TOOL ENGINEERING **Course Code : 315369**

Programme Name/s : Production Engineering
Programme Code : PG
Semester : Fifth
Course Title : TOOL ENGINEERING
Course Code : 315369

I. RATIONALE

Machining success hinges significantly on the quality of the tools employed. Optimal tool selection, considering factors such as shape, size, and material is paramount for achieving efficient and top-notch machining results. Employing jigs and fixtures facilitates swift and secure tool positioning, thereby enhancing machining outcomes. This course empowers students with the expertise to choose the best-suited tools for diverse machining assignments. Furthermore, it comprehensively covers the design aspects of cutting tools, jigs, and fixtures, imparting essential knowledge about these fundamental elements of machining.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Use different tools, dies, jigs and fixtures as per the requirement.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Evaluate cutting tool geometry and its tool signatures.
- CO2 - Apply locating and clamping concept to a given component.
- CO3 - Design a jig and fixture for a given component.
- CO4 - Analyze the press tool operation required for a specific component.
- CO5 - Compute parameters of bending and drawing dies.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315369	TOOL ENGINEERING	TEN	DSC	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain the principles of metal cutting. TLO 1.2 Differentiate between orthogonal and oblique cutting processes as per given criteria. TLO 1.3 Calculate cutting forces in metal cutting. TLO 1.4 Describe the geometry of a single point cutting tool. TLO 1.5 Select a suitable cutting tool materials for specific applications. TLO 1.6 Interpret ISO designation for carbide inserts.	**Unit - I Fundamentals of cutting tool** 1.1 Mechanics of metal cuttings. 1.2 Types of metal cutting process: Orthogonal and Oblique. 1.3 Cutting Forces: shear angle and Merchant's Circle. 1.4 Cutting tool geometry: Single point cutting tool and its tool signature. 1.5 Cutting tool materials: Types, composition, properties and applications. 1.6 Carbide inserts: Types, ISO - designation and Applications.	Model Demonstration Video Demonstrations
2	TLO 2.1 Describe the concepts of locating and clamping in the context of manufacturing. TLO 2.2 Apply the 3-2-1 principle to constrain and position workpieces effectively for machining operations. TLO 2.3 Classify locators based on their types. TLO 2.4 Explain working mechanisms of clamping devices in securing workpieces during machining. TLO 2.5 Describe fool-proofing techniques used in locating and clamping devices.	**Unit - II Locating and clamping devices** 2.1 Locating and clamping: Concept, definition. 2.2 Degree of freedom: Concept, significance and 3-2-1 principle. 2.3 Locators: Type, construction, working and applications. 2.4 Clamping devices: Types, constructions, working and application, 2.5 Fool proofing and ejecting techniques.	Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain the importance of jigs and fixtures in machining operations. TLO 3.2 Describe applications of jigs in various machining operations. TLO 3.3 Describe applications of fixture in various machining operations. TLO 3.4 Explain factors to be considered while designing jigs and fixtures. TLO 3.5 Explain modular flexible fixture system design.	**Unit - III Jigs and fixtures** 3.1 Introduction to Jigs and fixtures, difference between jigs and fixtures. 3.2 Jigs: Types ,construction, working and applications. 3.3 Fixtures: Types , construction, working and Applications. 3.4 Design considerations for the jigs and fixtures. 3.5 Introduction to modular flexible fixture system design.	Model Demonstration Demonstration
4	TLO 4.1 Identify the components of press tools and their functions. TLO 4.2 Differentiate between cutting and non-cutting dies. TLO 4.3 Discuss reasons for providing die clearance and its effects. TLO 4.4 Calculate cutting forces in press operations. TLO 4.5 Evaluate strategies to reduce cutting forces and optimize efficiency. TLO 4.6 Calculate the percentage stock utilization in strip layouts.	**Unit - IV Press tools** 4.1 Press tools: Types, operations, components, functions and working. 4.2 Dies:Cutting, non-cutting dies and their terminologies. 4.3 Die clearance: Concept, meaning, definition, Reasons, effects and methods of application. 4.4 Cutting force: Methods to calculate cutting forces. 4.5 Methods of reducing cutting forces: Shear angle on punch and die, staggering of punches. 4.6 Strip layout: Concept, importance, method to prepare, and determining percentage stock utilization.	Demonstration Video Demonstrations
5	TLO 5.1 Describe the functions of each components / parts of the given die. TLO 5.2 Compute Bending Pressure for a given component. TLO 5.3 Describe the construction features of drawing dies. TLO 5.4 Calculate blank size for a given component.	**Unit - V Bending and Drawing dies** 5.1 Bending dies: Type, Parts and functions of bending die. Bending allowances and spring back. 5.2 Method to compute bending pressure. 5.3 Drawing dies: Types, construction, working and applications of drawing dies. 5.4 Method to determine blank size for drawing operation.	Demonstration Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Interpret a tool signature. LLO 1.2 Re-sharpen a single point cutting tool.	1	Interpret a tool signature., Re-sharpen a single point cutting tool as per given tool signature.	2	CO1

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Draw Merchant's circle to illustrate the relationships between cutting force components LLO 2.2 Estimate magnitude of cutting forces developed during machining processes.	2	*Draw and analyze Merchant's circle to understand the relationships between cutting force components.	2	CO1
LLO 3.1 Classify cutting tools based on geometry, application , material composition , and method of use	3	Categorize cutting tools on the basis of their geometry, application, material composition, and method of usage.	2	CO1
LLO 4.1 Identify different locating devices LLO 4.2 Illustrate different locating devices	4	*Enumerate and draw various locating devices utilized for securely positioning diverse work pieces.	2	CO2
LLO 5.1 Identify various clamping devices LLO 5.2 Illustrate various clamping devices	5	*Enumerate and draw various clamping devices employed to securely holding diverse work pieces.	2	CO2
LLO 6.1 Apply design principles to create a jig or fixture. LLO 6.2 Idenify devices used to accurately positions a specified component.	6	*Design a jig or fixture for a given simple component.	2	CO3
LLO 7.1 Draw a detailed assembly and part drawings of the designed jig. LLO 7.2 Specify all required dimensions, features, and annotations.	7	Draw assembly and detailed drawing of the designed jig.	2	CO3
LLO 8.1 Draw a detailed assembly and part drawings of the designed fixture. LLO 8.2 Specify all required dimensions, features, and annotations.	8	Draw assembly and detailed drawing of the designed fixture.	2	CO3
LLO 9.1 Identify various operations performed using press tools. LLO 9.2 Enumerate the applications of these operations in manufacturing.	9	List different operations performed using press tools, providing examples where applicable.	2	CO4
LLO 10.1 Draw a progressive cutting die design for a specific component. LLO 10.2 List multiple stages of operations.	10	*Design a progressive cutting die for a given component (example washer).	2	CO4
LLO 11.1 Design a strip layout that optimizes material usage for a given component. LLO 11.2 Understand alterante way of strip layout for maximum utilization of material.	11	*Prepare a Strip layout of a given component for maximum utilization of material.	2	CO4
LLO 12.1 Apply bending principles to design a die for a specified component. LLO 12.2 Understand the effect of spring back of material.	12	Design a bending die for a given Component.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Determine the initial blank size needed for a drawing operation. LLO 13.2 Comprehend the importance of the draw ratio	13	*Calculate a blank size for deep drawing a simple.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Prepare a model of various dies/single point cutting tools
- Collect the various inserts and specify their ISO designation.
- Identify various clamping and locating device available in workshop of the institute.

Assignment

- Prepare or download specifications for the following:

i. Tools and equipment available in the Tool Engineering laboratory.
ii. Machinery available in the Tool Engineering laboratory.

- Conduct a market survey of local dealers for tools, equipment, machinery, and raw materials, and prepare a report.
- Visit an industrial press shop and compile a report that includes:

i. Safety precautions observed during the visit.
ii. Identification of challenges or problems encountered by the industry

No SLA

- NA

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Bench Grinder -1 Qty	1
2	Single point cutting tool- 2 Qty	1,3
3	Inserts of different geometries.	1,3
4	Locating and Clamping Devices for Lathe, drilling and milling machines.	4,5,6,7,8
5	Press Machine (maximum 1 Ton Capacity)	4,5,9,10
6	Press tool must include Die and Punch, Die holder, punch holder, tie rods.	4,5,9,10,12,13

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of cutting tool	CO1	10	4	6	6	16
2	II	Locating and clamping devices	CO2	6	4	4	4	12
3	III	Jigs and fixtures	CO3	8	4	4	6	14
4	IV	Press tools	CO4	10	4	6	6	16
5	V	Bending and Drawing dies	CO5	6	2	4	6	12
Grand Total				**40**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Test
- Term Work
- Seminar/Presentation

Summative Assessment (Assessment of Learning)

- Practical
- Theory
- End semester examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	2	-	-			
CO2	3	3	3	2	2	-	-			
CO3	3	3	3	2	2	-	-			
CO4	3	3	3	2	2	-	-			

CO5	3	3	3	2	2	-	-			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Sharma, P C	A Textbook of machine tools and tool Design	S. Chand Limited (2021), ISBN:9788121923620, 812192362X
2	Nagpal, G H	Tool Engineering and Design	Khanna Publication (8th Edition, 2021), New Delhi ISBN : 817409203X
3	Donaldson, Cyrll	Tool Design	McGraw Hill Education, New Delhi (4th Edition, 2022),Edition3, ISBN: 9780070153929, 0070153922
4	Joshi, P H	Jigs and Fixtures	McGraw Hill Education, New Delhi, (6th Edition, 2020), ISBN:9780070680739
5	Sharma, P C	Production Engineering	S. Chand Limited (9th edition, 2021), ISBN:8121901111

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=2E1UW_MxSWg	Tool Geometry: Single Point Cutting Tool Specifications
2	https://www.youtube.com/watch?v=I0nIHfQ6E-E	Cutting Tools
3	https://www.youtube.com/watch?v=7yzvno4AvKw	Jigs and Fixtures For Machine Shops
4	https://www.youtube.com/watch?v=vOo2MCYPsm4	Design and Applications of Jigs and Fixtures
5	https://www.youtube.com/watch?v=PhIFSTj-8WU&list=PLwdnzlV3ogoVIP4OxvoWMZXQYJdHn5NE9&index=1	Mechanics of Sheet Metal Forming
6	https://www.youtube.com/watch?v=xz7fHwF8uVk	Modular flexible fixture systems

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students