Program Name : **Diploma in Automobile Engineering**

Program Code : **AE**

Semester : **Fourth**

Course Title : **Automobile Manufacturing Processes**

Course Code : **22439**

1. RATIONALE

Automobile manufacturing processes is a core technological subject. With advent of technology there are many advances in manufacturing processes and equipment. The knowledge of these advances is essential for a diploma student engaged in automobile manufacturing organizations and as prerequisite knowledge for subject like Automobile component design. Students should be able to prepare CNC part programs and apply it on CNC machine in manufacturing industry.

2. COMPETENCY

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

- **Use various manufacturing processes to produce automobile components.**

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 automobile industry oriented COs associated with the above mentioned competency:

a. Use relevant forging hand tools,material and methods in manufacturing.
b. Use relevant press tool dies and materials to produce components.
c. Execute relevant welding methods for different materials.
d. Execute relevant surface treatment processes for automobile components.
e. Execute CNC part programs.

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*

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.

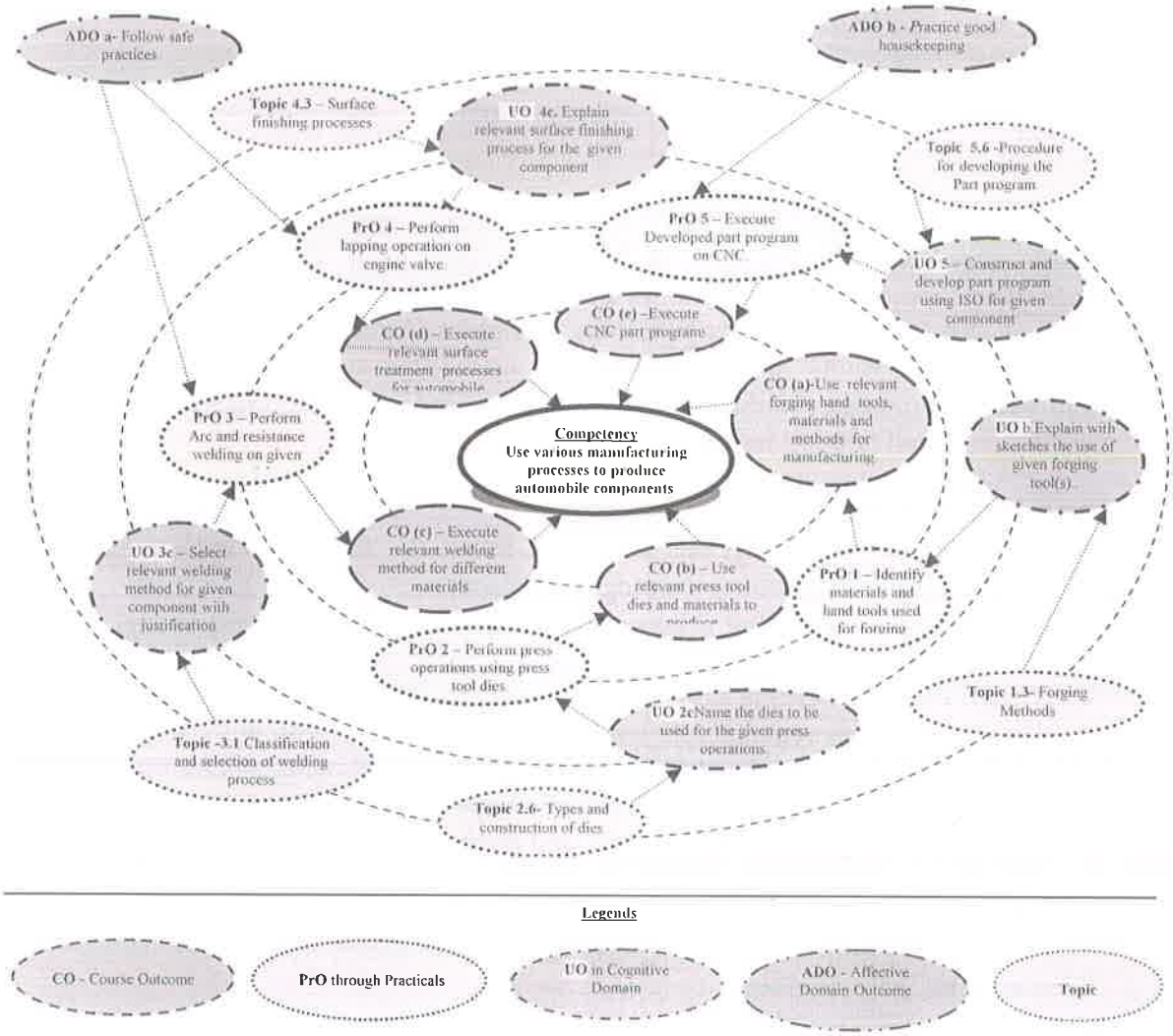

Figure 1 - Course Map

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:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Identify materials and hand tools used for forging.	I	01*
2.	Identify the parts of open die forging machine.	I	01
3.	Identify the parts of closed die forging machine.	I	01
4.	Shear the metal sheet as per dimensions.	II	01*
5.	Prepare the blank as per stamping shape	II	02
6.	Perform press operations using press tool dies.	II	02*
7.	Prepare the edge on metal piece for arc welding.	III	02
8.	Perform welding operation on any one of the arc welding machine.	III	02*
9.	Perform welding operation on any one of the resistance welding	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	machine.		
10.	Perform hand lapping operation on engine valve.	IV	02*
11.	Prepare part drawing and Determine the coordinates as per absolute coordinate method.	V	02*
12.	Cut the stock(raw material) of equal dimensions for a group of four students.	V	02*
13.	Prepare the part program using G codes and M codes.	V	02*
14.	Set the work and tool offset on CNC as per operations..	V	02*
15.	Feed the part program into CNC and simulate through dry run.	V	02
16.	Execute the part program for turning on CNC lathe.	V	02*
17.	Execute the part program for Drilling operation on VMC.	V	02*
18.	Execute the part program for Milling operation on VMC.	V	02*
	Total		**32**

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.	Dimensional accuracy	40
b.	Surface finish achieved	20
c.	Use of protective equipment	10
d.	Following safety rules	20
e.	Submitting workshop diary in time	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 safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. 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 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	Fly press of 1 tonne capacity	6
2	Arc welding machine upto 14 kVA	7,8
3	Resistance welding machine upto 10kVA	9
4	CNC lathe(turning centre) Oi-mate TD. 02. CAPACITY	13,14,15,16
5	VMC Machine. 1200M. Table size, mm, 1200 x 510, 1500 x 630. Traverses X, Y & Z axes, mm, 1000 x 500 x 500l), 1200 x 600 x 600. Rapid rate, m/min, 12 (standard), 20/32 (optional),	17,18

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
Unit – I Forging processes	1a. Select the material for the given forging operation with justification. 1b. Explain with sketches the use of given forging tool(s). 1c. Describe with sketches the salient features of the given forging method. 1d. Select the forging sequence(s) for the given forging method(s) with justification.	1.1 Forgeable materials and forgeability; Classification of forging processes 1.2 Forging hand tools. 1.3 Forging methods: open die, closed die, press and machine forging 1.4 Forging sequences for Auto components-Connecting rods, Crankshafts, Camshafts and Spanners.
Unit-II Press and Press Operations	2a. Select the material for the given press operation with justification. 2b. Describe with sketches the die accessories for the given press dies. 2c. Name the dies to be used for the given press operations with justification. 2d. List the relevant press operations for the given stampings.	2.1 Materials used in press work for automobile applications. 2.2 Classifications of presses and terminology used in presses 2.3 Major parts of Fly press 2.4 Parts of standard die set 2.5 Die accessories- Pilots, Stops, Strippers, Pressure pads and Knock outs 2.6 Types and construction of dies— Simple, progressive, compound and combination die. 2.7 Press operations – a) Cutting operations - Blanking,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Piercing, Lancing, Coining, Perforating, Notching, Embossing, Shaving. b) Forming Operations - Bending, Drawing, Squeezing.
Unit– III Welding Processes	3a. Categorize the welding processes for the given materials. 3b. Identify the type(s) of gas welding flame used for the given metal with justification. 3c. Select the relevant welding method for the given component with justification. 3d. Explain with sketches the use of filler and flux material for the given welding process.	3.1 Classification and selection of welding process. 3.2 Gas(Oxy-acetylene)welding and types of flames. 3.3 Arc welding – Shielded metal arc, TIG and MIG. 3.4 Resistance welding-Spot, Seam and Projection. 3.5 Brazing and soldering. 3.6 filler and flux materials in welding.
Unit– IV Surface Treatment Processes	4a. Select the relevant surface cleaning process for the given material(s). 4b. Explain with sketches the relevant surface coating process for the given component. 4c. Explain with sketches the relevant surface finishing process for the given component with justification 4d. State the applications of the given surface treatment processes with justification.	4.1 Surface cleaning processes- acid, alkaline, electrolytic cleaning, blasting and tumbling. 4.2 Metallic surface coating- Electroplating, Galvanizing, metal spraying and powder coating. 4.3 Surface finishing processes: Lapping, honing, super finishing, buffing, burnishing and their applications.
Unit –V CNC Machines and Programming	5a. Identify the specification of the given inserts with justification. 5b. Describe the absolute and incremental co-ordinate system for the given part program with examples. 5c. Develop part program using ISO codes for the given component. 5d. Describe with sketches the procedure to run the developed part program on CNC machine for the given component.	5.1 CNC machines:Classification. . 5.2 Insert spectification . 5.3 Absolute and Incremental Co-ordinate system; Axes configuration- X, Y and Z axes. 5.4 Procedure for developing the Part program; ISO Codes used in programming. 5.5 Simple Part programming as per ISO codes on CNC and VMC for operations like turning, drilling and Milling.

***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	Forging processes	08	2	4	4	10
II	Press and Press Operations	10	4	6	6	16
III	Welding processes	08	4	4	4	12
IV	Surface Treatment Processes	06	2	2	4	08
V	CNC machines and programming	16	4	8	12	24
Total		**48**	**16**	**24**	**30**	**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. Prepare specification of forging and press machines.
b. Prepare list of filler and flux materials used in welding.
c. List automobile components which require surface treatment process.
d. List G and M codes used in CNC machines.
e. Collect specifications of CNC machines and tools.
f. Prepare power point presentation or animation for understanding different manufacturing processes.

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. Use Flash/Animations to explain various manufacturing methods.
g. Guide student(s) in undertaking micro-projects.
h. Invite expert from industry for guest lecture on advanced manufacturing methods.
i. Industrial visit to relevant manufacturing processes.

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-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. Select any one component of automobile for each group.
b. List the materials and manufacturing methods for the selected components.
c. Study,compare and select best suitable material and manufacturing method for the selected component.
d. Prepare sequence of operations in manufacturing of selected component.
e. Select relevant surface finishing process for the manufactured component.
f. Engrave student name on a flat work piece using end mill.
g. Collect information on special attachments used in CNC machine like Automatic tool changer etc.
h. Prepare a report on how to select machining parameters for Aluminum, Mild steel, Stainless steel and Nickel materials.
i. Prepare a list of domestic and industrial components on which Lapping, honing, buffing, polishing, Electroplating, Galvanizing, metal spraying and powder coating are performed. For each process collect information about the material, machines and other resources required. Also prepare list of industries in your state doing these processes.
j. Survey nearby welding/fabrication shops and prepare a report on the type of welding performed, machine devices used, filler and fluxes used, metal welded. Compare the Arc welding machine used for Mild steel and Stainless steel.
k. 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.
l. 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.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Elements of Workshop Technology Vol. I and Vol. II	Hajra, Choudhury S.K. Hajra,	Media Promotors, Mumbai, 2010 Vol I-ISBN: 9788185099149 Vol II-ISBN: 9788185099156

S. No.	Title of Book	Author	Publication
		Choudhury A.K.	
2	Production technology	Sharma, P.C.	S. Chand, Mumbai, 2006 ISBN: 9788121911146
3	A Course in Workshop Technology, Vol. I and Vol. II	Raghuvanshi, B. S.	Dhanpat Rai and Company, New Delhi, 2015, Vol I-ISBN: 123456 7144613, Vol II-ISBN: 123456 7144375
4	CNC machines programming and applications	Pabla, Aditan	New age International Publication, New Delhi, 2012, ISBN:9788122434262
5	CAD/CAM Principles and applications	Rao, P.N.	McGraw-Hill Publishing Co. Ltd, New Delhi, 2012, ISBN:9780070681934
6	CAD/CAM/CAE	Chougule, N. K.	Scietech, Chennai, 2009 ISBN:9788183711753

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.mechanicalengineeringprojects.net/
b. www.npkauto.com/notes
c. http://www.nptelvideos.in/2012/12/physics-of-materials.html
d. http://gen.lib.rus.ec/search.php?req=automobile&open=0&res=25&view=simple&phrase=0&column=def
e. bookzz.org/automobile manufacturing processes