

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: TOOL ENGINEERING
(COURSE CODE: 3361902)**

Diploma Programme in which this course is offered	Semester in which offered
Mechanical Engineering	Sixth

1. RATIONALE.

Tools are as basic component for any machining process. The quality and efficiency of any machining operation basically depends upon quality of tools which in turn depends upon the proper shape, size and material of the tools. Productivity and quality of machining operations may further be enhanced by proper and quick mounting of tools and jobs on machines. Jigs and fixture plays an import roll in this process. Therefore this course attempts to develop abilities in students to select a tool of proper size and shape for required machining operation. The design of cutting tools, jigs and fixtures are also dealt with in this course. This course is therefore a core course for mechanical engineers.

2. COMPETENCY.

The course content should be taught and implemented with the aim to develop required skills in the students so that they are able to acquire following competencies.

- **Develop the ability to select and/or design cutting tools, tool holders, dies, jigs and fixture for given simple component.**

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 outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Re-sharpen given cutting tool.
- ii. Select proper tool for given manufacturing operation
- iii. Interpret designation system of cutting tool and tool holder.
- iv. Select locating and clamping devices for given component.
- v. Select and design jig and fixture for given simple component.
- vi. Classify and explain various press tools and press tools operations.
- vii. Select a die for a given simple component.

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	150
3	0	2	5	70	30	20	30	

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE -End Semester Examination; PA - Progressive Assessment.

5. COURSE CONTENT DETAILS.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I. Introduction.	1a. Explain role of tool engineering in industries. 1b. Establish importance of process planning in tool engineering. 1c. Identify and select elements of universal acts in manufacturing operations.	1.1 Concept, meaning and definitions of tool, tool design and tool engineering. 1.2 Tools-types, classification, features & applications. 1.3 Tool engineering-functions and importance to enhance productivity and quality. 1.4 Importance of process planning in tool engineering. 1.5 Economy-concept, meaning, importance and principles in tool engineering. 1.6 Universal acts & their elements of a manufacturing operation with suitable simple example.
Unit – II Cutting tools and tool holders.	2a. List cutting tool materials. 2b. Interpret ISO-designation for carbide inserts. 2c. Describe process for re-sharpening commonly used cutting tools. 2d. Interpret ISO-designation for tool holders for carbide inserts. 2e. Mount tool holders on conventional milling and drilling machines.	2.1 Cutting tool materials-types, composition, properties and applications. 2.2 Carbide inserts-types, ISO-designation and applications. 2.3 Re-sharpening methods of following cutting tools: i. Drill. ii. Side and face milling cutter. iii. End mill. iv. Centre drill, type A and B. v. Gear hob. 2.4 Tool holders for turning and milling carbide inserts-types, ISO-designation and applications. 2.5 Tool holding and tool mounting systems for conventional milling and drilling machine tools.
Unit – III Locating and clamping devices.	3a. Explain location and 3-2-1 principle of location. 3b. Establish importance of degree of freedom in location. 3c. Select and use appropriate	3.1 Concept, meaning and definitions of location and clamping. 3.2 Use of locating and clamping principles in day-to-day supervision on shop floor. 3.3 Degree of freedom-concept and importance. 3.4 3-2-1 principle of location. 3.5 Locators: i. Types- ii. Sketches with nomenclature. iii. Working. iv. Applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	locator for given work piece. 3d. Select and use appropriate clamping device for given work-piece situation.	3.6 Fool proofing and ejecting. 3.7 Clamping devices: i. Types. ii. Sketches with nomenclature. iii. Working. iv. Applications.
Unit – IV Jigs and fixtures.	4a. Differentiate between jigs and fixtures. 4b. Select and design appropriate jig or fixture for given simple work-piece.	4.1 Concept, meaning, differences and benefits of jigs and fixtures. 4.2 Types, sketches with nomenclature, working and applications of jigs. 4.3 Types, sketches with nomenclature, working and applications of fixtures. 4.4 Steps to design jigs and fixture. 4.5 For given simple component: i. Select type (Jig or fixture). ii. Develop locating method. iii. Develop clamping method. iv. Design jig and fixture (as applicable). v. Prepare details and assembly sketches.
Unit – V Press tools.	5a. Select suitable press tool operation for given simple press tool component. 5b. Operate simple press tool. 5c. Calculate press tonnage and center of pressure for given press tool component. 5d. Determine dimensions of punch and die for given press tool component. 5e. Determine shear angle. 5f. Prepare scrap strip layout for given press tool component.	5.1 Press working processes-types, sketches and applications. 5.2 Press tools: types, working, components and their functions. 5.3 Concept, meaning, definitions and calculations of press tonnage and shut height of press tool. 5.4 Shear action in die cutting operation. 5.5 Centre of pressure: Concept, meaning, definition, methods of finding and importance. 5.6 Die clearance: Concept, meaning, definition, reasons, effects and methods of application. 5.7 Cutting force: Methods to calculate and methods of reducing. 5.8 Shear angle- concept, need and method to give shear angle on punch and die. 5.9 Scrap strip layout: - Concept, importance, method to prepare, and determining percentage stock utilization. 5.10 Types, working, and applications of stock stop, pilots, strippers and knockouts. 5.11 Cutting dies-types and applications.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	5g. Design progressive cutting die for given simple press tool component.	5.12 Design of progressive cutting die: <ol style="list-style-type: none"> Sketch the component. Prepare scrap strip layout. Calculate tonnage. Determine centre of pressure. Determine dimensions of punches, die block and die shoe. Prepare sketch of stripper plate. General assembly sketch of punches arrangement, die block, die shoe and stripper plate.
Unit – VI Dies and moulds.	6a. Calculate bend radii, bend allowance and spring back for given simple part. 6b. Describe working of various dies. 6c. Select type of die/mould for given part.	6.1 Bending: <ol style="list-style-type: none"> Types. Parts and functions of bending die. Definition, calculations and factors affecting bend radii, bend allowance and spring back. Method to compute bending pressure. Types, sketch, working and applications of bending dies. 6.2 Drawing dies-types and method to determine blank size for drawing operation. 6.3 Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging). 6.4 Forging dies- terminology, types, sketch, working and applications. 6.5 Sketch, working and applications of following dies/mould: <ol style="list-style-type: none"> Extrusion. Plastic injection. Blow moulding.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (THEORY).

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction.	3	2	4	0	6
II	Cutting tools and tool holders.	7	4	4	4	12
III	Locating and clamping devices.	7	4	4	4	12
IV	Jigs and fixtures.	10	4	5	7	16
V	Press tools.	10	4	2	8	14

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
VI	Dies and moulds.	5	4	6	0	10
	Total	42	22	25	23	70

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

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 mid-sem test is part of continuous evaluation, unit numbers I, II, III and V (Up to 5.5 only) are to be considered.
- Ask the questions from each topic as per marks weight age. 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)	Approx. Hours required
1	I	Preparatory activity: <ol style="list-style-type: none"> Tabulate most commonly used limits, fits and tolerance values. Tabulate BIS designation and applications of most commonly used tool materials. Tabulate machining processes and surface finish achieved. Demonstrate models of / actual jigs, fixtures and progressive cutting dies. 	04
2	II	Cutting tools re-sharpening. <ol style="list-style-type: none"> Draw the cutting tool with nomenclature taken for re-sharpening. Re-sharpen any one cutting tool from following. <ol style="list-style-type: none"> Drill. Side and face milling cutter. 	04

		iii. Centre drill, type A. c. Freehand sketch set ups for grinding each angle.	
3	III, IV	Design of fixture: Faculty will demonstrate working of any one fixture. Faculty will assign one simple component for designing of fixture. Develop the design and: a. Sketch the component. b. Prepare production drawings of all parts of fixture (Details). c. Draw assembly.	06
4	III, IV	Design of jig: Faculty will demonstrate working of any one jig. Faculty will assign one simple component for designing of jig. Develop the design and: a. Sketch the component. b. Prepare production drawings of all parts of jig (Details). c. Draw assembly.	06
5	V	Design of progressive die: Faculty will demonstrate working of various press tools operations. Faculty will assign one simple component for designing of progressive cutting die. Develop the design and: a. Draw the component. b. Draw scrap strip layout. c. Calculate tonnage and centre of pressure. d. Work out dimensions of punches and die. e. Production drawings of die block, die shoe and stripper plate. f. Draw assembly which include punches, die, die shoe and stripper plate only.	08
Total Hours			28

Notes:

- a. Use only sketch-book to carry practice work as term work.
- b. Production drawings include-drawings with dimensions-scale, surface finish symbols, limits/fits, tolerances, surface treatment/s, heat treatment/s and other notes/details required to manufacture the part.
- c. Assembly drawing include minimum two views (one preferably sectional view if required) and parts list.
- d. In examination, students are required to sketch freehand only.(For all questions).
- e. 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.PA component of practical marks is dependent on continuous and timely evaluation and submission of exercises.
- f. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.
- g. For practical ESE part, students are to be assessed for competencies achieved. They should be given experience/part of experience to perform as under.
 - i. Design jig or fixture or progressive die for given simple part.

8. SUGGESTED LIST OF STUDENT ACTIVITIES.

SR.NO.	ACTIVITY
1	Download the catalogues for cutting tools, jigs and fixtures and prepare report on their features and specifications.
2	Visit nearby manufacturing unit and prepare the list with specifications of cutting tools, hand tools, press tools, measuring tools and consumables being used there.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any).

Sr. No.	Unit	Unit Name	Strategies
1	I	Introduction.	Movie, Industrial visit.
2	II	Cutting tools and tool holders.	Demonstration of physical cutting tools and tool holders.
3	III	Locating and clamping devices.	Demonstration of physical locating and clamping devices in operation, video movies,
4	IV	Jigs and fixtures.	Demonstration with operations, video movies, Industrial visits.
5	V	Press tools.	Demonstration with operations, video movies, Industrial visits.
6	VI	Dies and mould.	Video movies, Industrial visits.

10. SUGGESTED LEARNING RESOURCES.**A. List of Books:**

S. No.	Title of Book	Author	Publication
1.	Fundamentals of tool design	ASTME	PHI.
2.	Tool design.	Donaldson & Lecain.	TME
3.	Tool engineering	Doyal.	
4.	Principles of tool & jig design	M. H. A. Kempster.	
5.	Jigs and fixture	P. H. Joshi	TMGH
6.	Design Of Jigs Fixtures And Press Tools	C. Elanchezhian, T. Sunder Selwyn, B. Vijaya Ramnath	Eswar Press,2007, 2 nd Edition
7.	Cutting tools standards.	-	BIS
8.	Production technology	-	HMT
9.	PSG Design data book	PSG, Coimbatore	PSG, Coimbatore

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

Sr. No.	Resource with brief specification.
1	Tool and cutter grinding machine.
2	Cutting tools, mainly set consisting assorted sizes of drill bits, set consisting assorted

	sizes of end mills, set consisting assorted sizes of side and face milling cutters, set consisting assorted sizes of centre drills-Type A and B, assorted carbide inserts,
3	Tool holders for carbide inserts, drill spindles/quills, milling machine quills,
4	Most commonly used set of locators and clamping devices, jigs and fixtures.
5	Models of jigs and fixtures.
6	Press-2.5 to 5 Tonnes,(Hydraulic or electrical operated), set of assorted sizes punches and dies,

C. List of Software/Learning Websites.

- i. <http://www.psgdesigndata.org>
- ii. <http://www.carrlane.com>
- iii. <http://www.nptel.ac.in>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE.

Faculty Members from Polytechnics.

- **Prof. A.M. Talsaniya**, Lecturer in Mechanical Engineering, Sir BPI, Bhavnagar.
- **Prof. K.H. Patel**, Head of Mech. Engg. Dept., Dr. S.& S.S. Ghandhy College of Engg. & Tech., Surat
- **Prof. M.M. Jikar**, Head of Mech. Engg. Dept., N.G.PATEL POLYTECHNIC, Isroli, Bardoli.

Coordinator and Faculty Members from NITTTR Bhopal.

- **Dr. K.K. Jain**, Professor, Department of Mechanical Engineering,
- **Dr. A.K. Sarathe**, Associate Professor; Department of Mechanical Engineering.

SUGGESTED QUESTION PAPER FORMAT

(This is for reference only and is in suggestive form. Paper setter may opt for other marks distribution pattern maintaining distribution of marks as per specification table)

Q.NO.	SUB Q.NO.	QUESTION	MARKS DISTRIBUTION			UNIT
			R	U	A	
1		Answer ANY seven from following.				14
	i.		2			I
	ii.		2			I
	iii.			2		II
	iv.			2		II
	v.		2			III
	vi.		2			IV
	vii.		2			IV
	viii.		2			III
	ix.		2			V
	x.		2			V
2	a.			4		I
		OR				
	a.			4		I
	b.		4			II
		OR				
	b.		4			II
	c.		4			III
		OR				
	c.		4			III
	d.			2		V
		OR				
	d.			2		V
3	a.				4	II
		OR				
	a.				4	II
	b.		4			VI
		OR				
	b.		4			VI
	c.			6		VI
		OR				
	c.			6		VI
4	a.	Given simple component drawing, show the design of jig by freehand sketches of assembly with minimum two views. (Preferably one sectional view).			8	IV
		OR				
	a.	Given simple component drawing, show the design of fixture by freehand sketches of assembly. Also freehand sketch for locators.			8	IV
	b.			4		IV
	c.			2		II
5	a.	Given simple component for designing progressive cutting die, sketch scrap strip layout, calculate tonnage, calculate centre of pressure and determine dimensions of punch and die considering clearance.			8	V
	b.				2	III
	c.			4		III