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.**
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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.

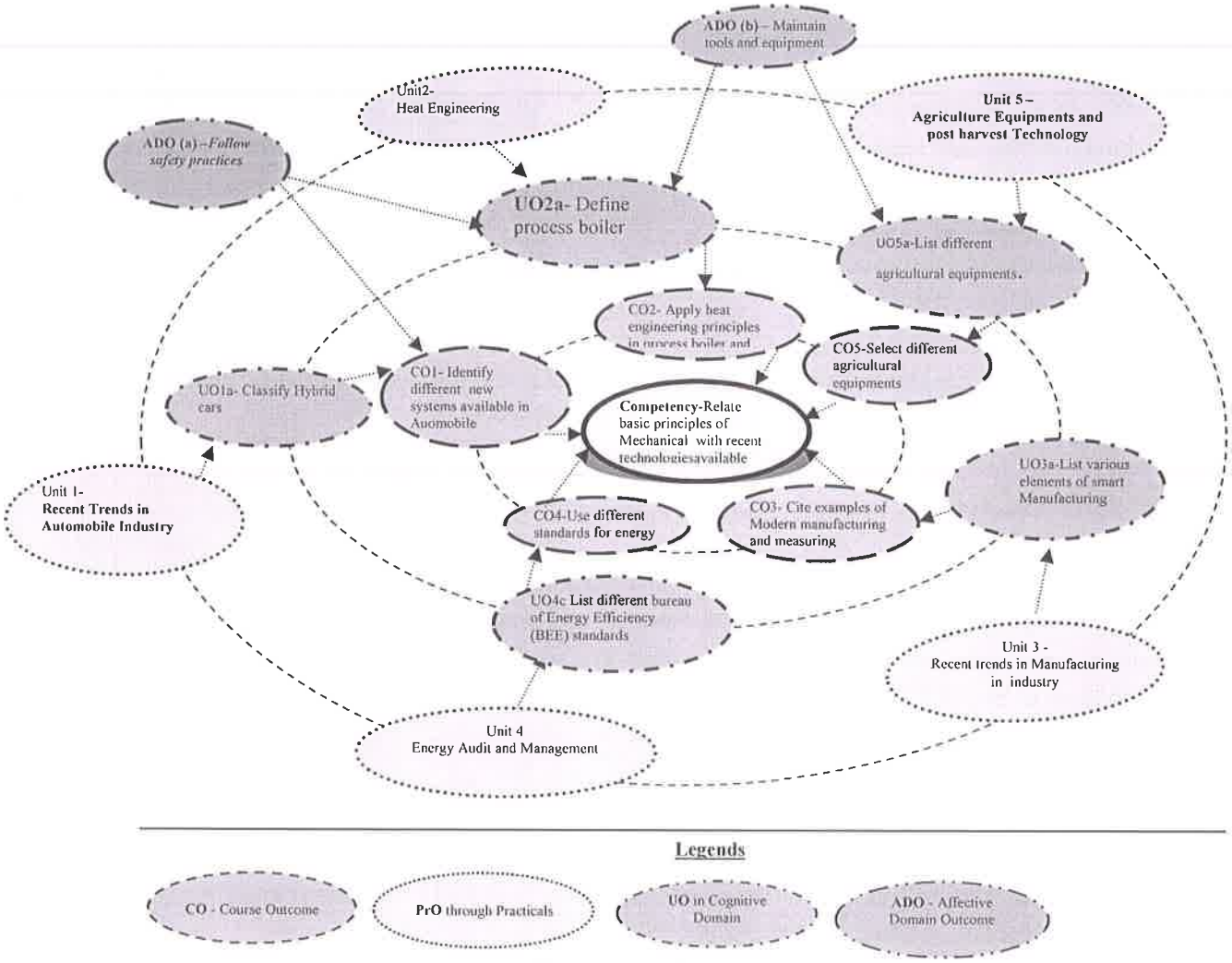

Figure 1 - Course Map

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)