GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2023 (COGC-2023)
Semester-V

Course Title: Mechanical Engineering Project-I
(Course Code: 4351904)

Diploma program in which this course is offered	Semester in which offered
Mechanical Engineering	5th Semester

1. RATIONALE

Functionality, Reliability, Durability, Safety, Maintainability, Sustainability, Ergonomics, Aesthetics, Cost-effectiveness, and Manufacturability of a product is always a prime concern for a designer. Even a well designed product may have the scope of improvement looking at the situation's demand. It is a moral duty of an engineer to work proactively to provide a new product to the customer or modify the existing product for a safer, qualitative, cost effective or sustainable solution. This course provides an opportunity to the students to demonstrate their abilities to address at least one of such problems in a product. This course also aims to develop in a student an engineering skill like diagnose the problem, design an innovative/optimal solution and management skills like conduct the visit or survey, leadership, coordination, team-work, decision making, planning for the resources, reporting etc.

2. COMPETENCY

The course content should be taught and implemented to develop different skills so that students can acquire the following competency.

- Apply systematic approach for problem selection and provide its safer, qualitative, cost effective or sustainable solution.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge, and the relevant soft skills associated with the identified competency are to be developed in the student for the achievement of the following COs:

CO	CO Statement
CO-1	Conduct the visit and/or survey to search the problem.
CO-2	Select the problem and outline the conceptual model of its solution.
CO-3	Modify the conceptual model of a solution based on safety, quality, cost or sustainability.
CO-4	Prepare plans and estimates for the solution and Project-I report.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
0	0	4	2	0	0	50	50	100

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

5. SUGGESTED PRACTICAL EXERCISES

Following practical outcomes (PrOs) are the subcomponents of the Course Outcomes (COs). Some **POs** marked **'*'**are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to the 'Psychomotor Domain.'

Exercise No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.
01	**Project Initialization:** Mechanical Engineering Project-I activities should be initialized at the end of semester IV but well before the start of semester-V. Following activities should be done during this exercise. a. Refer to the curriculum of courses Mechanical Engineering Project-I and Mechanical Engineering Project–II. b. Understand the importance of a project. c. Understand Project domains/areas and project constraints. d. Understand Dos and Don'ts in context of the project. e. Understand product design criterion and parameters on which the performance of a product depends. f. Overview/showcase the previously completed projects. g. Understand the relationship between the Project and Intellectual Property Rights (IPRs) h. List of various agencies funding the projects, if any. i. Explore the probability with the nearby industries to see if they have any projects that students can work on. j. Consult faculties/guides, industry professionals and/or anybody who have expertise in the field of engineering to find suitable project.	-	-

Exercise No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.
02	**Data collection for the project:** a. Conduct research in the field/industry or explore online platforms to gain an understanding of the current mechanical engineering projects being undertaken. Additionally, perform a literature survey of relevant resources such as journals, websites, and blogs that focus on mechanical engineering projects. This will help gather information for problem selection. b. Record key findings and collect essential data about the identified problem from the site visit or literature survey. Note: 1. This exercise will be completed individually by each student. 2. Students have the flexibility to work on any real-life problem related to the field of mechanical engineering. This may include a User Defined Problem (UDP), a live problem sourced from the industry (IDP), or an extension/modification of an existing product/project. It is not limited to the creation of physical models exclusively.	-	16
03	**Project Selection.** Refer to the data collected during exercises No. 01 & 02 and do the following. a. Each batch member should present their key findings. b. Form groups for Mechanical Engineering Project-I from the batch members. c. Select a problem and prepare a project definition. d. Create a schedule for the group's work allocation, covering all the milestone activities/tasks of the project for the entire duration of the term, both planned and actual. e. Apply relevant product/system design and/or management techniques such as Root Cause Analysis (RCA), Finite Element Analysis (FEA), Failure Mode and Effects Analysis (FMEA), Computational Fluid Dynamics (CFD), Fault Tree Analysis (FTA), 5W2H critical examination technique, Ishikawa (Fishbone) Diagram, Pareto Analysis, Statistical Process Control (SPC), Design of Experiments (DOE), Value Stream Mapping (VSM), Simulation and Modeling, 5S strategies, 7S framework, SWOT analysis, Life Cycle Management (LCM), Lean Manufacturing, Six Sigma, Total Quality Management (TQM), etc. Then, outline the conceptual model of the solution with key data. Note: 1. The group size for students is preferably in the range of 3 to 8, based on the requirements of the project. 2. Interdisciplinary groups may be allowed based on the specific demands of the project. 3. Each project group will be assigned a guide. Ideally, the majority, if not all, of the department's faculties should be assigned the duty of Project-I guide-ship. 4. The group may proceed with the process of Intellectual Property Rights (IPR) based on advice from the guide, if necessary.	-	12

Exercise No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.
04	**Plans & estimates of the project.** Refer to the details collected during exercises No. 01 and 02 and follow the instructions provided below, based on their applicability. a. Prepare a user manual containing project specifications and other key details. b. Create detailed assembly and production drawings. c. Develop an Operation Process Chart (OPC), process plans, quality/test plans, a statement of bought-out parts, a statement of raw material, budget estimation, and any other relevant documents.	-	16

Exercise No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs.
05	**Project-I report.** a. Prepare a computerized project report following the guidelines provided below. PAGE : A4 (print on both side of paper) MARGIN : TOP 15mm BOTTOM 15mm INSIDE & OUTSIDE 30mm (mirror margining) FONT : ARIAL FONT SIZE: TITLE:12 BOLD, CONTENT:12, SPACING :18pt HEADER: PROJECT TITLE, PAGE No ON TOP RIGHT. FOOTER : ACADEMIC YEAR, SHORT NAME SAMPLE FORMAT OF UDP PROJECT-I REPORT The Report may include the following. Text shown in the square bracket [] is an explanation on the chapter/topic. Certificate (in the Format given in Appendix-C) Acknowledgement Index 1. Abstract: [A brief summary of the project, including its objectives, methodology, and results.] 2. Introduction: [An introduction to the project, including its background and scope.] 3. Literature Review: [A review of the existing literature related to the project, including any relevant theories or concepts. This may include Prior Art Search.] 4. Methodology: [A description of the research methodology used in the project, including data collection and analysis methods.] 5. The Outline of the solution: [This may include output of exercise-01 to 03] 6. Results and Discussion: [A presentation of the project's probable results, including any statistical analysis, charts, or graphs. This section should also include a discussion of the results and their implications.] 7. Conclusion: [A summary of the project's main findings.] 8. Recommendations: [Suggestions for future research or improvements.] 9. References: [A list of all sources cited in the report.] 10. Appendices: [Any additional materials that support the report, such as work allocation schedule (planned and actual), photographs, technical drawings, circuits, software or data sets.] b. Print the required number of copies of the Mechanical Engineering Project-I report after obtaining approval from the guide. c. Submit the hard and/or soft copies of the following documents: • Mechanical Engineering Project-I report • Mechanical Engineering Project-I logbook • Additional records referred to in appendices, if any Note: The report format for an IDP (Industry-Defined Problem) may differ from the UDP (User-Defined Problem) report format suggested above.	-	12
Total (Hours)		**-**	**56**

Note: Each project group will present its work upon completing each exercise, following the department's plan.

I. More **Practical Exercises** can be designed and offered by the concerned course teacher to develop

the industry-relevant skills/outcomes to match the COs. The above table is only a representative list**.**

II. Care must be taken in assigning and assessing the study report as it is a Second-year study report. The study report, data collection, and analysis report must be assigned to a group. A teacher has to discuss the type of data (which and why) before the group starts their market survey.

6. Sample rubrics Performance Indicators for the PrOs

Criteria	%	5	4	3	2
Logbook	10%	Always maintains proper order of meetings and assigned tasks	Consistently maintains proper order of meetings and assigned tasks	Sometimes maintains proper order of meetings and assigned tasks	Rarely maintains proper order of meetings and assigned tasks
Literature Survey	10%	Always lists journals, websites etc. and generate idea with scope of product	Consistently lists journals, websites etc. and generate idea with scope of product	Sometimes lists journals, websites etc. and generate idea with scope of product	Rarely lists journals, websites etc. and generate idea with scope of product
Concept development and finalization of topic	10%	Always compares existing concepts and derives final topic	Consistently compares existing concepts and derives final topic	Sometimes compares existing concepts and derives final topic	Rarely compares existing concepts and derives final topic
Drawings, plans and estimates	20%	Always provides required no. of views of each part with required details in detail and assembly drawings and prepare necessary plans & estimates	Consistently provides required no. of views of each part with required details in detail and assembly drawings and prepare necessary plans & estimates	Sometimes provides required no. of views of each part with required details in detail and assembly drawings and prepare necessary plans & estimates	Rarely provides required no. of views of each part with required details in detail and assembly drawings and prepare necessary plans & estimates
Budget Analysis	10%	Always list parts used in the assembly and costing with competitive rates	Consistently list parts used in the assembly and costing with competitive rates	Sometime list parts used in the assembly and costing with competitive rates	Rarely list parts used in the assembly and costing with competitive rates
Presentation	10%	Always discuss all content with outline and methodology used	Consistently discuss all content with outline and methodology used	Sometime discuss all content with outline and methodology used	Rarely discuss all content with outline and methodology used

Criteria	%	5	4	3	2
Report write-up	10%	Always preparer basic category/section and summary	Consistently preparer basic category/section and summary	Sometime preparer basic category/section and summary	Rarely preparer basic category/section and summary
Conclusion, Future Scope	10%	Conclusion and future scope derived appropriately	Conclusion and future scope derived but partial	No relevant conclusion or future scope	No conclusion or future scope

7. MAJOR EQUIPMENT/INSTRUMENTS REQUIRED

Sr.No.	Equipment Name	PrO.No.
1.	Computer with word processor and modeling software	4

8. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above COs and PrOs. More can be added to fulfill the development of this course competency.

a. Work as a leader/team member.

b. Follow safety practices.

c. Follow ethical practices

d. Maintain tools and equipment

e. Practice environment-friendly methods and processes.(Environment Related)

9. SOFTWARE/LEARNING WEBSITES

- https://www.theengineeringprojects.com/
- https://asmedigitalcollection.asme.org/mechanicaldesign
- https://blog.creationcrate.com/mechanical-engineering-projects/
- https://plagiarisma.net/

10. PO-COMPETENCY-CO MAPPING

Semester V	POs						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Competency & Course Outcomes	Basic & Discipline-specific knowledge	Problem Analysis	Design/development of solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability & environment	Project Management	Life-long Learning
Competency	Apply systematic approach for problem selection and provide its safer, qualitative, cost effective or sustainable solution.						

Semester V	POs						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
Competency & Course Outcomes	Basic & Discipline-specific knowledge	Problem Analysis	Design/development of solutions	Engineering Tools, Experimentation & Testing	Engineering practices for society, sustainability & environment	Project Management	Life-long Learning
CO.1 Conduct the visit and/or survey to search the problem.	3	-	-	-	-	2	2
CO.2 Select the problem and outline the conceptual model of its solution.	2	2	-	-	2	2	2
CO.3 Modify the conceptual model of a solution based on safety, quality, cost or sustainability.	3	2	3	2	2	2	2
CO.4 Prepare plans and estimates for the solution and Project-I report.	-	-	-	2	-	2	2

Legend:'3' for high, '2' for medium, '1' for low, and '-'for no correlation each CO with PO.

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE (GTU Resource Persons)

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Jitendra P. Parmar, Lecturer Mechanical Engineering	609 – C U Shah Polytechnic Surendranagar	9429942662	jpparmar66@gmail.com
2.	Muhammad Azharuddin U. Badi, Lecturer Mechanical Engineering	627 - Government Polytechnic, Porbandar	9558800951	muhammadbadi92@gmail.com

12. BOS Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. S. H. Sundarani, BOS Chairman & HOD Mechanical	Government Polytechnic, Ahmadabad	9227200147	gpasiraj@gmail.com
2	Dr. Rakesh D. Patel, BOS Member & HOD Mechanical	B. & B. Institute of Technology, V. V. Nagar	9825523982	rakeshgtu@gmail.com
3.	Dr. Atul S. Shah, BOS Member & Principal	B. V. Patel Institute of Technology, Bardoli	7567421337	asshah97@yahoo.in

Appendix-A

SAMPLE LOGBOOK

Enrolment No: Name of the Student:

Date: Time from: to (Total hrs)

Place/s of work or visit:	
Detailed description of work done:	
Name of concerned person/s, if any	
Document/s referred, collected, created or modified, if any	
Financial details, if any	
Student’s dated sign	Guide's dated sign

Appendix-B

SAMPLE PROCESS PLAN

Drawing No: Part No/Id: Name of the Part:

Raw material: Raw wt: Finish wt:

Op. No	Name of Operation	Size, tol., surface finish etc req'd	Machine details	Machining Parameters	Cutting Tools, Jig/ Fixture, coolant etc req'd	Measuring, inspection, Test instruments required	Time in Hr	
							Set-up	machining

Student's dated sign Project guide's dated sign

Appendix-C

SAMPLE CERTIFICATE

This is to certify that Enrolment No: _____

Mr./Ms._____

from_____College has completed Mechanical Engineering Project-I Report of Semester-V having title _____(Project Id: _____) in a group consisting of _____ students under the guidance of the Faculty Guide _____ in the academic year: _____

The mentor from the industry for the project, if any:

Name:

Industry:

Contact Details:

Institute Guide Industry Guide Head of Department