal, cast iron and aluminum).</p>
	5e. Explain tool angles of cutting tools and their importance.	<p>5.6 Cutting tool angles and their functions.</p> <p>5.7 Various cutting tools (with tool geometry, nomenclature, tool materials, sketch/drawing of each, ISO/BIS standards) used for various operations on lathe, milling and drilling machines.</p> <ol style="list-style-type: none"> <li>i. Single point cutting tool.</li> <li>ii. Plain milling cutter.</li> <li>iii. Side and face milling cutter.</li> <li>iv. Centre drill.</li> <li>v. Twist drill.</li> </ol> <p>5.8 Functions and types of chip breakers.</p>
	5f. Explain factors affecting tool life.	<p>5.9 Tool life, tool wear and mach inability, factors affecting them.</p> <p>5.10 Re-sharpening of cutting tools specified at 5.7 above.</p>
<b>Unit – VI</b> <b>Automates.</b>	<p>6a. Explain classification, working principles, construction and operation of capstan lathe, turret lathe and automats.</p> <p>6b. Outline the tool layout for Capstan &amp; Turret Lathe</p>	<p>6.1 Capstan and turret lathe:</p> <ol style="list-style-type: none"> <li>i. Constructional features and working principle.</li> <li>ii. Functions and applications.</li> <li>iii. Difference between capstan and turret lathe.</li> <li>iv. Preparation of tool layout.</li> <li>v. Merits and demerits.</li> <li>vi. Turret lathe in comparison with basic centre lathe.</li> <li>vii. Work holding devices.</li> </ol> <p>6.2 Single spindle Automats:</p> <ol style="list-style-type: none"> <li>i. Need.</li> <li>ii. Constructional features.</li> <li>iii. Working principle and applications.</li> <li>iv. Collets-constructional features</li> </ol>

Unit	Major Learning Outcomes	Topics and Sub-topics
		and applications. 6.3 Introduction to multi spindle automates and special purpose automates.

## 6. 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 and mechanics of cutting.	06	6	2	2	10
II	Basic machine tools-I.	10	3	6	7	16
III	Basic machine tools-II.	08	2	6	6	14
IV	Basic machine tools-III.	06	2	6	2	10
V	Cutting tools and tool holders.	08	2	4	8	14
VI	Automates.	04	0	4	2	06
<b>Total</b>		<b>42</b>	<b>15</b>	<b>28</b>	<b>27</b>	<b>70</b>

**Legends:** R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's 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.

### General Notes:

- If midsem test is part of continuous evaluation, unit numbers I,II (Up to 2.5 only) and III are to be considered.
- 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.

## 7. SUGGESTED LIST OF EXERCISES/PRACTICALS.

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

*Note: Here only 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.*

Sr. No.	Unit Number	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	<p><b>PREPARATORY ACTIVITY:</b></p> <p>a. For given work piece and tool material; select, set and observe cutting speed, feed and depth of cut on lathe machine. Also define these terms.</p> <p>b. Calculate metal removal rate (MRR) for above case.</p> <p>c. Identify various cutting tools, its geometry and material available at workshop. Sketch them.</p> <p>d. Identify various carbide inserts and ISO codification.</p> <p>e. Calculate revolution per minute (RPM) for lathe, milling cutter and drill spindle based on given data.</p>	06
2	I	<p><b>EFFECT OF VARYING CUTTING PARAMETERS:</b></p> <p>Demonstrate type of chips, surface finishes and tool life for varying cutting parameters for same work piece material and tool material. Tabulate the observations.</p>	02
3	I	<p><b>EFFECT OF VARYING WORK PIECE MATERIALS:</b></p> <p>Demonstrate type of chips, surface finishes and tool life for varying work piece material with same cutting parameters. Tabulate the observations.</p>	02
4	II	<p><b>TURNING JOB:</b></p> <p>Prepare a job on centre lathe as per the given drawing. (Including plain turning, taper turning, knurling, threading, grooving, etc). Student will also prepare report including:</p> <p>a. Drawing of the job.</p> <p>b. Operation sequences including details of cutting parameters used.</p> <p>c. Sketch of cutting tools used.</p> <p>d. Specification of machines used.</p> <p>e. Machine settings for threading.</p>	12
5	III	<p><b>MILLING JOB:</b></p> <p>Prepare a job using milling operations including use of indexing head (Excluding gear tooth cutting). Student will also prepare report including:</p>	10



		<ul style="list-style-type: none"> <li>a. Drawing of the job.</li> <li>b. Operation sequences including details of cutting parameters used.</li> <li>c. Sketch of cutting tools used.</li> <li>d. Specification of machines used.</li> <li>e. Machine settings for indexing.</li> </ul>	
6	IV	<p><b>SHAPING AND DRILLING JOB:</b></p> <p>Prepare a job having plain and inclined surfaces on shaping machine with minimum two holes as per given drawing. Student will also prepare report including:</p> <ul style="list-style-type: none"> <li>a. Drawing of the job.</li> <li>b. Operation sequences including details of cutting parameters used.</li> <li>c. Sketch of cutting tools used.</li> <li>d. Specification of machines used.</li> </ul>	10
7	V	<p><b>SINGLE POINT CUTTING TOOL:</b></p> <ul style="list-style-type: none"> <li>a. Sketch single point cutting tool(SPCT) with nomenclature.</li> <li>b. Grind SPCT as per given geometry.</li> <li>c. Sketch the set up to grind each angle of SPCT.</li> </ul>	04
8	VI	<p><b>TOOL LAYOUT:</b></p> <p>Prepare a tool lay-out of a given component for capstan and turret lathe.</p>	02
9	ALL	<p><b>INDUSTRIAL VISIT:</b></p> <p>Visit a nearby machine shop and prepare a two page report comprises of list of machine tools including automates, its technical specification, machining parameters for various operations being performed, cutting tools and work holding devices used, observation of skill and safety criteria.</p>	02
10	ALL	<p><b>MINI PROJECT AND PRESENTATION:</b></p> <p>For a given product (separate for each student) prepare complete report in suggested format including selection of raw material type &amp; section, sequence of various manufacturing operations, selection of machine, machining parameters, work holding device, tool holder, etc. for each machining operation. Each student will also present the outcome.</p>	06

**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. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.
  - c. Mini project and presentation topic/area has to be assigned to the student in the beginning of the term by batch teacher. This has to be assigned individually to each student.
  - d. Student activities are compulsory and are also required to be performed and recorded in logbook.
  - e. For 40 marks ESE, students are to be assessed for competencies achieved. They should be given following tasks (minimum two):
    - i. Sketch or explain tool geometry for a given cutting tool.
    - ii. Prepare a job on lathe machine. (At least two operations).
    - iii. Prepare a job on shaper and drilling machine. (At least two operations).
    - iv. Prepare a job on milling machine.
    - v. Prepare a tool lay out for a given component for capstan & turret lathe.
    - vi. Competency based questions and answers.

## 8. SUGGESTED LIST OF STUDENT ACTIVITIES.

SR.NO.	ACTIVITY.
1	Select two industrial components (approved by teacher) and list various machine tools and operations used to produce these components. Use one component for mini project and presentation.
2	Prepare a list of household items which are prepared by machining processes.
3	Collect/download at least four different machine tool catalogues including at least one automate.
4	Collect/download at least one catalogue each of cutting tool, work holding device and tool holder.

## 9. SPECIAL INSTRUCTIONAL STRATEGIES.

Sr. No.	Unit	Unit Name	Strategies
1	I	Introduction and mechanics of cutting.	Chart, PPT, Demonstration, Video.
2	II	Basic machine tools-I.	Chart, PPT, Demonstration, Video, Industrial visit.
3	III	Basic machine tools-II.	Chart, PPT, Demonstration, Video, Industrial visit.
4	IV	Basic machine tools-III.	Chart, PPT, Demonstration, Video, Industrial visit.
5	V	Cutting tools and tool holders.	Chart, PPT, Demonstration, Video, Industrial visit, physical tools.

6	VI	Automates.	Chart, PPT, Demonstration, Video, Industrial visit.
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## 10. SUGGESTED LEARNING RESOURCES

### (A). List of Books:

Sr no.	Title of Books	Author	Publication
1	Workshop Technology I	J. A. Schey	McGraw-Hill
2	Workshop Technology I & II	Raghuwanshi	Dhanpat Rai and Company(P) Limited
3	Workshop Technology I, II & III	W. A. J. Chapman	Viva books
4	Manufacturing Processes	M. L. Begman	John Wiley and Son
5	Production Technology	R. K. Jain and S. C.	Khanna Publishers
6	Elements of Workshop Technology Volume No. II Machine Tools	Hajra Choudhary, Bose S. K., Roy Nirjhar	Media promoters and publishers pvt. Limited
7	Manufacturing Processes	S. E. Rusinoff	Times of India Press
8	Production Technology	H. H. Marshall	Pitman
9	Production Technology	HMT	Tata Mcgraw-Hill Publishing Co.
10	All about machine tools	Gerling	John Wiley & Sons Canada Limited
11	Manufacturing processes	Bava	McGraw-Hill

### (B) List of Software/Learning Websites.

- a. <http://nptel.iitm.ac.in/video.php?subjectId=112105126>
- b. <http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-01.pdf>
- c. <http://www.youtube.com/watch?v=H0AyVUf18-k&list=PLEFE7D1579523C45D>
- d. <http://www.youtube.com/watch?v=FFzRIop5bpg&list=PL843C2A830C65E2EE>
- e. <http://www.youtube.com/watch?v=81Fdif5e85c>
- f. [http://www.youtube.com/watch?v=A0dTvf\\_Q8BA&list=PL2C105C94D2955C8B](http://www.youtube.com/watch?v=A0dTvf_Q8BA&list=PL2C105C94D2955C8B)
- g. <http://www.youtube.com/watch?v=tDc0I9Gm8D4&list=PL3AFB507B668AF162>
- h. <http://www.youtube.com/watch?v=THVgkBnjLq0>
- i. <http://www.youtube.com/watch?v=6VpCBk7FahI>
- j. <http://www.youtube.com/watch?v=7wC1u4W0V1o>
- k. <http://www.youtube.com/watch?v=VDIoUZuTunI>
- l. <http://www.youtube.com/watch?v=fGqc9mZS0YI>
- m. <http://www.youtube.com/watch?v=Mn9jppqI8rao>
- n. <http://www.youtube.com/watch?v=8SuoH5aL1SY>
- o. [http://www.youtube.com/watch?v=xxNZSQML\\_ZA](http://www.youtube.com/watch?v=xxNZSQML_ZA)
- p. <http://www.youtube.com/watch?v=XXUHZxweBcw&list=PLD07DE61CB871A0CB>
- q. <http://www.youtube.com/watch?v=Q7QUiCJJmew>

## **11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**

### **Faculty Members from Polytechnics.**

1. Prof. M. M. Jikar, HOD, Mechanical Engineering, N. G. Patel Polytechnic, Bardoli.
2. Prof. J. P. Parmar, Lecturer in Mechanical Engineering, C. U. Shah Polytechnic, Surendranagar.
3. Prof. R. M. Rajyaguru, Lecturer in Mechanical Engineering, G. P. Rajkot.
4. Prof. M. K. Patel, Lecturer in Mechanical Engineering, M. L. Institute of Diploma Studies, Bhandu.

### **Coordinator and Faculty Members from NITTTR Bhopal.**

1. Dr. Prof. C.K.Chugh.