Program Name : **Diploma in Mechanical Engineering**

Program Code : **ME**

Semester : **Fourth**

Course Title : **Manufacturing Processes**

Course Code : **22446**

1. RATIONALE

Diploma engineers require the knowledge of core principles of manufacturing processes to design, analyze and manufacture industrial equipments, transport systems, aircrafts, robots and others. This subject intends to help the students in performing various operations on Lathe, Drilling machine, Shaper, Slotter, Welding and Foundry shop. It gives insight of how the raw material gets converted into finished products using various manufacturing processes an parameters.

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 components using conventional manufacturing 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:

a. Produce jobs using lathe and drilling machines.
b. Produce jobs using shaping and slotting operations.
c. Prepare product using different casting processes.
d. Prepare product using different forming processes.
e. Use joining process to produce jobs.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		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 UOs 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.* @ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based 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.

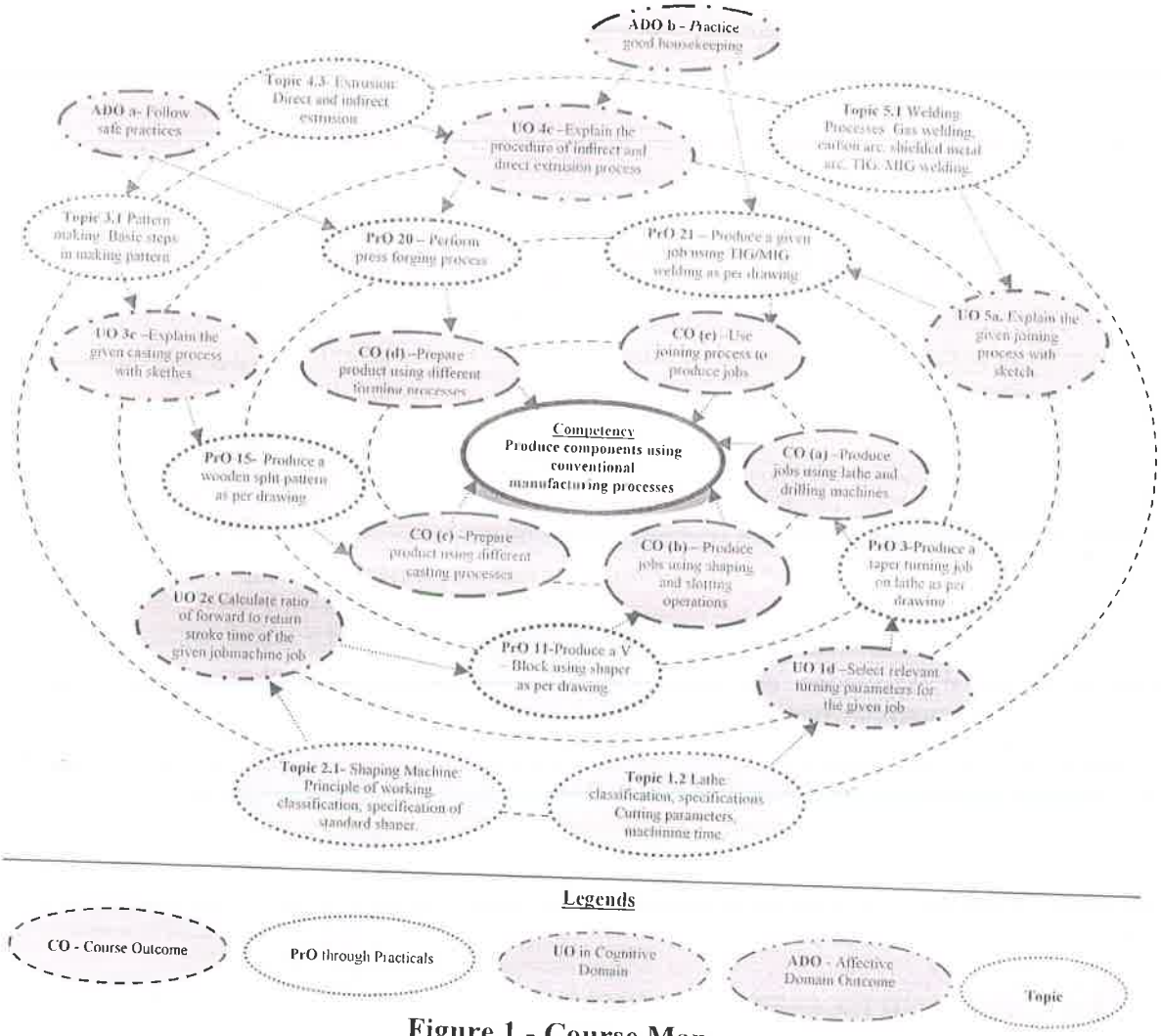

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/EXERCISES:

The practicals 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:

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Produce a plain turning job on lathe as per given drawing.	I	02*
2.	Produce a step turning job on lathe as per given drawing.	I	02
3.	Produce a taper turning job on lathe as per given drawing.	I	02
4.	Produce a turning job on lathe with knurling and chamfering operation as per given drawing	I	02*
5.	Produce an eccentric turning job on lathe as per given drawing	I	02
6.	Produce turning job on lathe with threading operation as per given drawing	I	02

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
7.	Produce turning job on lathe with drilling and boring operations as per given drawing.	I	02*
8.	Use radial drilling machine to produce job with drilling, reaming, tapping and countersinking operation as per given drawing.	I	02*
9.	Produce drilling job on radial drilling machine with boring and spot facing operation as per given drawing.	I	02
10.	Use radial drilling machine to produce job with counterboring and counter-sunk operation as per given drawing.	I	02
11.	Produce a wooden solid pattern as per given drawing.	III	02
12.	Produce a mould by using solid pattern/split pattern as per drawing.	III	02*
13.	Produce a simple Job/product with the help of Hand Plastic molding machine as per given drawing.	III	02
14.	Produce a given job using TIG/MIG welding as per drawing.	V	02
15.	Perform soldering / brazing operation on the given job.	V	02*
	Total		**30**

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 judicial 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 Job drawing, selection of material, tool and estimation of cutting parameters.	20
b.	Setup of machine, tool and Job	15
c.	Actual machining operation	20
d.	Inspection of Job using measuring instrument.	15
e.	Answer to questions on operations	10
f.	Submission of job and workshop diary in time.	10
g.	Safety precautions and good housekeeping	10
	Total	**100**

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/or a team member.
d. Maintain tools and equipment in good working condition.
e. Handle the machine and tools with care.

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 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd 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	Center Lathe Machine (Length between centers : 2000 mm)	1 to 7
2	Radial drilling machine (Drill diameter : upto 40 mm)	8 to10
3	Shaping/Slotting machine (Maximum stroke length : upto 150 mm)	11to13
4	Pattern making, moulding and casting shop with necessary equipments.	14 to16
5	Plastic Hand Moulding Machine	17
6	Rolling mill made for Laboratory work	18
7	Hardness Tester with standard specification of Rockwell Hardness	18
8	Metallurgical Microscope ideal for examining Large and Single Side polished Metal samples	18
9	Extruder and extrusion dies	19
10	Feed system mechanism.	19
11	Forging press	20
12	Dies and punches for press forging.	20
13	Reheating furnace	20
14	TIG/MIG welding set up with suitable specification	21
15	Soldering machine	22

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-I Fundamentals of Machining and Machining Operations	1a. Identify different machining operations to be performed for the given job with justification. 1b. Explain with sketches the procedure of performing the given lathe machine operation on a job. 1c. Explain with sketches the procedure of performing the given Drilling machine operation on a job.	1.1 **Machining Process:** Mechanics of Chip formation, Single point cutting Tool and its geometry. Methods of Machining, Types of Chips, Principal elements of Metal Machining. 1.2 **Lathe:** classification, specifications of center lathe; Basic parts of center lathe and their functions; Lathe accessories: chucks (three jaw, four jaw, and magnetic chuck), mandrels, rests, face plates, centers, and angle

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	1d. Select the relevant turning and drilling process parameters for the given job with justification. 1e. Explain with sketches to measure cutting speed, feed, and depth of cut for the given job in turning and drilling operations.	plates; Lathe operations like facing, plain turning, taper turning, thread cutting, chamfering, grooving, knurling. Cutting tool nomenclature and tool signature. Cutting parameters – speed, feed, depth of cut and machining time. 1.3 **Drill Machine**: Classification, specifications of radial drilling machine. Basic parts of radial drilling machine, sensitive drilling and their functions. Drilling machine operations like drilling, reaming, boring, counter sinking, counter boring, spot facing. Cutting parameters - speed, feed, depth of cut and machining time.
Unit –II Shaping/ Slotting Machines.	2a. Explain with sketches the working of shaping and slotting machines with sketches. 2b. Select the relevant cutting speed, feed, depth of cut for the given job with justification. 2c. Calculate ratio of forward to return stroke time of the given shaping machine job. 2d. Explain with sketches the procedure to produce keyway by the given machine as per the given sketch.	2.1 **Shaping Machine**: Principle of working, classification, specification of standard shaper. Basic parts of standard shaping machine and their functions. Quick return mechanism. Different shaping operations. 2.2 **Slotting Machine**: Principle of working, classification, specification. Basic parts of Slotting machine and their functions.
Unit – III Casting Processes and Plastic Moulding :	3a. Design a pattern for the given job. 3b. Design a mould for the given the job. 3c. Explain with sketches the given casting process with skethes. 3d. Select the relevant furnace for the given raw material with justification. 3e. Select the relevant plastic moulding process for the given job with justification.	3.1 **Pattern making:** Basic steps in making pattern, types, materials and allowances. 3.2 Color coding of patterns 3.3 **Moulding**: Types of moulding sands, properties of sand, moulding methods, cores and core prints. Elements of gating system. Bench and floor moulding methods. 3.4 **Casting:** Safety practices / precautions in foundry shop. Furnaces, construction and working of cupola furnace, electric arc furnace. Centrifugal casting- Method and applications. Casting defects -

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Causes and remedies. 3.5 **Plastic**: Types of plastics; Plastic processing like Calendering and vacuum forming. 3.6 **Plastic moulding methods** – Compression moulding, Injection moulding, Blow moulding and Extrusion. Applications of plastic moulding methods.
Unit– IV Forming Processes	4a. Select the relevant forming process for the given component with justification. 4b. Identify the point of differences between forging, rolling and extrusion process with justification and sketches. 4c. Explain with sketches the given extrusion process as per the given job with sketches.	4.1 **Drop forging**: Introduction to forging. Upset forging, press forging, open die and closed die forging operations. 4.2 **Rolling**: Principle of rolling, hot and cold rolling. Types and applications of rolling mill. 4.3 **Extrusion**: Direct and indirect extrusion. Advantages, disadvantages, applications of extrusion processes.
Unit–V Joining Processes	5a. Explain with sketches the given joining process with sketch. 5b. Select the relevant joining process for the given job with justification. 5c. Select the relevant soldering/ brazing process for the given job with justification. 5d. Identify types of the welding defects in the figure given component with justification. 5e. Select the relevant fillers as per the job with justification.	5.1 **Welding Processes:** Gas welding, carbon arc welding, shielded metal arc welding, TIG welding, MIG welding, plasma arc welding, resistance welding types - spot, seam and projection. Electron beam welding, laser beam welding, welding defects. 5.2 **Introduction to soldering and brazing** Process, fillers, heating methods and applications.

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	Fundamental of machining and Machining Operations	12	04	04	08	16
II	Shaping/Slotting Machines.	08	02	04	06	12
III	Casting Processes and plastic moulding	12	04	06	08	18

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Forming Processes	10	02	06	08	16
V	Joining Processes	06	02	02	04	08
Total		**48**	**14**	**22**	**34**	**70**

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. Visit a Foundry shop and observe the Centrifugal/Investment/Die Casting process and identify the different defects on the surface of component.
b. Visit a plastic molding industry and collect information on types of molding machines, its specification and observe various activities performed in a molding process.
c. Visit an industry where the operation like drop forging, rolling and extrusion are carried out. Collect information on types these machines, their specification and observe various activities performed and characteristics of output product.
d. Visit a Industry/workshop to observe the process like seam, spot, TIG and MIG welding. Collect information on these machines, their specification and observe these processes critically to get information regarding various accessories (electrodes, current rating etc.) used in these processes.
e. Collect information of recent advancement in manufacturing processes, machines/tools/equipment and their specifications/manufacturer and application in the industries.
f. Collect information of various forming processes used in industries. Observe shape of input and output products and suggest suitable operation for various jobs.

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 the different components of the machine to the students thoroughly before they start doing the practice.
g. Demonstrate trouble shooting practice to the students.
h. Encourage students to refer different technical websites, videos of manufacturing processes to have deeper understanding of the subject.

12. SUGGESTED MICROPROJECT:

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-project 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.

A suggestive list of micro-projects are given here. Similar micro-projects could be added by the concerned faculty:

a) Prepare a cast product of different mechanical engineering drawing models with wax material.
b) Prepare various types of welding joints (with metal components). Display them on wall board.
c) Fabricate types of keys like sunk key, woodruff key, spline etc.
d) Prepare various types of patterns/ core/ core box etc with suitable material.
e) Prepare a model of Quick-Return Mechanism using wood material.
f) Prepare model Pulley and Belt drive system used in the lathe.
g) Prepare Model of Direct Extrusion process.
h) Prepare Hammer forging working Model.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Manufacturing Engineering Handbook	Hwaiyu Geng	McGraw Hill,New York, 2000, ISBN:9780071398251
2	Workshop Technology, Volume- I and II	Raghuvanshi B.S.	Dhanpat Rai Publications, New Delhi, 2009, ISBN 10:0470534915
3	Production Technology (Manufacturing Processes)	Sharma P.C.	S. Chand and Company, 2013, New Delhi, ISBN:9788721911146
4	Text book of Production Technology	Khanna O.P.	Dhanpat Rai Publications, New Delhi, 2010, ISBN :9788189928322
5	A text book of Foundry Technolgy	Khanna O.P.	Dhanpat Rai Publications, New Delhi, 2010, ISBN :9788189928346
6	Elements of workshop Technology-Volume I	Chaudhary Hajra S.K.	Media Promoters and Publishers Ltd., Mumbai, 2005

	and Volume II		ISBN : 9788185099156
7	Workshop Technology Volume- I and II	Bawa H.S.	McGraw-Hill Education, New Delhi, 2011. ISBN : 13:EBK0009651
8	Workshop Technology Part- I and II	Chapman W.	Taylor and Francis, New Delhi, 1995, ISBN:13:9780415503020
9	Materials and Processing in Manufacturing	Black J.T. Kosher Ronald A.	Wiley India Pvt.Ltd., New Delhi 1999, ISBN:9788126540464

14. LEARNING WEBSITES

a) http://nptel.ac.in
b) www.basicmechanicalengineering.com/lathe-machine-operations-basic-turning-
c) www.mechengg.net/2016/0peration-performed-on-shaping-machine.html
d) www.protolabs.com/injection-molding/plastic-injection-molding/
e) www.thelibraryofmanufacturing.com /forming_basics.html
f) www.themetalcasting.com/casting-process.html