

Program Name : Diploma in Plastic Engineering
Program Code : PS
Semester : Fourth
Course Title : Maintenance of Plastic Processing Machines
Course Code : 22047

1. RATIONALE

Plastics diploma engineer (also called technologist) are supposed to work on various plastic processing machines. These machines must be maintained properly by routine, preventive and breakdown maintenance in order to achieve steady and long life performance. In small scale industries maintenance of machines is assigned to production technicians. This course is intended to create awareness about routine, preventive, online and breakdown maintenance of various plastics processing machines.

2. COMPETENCY

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

- **Maintain plastic processing machines and auxillary equipments.**

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:

- Plan the maintenance of plastic processing machies.
- Diagnose the electrical faults of plastic machines.
- Maintain plastic machines for mechanical faults.
- Trouble shoot machines under breakdown.
- Maintain record of preventive and breackdown maintenance.

4. TEACHING AND EXAMINATION SCHEME

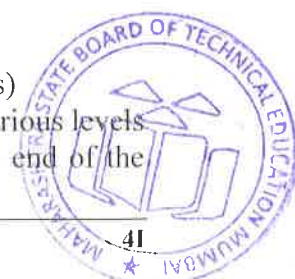
Teaching Scheme				Credit (L+T+P)	Examination Scheme											
L	T	P	Theory						Practical							
			Paper Hrs.		ESE		PA		Total		ESE		PA		Total	
				Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
-	-	4	4	--	--	--	--	--	--	50@	20	50~	20	100	40	

(~): For the **practical only courses**, the PA has two components under practical marks i.e. the assessment of practicals (seen in section 6) has a weightage of 60% (i.e.30 marks) and micro-project assessment (seen in section 12) has a weightage of 40% (i.e.20 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

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.

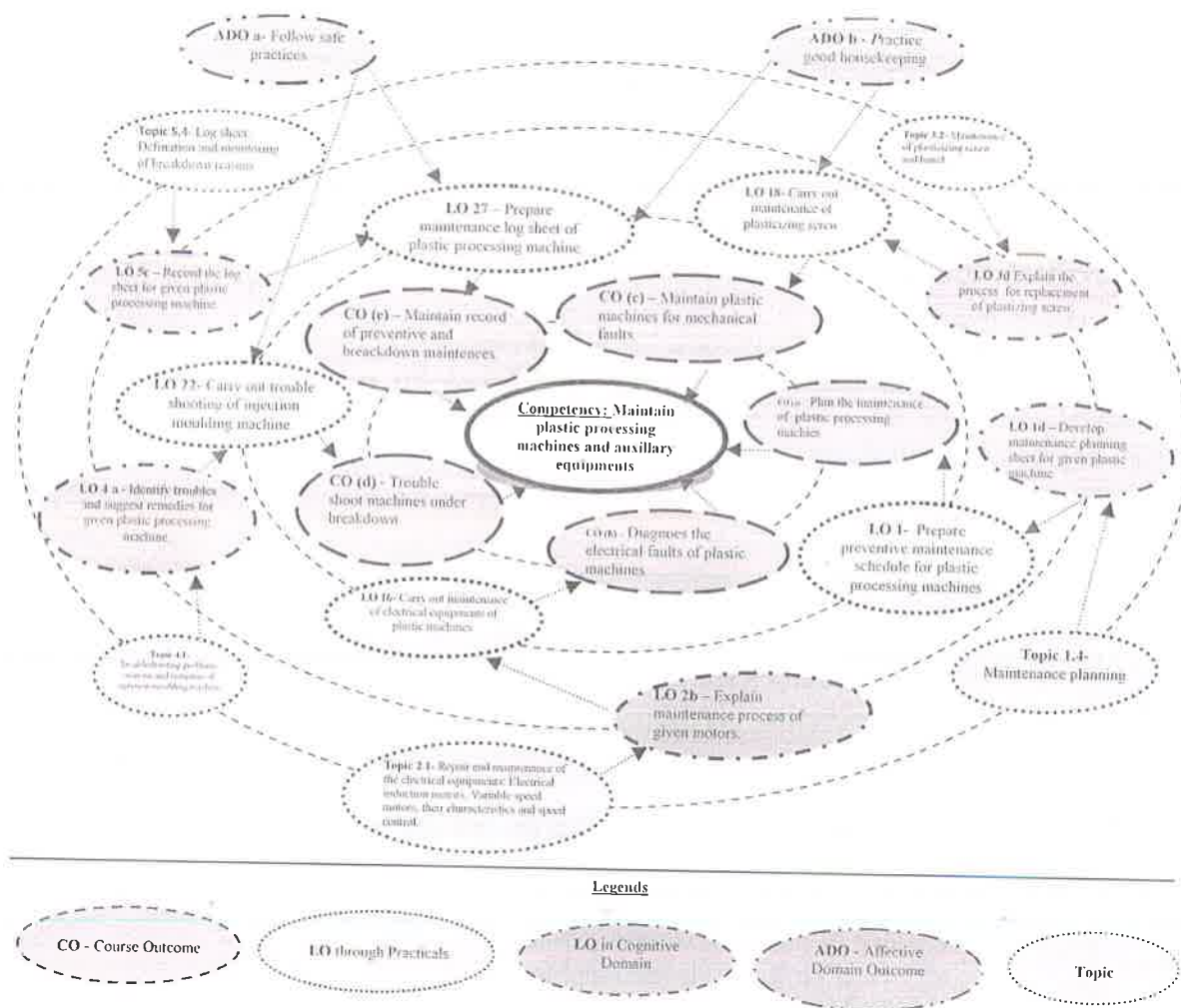


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals/exercises/tutorials in this section are psychomotor domain LOs (i.e. sub-components of the COs) are to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
1	Prepare preventive maintenance schedule for plastic processing machines.	I	02
2	Perform the maintenance using different tools and accessories.	I	02
3	Lubricate plastic processing machines.	I	02
4	Carry out preventive maintenance of moulds.	I	02
5	Carry out preventive maintenance of dies.	I	02
6	Carry out maintenance of hydraulic systems of machines	I	02
7	Carry out maintenance of pneumatic systems of machines	I	02
8	Carry out preventive maintenance of Melt Flow Index equipment.	I	02
9	Carry out maintenance of Environmental stress cracking equipment.	I	02
10	Carry out maintenance of Dart impact testing equipment.	I	02



S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. Required
11	Carry out maintenance of lamination machine.	I	02
12	Carry out maintenance of abrasion testing equipment.	I	02
13	Carry out maintenance of High speed mixer.	I	02
14	Carry out maintenance of Tumbler mixer.	I	02
15	Carry out maintenance of Grinder.	I	02
16	Carry out maintenance of electrical equipments of plastic machines.	II	02*
17	Carry out calibration of thermocouples	II	02
18	Carry out maintenance of plasticizing screw	III	02
19	Carry out maintenance of heat exchanger	III	02
20	Align injection unit with mould.	III	02*
21	Carry out maintenance of extrusion plant.	IV	02*
22	Carry out trouble shooting of injection moulding machine.	IV	02
23	Carry out maintenance of hand operated injection moulding machine.	IV	02
24	Carry out maintenance of plunger type injection moulding machine.	IV	02
25	Carry out maintenance of blow moulding machine.	IV	02
26	Carry out maintenance of thermoforming machine.	IV	02
27	Prepare maintenance log sheet of plastic processing machine.	V	02*
28	Prepare history sheet for plastic processing machines	V	02
	Total		56

Note

- i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical LOs/tutorials needs to be performed, out of which, the practicals marked as “*” are compulsory, so that the student reach the ‘Precision Level’ of Dave’s ‘Psychomotor Domain Taxonomy’ as generally required by the industry.
- ii. Hence, the ‘Process’ and ‘Product’ related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

Assessment of the ‘Process’ and ‘Product’ related skills in the laboratory/workshop/field work should be done as per suggested sample below:

S. No.	Performance Indicators	Weightage in %
1	Arrange tools and accessories for maintenance	20
2	Operate tools and equipment skillfully	20
3	Follow safety measures	10
4	Observations and recording	10
5	Overcome the faults	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	100

Additionally, the following affective domain LOs (social skills/attitudes), are also important constituents of the competency which can be best developed through the above mentioned laboratory/field based experiences:

- a. Follow safe practices
- b. Practice good housekeeping
- c. Practice energy conservation
- d. Demonstrate working as a leader/a team member



- e. Maintain tools and equipment
- f. Follow ethical practices

The development of the attitude related LOs of Krathwohl's 'Affective Domain Taxonomy', the achievement level may reach:

- '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	Exp. No.
1	Tool kit (Hand tools, Industrial tools, Spanners etc.)	ALL
2	Injection moulding machine, shot weight 70 gram, clamping force 60 ton	2-7, 9,12
3	Blow moulding machine, 1 cavity, 10 liter ,clamping force 180KN	2,4,6,7, 10,12
4	Extrusion moulding machine, Plasticizing capacity 15-18 kg/hr, Article wt 50 grams.	2-4, 6-8
5	Thermoforming moulding machine, forming area 500x300 mm. compressor air 2000 ltr/minute at 7atm 15 HP	11
6	Melt Flow Index Tester Micro processor based PID controller with temperature range from ambient to 400°C, resolution of 0.1°C and accuracy of + 0.1°C., Timer : Digital presettable with a range up to 59 minutes, Sample cutting : Auto, Weights : 2.16 kg, 5 kg, Accessories : Standard accessories, Power : 230 Volts, 50	13
7	Taber abrasion resistance tester Turntable speed-60 rpm and 72 rpm, weight of the abrading arm-250 grams with wheel loads of 250,500,750 and 1000 grams.	17
8	Environmental stress cracking test apparatus Rate of heating- 50 °C/hr, Capacity- 5-10 lit. with standard accessories	14
9	Air compressor. 5 HP 3.7 KW, Air receiver 220 Litres.	7,10
10	Falling Dart Impact Tester Variable drop height adjustment as standard 660mm – 1500mm, Pneumatic clamping system, constant sample tension for repeatability, Dart return shoot, 38.1mm (1 ½”) and 50.8mm (2”) spherical darts as standard	15
11	Lamination machine, lamination speed 1000mm/minute ,max pouch size A3	16

8. UNDERPINNING THEORY COMPONENTS

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

Unit	Major Learning Outcomes (In cognitive domain)	Topics and Sub-topics
Unit – I Types of maintenance	1a. Contrast the significance of given types maintenance. 1b. Explain the use of given tools for maintenance.	1.1 Maintenance: terms and definition, types-preventive and breakdown maintenance and their objectives. 1.2 Maintenance tools and accessories.



Unit	Major Learning Outcomes (In cognitive domain)	Topics and Sub-topics
	1c. Explain the process of preventive maintenance for given machines. 1d. Develop maintenance planning sheet for given plastic machine.	1.3 Maintenance department organization and functions. 1.4 Maintenance planning
Unit-II Electrical maintenance	2a. Prepare preventive maintenance chart for given electric equipments. 2b. Explain maintenance process of given motors. 2c. Employ maintenance of given Starter and Circuit Breakers. 2d. Illustrate maintenance of given Controllers and Thermocouples.	2.1 Repair and maintenance of the electrical equipments: Electrical induction motors, Variable speed motors, their characteristics and speed control. 2.2 Maintenance of starter, circuit breakers (air circuit breakers and miniature circuit breakers). 2.3 Limit switches, timers and relays. 2.4 Temperature controllers and thermocouples. 2.5 Heaters (mica and ceramic type).
Unit- III Mechanica I Maintenance	3a. Explain the procedure of inspection. 3b. Diagnose problem through inspection. 3c. Explain the procedure for cleaning of given screw and barrel. 3d. Explain the process for replacement of given screw. 3e. Outline replacement process of o-ring in given gear box.	3.1 Inspection, small repair, medium repair and complete overhauling of processing machines. 3.2 Maintenance of plasticizing screw and barrel. 3.3 Maintenance of thrust bearing unit. 3.4 Maintenance of gear box. 3.5 Maintenance of moving parts.
Unit – IV Troublesh ooting of machines	4a. Identify troubles and suggest remedies for given plastic processing machine. 4b. Minimize troubleshooting time for given plastic machine.	4.1 Troubleshooting problems, reasons and remedies of injection moulding machine 4.2 Troubleshooting problems, reasons and remedies of blow moulding machine 4.3 Troubleshooting problems, reasons and remedies of extrusion plant.
Unit –V Record keeping and documenta tions	5a. Compute manpower for maintenance of given plastic processing plant. 5b. Maintain spare part record for given processing machines. 5c. Record the log sheet for given processing machines.	5.1 Manpower planning for maintenance department. 5.2 Managing spare part inventories, specifying its purpose and types. 5.3 Compilation of breakdown time and percentage. 5.4 Log sheet: definition and monitoring of breakdown reasons.

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

- Not applicable -



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:

- Prepare journals based on practical performed in laboratory.
- Follow the safety precautions.
- Use various tools for maintenance of plastic machines.
- Library /Internet survey of plastic machinaries.
- Prepare power point presentation or animation for understanding different maintenance techniques.
- Visit to plastic industry to show preventive and breakdown maintenance activities.

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:

- Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
- '*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.
- 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 LOs/COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
- Use Flash/Animations to explain various maintenances techniques.
- Guide student(s) in undertaking micro-projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. 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.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should 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. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

- Information search:** Collect information (specifications, rates, terms and conditions, discounts, addresses) of plastic processing machines and make class presentation.
- Chart preparation:** Prepare the chart of preventive and breakdown maintenance schedules.
- Maintenance Plan:** Prepare detail preventive maintenance plan for various plastic processing machines.
- Video presentation:** collect videos/animation films depicting the working principle and their processes of maintenance of plastic processing machines and make presentation.



13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Engineering Maintenance: A Modern Approach	Dhillon, B.S.	CRC Press, London, 2002 ISBN : 1-58716-142-7
2	Lubrication and Reliability	Neale, M.J.	Botterworth Heinemann, Boston, 2001 ISBN : 0 7506 51 54 7
3	Maintenance Engineering Handbook	Mobley, R.K. Higgins, L.R. Wikoff, R.J.	Mc Graw Hill, New Delhi, 2008 ISBN : 0-07-164101-7
4	SPI Plastics Engineering Handbook	Berins, M. L.	Kluwer Academic Publishers, Boston, 2000 ISBN: 978-1-4615-7606-8
5	Injection Moulding Handbook	Rosato, D.V., Rosato, M. G., Rosato, D.V.	Springer Science and Business Media, 2000 ISBN 978-1-4615-4597-2
6	Practical Injection Moulding	Bernie, A., Martin,	CRC Press book, Taylor and Francis Group, 2001 ISBN 9780824705299
7	Industrial safety, Health and Environment Management system	Jain, R. K., Rao, S.S.	Khanna Publishers, New Delhi, 2015 ISBN 8174092102
8	Industrial Maintenance	Garg, H. P.	S. Chand Publishing, New Delhi, 2010 ISBN 9788121901680

14. SOFTWARE/LEARNING WEBSITES

- <https://www.youtube.com/watch?v=uEyYV9HYSaU>
- <https://www.youtube.com/watch?v=Gqpuz3XHE4w>
- <https://www.youtube.com/watch?v=T40quUYF4qo>
- https://www.youtube.com/watch?v=sBWg5_Kl1BM
- <https://www.youtube.com/watch?v=ltGB9E4Qy4o>
- <https://www.youtube.com/watch?v=VW-V4MCXeSY>
- <https://www.youtube.com/watch?v=bEqfHlchJaE>
- <https://www.youtube.com/watch?v=MYh4mtT-fKI>



