

**Program Name** : Diploma in Production Engineering / Production Technology  
**Program Code** : PG / PT  
**Semester** : Third  
**Course Title** : Machining Processes  
**Course Code** : 22338

### 1. RATIONALE

Production Engineers /Technicians often come across various type of machining processes. This is one of the core Production technology subject intends to help the students in understanding various aspects of conventional machining processes like turning, drilling, milling, broaching, gear cutting etc.

### 2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Produce various types of components using machining processes.**

### 3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency

- Produce cylindrical jobs using lathe machine.
- Perform drilling operations using relevant parameters.
- Produce jobs using milling machines.
- Produce jobs using grinding machine
- Produce gear using milling machines.
- Perform boring operation using relevant parameters.

### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(\*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain required for the attainment of the COs.

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

### 5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the



course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

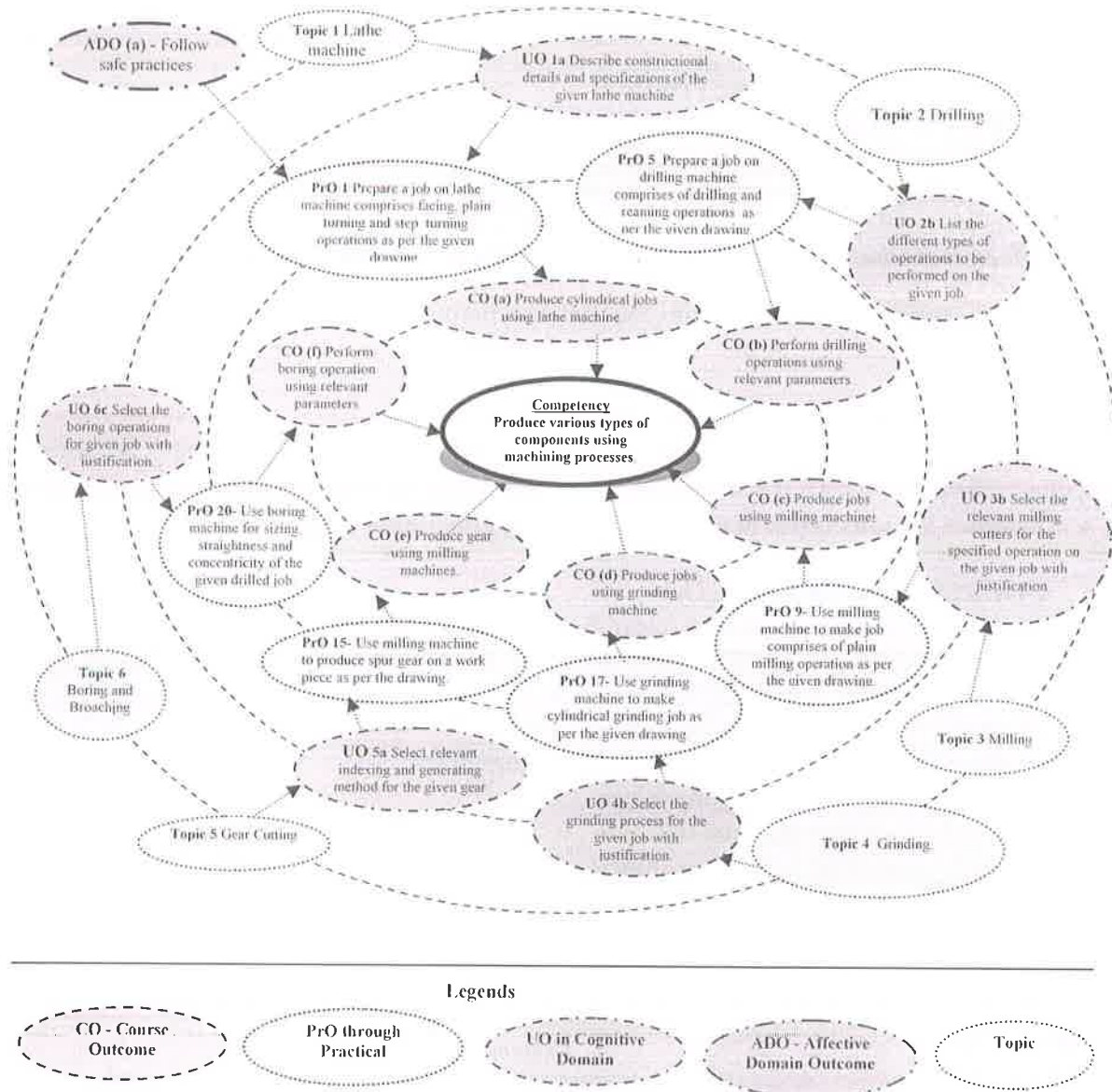


Figure 1 - Course Map

## 6. SUGGESTED PRACTICALS/ EXERCISES

The practical's in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Prepare a job on lathe machine comprises facing, plain turning and step turning operations as per the given drawing.	I	02*
2.	Prepare a job on lathe machine comprises taper turning and grooving operations as per the given drawing.	I	02*
3.	Prepare a job on lathe machine comprises knurling and chamfering operations as per the given drawing.	I	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
4.	Prepare a job on lathe machine comprises threading as per the given drawing.	I	02*
5.	Prepare a job on drilling machine comprises of drilling and reaming operations as per the given drawing.	II	02*
6.	Prepare a job on drilling machine comprises of tapping operation as per the given drawing.	II	02
7.	Prepare a job on drilling machine comprises of counter-boring operation as per the given drawing.	II	02*
8.	Prepare a job on drilling machine comprises of countersinking as per the given drawing.	II	02
9.	Use milling machine to make job comprises of plain milling operation as per the given drawing	III	02*
10.	Use milling machine to make job comprises of side milling operation as per given drawing.	III	02
11.	Use milling machine to make job comprises face milling as per the given drawing.	III	02
12.	Use milling machine to make job comprises slitting operation as per the given drawing.	III	02
13.	Use milling machine to make job comprises end milling operation as per the given drawing.	III	02*
14.	Use milling machine to make job comprises gang milling operation as per the given drawing.	III	02
15.	Use milling machine to produce spur gear on a work piece as per the given drawing.	III and V	02 *
16.	Use surface grinding machine to make grinding job as per the given drawing.	IV	02*
17.	Use grinding machine to make cylindrical grinding job as per the given drawing.	IV	02
18.	Use bench grinding machine to prepare single point cutting tool geometry as per the given drawing.	I and IV	02
19.	Use tool and cutter grinder to prepare single point cutting tool geometry as per the given drawing.	I and IV	02
20.	Use boring machine for sizing, straightness and concentricity of the given drilled job.	VI	02
21.	Use broaching machine for internal or external broaching of the given job.	VI	02
<b>Total</b>			<b>42</b>

**Note**

- i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicious mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '\*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.
- ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below.



S.No.	Performance Indicators	Weightage in %
a.	Preparation of experimental set up	20
b.	Setting and operation	20
c.	Inspection of Job using measuring instrument.	10
d.	Safety measures	10
e.	Observations and Recording	10
f.	Interpretation of result and Conclusion	10
g.	Answer to sample questions	10
h.	Submission of report in time	10
<b>Total</b>		<b>100</b>

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field-based experiences:

- a. Follow safety practices.
- b. Practice good housekeeping.
- c. Demonstrate working as a leader/a team member.
- d. Maintain tools and equipment.
- e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1<sup>st</sup> year.
- 'Organising Level' in 2<sup>nd</sup> year.
- 'Characterising Level' in 3<sup>rd</sup> year.

## 7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1.	Lathe Machine (distance between centers 1000 mm)	1 to 4
2.	Radial Drilling Machine: (Drill diameter up to 40 mm)	5 to 8
3.	Column and Knee type milling machine along with dividing head (Length x width of working table 800 mm x 300 mm)	9 to 15
4.	Bench Grinder	16,18
5.	Cylindrical / Surface Grinder	16 to 19
6.	Boring Machine	20
7.	Broaching Machine	21

## 8. UNDERPINNING THEORY COMPONENTS

The following topics are to be taught and assessed in order to develop the sample UOs given below for achieving the COs to attain the identified competency. More UOs could be added.





Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
<b>Unit – I Lathe</b>	1a. Describe constructional details and specifications of the given lathe machine. 1b. List the different operations to be performed on a given job. 1c. Select the relevant machining parameters for given job with justification. 1d. Compute the machining time for the given job.	1.1 Introduction: Importance of material removal, mechanism of metal cutting. 1.2 Lathe Machine: Introduction, classification, basic parts of center lathe and their functions, Lathe specifications. 1.3 Lathe operations: facing, plain turning, taper turning (using compound slide), thread cutting, thread rolling, chamfering, grooving, knurling. 1.4 Cutting tool nomenclature and tool signature, cutting parameters and machining time calculations.
<b>Unit– II Drilling</b>	2a. Describe with sketches the construction and specifications of a given drilling machine. 2b. List the different types of operations to be performed on the given job. 2c. Name the nomenclature of given type of drill(s). 2d. Compute the drilling time for the given job.	2.1 Drilling Machine: Introduction, classification, machine specifications, basic parts of radial drilling machine and their functions, 2.2 Drilling machine operations: drilling, reaming, boring, counter sinking, counter boring, spot facing. 2.3 Twist drill nomenclature, cutting parameters and machining time calculations.
<b>Unit– III Milling</b>	3a. Describe with sketches the construction and specifications of the given milling machine. 3b. Select the relevant milling cutters for the specified operation on the given job with justification. 3c. Compute the milling time for the given job. 3d. Name the nomenclature of given milling cutter.	3.1 Milling Machine: Introduction, classification, machine specifications, basic parts of column and knee type milling machine and their functions. 3.2 Milling operations: plain milling, side milling, straddle milling, gang milling, face milling, slot milling, end milling, slitting. Up milling and down milling. 3.3 Standard milling cutter and its nomenclature, cutting parameters and machining time calculations.
<b>Unit –IV Grinding</b>	4a. Describe with sketches the construction and specifications of the given grinding machine. 4b. Select the grinding process for the given job with justification. 4c. Choose the relevant grinding wheel for the given job with justification.	4.1 Grinding: Introduction, classification, and working of surface and centerless grinding machine. 4.2 Types of grinding wheel, grinding wheel specifications, grinding wheel dressing and truing. Selection criteria for grinding wheel, balancing of grinding wheels, safety



	4d. Prepare the specifications of the specified grinding wheel.	precautions.
<b>Unit-V Gear Cutting</b>	5a. Select relevant indexing and generating method for the given gear. 5b. Choose gear finishing method for a given job. 5c. Explain with sketch given gear finishing method. 5d. Explain with sketch given gear generating method.	5.1 Gear Cutting: Introduction, gear manufacturing methods, universal dividing head and indexing (simple and compound) methods. 5.2 Gear generating methods: Working principles of gear shaping and hobbing. 5.3 Gear finishing methods: Grinding, shaving, advantages, disadvantages and applications.
<b>Unit-VI Boring and Broaching</b>	6a. Select the relevant boring machine for the given job with justification 6b. Select the relevant broaching machine for the given job with justification. 6c. Select the boring operations for given job with justification. 6d. List the different elements of a given broach.	6.1 Boring: Introduction, classification, machine specifications, working of table type horizontal boring machine, tools and operations. 6.2 Broaching: Introduction, classification, specifications of broaching machines, basic parts of horizontal broaching machine and their functions. 6.3 Broach nomenclature, advantages, limitations and applications of broaching machine.

*Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

## 9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Lathe	10	04	06	04	14
II	Drilling	06	02	04	04	10
III	Milling	08	04	04	04	12
IV	Grinding	10	04	04	04	12
V	Gear Cutting	08	04	04	04	12
VI	Boring and Broaching	06	02	04	04	10
<b>Total</b>		<b>48</b>	<b>20</b>	<b>26</b>	<b>24</b>	<b>70</b>

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

*Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

## 10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related co-curricular activities which can be undertaken to accelerate the attainment of the various



outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- a. Prepare journals based on practical performed in workshop.
- b. Visit to manufacturing to industries.
- c. Write specifications of different machine tools observed during industrial visit.
- d. Undertake micro-projects.

#### 11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- b. '*L*' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the COs through classroom presentations (see implementation guideline for details).
- d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- e. Guide student(s) in undertaking micro-projects.
- f. Demonstrate students thoroughly before they start doing the jobs.
- g. Encourage students to refer different websites to have deeper understanding of the subject.
- h. Use Flash/Animations to explain working of machines and its process.

#### 12. SUGGESTED MICRO-PROJECTS

*Only one micro-project* is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based. However, in the fifth and sixth semesters, it should be preferably be *individually* undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should *not exceed three*.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

Suggestive lists of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

- a. Take any 05 component/machine part and identify machining processes required to manufacture it and plan the sequence of operations.
- b. Take any component manufactured using 2-3 machining processes and calculate total machining time required for the same.
- c. Prepare display board to demonstrate the type of gears.
- d. Prepare a report with detailed specifications of machines available in the institute workshop.



**13. SUGGESTED LEARNING RESOURCES**

S. No	Title of Book	Author	Publication
1	Workshop Technology Vol-II	Hajra Choudhury, S. K.	Media Promoters and Publishers; New Delhi ISBN: 9788185099156
2	Manufacturing Technology Vol-II	Rao P. N.	McGraw Hill, New Delhi ISBN: 9781259081231
3	Hand book on Production Technology	HMT	McGraw Hill, New Delhi ISBN: 9780070964433
4	Production Technology Vol- II	Khanna O. P	Dhanpat Rai Publications, New Delhi, 2012, ISBN: 978-9383182039
5	Production Engineering	Sharma P. C.	S. Chand and Co, New Delhi, 1999, ISBN: 978-8121901116

**14. SUGGESTED SOFTWARE/LEARNING WEBSITES**

- a. <http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html>
- b. <http://www.nptelvideos.in/2012/12/manufacturing-processes-i.html>
- c. Simulations of machining processes from YouTube and educational websites.

