GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

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

Diploma Programme in which this course is offered	Semester in which offered
Mechanical Engineering, Mechatronics Engineering	4th Semester

1. RATIONALE

Large number of industrial parts has to undergo various machining operations for conversion into finished products. 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:

Make a part/component as per given specification using appropriate machine tools, work holding devices, cutting tools & tool holders by employing optimum process parameters and safe working procedures.

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

i. Explain mechanics of cutting.
ii. Classify and explain working of basic machine tools with kinematics.
iii. Observe and conclude the effect of varying tool materials, cutting parameters and work piece materials.
iv. Interpret and select tool and tool holder designation system.
v. Identify the machine tool and select cutting parameters for given job.
vi. Make the job as per given manufacturing drawing.

4. 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 Student Activity; **P** -Practical; **C** - Credit; **ESE**-End Semester Examination; **PA** -Progressive Assessment.

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I **Introduction and mechanics of cutting**	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. Explain 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.
Unit – II **Basic machine tools-I**	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. i. Types. ii. Working principle (using block diagram). 2.4 All geared head stock centre lathe. i. Constructional features. ii. Kinematics-(drive, head stock, feedbox, carriage, cross slide, top slide, swivel, apron, tailstock,) constructional sketch, working, and use. iii. Detailed specifications. iv. Operations performed. v. Work holding devices-constructional sketch, working and applications. (3 jaw chuck, 4 jaw chuck, face plate, centers).

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		vi. Lead screw and feed rod mechanisms. vii. Thread cutting setting-concept methods and simple numerical. viii. Accessories- types, constructional sketch, working and applications. 2.5 Metal removal rate (MRR) – concept and method to calculate on lathe. 2.6 Drilling machine. i. Types. ii. Working principle (using block diagram). 2.7 Redial drilling machining. i. Constructional features. ii. Kinematics (drive, spindle speeds, feed mechanism, radial movement, etc.) constructional sketch, working, and use. iii. Detailed specifications. iv. Accessories- types, constructional sketch, working and applications. v. Tool holding and setting methods. vi. Operations performed. vii. Work holding devices- constructional sketch, working and applications. 2.8 Metal removal rate (MRR) –method to calculate on drilling machine.
Unit – III **Basic machine tools- II**	3a. Explain classification, working principles, construction and operation of milling machine. 3b Describe mechanism & motion transmission in milling machine.	3.1 Milling machine. i. Types. ii. Working principle (using block diagram). 3.2 Plain horizontal milling machining. i. Constructional features. ii. Kinematics (drive, spindle speeds, feed mechanism, table movement, etc.) constructional sketch, working, and use. iii. Detailed specifications. iv. Operations performed.
	3c. Select appropriate milling cutter for required milling	3.3 Milling cutters-types and applications. 3.4 Up milling and down milling- concept, advantages, disadvantages and

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	operation.	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.
Unit – IV **Basic machine tools-III**	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. i. Types. ii. Working principle (using block diagram). iii. Constructional features and detailed specifications. iv. Quick return mechanisms- kinematic sketch, working and advantages. v. Operations performed. vi. Work holding devices- constructional sketch, working and applications. 4.2 Slotting machine. i. Types. ii. Working principle (using block diagram). iii. Constructional features and detailed specifications. iv. Operations performed. v. Work holding devices- constructional sketch, working and applications. 4.3 Planning machine. i. Types. ii. Working principle (using block diagram). iii. Constructional features and detailed specifications of double column planner iv. Operations performed. v. Work holding devices- constructional sketch, working and applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – V **Cutting tools and tool holders**	5a. Select cutting tool material for given work piece material and machining operation. 5b. Describe various effect of alloying elements on tool properties.	5.1 Various cutting tool materials, their compositions and properties. 5.2 Alloying elements in tool materials and their effects.
	5c. Interpret carbide insert and tool holder designation system. 5d. Suggest suitable carbide inserts and tool holder for specified operation.	5.3 Carbide inserts: i. Designation method for turning, milling and drilling (As per ISO). ii. Need. iii. Benefits. 5.4 Tool holders for carbide inserts: i. Designation method for turning, milling and drilling (As per ISO). ii. Need. iii. Benefits. iv. Mounting and replacement methods of carbide insert. 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).
	5e. Explain tool angles of cutting tools and their importance.	5.6 Cutting tool angles and their functions. 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. i. Single point cutting tool. ii. Plain milling cutter. iii. Side and face milling cutter. iv. Centre drill. v. Twist drill. 5.8 Functions and types of chip breakers.
	5f. Explain factors affecting tool life.	5.9 Tool life, tool wear and machinability, factors affecting them. 5.10 Re-sharpening of cutting tools specified at 5.7 above.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – VI **Automates**	6a. Explain classification, working principles, construction and operation of capstan lathe, turret lathe and automats. 6b. Outline the tool layout for Capstan & Turret Lathe	6.1 Capstan and turret lathe: i. Constructional features and working principle. ii. Functions and applications. iii. Difference between capstan and turret lathe. iv. Preparation of tool layout. v. Merits and demerits. vi. Turret lathe in comparison with basic centre lathe. vii. Work holding devices. 6.2 Single spindle Automats: i. Need. ii. Constructional features. iii. Working principle and applications. iv. Collets-constructional features 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
Total		**42**	**15**	**28**	**27**	**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.

General Notes:

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

b. 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 skills **(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 outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes (**as given in a common list at the beginning of curriculum document for this programme) would be assured.*
Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

Sr. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Hrs. required
1	I	**Preparatory Activity:** 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. b. Calculate metal removal rate (MRR) for above case. c. Identify various cutting tools, its geometry and material available at workshop. Sketch them. d. Identify various carbide inserts and ISO codification. e. Calculate revolution per minute (RPM) for lathe, milling cutter and drill spindle based on given data.	06
2	I	**Effect of Varying Cutting Parameters:** Demonstrate type of chips, surface finishes and tool life for varying cutting parameters for same work piece material and tool material. Tabulate the observations.	02
3	I	**Effect of Varying Work Piece Materials:** Demonstrate type of chips, surface finishes and tool life for varying work piece material with same cutting parameters. Tabulate the observations.	02
4	II	**Turning Job:** 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: a. Drawing of the job. b. Operation sequences including details of cutting parameters used. c. Sketch of cutting tools used. d. Specification of machines used. e. Machine settings for threading.	12

5	III	**Milling Job:** Prepare a job using milling operations including use of indexing head (Excluding gear tooth cutting). Student will also prepare report including: a. Drawing of the job. b. Operation sequences including details of cutting parameters used. c. Sketch of cutting tools used. d. Specification of machines used. e. Machine settings for indexing.	10
6	IV	**Shaping and Drilling Job:** 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: a. Drawing of the job. b. Operation sequences including details of cutting parameters used. c. Sketch of cutting tools used. d. Specification of machines used.	10
7	V	**Single Point Cutting Tool:** a. Sketch single point cutting tool(SPCT) with nomenclature. b. Grind SPCT as per given geometry. c. Sketch the set up to grind each angle of SPCT.	04
8	VI	**Tool Layout:** Prepare a tool lay-out of a given component for capstan and turret lathe.	02
9	ALL	**Industrial Visit:** 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.	02
10	ALL	**Mini Project and Presentation:** For a given product (different for each student) prepare complete report in suggested format including selection of raw material type & 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.	06
Total Hours			56

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.

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	Identify and list different cutting tools available in your institute's workshop.
4	Collect/download at least four different machine tool catalogues including at least one automate.
5	Collect/download at least one catalogue each of cutting tool, work holding device and tool holder.
6	Identify type of electric motor used in each type of machine tools in your college workshop.

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/workshop visit, machine tool catalogues
3	III	Basic machine tools-II	Chart, PPT, Demonstration, Video, Industrial/workshop visit, machine tool catalogues
4	IV	Basic machine tools-III	Chart, PPT, Demonstration, Video, Industrial/workshop visit, machine tool catalogues
5	V	Cutting tools and tool holders	Chart, PPT, Demonstration, Video, Industrial/workshop visit, physical tools, cutting tool catalogues
6	VI	Automates	Chart, PPT, Demonstration, Video, Industrial/workshop visit, work & tool holding

			device catalogues

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. Gupta	Khanna Publishers
6	Elements of Workshop Technology Volume No. II Machine Tools	Hajra Choudhary, Bose S. K., Roy Nirjhar	Media promotors 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 – I	Bava	McGraw-Hill

(B) List of equipments:

i Following machine tools.
   a. Hacksaw.
   b. Lathe with standard and special accessories.
   c. Milling machines-Vertical and Horizontal with standard accessories and indexing/dividing head.
   d. Column drill.
   e. Radial Drill.
   f. Shaper.
   g. Slotting.
   h. Planning.
   i. Tool and cutter grinder.
   j. Automats-turret and capstan.

ii Required cutting tools-HSS and Carbides.

iii Required cutting tool holders.

(C) List of Software/Learning Websites:

i. http://nptel.iitm.ac.in/video.php?subjectId=112105126
ii. http://nptel.iitm.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Manuf%20Proc%20II/pdf/LM-01.pdf
iii. http://www.youtube.com/watch?v=H0AyVUfl8-k&list=PLEFE7D1579523C45D
iv. http://www.youtube.com/watch?v=FFzRIop5bpg&list=PL843C2A830C65E2EE
v. http://www.youtube.com/watch?v=81Fdif5e85c
vi. http://www.youtube.com/watch?v=A0dTvf_Q8BA&list=PL2C105C94D2955C8B
vii. http://www.youtube.com/watch?v=tDc0l9Gm8D4&list=PL3AFB507B668AF162
viii. http://www.youtube.com/watch?v=THVgkBnjLq0
ix. http://www.youtube.com/watch?v=6VpCBk7FahI
x. http://www.youtube.com/watch?v=7wC1u4WOV1o
xi. http://www.youtube.com/watch?v=VDIoUZuTunI
xii. http://www.youtube.com/watch?v=fGqc9mZS0YI
xiii. http://www.youtube.com/watch?v=Mn9jpqI8rao
xiv. http://www.youtube.com/watch?v=8SuoH5aL1SY
xv. http://www.youtube.com/watch?v=xxNZSQML_ZA
xvi. http://www.youtube.com/watch?v=XXUHZxweBcw&list=PLD07DE61CB871A0CB

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics.

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

Coordinator and Faculty Members from NITTTR Bhopal.

- **Prof. Sharad K. Pradhan**, Head, Department of Mechanical Engineering.
- **Dr. K.K. Jain,** Professor and Dean, Department of Mechanical Engineering