Maharashtra State Board of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Production Engineering / Diploma in Production Technology

Program Code : PG / PT | **With Effect From Academic Year: 2017 - 18**

Duration of Program : 6 Semesters | **Duration : 16 Weeks**

Semester : Sixth | **Scheme : I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Management	MAN	22509	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--	100
2	Tool Engineering	TEN	22565	3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Emerging Trends in Mechanical Engineering	ETM	22652	3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--	100
4	Estimation and Costing	EAC	22662	3	2	-	5	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
5	Process Engineering	PEN	22664	4	-	2	6	3	70	28	30*	00	100	40	25#	10	25	10	50	20	150
6	Capstone Project - Execution and Report Writing	CPE	22060	-	-	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40	100
			Total	**16**	**2**	**8**	**26**	--	**350**	--	**150**	--	**500**	--	**100**	--	**100**	--	**200**	--	**700**

Student Contact Hours Per Week: **26 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **700**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* 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 LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Diploma in Mechanical Engineering / Diploma in Production Technology / Diploma in Production Engineering**

Program Code : **ME / PG / PT**

Semester : **Fifth for ME (Elective) and Sixth for PG/PT**

Course Title : **Tool Engineering (Elective for ME)**

Course Code : **22565**

1. RATIONALE

Tools are basic component required 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 using suitable Jigs and Fixtures. 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 basic cutting tools, jigs and fixtures are also dealt with in this course.

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 different types of tools, dies, jigs and fixtures to machine simple 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 industry oriented COs associated with the above mentioned competency:

a. Interpret geometries of various cutting tools.
b. Use relevant cutting tool insert and tool holders for different machining operations.
c. Use relevant locating and clamping devices for components.
d. Use relevant Jig and Fixture for components and machining operations.
e. Use relevant Press tools and Press tools operations.
f. Use relevant Die for bending and forging simple components.

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.

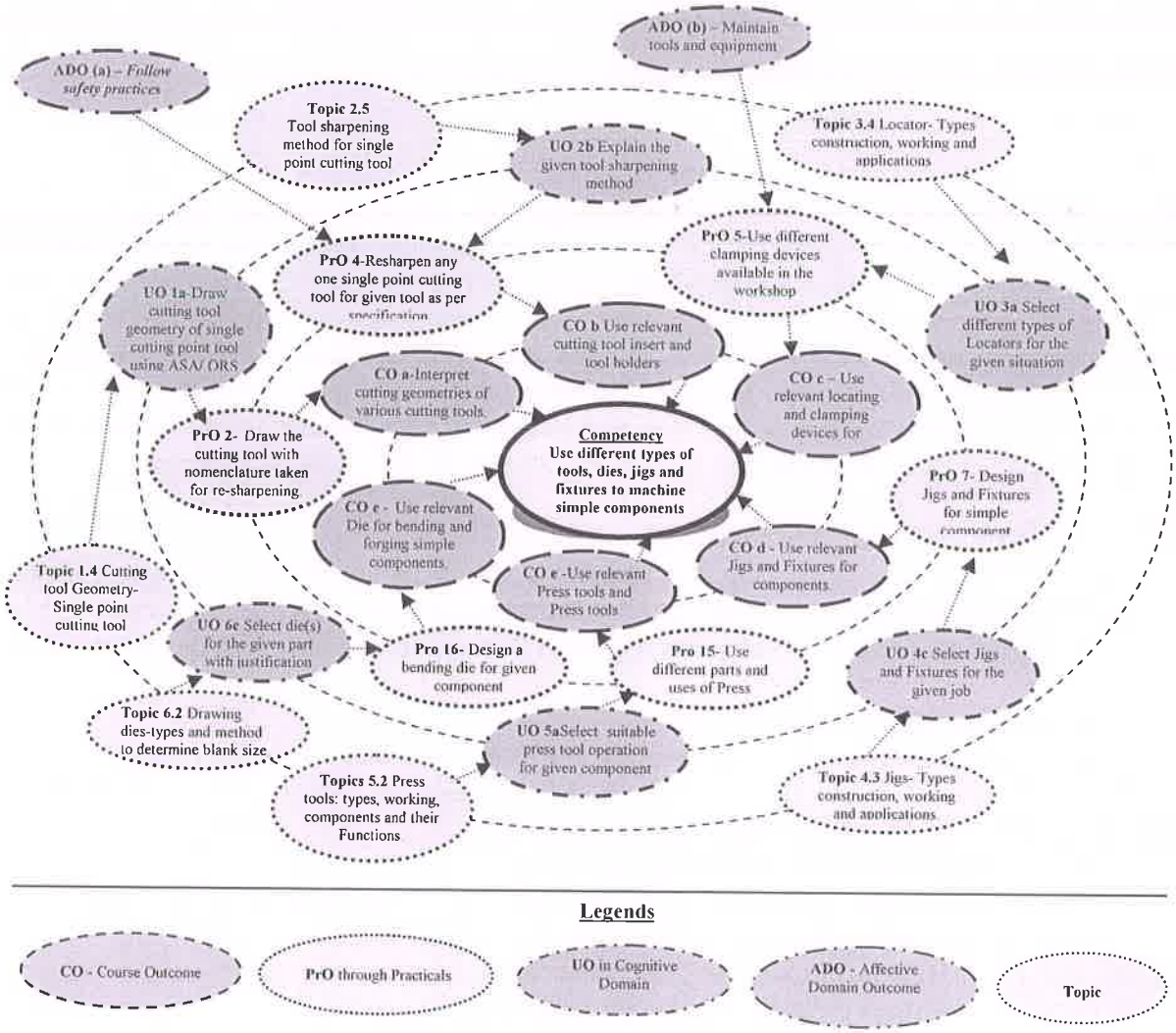

Figure 1 - Course Map

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 the use of different types of tools, and their designation systems.	I	02*
2	Draw the cutting tool with nomenclature taken for re-sharpening.	I	02
3	Use different tool holders and their use with specific applications.	II	02*
4	Re-sharpen any one Single Point Cutting Tool as per given specification.	II	02
5	Use different clamping devices and their use available in the workshop.	III	02
6	Use different locators and their use available in the workshop	III	02
7	Design a Jig and Fixture for machining of a given simple component. (Part-I)	IV	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
8	Design a Jig and Fixture for machining of a given simple component. (Part-II)	IV	02*
9	Draw assembly and detail drawing of the designed Jig.	IV	02*
10	Draw assembly and detail drawing of the designed Fixture.	IV	02*
11	Design a progressive cutting die for a simple component.	V	02
12	Draw assembly and detail drawing of the designed progressive cutting die. (Part-I)	V	02
13	Draw assembly and detail drawing of the designed progressive cutting die. (Part-II)	V	02
14	Prepare Strip layout of simple component.	V	02*
15	Use different parts and uses of Press.	V	02*
16	Design a bending die for given component.	VI	02*
17	Draw bending die indicating all parts and dimensions.	VI	02
18	Estimate blank size for Deep Drawing a simple component.	VI	02
	Total		**36**

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 experimental set up	20
b.	Setting and operation	20
c.	Safety measures	10
d.	Observations and Recording	10
e.	Interpretation of Result and Conclusion	20
f.	Answer to sample questions	10
g.	Submission of report 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 safety practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
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 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	Single point cutting tool- 2 Qty	1,4,5
2	Drill – M12/M16/M20 size	1
3	Grinding Machine- Grinder Size 100 mm min.	1,4,5
4	Tool holders- Milling Cutter mandrill, Drill tool holder, Tool post of Lathe machine (Qty one each)	2
5	Clamping devices for drilling machine, Milling machine, Chucks (Qty one each)	5
6	Different Press tools	13

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 Basics of Tool Engineering	1a. Classify the given cutting Processes. 1b. Estimate cutting forces in the given simple numerical problem situation. 1c. Draw cutting tool geometry of single cutting point tool using given ASA or ORS system. 1d. State the shear angle required for the given job with justification	1.1 Principles in tool engineering. 1.2 Mechanics of Metal cutting: requirements of tools. 1.3 Cutting forces – Merchant circle, types of chips, chip thickness ratio, shear angle. Shear angle- concept, need and method to give shear angle on punch and die. 1.4 Types of metal cutting process - orthogonal, cutting 1.5 Cutting tool Geometry- Single point cutting tool
Unit– II Cutting Tool Material and Holding Devices	2a. List the different properties and composition of the given tool material(s). 2b. Interpret ISO designation of the given tool insert. 2c. Select tool holders and inserts for the given component and machining operation with justification. 2d. Explain the given tool sharpening method(s).	2.1 Cutting tool materials - types, composition, properties and applications. 2.2 Carbide inserts -types, ISO -designation and Applications. Other inserts like CBN and PCBN. 2.3 Tool holders for turning, milling machines and CNC machines. 2.4 ISO designations of Tool holders. 2.5 Tool sharpening method for single point cutting tool.
Unit-III Locating and Clamping devices	3a. Explain principle of location with reference to the given work piece. 3b. Calculate the Degrees of freedom in the given	3.1 Concept, definition locating and clamping. 3.2 Use of locating and clamping principles on shop floor. 3.3 Degree of freedom concept and importance.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	situation. 3c. Select different types of Locators for the given situation with justification. 3d. Select different types of Clamping devices for the given situation with justification.	3.4 Locator- Types construction, working and applications. 3.5 Clamping devices - Types construction, working and applications 3.6 Fool proofing and ejecting techniques.
Unit –IV Jigs and Fixtures	4a. Differentiate between given type of jig and fixture. 4b. Select the relevant Jigs for the given component with justification. 4c. Select the relevant fixtures for the given component with justification 4d. Explain the design procedure for the given Jig and fixture.	4.1 Concept, definition of jigs and fixtures. difference between jigs and fixtures. 4.2 Jigs- Types construction, working and applications. 4.3 Fixtures - Types construction, working and Applications. 4.4 Design considerations and procedure for Jigs and Fixtures.
Unit-V Press Tool design	5a. Select suitable press tool operation for the given simple press tool component with justification. 5b. Calculate press tonnage and centre of pressure for the given press tool component. 5c. Prepare scrap strip layout for the given press tool component. 5d. Design progressive cutting die for the given simple 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. Shear action in die cutting operation. 5.4 Centre of pressure: Concept, meaning, definition, Methods of finding and importance. 5.5 Die clearance: Concept, meaning, definition, Reasons, effects and methods of application. 5.6 Cutting force: Methods to calculate and methods of reducing. 5.7 Scrap strip layout: - Concept, importance, method to prepare, and determining percentage stock utilization. 5.8 Types, working, and applications of stock stop, pilots, strippers and knockouts. 5.9 Cutting dies-types and applications. 5.10 Design of progressive cutting die: a) Sketch the component. b) Prepare scrap strip layout. c) Calculate tonnage. d) Determine centre of pressure. e) Determine dimensions of punches, die block and die shoe. f) Prepare sketch of stripper plate. g) General assembly sketch of punches arrangement, die block, die shoe and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		stripper plate.
Unit-VI Bending, Drawing and Forging Dies	6a. Calculate bend radius, bend allowance and spring back for the given simple part. 6b. Draw labeled sketch of the given die(s). 6c. Select die(s) for the given part with justification.	6.1 Bending dies - a) Types and Parts and functions of bending die. b) Definition, calculations and factors affecting bend radii, bend allowance and spring back. c) 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, Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging). 6.3 Forging dies- terminology, types, sketch, working and application

***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	Basics of Tool Engineering	06	02	02	04	08
II	Cutting Tool Material and holding devices	06	02	02	04	08
III	Locating and Clamping devices	06	02	04	04	10
IV	Jigs and Fixtures	08	02	04	06	12
V	Press Tool design	12	04	06	10	20
VI	Bending, Drawing and Forging Dies	10	02	04	06	12
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 any industry and collect information related to tool engineering practices.

b. Prepare journal based on practical performed in Tool Engineering laboratory. Journal consists of drawing, observations, required materials, tools, equipments, date of performance with teacher signature.
c. Prepare/Download specifications of followings:
   i. Tools and equipment in Tool engineering laboratory.
   ii. Machineries in Tool Engineering laboratory
d. Undertake a market survey of local dealers for tools, equipments; machineries and raw material and prepare a report.
e. Visit to any press tool industry and prepare a report consisting of
   i. Types of press
   ii. Types of dies
   iii. Types of operations
   iv. Types of fool proofing arrangement
   v. Safety precautions observed.

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 practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.
i. Guide student(s) in undertaking micro-projects.
j. Arrange visit to nearby industries for understanding various tool engineering operations
k. Show video/animation films to explain tool design processes.
l. Use different instructional strategies in classroom teaching.
m. In respect of item no.10 above the teachers need to ensure to create opportunities and support sustem for such co-curricular activities.

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 thc 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. Preparation of Wax/Rubber model of various dies/single point cutting tools.
b. Collect various Carbide inserts as per ISO specification.
c. Measure press capacity of any press available in industry or nearby industry.
d. Design simple Clamming devices/Jigs/Fixtures/locating for simple jobs.
e. Collect specifications of different Jigs and fixtures.
f. Sketch different jigs /fixtures/clamping devices available in institute workshop.
g. Identify and restrict degree of freedom of a given component for designing a clamping/locating device for a given machining operation.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Fundamentals of Electrical Networks	Gupta, B.R, and Singhal Vandana	S.Chand and Co., New Delhi, 2005 ISBN: 978-81-219-2318-7
2	Tool Design	Donaldson Cyrll	Mcgraw Hill Education, 2000 ISBN: 9780070153929, 0070153922
3	Tool Engineering, Jigs and Fixture	Atkins Albert	McGraw-Hill, 1922 ISBN/ASIN: 1151454966
4	Fundamentals of Tool Engineering Design	Basu S. K.	Oxford Ibh, 1979 ISBN 812040016X, 9788120400160
5	Tool Engineering and Design	Nagpal G. H.	Khanna Publication, 2003 ISBN : 817409203X
6	Machine tool and Tool Design	Sharma P. C.	S.Chand Publishing, 2012 SBN: 9788121923620,

14. SOFTWARE/LEARNING WEBSITES

a. https://www.youtube.com/watch?v=Mn9jpqI8rao
b. https://www.youtube.com/watch?v=bUrp8JMRwx4andvl=en
c. https://www.youtube.com/watch?v=qaG_vxsfLUg
d. https://www.youtube.com/watch?v=EgTzD_8dUFc
e. https://www.youtube.com/watch?v=CrWxJ58la1E
f. https://www.youtube.com/watch?v=Pb20Rkx25yA
g. https://www.youtube.com/watch?v=Hp7UC5ite5M
h. https://www.youtube.com/watch?v=lcrK2Po8fJI
i. https://www.youtube.com/watch?v=_E1GCE2dDcY
j. https://www.youtube.com/watch?v=7yzvno4AvKw
k. https://www.youtube.com/watch?v=yoUxqeAN0So
l. https://www.youtube.com/watch?v=_r7djWX8X34
m. https://www.youtube.com/watch?v=Us7kjBmRL-Q
n. https://www.youtube.com/watch?v=S9qzJat3Mzk
o. https://www.youtube.com/watch?v=I71YrXafg0o
p. https://www.youtube.com/watch?v=wulJZzORm3wandpbjreload=10
q. https://www.youtube.com/watch?v=i5ZGSMXw5nU
r. https://www.youtube.com/watch?v=WJ_VlWd0EsA
s. https://www.youtube.com/watch?v=93-VH01ACB4
t. https://www.youtube.com/watch?v=MtNTFvP0uAI
u. https://www.youtube.com/watch?v=eqKa2gv9Kx0
v. https://www.youtube.com/watch?v=m8EoGASM0SI
w. https://www.youtube.com/watch?v=til4UOBTRg0

Program Name : **Diploma in Production Engineering / Production Technology**

Program Code : **PG/ PT**

Semester : **Sixth**

Course Title : **Estimation and Costing**

Course Code : **22662**

1. RATIONALE

The aim of this course is the present course intends to give the exposure of various methods estimating and costing of various product as well as processes of manufacturing. The subject will give the better knowledge of costing as well as estimating for a product whose scale ranges from miniature to extra-large. Since 'Estimation and Costing' is an important manufacturing route to fabricate bulk storage and processing equipment's. The course focuses on knowledge and understanding of various costing techniques.

2. COMPETENCY

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

- **Optimize the cost of the product by estimation and costing techniques.**

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) Interpret the cost sheet and estimate sheet.
b) Evaluate project report.
c) Prepare estimate of material and process.
d) Use cost control and cost reduction techniques
e) Interpret balance sheet.

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	--	--	--	--	--	--	

(*): 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 LOs 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, Learning Outcomes i.e. LOs 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.

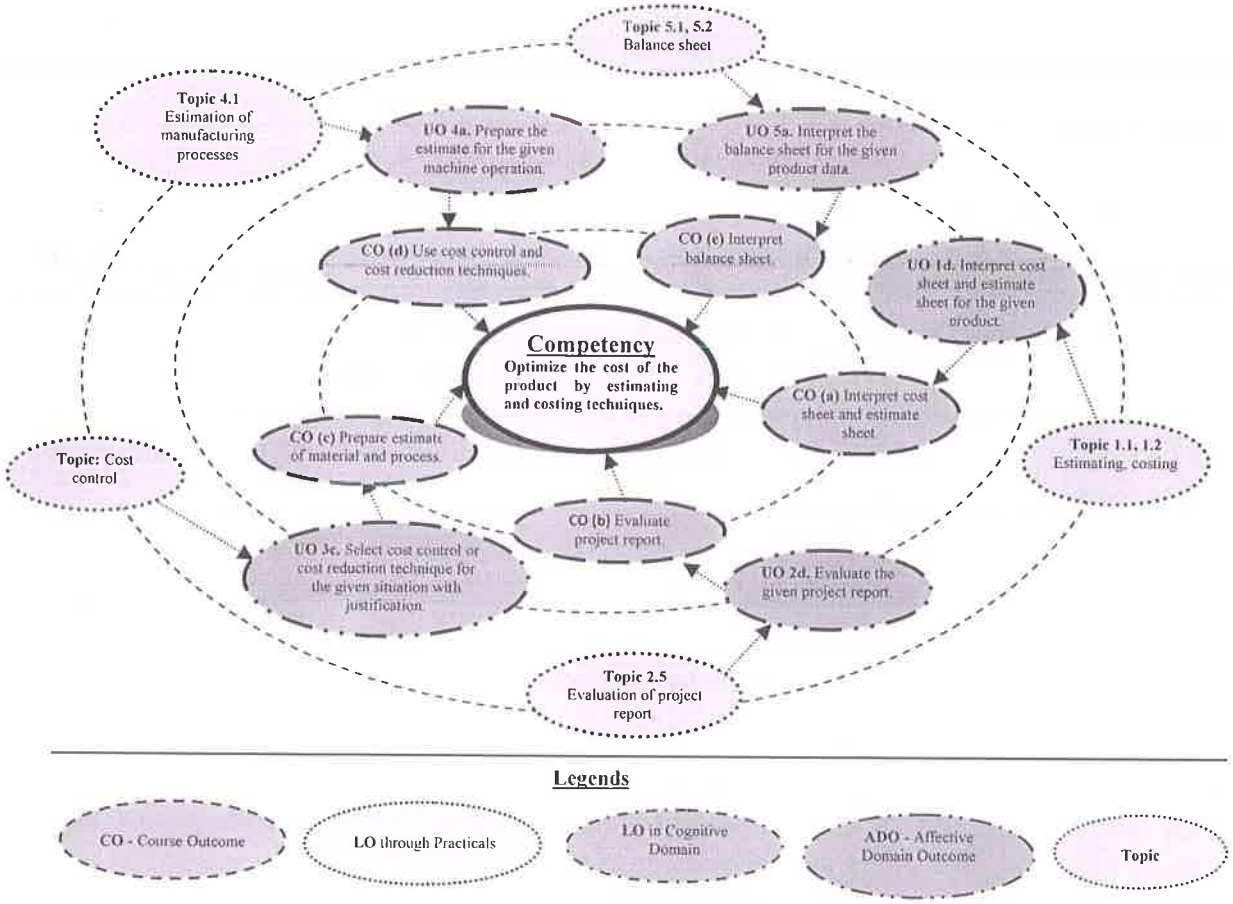

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

Not Applicable

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Not Applicable

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 Introduction to estimating and costing	1a. Describe estimation procedure for the given product/process. 1b. Describe the costing method for the given product/process. 1c. Estimate the cost of given product. 1d. Interpret cost sheet and estimate sheet for the given product.	1.1 Estimating: Definition, importance, aim, functions, estimating tools and resources, estimating workload, profit, estimation procedure. 1.2 Costing: Definition, aims of costing, elements of costs (prime, material, labour and overheads), standard cost, advantage of standard cost. 1.3 Costing methods: Procedure for costing, product costing, job

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		costing and process costing. 1.4 Difference between estimating and costing.
Unit– II Cost accounting	2a. Suggest relevant pricing method for given product with justification. 2b. Prepare cost sheet for the given product. 2c. Calculate the breakeven point for the given production. 2d. Evaluate the given project report.	2.1 Introduction to Pricing, Pricing methods - Cost based pricing, Competition based pricing, customer-based pricing, pricing decisions. 2.2 Nature and types of costs, elements of costs, overheads, relationship among elements of costs, determination of product cost and selling price. 2.3 Preparation of cost sheet, 2.4 Breakeven analysis (cost benefit analysis): Typical uses, assumptions and application of breakeven analysis, Calculation of breakeven point, profitability analysis. 2.5 Evaluation of project report.
Unit– III Cost control	3a. Describe the given cost control techniques. 3b. Apply cost control techniques for the given situation. 3c. Select cost control or cost reduction technique for the given situation with justification. 3d. Apply cost reduction techniques for the given situation. 3e. Perform value analysis of the given product. 3f. Explain the given terms like value analysis, simplification and rationalization with examples. 3g. Calculate depreciation for given equipment.	3.1 Cost control- techniques of cost control. Control of material, labour and overhead cost. 3.2 Cost reduction, cost saving areas, rework and rejection, variance analysis. 3.3 Value analysis: Introduction, Definition, objectives of value analysis, difference between value analysis and value engineering, unnecessary costs, techniques of value analysis and value engineering, advantages of value analysis. 3.4 Simplification, standardization, rationalization. 3.5 Depreciation: Definition and concept of depreciation, Classification of depreciation, methods of calculating depreciation, Obsolesce.
Unit– IV Estimation of Manufacturing Processes	4a. Prepare the estimate of the given machine operation. 4b. Prepare the estimate for the given non-traditional machining operations. 4c. Estimate the melting efficiency for the given welding process. 4d. Estimate the dimensions of the pattern for the given part.	4.1 Machine shop: Estimation of machining time in lathe work, drilling, face and slab milling and surface grinding, Estimation of MRR in drilling operation. 4.2 Non-tradition machining process: Estimation of machining time and MRR in

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	4e. Estimate the pouring time and pouring rate for given part.	EDM, ECM, AJM machining. 4.3 Welding shop: Estimation of melting efficiency in arc welding and resistance welding. 4.4 Pattern making and foundry shops: Estimation of pattern dimensions, pouring time and pouring rate for grey cast.
Unit –V Financial analysis	5a. Interpret the balance sheet for the given product data. 5b. Calculate simple and compound interest for the given time period. 5c. Describe the reasons of replacement of equipment with justification. 5d. Describe the given terms like N.P.V., yield annual capital charges and DCF with examples. 5e. Calculate the rate of return for the given time period.	5.1 Balance sheet, elements of balance sheet. 5.2 Interest- simple and compound interest, normal and effective rate of interest. 5.3 Meaning of EMI 5.4 Replacement analysis: Introduction, reasons of replacement of equipment, factors for replacing equipment, advantages of replacement analysis. 5.5 Meaning of N.P.V., yield annual capital charges and DCF. 5.6 Conventional methods and comparison of investment decision - payback period, accounting rate of return and discounted cash flow (DCF) method.

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	Introduction to Estimating and Costing	8	04	04	04	12
II	Cost accounting	14	04	08	06	18
III	Cost Control	8	04	04	04	12
IV	Estimation of Manufacturing Processes	10	04	06	06	16
V	Financial Analysis	8	04	04	04	12
Total		**48**	**20**	**26**	**24**	**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 LOs. 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 laboratory/workshop.
b) Give seminar on relevant topic.
c) Undertake micro-projects.
d) Prepare models/charts related to different processes.
e) Collect information on the latest modification and improvement done regarding various techniques.
f) Visit to the industries and identify different type of procedure/methods adopted by the industry to optimize the cost.

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/subtopics.
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) Arrange visit to nearby industries.
g) Give Micro projects.
h) Use different instructional strategies in classroom teaching.
i) In respect of item no.10 above the teachers need to ensure to create opportunities and pursue for such co-curricular activities.

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.

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

a) Prepare a report on cost control techniques used by manufacturing firm in your area.

b) Visit nearby industry/workshop and identify the elements of costs and the techniques used by them to control and reduce the cost and prepare a report.
c) Prepare a project report for workshop/auto mobile shop.
d) Prepare a case study on balance sheet of various processes included in manufacturing industry/Automobile industry/Workshop nearby you.
e) Visit machine shop/forging shop/sheet metal shop/welding shop and prepare estimate of various process used by them.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Production Engineering Estimating and Costing	Aduthan M., Pabla B. S.	Konark Publishers Pvt. Ltd, New Delhi, ISBN-13: 978-8122001426
2	Mechanical Estimation and Costing	Banga T. S., Sharma S. C.	Khanna publishers, New Delhi ISBN-13: 978-8174091000
3	Process planning and cost estimation	Adithan M	New Age International, New Delhi ISBN: 978-81-224-3454-5
4	Mechanical Estimating and Costing	Sinha B.	Khanna publishers, New Delhi ISBN-13: 978-0074624111
5	A Textbook of Production (Operation) Management	L. C. Jhamb	Everest publishing house, ISBN - 81-86314-24-5
6	Manufacturing Technology – Foundry, forming and welding	P. N. Rao	Tata MaGraw Hill Publishing company Limited, New Delhi. ISBN – 0-07-463180-2
7	Manufacturing Science	Amitabh Ghosh, Ashok kumar Malik	East-West Press Pvt. Ltd; New Delhi. ISBN – 81-85095-85-x

14. SOFTWARE/LEARNING WEBSITES

a) https://nptel.ac.in/courses/105103023/23
b) https://nptel.ac.in/courses/110101005/downloads/Lecture%2022.pdf
c) https://nptel.ac.in/courses/110101003/35

Program Name : **Diploma in Production Engineering / Production Technology**

Program Code : **PG/ PT**

Semester : **Sixth**

Course Title : **Process Engineering**

Course Code : **22664**

1. RATIONALE

The main intention to study process engineering course is to focus on the planning , development, design, operations and control of manufacturing processes in industry. The course aims to develop an understanding of fundamental knowledge of process engineering principles and apply the same to design and plan the operations of manufacturing processes. It provides the technologists (diploma engineers) in the process industry an opportunity to integrate the knowledge gained with practice.

2. COMPETENCY

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

- **Prepare process plans for manufacturing of mechanical engineering 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 industry oriented COs associated with the above mentioned competency:

a) Evaluate products for product analysis and process plans.
b) Prepare Bill of Material for the assembly drawings.
c) Prepare process plans for different types of components.
d) Create machine and tooling Groups.
e) Prepare process plan using CAPP.

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
4	-	2	6	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.

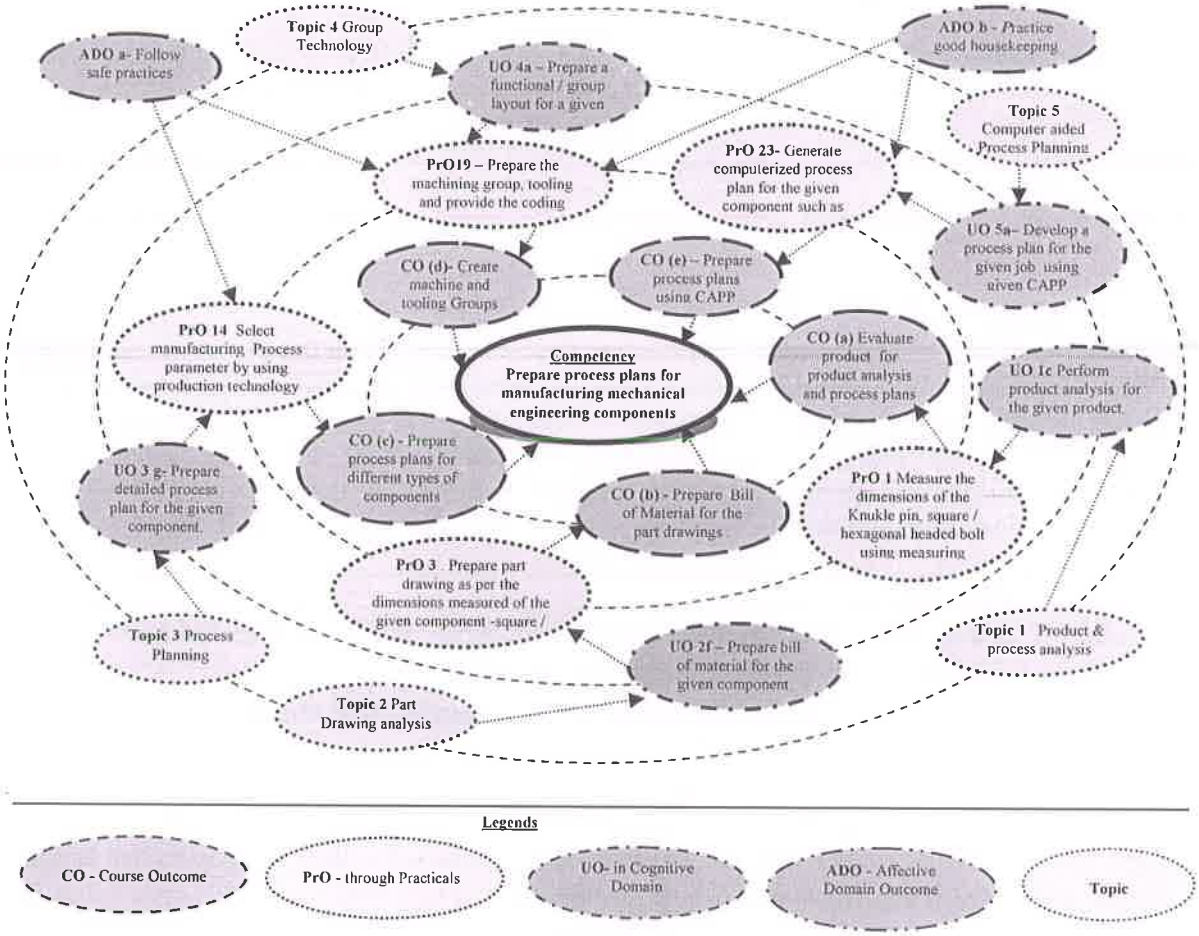

Figure 1 - Course Map

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	Measure the dimensions of the Knukle pin, square / hexagonal headed bolt using measuring instruments	I	02*
2	Measure the dimensions of the square / hexagonal nut, Cotter Key using measuring instruments	I	02
3	Prepare part drawing as per the dimensions measured of the given component -square / hexagonal nut, Knukle pin by using Auto CAD.	II	02*
4	Prepare part drawing as per the dimensions measured of the given component -Knukle pin, square / hexagonal headed bolt using measuring instruments by using Auto CAD	II	02
5	Interpret given industrial part drawing and record the information.	II	02*
6	Select appropriate special and standard toolings for the given component such as square / hexagonal nut, Cotter Key, Knukle pin, square / hexagonal headed bolt.	II	02
7	Select the various processes and operations of the given component Knukle pin, square / hexagonal headed bolt using CAPP software.	III	02*
8	Select the various processes and operations of the given component square / hexagonal nut, Cotter Key using CAPP software.	III	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
9	Prepare Bill of material for the given Knukle pin, square / hexagonal headed bolt using CAPP software.	III	02*
10	Prepare Bill of material for the given component such as square / hexagonal nut, Cotter Key using CAPP software.	III	02
11	Prepare sequence of operations for the given component Knukle pin, square / hexagonal headed bolt using CAPP software.	III	02*
12	Prepare sequence of operations for the given component such as square / hexagonal nut, Cotter Key using CAPP software.	III	02
13	Select appropriate maching parameters for the given Cotter Key, Knukle pin, square / hexagonal headed bolt using CAPP software.	III	02*
14	Select appropriate maching parameters for the given component such as square / hexagonal nut using CAPP software.	III	02
15	Select manufacturing process parameter by using production technology handbook.	III	02*
16	Select the various processes and operations for the Cotter pin having slope 1:25 or 1:50.	III	02
17	Prepare tool layout for the given component such as square / hexagonal nut, Cotter Key, Knukle pin, square / hexagonal headed bolt. (any two components)	IV	02*
18	Prepare the component family for riveted butt joint double strap.	IV	02
19	Prepare the machining group, tooling and provide the coding system for riveted butt joint double strap.	IV	02
20	Prepare route sheet for the given component such as square / hexagonal nut, Cotter Key, Knukle pin, square / hexagonal headed bolt . (any two components)	V	02*
21	Prepare operation sheet for the given component such as square / hexagonal nut, Cotter Key, Knukle pin, square / hexagonal headed bolt . (any two components)	V	02
22	Generate computerized process plan for the given component Knukle pin, square / hexagonal headed bolt by using available CAPP software.	V	02*
23	Generate computerized process plan for the given component such as square / hexagonal nut, Cotter Key by using available CAPP software.	V	02
	Total		**46**

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 24 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 %
1	Preparation of experimental set up	10
2	Setting and operation	10
3	Safety measures	20

4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	20
7	Submission of report 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 safety practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Work as a leader/a team member..
a. 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
- 'Organisation Level' in 2nd year
- 'Characterisation 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	Various components such as bearings, joints, Engine, square / hexagonal nut, Cotter Key, Knukle pin, square / hexagonal headed bolt components	1 to 23
2	Measuring Instruments:- Vernier Calliper, Gauges and Comparator	1,2
3	Auto Cad software	3,4
4	CAPP softwares	7-14,22,23
5	Sample industrial assembly and part drawings.	1 to 23

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 Product and Process analysis	1a. Explain the given element for the specified product. 1b. Select the elements for the given product design with justification. 1c. Perform product analysis for the given product. 1d. Prepare the process flow chart for the given product. 1e. Identify the criteria for process plan for the given product.	**Product Analysis** 1.1 Introduction to product engineering 1.2 Functions of product engineering department. 1.3 Design for production: Materials, Methods, Standards, Surface Finish, Concept and general guideline for design for machining (DFM). 1.4 Criteria for product analysis. **Process Analysis** 1.5 Introduction to process engineering. 1.6 Role of process engineering department 1.7 Functions of process engineering department. 1.8 Criteria for process plan.
Unit– II Part drawing analysis	2a. Interpret the given part drawing. 2b. Choose the manufacturing processes for the given part drawing with justification. 2c. Calculate the material required for manufacturing the component given in part drawing and planning material. 2d. Select the relevant machine and tooling for each operation of the given part drawing with justification. 2e. Select inspection and gauging devices for the given job with justification. 2f. Prepare tolerance chart for a given component.	2.1 General characteristics, Visualization of the part, Areas for processing, surface finish 2.2 Tolerance Analysis: Tolerance calculation, tolerance stacking, tolerance chart prepartion. 2.3 Categorisation of surfaces:- Functional, locating, support and clamping surface 2.4 Decision making :- Handling, type of process, tooling, machine tool , blank requirement. Material selection, material requirement calculations, Bill of material (BOM) / Part list. 2.5 Gauging and Inspection methods.
Unit– III Process Planning	3a State the information required for process planning for the given component. 3b Select the relevant machine and tooling for the given component with justification. 3c Prepare the sequence of operations for the given component. 3d Select the machining parameters for the given job with justification. 3e Select the tooling and gauges for the given job with justification. 3f Prepare the tool layout for the	3.1 Product cycle in manufacturing 3.2 Information required for process planning. 3.3 Process planning procedure. 3.4 Machines and tool Selection procedure. 3.5 Classifying operations:- Basic, Major/Principal, Auxillary and Supporting process opertaions 3.6 Process planning (Operation and Route sheet) details consisting of a) sequence of operations b) machining parameters c) special and standard tooling d) measuring gauges e) Cutting tool specifications f) Auxillary tools

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	given job. 3g Prepare detailed process plan for the given component.	3.5 Methods of eliminating operations 3.6 Process pictures and tool layout.
Unit IV Group Technology	4a Prepare the functional / group layout for a given component. 4b Sort the given components into families with justification. 4c Develop the relevant coding system based on given basic requirements. 4d Create the machine group and tooling as per given component family.	4.1 Introduction to Group technology, definition and application. 4.2 Functional and Group / Cell layouts. 4.3 Define and construct a component family. 'A'. 'B' and 'C' type families. 4.4 Basic requirements for the coding system.
Unit– V Computer aided process planning	5a. Develop a process plan for the given job using given CAPP approach. 5b. Prepare a process plan of a given component using LISP software. 5c. Prepare process plan of a given component using PROLOG software. 5d. Justify role of CAPP in CIM.	5.1 Concept of Computer aided process planning. (CAPP) 5.2 Types ofCAPP : Generative type Varient type 5.3 CAPP implenmentation techniques:- Decision table and decision tree 5.4 Use of open source CAPP softwares such as LISP, PROLOG, PRIMA or equivalent. 5.5 Application of 3D scanner in process plan. 5.6 Contribution of CAPP in implementation of CIM.

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	Product and process analysis	12	04	04	04	12
II	Part drawing analysis	12	04	04	06	14
III	Process Planning	16	04	08	08	20
IV	Group Technology	12	04	04	04	12
V	Computer aided process planning	12	04	04	04	12
Total		**64**	**20**	**24**	**26**	**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 journals based on practical performed in laboratory.
b) Collect a samples of used cutting tools and components of various manufacturing processes from workshops and industries.
c) Visit to websites of CAPP software suppliers.
d) Collect the data of machined components from the industry or workshop and perform task of dimension measurement for atleast 25 identical components.
e) Prepare a CAPP for the component available .
f) Collect samples of part prints, working drawing, process sheet, tooling layout from the industry.

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) Visit to near by industry (any three) and collect the information regarding plant layout method adopted by the industries and prepare a report.
g) Visit to near by industry (any three) and collect the information reharding tool layout system, material handling system, part drawings, tolerance charts prepared and its representation etc and prepare a report.

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) Prepare a report on facilities provided in the institute workshop releted to process planning.
b) Visit atleast two industries, prepare report on following parameters releted to- process plan
   - Type of product
   - Product Part print
   - cutting tools
   - machining parameters
   - special and standard tooling
c) Collect samples of part prints, working drawing, process sheet, tooling layout from the industry.
d) Convert the process plan of any two component manufactured by conventional maching to the process plan for CNC machines.
e) Prepare detail process plan from the selected part print considering following elements
   - Drwaing interpretation and material evaluation
   - Process selection and sequencing
   - Machine selection and operations sequencing.
   - Tooling selection
   - Setting the process parameters.
   - Determining the workholding requirements
   - Documenting the plan.

13. SUGGESTED LEARNING RESOURCES

S.No.	Title of Book	Author	Publication
1	Industrial Engineering and Management	Khanna O.P	Dhanpat Rai Publications New Delhi ISBN- 13:9788189928353
2.	Production Planning and Control	Samuel Eilon	Collier Macmillan Ltd; 1st Printing, New Delhi ISBN-13: 978-0023318009
3.	Production Technology	Khanna O.P	Dhanpat Rai Publications,New Delhi ISBN-13: 978-9383182046
4.	Process Planning: The Design/Manufacture Interface	Scallan Peter	Butterworth-Heinemann (20 June 2003) ISBN-13: 978-0750651295
5.	Process Planning and Cost Estimation	Adithan M	New Age International (P) Limited, New Delhi ISBN-13: 978-8122421293
6.	Engineering Metrology	Jain R.K	Khanna Publishsers, New Delhi ISBN:9788174091536, 817409153X
7.	Manufacturing Technology – Metal cutting and machine tools Vol. 2	P. N. Rao	Tata McGraw Hill Publishing company ltd; New Delhi. ISBN – 0-07-463843-2

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a) www.youtube.com
b) www.nptel.ac.in
c) www.thomasnet.com/.../computer-aided-process-planning-capp-software-1726...
d) https://smartermanager.com/manufacturing-process-planning-software/
e) https://www.aras.com/solutions/manufacturing-process-planning

Program Name : **Diploma in Mechanical Engineering**

Program Code : **ME/PG/PT/AE**

Semester : **Sixth**

Course Title : **Emerging Trends in Mechanical Engineering**

Course Code : **22652**

1. RATIONALE

Over the coming years, technological developments such as Robotics, IOT, Artificial intelligence, smart controls are likely to have a significant impact on the world of work and employment as well as to trigger far reaching changes. Looking towards the era in Technology advancement, Mechanical/Automobile/Production Engineering offers addition of new Dynamic subjects and new versions of core subjects. Diploma Mechanical/Automobile/Production Engineers should be familiar with new technologies from the fields of Automobile Engineering, Energy Management, Advanced Manufacturing Processes, Agriculture and Farm Machines and many more. This Dynamic course will give insight to the recent practices adopted by the Mechanical Industries and awareness of these techniques will enhance career opportunities of Diploma Mechanical/Automobile/Production Engineers.

2. COMPETENCY

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

- **Relate basic principles of Mechanical Engineering with Recent Technologies available in Industry.**
-

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. Identify different New Systems available in Automobile.
b. Apply Heat engineering principles in process Boilers and waste heat Recovery systems used in Process Industry
c. Cite examples of Modern manufacturing Technology in industry
d. Use different standards for energy Management and Audit of a given system.
e. Select recent agricultural equipment for pre and post harvesting.
f.

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	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--

(*): 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 MULTI CHOICE QUESTION 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.

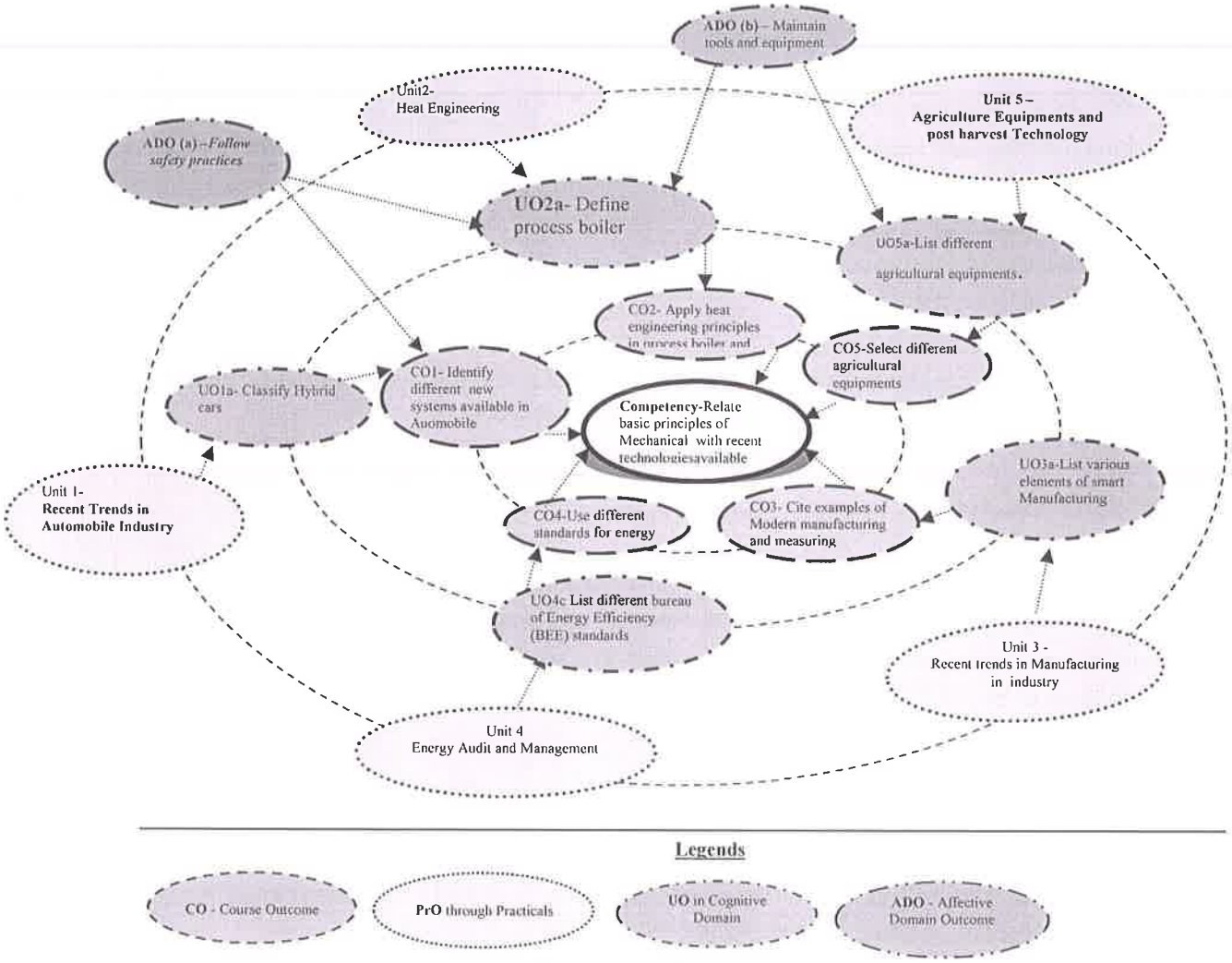

Figure 1 - Course Map

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	NA		

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 24 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.	NA	

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. 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
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTSREQUIRED

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	LCD Projector	-

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 Recent Trends in Automobile Industry	1a. Classify Hybrid cars 1b. List different batteries used in E-Vehicles 1c. Name different safety systems used in given vehicle.	1.1 Hybrid cars-manufactures, Types- Micro Hybrid, Mild Hybrid, Full Hybrid, Series hybrid, Parallel Hybrid 1.2 E-vehicles- Manufacturers, specifications, Types of Batteries, Li-ion batteries, Sodium Nickel

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		Chloride Batteries ,Sodium Sulphor Batteries, Fuel Cell, Charging- Charging Methods and Modes. Issues with e-vehicles 1.3 Safety in Automobile- Air bags, Automatic Emergency Braking, Adaptive Cruise Control, Electronic stability programmer, Anti Collision system, Active Passive Integration system.
Unit– II Process Engineering	2a. Define process boiler 2b. State principles of ultra-super critical boilers. 2c. List commerciality viable waste heat recovery devices.	2.1 Process Boilers-Steam and Condensate loop in process industries 2.2 Introduction to ultra-super critical Boilers. 2.3 Hyperbolic cooling towers. 2.4 Waste heat recovery-process industry
Unit –III Recent Trends in Manufacturing in industry	3a. List various elements of smart Manufacturing 3b. Interpret the Automation in Mechanical Industry 3c. List Different types of Automation 3d. Select Robot for given application 3e. Compare 4 D printing technology with 3D printing technology. 3f. Describe the importance of 3-D scanning with reverse engineering.	3.1 **Smart Manufacturing Technology** introduction, Elements and applications 3.2 **Automation**: Need, Basic elements of automated systems, automation principles and strategies, Benefits. 3.3 **Types of automation:** fixed, programmable, flexible, hard and soft automation. 3.4 **Industrial robotics**: robot anatomy, robot control systems, end effectors, sensors in robotics, industrial Robot applications 3.5 4-D printing Technology- Printing Techniques, 3D scanning Technology-Function, ,Applications
Unit-IV Energy Audit and Management	4.a List different bureau of Energy Efficiency (BEE) standards. 4.b Describe methods of Energy Monitoring and Targeting 4.c Identify steps for conducting Energy Audit.	4.1 Standards and labelling standard(HVAC) 4.2 Energy Monitoring and Targeting. 4.3 Energy Management and Audit
Unit-V Agriculture Equipment and post harvest Technology	5.a Explain working of different agricultural equipment. 5.b Name different elements of Cold Chain 5.c List the features of NCAP	5.1 Tillers, Sowing and planting equipment, Weeding Machines, Spraying Machines, Harvesting, Post harvesting Machineries 5.2 Elements of Cold chain 5.3 National Cooling Action Plan (NCAP)

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 FORQUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Recent Trends in Automobile Industry	14	06	10	04	20
2	Process Engineering	06	02	06	02	10
3	Recent Trends in Manufacturing in industry	14	06	10	04	20
4	Energy Audit and Management	08	02	06	02	10
5	Agriculture Equipment and post-harvest Technology	06	02	06	02	10
	Total	**48**	**18**	**38**	**14**	**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 any industry and collect information of recent trends in Industry.
b. Undertake a market survey of local dealers for agricultural equipments, machineries, HVAC equipments and prepare a report.
c. Visit to any Industrial press shop and prepare a report consisting
    i. Safety precautions observed.
    ii. Identify problems related to energy conservations faced by industry

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 practice.
g. Encourage students to refer different websites to have deeper understanding of the subject.

h. Observe continuously and monitor the performance of students in Lab.
i. Demonstrate students thoroughly before they start doing the practice.
j. Encourage students to refer different websites to have deeper understanding of the subject.
k. Guide student(s) in undertaking micro-projects.
l. Arrange visit to nearby industries for understanding various tool engineering operations
m. Show video/animation films to explain tool design processes.
n. Give Micro projects.
o. Use different instructional strategies in classroom teaching.
p. In respect of item no.10 above the teachers need to ensure to create opportunities and pursue for such co-curricular activities.

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. Prepare energy audit report of any one Lab rotary.
b. Collect data with respect to safety systems available in Modern cars
c. Identify different heat losses in Furnace available in workshop.
d. Compile the different products manufactured by 4-D printing Technology
e. Prepare report of pre and post harvesting using recent agricultural equipment
f. Collect information of District cooling.
g. Collect information of Robotics
h. Visit the local industry nearby and study the manufacturing systems. Thereby prepare the low cost automation plan for improvement in the productivity and quality of the industry

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Electric and Hybrid Vehicles	Tom Denton	IMI (Institute of Motor Industry) ISBN-13: 978-1138842373 ISBN-10: 1138842370
2	The Electric car	M H Westbrook	IET,2001, ISBN-0852960131
3	Hybrid, Electrical and Fuel Cell Vehicles	Jack Erjavec	Cengage Learning,2012 ISBN-1285415051
4	Boilers for Power and process	Kumar Rayaprole	CRC Press,2009, ISBN-1420075373
5	Steam generators and	V Ganpathy	CRC press,

S. No.	Title of Book	Author	Publication
	Waste heat Boilers		ISBN 1482247127
6	Introduction to process Technology	C.E Thomas	Cengage Learning,2009 ISBN 1435454251
7	Industry 4.0 Smart manufacturing for the future	William MacDougall	Germany trade and Investe,2014
8	Energy Management and Conservation	K V Sharma	I K International Publishing House Pvt ltd, 2011, ISBN- 9381141290
9	Energy Management, Audit and Conservation	B K De	Vrinda Publication, Indiana University,2007, ISBN-8182810930
10	Farm Tools and Equipments for Agriculture	Surendra Singh	New India Publishing,2015 ISBN-9385516221
11	Cold storage, cold chain, ware houses	NPCS Board of Consultant	3rd Edition,2018 ,NIR project consultancy services, Delhi ISBN-978-93-81039-66-3
12	4 D Printing- the next generation technology	Dirk Schreder	ISBN-13-978-8963495
13	Additive Manufacturing to 3 D/4D Printing 1	J D Andre	John Eiley & Sons,2017 ISBN 1119437393
14	Automation, Production Systems, and Computer Integrated Manufacturing	Groover, Mikell. P.	PHI, ISBN-13: 978-8120334182
15	Computer based Industrial Control	Kant, Krishna.	PHI Learning ISBN 13: 9788120339880

SOFTWARE/LEARNING WEBSITES

1. https://www.youtube.com/watch?v=MdFWgat9ddA(Agri Equipments)
2. https://www.chargepoint.com/about (Electrical Vehicle)
3. http://www.plugndrive.ca/ev-models (Electrical vehicle)
4. http://www.oorja.in/what-is-radiant-cooling/types-of-radiant-cooling-systems/(Cold Chain)
5. https://www.beeindia.gov.in/content/standard-labeling (Energy audit)
6. www.beestarlabel.com/ 9energy audit)
7. htttps:// Four-dimensional product/about (4 Dprinting)

Program Name : **Diploma in Automobile Engineering / Civil Engineering Group / Electronics Engineering Group / Diploma in Plastic Engineering / Diploma in Production Engineering /Diploma in Fashion & Clothing Technology/ Computer Engineering Group**

Program Code : **AE/CE/CR/CS/ DE/EJ/ET/EN/EX/EQ/IS/IC/IE/PG/PT/DC/ CO/CM/CW/IF**

Semester : **Sixth**

Course Title : **Management**

Course Code : **22509**

1. RATIONALE

An engineer has to work in industry with human capital and machines. Therefore, managerial skills are essential for enhancing their employability and career growth. This course is therefore designed to provide the basic concepts in management principles, safety aspects and Industrial Acts.

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 relevant managerial skills for ensuring efficient and effective management.**

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. Use basic management principles to execute daily activities.
b. Use principles of planning and organising for accomplishment of tasks.
c. Use principles of directing and controlling for implementing the plans.
d. Apply principles of safety management in all activities.
e. Understand various provisions of industrial acts.

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	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--	

(*#) Online Theory Examination.

(*): 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.(#): Online examination*

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.

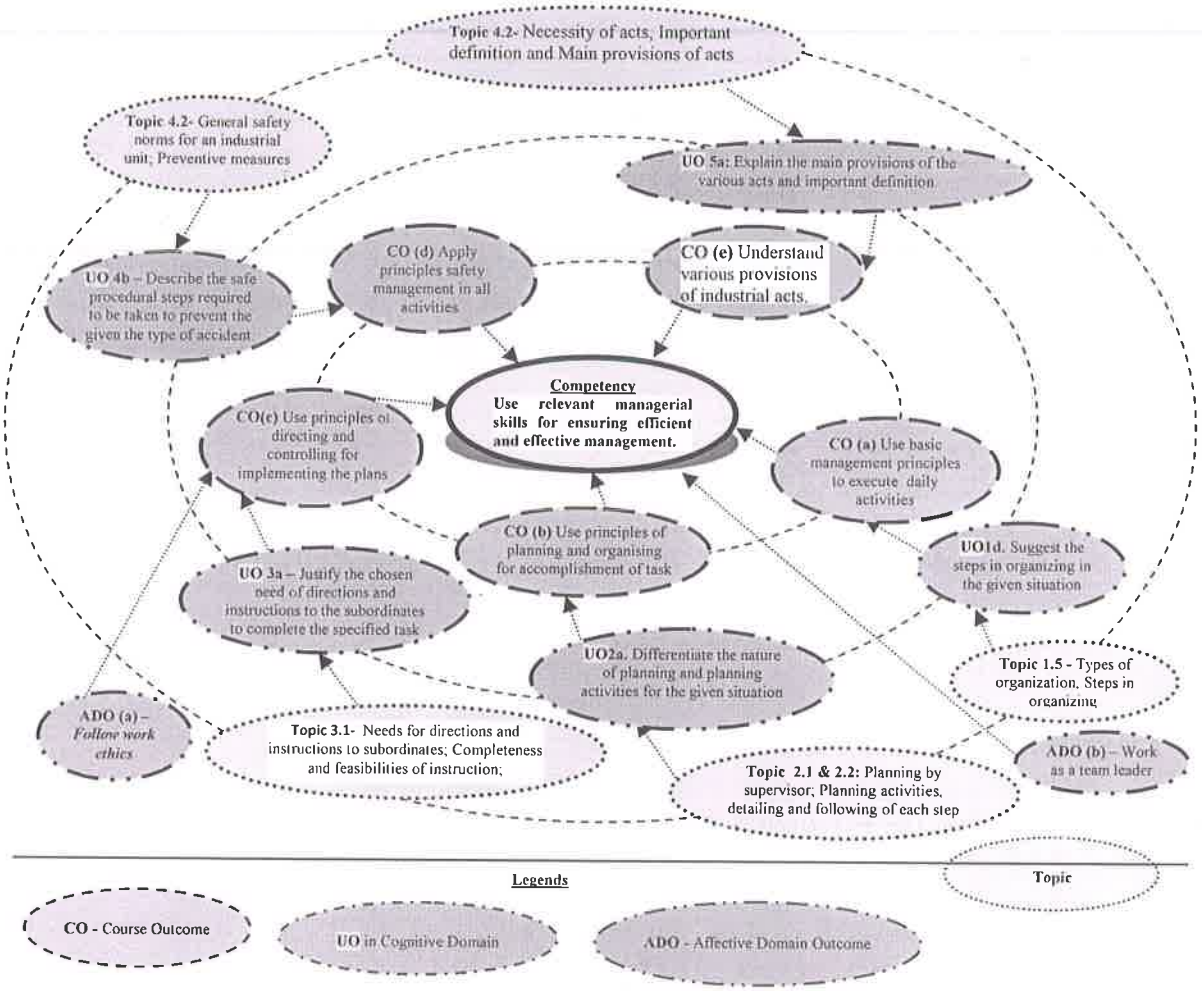

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

- Not applicable -

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable -

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 Introduction to management concepts and managerial skills	1a. Differentiate the concept and principles of management for the given situation. 1b. Explain functions of management for given situation. 1c. Compare the features of the given types of planning 1d. Suggest the steps in organizing in the given situation. 1e. Suggest suitable type of organization for the given example. 1f. Identify the functional areas of management for the given situation 1g. Suggest suitable managerial skills for given situation with justification	1.1 Definitions of management, role and importance of management. 1.2 Management characteristics and principles, levels of management and their functions; management, administration and organization, relation between management and administration. 1.3 Functions of management: planning, organizing, leading/directing, staffing and controlling. 1.4 Types of planning and steps in planning 1.5 Types of organization, Steps in organizing 1.6 Functional areas of management. 1.7 Managerial skills.
Unit – II Planning and organizing at supervisory level	2a. Differentiate the nature of planning and planning activities for the given situation. 2b. Suggest the step wise procedure to complete the given activity in the shop floor. 2c. Prepare materials and manpower budget for the given production activity. 2d. Describe with block diagrams the organization of the physical resources required for the given situation. 2e. Describe the human needs to satisfy the job needs for the specified situation. 2f. List the tasks to be done by the concerned individuals for completing the given activity.	**Planning at supervisory level** 2.1 Planning by supervisor. 2.2 Planning activities, detailing and following of each step. 2.3 Prescribing standard forms for various activities. 2.4 Budgeting for materials and manpower. **Organizing at supervisory level** 2.5 Organizing the physical resources. 2.6 Matching human need with job needs. 2.7 Allotment of tasks to individuals and establishing relationship among persons working in a group
Unit– III Directing and Controlling at supervisory level	3a. Justify the chosen need of directions and instructions to the subordinates to complete the specified task. 3b. Select the feasible set of instructions to complete the given simple task, with justification 3c. Predict the possible mistakes for completing the given simple activity. 3d. Describe the managerial control	**Directing at supervisory level** 3.1 Needs for directions and instructions to subordinates; Completeness and feasibilities of instructions 3.2 Personal counselling advanced predictions of possible mistakes. 3.3 Elaborating decisions, laying disciplinary standards in overall working **Controlling at supervisory level**

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	actions and remedial measures required to be taken for completing the given task successfully.	3.4 Managerial control; Understanding team and link between various departments in respect of process and quality standards; Steps in control process 3.5 Controlling methods; Control over the performance in respect of quality, quantity of production, time and cost. Measuring performance, comparing with standards, correcting unfavorable deviations.
Unit – IV Safety Management	4a. State the general safety norms required to be taken in the given case. 4b. Suggest preventive measures of plant activities in the given situation. 4c. Describe the safe procedural steps required to be taken to prevent the given the type of accident. 4d. Prepare a work permit in to conduct the given maintenance activity. 4e. Explain the causes of the specified type of accident in the given situation. 4f. Prepare the specifications of the firefighting equipment required for the given type of fire.	4.1 Need for safety management measures 4.2 General safety norms for an industrial unit; Preventive measures. 4.3 Definition of accident, types of industrial accident; Causes of accidents; 4.4 Fire hazards; Fire drill. 4.5 Safety procedure 4.6 Work permits.
Unit – V Legislative Acts	5a. Explain the purpose of the act 5b. Explain the main provisions of the various acts and important definition.	5.1 Necessity of acts, Important definition and Main provisions of acts. 5.2 Industrial Acts: a. Indian Factory Act b. Industrial Dispute Act c. Workman Compensation Act d. Minimum Wages Act

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	Introduction to management	12	06	06	04	16

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	concepts and managerial skills					
II	Planning and organizing at supervisory level	08	04	06	04	14
III	Directing and controlling at supervisory level	08	04	06	04	14
IV	Safety Management	08	04	06	04	14
V	Legislative Acts	12	02	06	04	12
Total		**48**	**20**	**30**	**20**	**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. Write assignments based on the theory taught in classrooms. Assignments consist of ten questions having long answers including charts, symbols, drawing, observations etc.
b. Prepare/Download information about various industrial acts.
c. Visit to any Manufacturing industry and prepare a report consisting of:
    i. Organization structure of the organization/ Dept.
    ii. Safety measures taken in organization.
    iii. Mechanism to handle the disputes.
    iv. Any specific observation you have noticed.
d. Give seminar on relevant topic.
e. 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 practice.

g. Encourage students to refer different websites to have deeper understanding of the subject.
h. Observe continuously and monitor the performance of students in Lab.

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. Study of management principles applied to a small scale industry.
b. Study of management principles applied to a medium scale industry.
c. Study of management principles applied to a large scale industry.
d. Prepare case studies of Safety measures followed in different types of organization.
e. Study of measures to be taken for ensuring cyber security.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Management and entrepreneurship	Veerabhadrappa, Havinal	New age international publishers, New Delhi, 2014: ISBN: 978-81-224-2602-1
2	Principles of management	Chaudhry omvir Singh prakash	New Age international publishers, 2012, New Delhi ISBN: 978-81-224-3039-4
3	Industrial Engineering and management	Dr. O. P. Khanna	Dhanpath ray and sons, New Delhi
4	Industrial Engineering and management	Banga and Sharma	Khanna Publication, New Delhi

14. SUGGESTED SOFTWARE/LEARNING WEBSITES

a. https://www.versesolutions.com/
b. https://www.books.google.co.in/books?isbn=817758412X
c. https://www. www.educba.com › Courses › Business › Management

Program Name : **All Branches of Diploma in Engineering and Technology.**

Program Code : **CE/CR/CS/CH/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/ MU/EE/EP/EU/IS/IC/AE/FG/ME/PG/PT/DC/TX/TC**

Semester : **Sixth**

Course Title : **Capstone Project – Execution & Report Writing**

Course Code : **22060**

1. RATIONALE

This course on 'Capstone Project–Execution and Report Writing' is the continuation of the previous semester course on 'Capstone Project–Planning'. So, in this semester, the students are to implement the detailed Capstone Project Plan, which they have prepared in the preceding semester. Therefore, to successfully complete this Capstone Project by the end of this semester, it is necessary to incorporate the suggestions of the guide/examiners of the preceding semester. Hence, it is of utmost importance for the student to again re-capitulate and comprehend the importance, concept and need of the 'Capstone Projects' which are well explained in the 'Capstone Project–Planning' course in the previous semester.

Often, the jobs in the industry, which the diploma holders will come across when they join it and will be in the form of small or large projects. Such projects are generally an integration of the various types of skills which cut across the three major domains of learning i.e. cognitive, psychomotor and affective domain which must have acquired during their journey from first semester to the last semester. Hence, it is essential that students are also given an opportunity to do large projects which require more time compared to the micro-projects in order to develop and integrate the highly essential industry oriented competencies and associated skills in the students. Therefore, in this semester the 'Capstone Project – Execution and Report Writing' will continue to integrate some more additional competencies along with those in the previous semester and hence build up greater confidence to face such situations in the world of work.

2. COMPETENCY

The course should be taught and implemented with the aim to develop the required course outcomes (COs) so that students will acquire following competency needed by the industry:

- **Implement the Capstone Project Plan to solve the identified problem/task faced by industry/user related to the concerned occupation by integrating the various types of skills acquired during the programme.**

3. COURSE OUTCOMES (COs)

Depending upon the nature of the projects undertaken, the following could be some of the major course outcomes that could be attained, although, in case of some projects few of the following course outcomes may not be applicable.

a) Implement the planned activity individually and/or as team.
b) Select, collect and use required information/knowledge to solve the identified problem.
c) Take appropriate decisions based on collected and analysed information.
d) Ensure quality in product.
e) Incorporate energy and environment conservation principles.
f) Consider the ethical issues related to the project (if there are any).
g) Assess the impact of the project on society (if there is any).
h) Communicate effectively and confidently as a member and leader of team.

i) Prepare project report after performing due plagiarism check using appropriate tools.

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	
-	-	4	4	--	--	--	--	--	--	--	50#	20	50~	20	100	40	

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

5. Course details

As the implementation of the Capstone project progresses and which has to be submitted at the end of project work, one of the outputs of this course is a detailed ***Project Report*** that is continuously prepared by the student. There will also be regular progressive assessment by the teacher as per the criteria no 7 on the basis of rubrics mentioned in **Appendix –C** and in the formats as shown in **Appendix-B** and also for the end-of-semester examination.

5.1 Guidelines for Capstone Project–Execution and Report Writing

a) The students would like to revise the 'Capstone Project – Plan' based on the feedback received in the fifth semester examination.

b) This revised 'Capstone Project – Plan' would be again approved by the project guide. As soon as the revised plan is approved by the teacher, the student will begin to work according to it and would also continue to maintain a dated ***'Project Diary'*** for the whole semester. This is a sort of a 'weekly diary' indicating all the activities conducted by the student every week in the semester to complete the project. This 'Project Diary' should be got signed by the teacher at regular intervals for progressive assessment. If this is maintained sincerely and truthfully by the student, it will be very helpful in compiling the ***Final Project Report*** at the end of the semester by him/her.

6. Project report

During the final Semester, the student will prepare a 'Project Report' in continuation with the activities conducted in fifth semester under Project Planning having following sub-titles:

Suggested contents of the Project report

- Title page (with name of team members and mentor teacher)
- Certificate (in the Format given in this document as annexure A)
- Acknowledgements (this may need revision at the end of the final semester)
- Abstract (in one paragraph not more than 150 words)
- Content Page

Chapters

1. Chapter–1 Introduction (background of the Industry or User based Problem/Task)
2. Chapter–2 Literature Survey (to finalise and define the Problem Statement)
3. Chapter–3 Scope of the project
4. Chapter–4 Methodology
5. Chapter-5 Details of designs, working and processes

6. Chapter-6 Results and Applications
7. Chapter-7 Conclusions And future scope
8. Appendix (if any)
9. References and Bibliography

Note:

i. The report should contain as many diagrams, figures and charts etc as relevant for the project.
ii. Originality of the report (written in own words) would be given more importance rather than quality of printing and use of glossy paper or multi-colour printing

7. ASSESSMENT OF PROJECT WORK

Project work has two components, first is Progressive Assessment (PA), while another is End Semester Examination (ESE).

7. 1. Progressive Assessment (PA) Guidelines and Criteria

Project guide is supposed to carry out this assessment. It is a continuous process, during which for developing desired qualities in the students, faculty should orally give **informal feedback** to students about their performance and interpersonal behaviour while guiding them on their project work every week. **F**ollowing criteria should be considered while assessing students informally or formally during different stages of the project work.

The following factors need consideration for both Capstone Project-Planning and Capstone Project-Execution and Report Writing.

a) Students should be assessed during the project work so that students can also get feedback for further improvement.
b) It should be kept in mind that project work is mainly experiential learning and it is not the research work, so emphasis should be on work based learning or learning from experience and development of attitudes and skills as mentioned in course outcomes. So focus of assessment should also be on learning from the process of completing project work rather than on novelty or innovation in the project work.
c) For progressive assessment at the end, students should be asked to give the power point presentation before group of teachers and junior students (so that junior students may also get awareness about the major project work they have to carry out in future)
d) The students would be awarded marks for their efforts (In some cases it may happen that due to some reasons such as unavailability of some material or component or some other resources, students may not be able to complete the project, but they have tried their best, in such cases students would be given appropriate marks if they have done enough efforts.)
e) The students would not be awarded marks if they have completed the project by getting done the work from market or some professionals (taking some help and guidance is different as compared to getting the work or maximum part of the work completed from others on payment basis).
f) Originality of the report (written in own words) would be given more importance.
g) The Project Guide will assure the quality of project done by his group.

Criteria of Marks for PA for Capstone Project -Execution and Report Writing.

S. No.	Criteria	Marks
1	**Project Proposal /Identification**	10
2	**Punctuality and overall contribution**	
3	**Project Diary**	
4	**Execution of Plan during sixth semester**	20
5	**Project Report including documentation**	15
6	**Presentation**	05
	Total	**50**

7.2 END SEMESTER EXAMINATION (ESE)

Evaluation shall be carried out according to following criteria. For each project, students from the concerned group should be asked to make presentation of their project , in front of the external and internal examiners which should be followed by question answer session to ascertain the contribution made by each student.

Criteria of Marks for ESE for Capstone Project -Execution and Report Writing

S. No.	Criteria	Marks
1	Project Proposal	05
2	Punctuality and overall contribution	
3	Project diary	
4	Execution of Plan during sixth semester	10
5	Project Report including documentation	10
6	Presentation	10
7	Question and Answer	15
	Total	**50**

8. SPECIAL TEACHING STRETAGIES (If any)

a) Teacher's should not spoon feed the students and let them try on their own at different stages of the project work and even first let them strive hard and only when efforts of students have failed, then teacher should guide them. Guidance should be in initially in the form of clues or hints rather than complete explanation, detailed explanation should be given only when students are not able to work based on clues/hints. The role of teacher should be limited to guide and facilitator

b) Teachers should help students in selecting a topic which is relevant and challenging (but within capacity) for students according to their abilities.

c) ***Teachers should come out of the mindset that there should be compulsorily some innovation and novelty in the project work. Because as discussed earlier, project is mainly opportunity for work based or experiential learning, the aim of which is to develop higher order cognitive skills and attitudes. Project at diploma level is not research or innovation.*** The main thing teachers have to ensure is that students choose a task or problem for their project work which is challenging but according to their capability i.e. a task which they can complete on their own without getting it done from market.

d) Teachers should ensure that students prepare the project plan in as much detail as possible, since this way only they would learn the importance of planning and how to do the detail planning. Teachers should allow students to proceed ahead only when they have detailed plan with them.

e) Teachers should motivate students to maintain project document project diary and project report. They should explain benefits of these activities to students and also train them in these activities, because most of them may be doing this first time.

f) Project Guide should ensure that students submit chapter of report one by one to him/her as per schedule and should check the content of the chapters. The Project guide should monitor that schedule is maintained and report writing is not left till last few weeks. It should not be a problem since first three chapters of the report should have been written in fifth semester itself.

g) Teachers should also encourage students to openly discuss their weaknesses and shortcomings .Teachers should develop confidence in students that admitting mistakes and weaknesses helps in improving them.

h) Teachers should continuously discuss with students about working of group and progress in the project and from this discussion should identify their personal qualities (both strengths and weaknesses) and suggest to them ways for improving those qualities.

i) Internal as well as external examiners should reward students for original work and efforts of students even if they are not fully successful or not able to complete the project in comparison to those students who have taken paid help from others to complete their project.

Appendix–A

CERTIFICATE

This is to certify that Mr./Ms.....

from .....Institute having Enrolment No: .....

has completed project of final year having title .....,.... during the academic year20__-20__. The project completed by individually/ in a group consisting of..... persons under the guidance of the Faculty Guide.

.....

.....

Name & Signature of Guide: .....

Telephone:.....

Appendix–B

PROGRESSIVE ASSESSMENT (PA) OF CAPSTONE PROJECT – EXECUTION AND REPORT WRITING

Evaluation Sheet for Internal Assessment

Name of Student: .....

Name of Programme..... **Semester: Sixth**

Course Title: Capstone Project : Execution and Report Writing **Code:22060.**

Title of the Capstone Project: .....

.....

A. **POs addressed by the Capstone Project** (Mention only those predominant POs)

a) .....

b) .....

c) .....

d) .....

B. **COs addressed by the Capstone Project** (Mention only those predominant POs)

a) .....

b) .....

c) .....

d) .....

C. **OTHER LEARNING OUTCOMES ACHIEVED THROUGH THIS PROJECT**

1. **Unit Outcomes (Cognitive Domain)**

a) .....

b) .....

c) .....

d) .....

2. **Practical Outcomes (In Psychomotor Domain)**

a) .....

b) .....

c) .....

d) .....

3. **Affective Domain Outcomes**

a) .....

b) .....

c) .....

d) .....

PROGRESSIVE ASSESSMENT (PA) Sheet		
S. No.	**Criteria**	**Marks**
1	Project Proposal /Identification	10
2	Punctuality and overall contribution	
3	Project Diary	
4	Execution of Plan during sixth semester	20
5	Project Report including documentation	15
6	Presentation	05
Total		**50**

Appendix–B

Suggested Rubric for Capstone Project – Execution and Report Writing

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
1	**Problem/Task Identification (Project Title)**	Relate to very few POs Scope of Problem not clear at all	i. Related to some POs ii. Scope of Problem/Task vague	i. Take care of at-least Three POs ii. Scope of Problem/task not very specific	• Take care of more than three POs ii. Scope of problem/task very clear
2	**Literature Survey /Industrial Survey**	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At –least 15 relevant sources, most latest	About 20 relevant sources, most latest
3	**Project proposal**	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable).	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed. Design of Prototype is not complete. (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)
4	**Project Diary**	Entries for most weeks are missing. There is no proper sequence and details are not correct.	Entries for some weeks are missing, details are not appropriate, not signed regularly by the guide.	Entries were made every week but are not in detail. Signed and approved by guide every week	Entries were made every week in detail, signed and approved by guide every week
5	**Final Report Preparation**	Very short, poor quality sketches, Details about methods, material, precaution and conclusions	Detailed, correct and clear description of methods, materials, precautions and	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions. Enough tables,

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
		omitted, some details are wrong			charts and sketches
6	**Presentation**	Major information is not included, information is not well organized .	Includes major information but not well organized and not presented well	Includes major information and well organized but not presented well	Well organized, includes major information ,well presented
7	**Defense**	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly

Appendix C
Suggestive Project Diary format

Week no:
Activities planned:
Activities Executed:
Reason for delay if any
Corrective measures adopted
Remark and Signature of the Guide