GOVERNMENT COLLEGE OF ENGINEERING KARAD

(*An Autonomous Institute of Government of Maharashtra*)

DEPARTMENT OF MECHANICAL ENGINEERING

SCHEME OF INSTRUCTION FOR

ADDITIONAL CREDIT COURSES (Offline Mode)

(Honours, Honours with Research and Double Minor)

AS PER NEP-2020

W.E.F

AY 2024-25

Scheme of Instructions for

'Honors'

Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: B.Tech Mechanical Honors (Industrial Product Design) (wef 2024-25)

Guidelines

Students will take up 5-6 additional courses in the same Engineering/ Technology discipline of 18 credits distributed over semester III –VIII. These 18 credits will be over and above the 176 credits prescribed for four year Multidisciplinary Bachelor's degree in Engg/Tech Program.

Minor: Semester – I (Major: Semester – IV)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEHO-0401	Fundamentals of Product design and process	03	--	03	03	20	30	50
2	MEHO-0402	Product design techniques lab	--	02	02	01	-	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

Minor: Semester – II (Major: Semester – V)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEHO-0501	Product packaging and Materials	03	--	03	03	20	30	50
2	MEHO-0502	Product packaging CAD lab	--	02	02	01	--	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

L- Lecture

P-Practical

FA-I- Formative Assessment

SA - Summative Assessment (For Laboratory End Semester performance)

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Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: B.Tech Mechanical Honors (Industrial Product Design)

Minor: Semester – III (Major: Semester – VI)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEHO-0601	Product Ergonomics	03	--	03	03	20	30	50
2	MEHO-0602	Design for medical and agriculture applications lab	--	02	02	01	--	50	50
		Total	**03**	**02**	**05**	**04**	**20**	**80**	**100**

Minor: Semester – IV (Major: Semester – VII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEHO-0701	Product estimation and costing	02	--	02	02	20	30	50
2	MEHO-0702	Prototyping Techniques lab	--	02	02	01	--	50	50
		Total	**02**	**02**	**04**	**03**	**20**	**80**	**100**

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L- Lecture P-Practical

FA- Formative Assessment-

SA - Summative Assessment (For Laboratory End Semester performance)

Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: B.Tech Mechanical Honors (Industrial Product Design)

Minor: Semester – V (Major: Semester – VIII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							PBE-I	PBE-II	TOTAL
1	MEHO-0801	Major Capstone Project (Design & Development)	--	6	6	3	50	50	100
		Total	--	**6**	**6**	**3**	**50**	**50**	**100**

L- Lecture P-Practical

SA - Summative Assessment (For Laboratory End Semester performance)

PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

PBE- II Project-based Examination (For Laboratory End Semester Performance)

PROGRESSIVE TOTAL CREDITS: 18

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NOTE:

For students enrolled in **internship mode**, the **examination evaluation for the above-mentioned subjects** will be conducted **online**. Additionally, **all associated academic activities** for these students will also be carried out **in online mode**

Scheme of Instructions for

'Double Minor'

Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: B.Tech Mechanical with Double Minors (wef 2024-25)

Guidelines

Students will take up 5-6 additional courses in another Engineering/ Technology/ Emerging Area of Specialization of 18 credit distributed over semester III – VIII. These 18 credits will be over and above the 176 credits prescribed for four year multidisciplinary bachelor's degree in Engg/Tech Program

Minor: Semester – I (Major: Semester – III)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEDO-0301	Material Science	02	--	02	02	50	50	100
		Total	**02**	**00**	**02**	**02**	**50**	**50**	**100**

Minor: Semester – II (Major: Semester – IV)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEDO-0401	Analysis of Mechanical elements	02	--	02	02	50	50	100
		Total	**02**	**00**	**02**	**02**	**50**	**50**	**100**

L- Lecture P-Practical FA- Formative Assessment-I

SA - Summative Assessment (For Laboratory End Semester performance)

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PROPOSED SCHEME OF INSTRUCTION

Programme: Double Minors

Minor: Semester – III (Major: Semester – V)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEDO-0501	Thermal Engineering	03	--	03	03	50	50	100
2	MEDO-0502	Mechanical Engineering Lab	--	02	02	01	50	--	50
		Total	**03**	**02**	**05**	**04**	**100**	**50**	**150**

Minor: Semester – IV (Major: Semester – VI)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEDO-0601	Manufacturing Engineering	02	--	02	02	50	50	100
		Total	**02**	**00**	**02**	**02**	**50**	**50**	**100**

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Government College of Engineering, Karad

PROPOSED SCHEME OF INSTRUCTION

Programme: Double Minors

Minor: Semester – V (Major: Semester – VII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							FA	SA	TOTAL
1	MEDO-0701	Energy Conservation and Management	02	--	02	02	50	50	100
		Total	**02**	**00**	**02**	**02**	**50**	**50**	**100**

Minor: Semester – VI (Major: Semester – VIII)

Sr. No.	Course Code	Course Title	L	P	Contact Hrs/Wk	Course Credits	EXAM SCHEME		
							PBE-I	PBE-II	TOTAL
1	MEDO-0801	Mechanical System Design	2	--	2	2	50	50	100
2	MEDO-0802	Major Capstone Project (Design & Development)	--	8	8	4	50	50	100
		Total	**2**	**8**	**10**	**6**	**100**	**100**	**200**

L- Lecture P-Practical

SA - Summative Assessment (For Laboratory End Semester performance)

PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

PBE- II Project-based Examination (For Laboratory End Semester Performance)

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PROGRESSIVE TOTAL CREDITS: 18

NOTE: For students enrolled in **Internship mode**, the **examination evaluation for the above-mentioned subjects** will be conducted **online**. Additionally, **all associated academic activities** for these students will also be carried out **online**

Course Syllabi for

B.Tech Mechanical Honors

Industrial Product Design

Government College of Engineering, Karad

Minor: Semester – IV (Major: Semester – VII) B. Tech. Mechanical Engineering Honors

MEHO-0701: Product estimation and costing

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		FA	20
Tutorials	--		SA	30
Total Credits	03		Total	50
			Duration of ESE	2 Hrs 30 Min

Prerequisite : Manufacturing processes, Industrial Engineering, Workshop technology

Course Outcomes (CO): Students will be able to

CO1	Understand the concept of estimation and costing.
CO2	Analyze the concept of depreciation cost. Determine material cost of simple machine components
CO3	Ability to estimate the various machining operations
CO4	Understand the concept of Process costing, and types of Budgets, and familiarize with accounting terminology & modern tools for cost estimation

	Course Contents	**CO**	**Hours**
Unit 1	**Introduction to Estimating and Costing** Importance and aims of cost estimation – functions of estimation – difference between estimating and costing – importance of preparing realistic estimates – estimating procedure.	**CO1**	**(04)**
Unit 2	**Elements of Costs** Introduction- Material Cost- Determination of material cost, Labor Cost- Determination of direct labor cost- Expenses- Cost of Product (Ladder of Cost) Factory Expenses- Depreciation- Causes of Depreciation, Methods of Depreciation, Administrative Expenses- Selling and Distributing Expenses,	**CO2**	**(05)**
Unit 3	**Overhead Costs** Analysis of overhead expenses, Distribution of overhead costs – depreciation – causes of depreciation – methods of calculating depreciation. Estimation of machining time, Calculation of machining time for lathe operations estimation of drilling time on drilling machine – estimation of time for shaping, planning, milling and grinding.	**CO2**	**(05)**
Unit 4	**Estimation in Different Shops/Industries** Foundry Shop: Pattern cost, casting cost, pattern allowances, and associated examples. Forging Shop: Forging losses, material cost calculations, and total forging cost Welding/Fabrication Shop: Estimation for gas cutting and electric welding operations.	**CO3**	**(06)**
Unit 5	**Cost Accounting, Cost Control and Cost Reduction:** Important terms, cost accounting, standard costing, procedure for costing, costing methods, cost control, techniques of cost control. Cost reduction, cost saving areas, variance analysis	**CO4**	**(05)**
Unit 6	**Modern Concepts and Tools** Computer-Aided Process Planning (CAPP): Understanding generative and retrieval systems, Value Analysis/Engineering: Techniques to enhance product value and reduce costs without sacrificing quality, Software Estimation in mechanical engineering, estimating project scope, resources, schedules, and managing risks.	**CO4**	**(05)**

Assignments

1.	Assignment on each unit (Total 6 nos.)

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Text Books

1.	*"Mechanical estimation and costing"*, T.R.Banga and S.C.Sharma, Khanna Publishers, 17th Edition, 2001 (Unit 1, 2, 3)
2.	*"Industrial Organization & Engineering Economics"*, T.R.Banga and S.C.Sharma, Khanna Publishers, January 2006, (Unit 3, 5)
3.	"*Mechanical Costing & Estimation*", Singh & Khan, Standard Publishers and Distributors, 1st edition, 2013, (Unit 4, 6)

Reference Books	
1.	"*Mechanical Estimating and Costing*" B. P. Sinha, McGraw-Hill Education, 1995 Edition
2.	"*Process Planning & Cost Estimation*", M. Adithan, New Edge International, 2nd Edition, January 2019
Useful Links	
1.	(NPTEL Course on Mechatronics, IIT Roorkee) http://www.digimat.in/nptel/courses/video/103103039/L40.html
2.	(Software Learning Website) http://calculatoredge.com/index.htm#mechanical
3.	(Production and cost estimation) https://www.youtube.com/watch?v=KIzBodrevQk

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	-	-	-	-	-	-	-	2	3	2	-
CO 2	3	-	2	2	-	-	-	1	-	-	2	3	3	-
CO 3	3	3	2	2	2	-	-	1	-	-	2	3	3	3
CO 4	3	3	2	2	2	-	-	1	-	-	2	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	FA	SA
Remember		5
Understand	5	5
Apply	5	5
Analyse	5	5
Evaluate	5	5
Create		5
TOTAL	20	30

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Government College of Engineering, Karad				
Minor: Semester – IV (Major: Semester – VII) B. Tech. Mechanical Engineering Honors				
MEHO-0702: Prototyping Techniques Lab				
Laboratory Scheme:			**Examination Scheme:**	
Practical	02 Hrs/week		FA	-
Total Credits	01		SA	50
Prerequisite: Any department enthusiast willing to learn prototyping techniques				
Course Outcomes (CO): Students will be able to				
CO1	Identify engineering problems and formulate structured design requirements for prototype development using systematic analysis tools.			
CO2	Generate, model, and evaluate prototype concepts using digital tools such as CAD modeling, virtual assembly, simulation, and slicing software.			
CO3	Apply appropriate prototyping techniques—including additive, subtractive, low-fidelity, and design optimization—to develop feasible prototype solutions			
CO4	Assess prototype feasibility through material selection, cost analysis, risk assessment (DFMEA), and prepare professional engineering documentation			

Course Contents		CO
Experiment 1	Problem Identification & Requirement Engineering for Prototype Development	**CO1**
Experiment 2	Concept Generation Using Function Decomposition & Morphological Chart	**CO1**
Experiment 3	Reverse Engineering Study Through Visual & Functional Decomposition	**CO1**
Experiment 4	Virtual Assembly & Motion Simulation Using CAD Software	**CO2**
Experiment 5	Parametric 3D CAD Modeling of a Selected Prototype Concept	**CO2**
Experiment 6	Additive Manufacturing Pre-Processing: Orientation, Slicing & Toolpath Planning (Theory Only)	**CO3**
Experiment 7	Material Selection for Prototyping Using Ashby-Based Decision Methods	**CO4**
Experiment 8	Cost Estimation & Manufacturing Feasibility Study (AM vs Subtractive Route)	**CO4**
Experiment 9	Design for Additive Manufacturing (DfAM): Model Optimization & Support Reduction(Theory Only)	**CO3**
Experiment 10	Understanding Low-Fidelity Prototype Planning Using 2D Layouts	**CO3**
Experiment 11	Design Failure Mode & Effects Analysis (DFMEA) for Proposed Prototype	**CO4**
Experiment 12	Prototype Design Documentation: Engineering Report + Presentation Preparation	**CO4**
List of Submission: Minimum 10 experiments of the above		

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	2	2	1	1	-	1	2	1	2	2	2
CO 2	2	1	3	2	3	-	1	-	1	1	1	2	2	2
CO 3	2	1	3	2	3	1	1	1	2	1	1	3	2	2
CO 4	2	3	3	3	2	-	-	1	3	3	1	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern:

Skill Level (as per CAS Sheet)	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7	Exp 8	Exp 9	Exp 10	Avg
Task I	30	30	30	30	30	30	30	30	30	30	30
Task II	10	10	10	10	10	10	10	10	10	10	10
Task III	10	10	10	10	10	10	10	10	10	10	10

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Government College of Engineering, Karad				
Minor: Semester – V (Major: Semester – VIII) B. Tech. Mechanical Engineering Honors				
MEHO-0801: Major Capstone Project (Design & Development)				
Teaching Scheme			**Examination Scheme**	
Contact Hrs	06 Hrs/week		PBE-I	50
Tutorials	--		PBE-II	50
Total Credits	03			
			TOTAL	100

Prerequisite : Machine Tools & Processes

Course Outcomes (CO): Students will be able to

CO1	Make proper decision and plan for capstone project with evaluating practicability, resources, limitations, and ethical considerations.
CO2	Apply engineering principles and theoretical knowledge to analyze and solve complex problems under project constraints.
CO3	Perform effective research to critically analyze results that support decision-making, and optimize engineering solutions.
CO4	Establish and manage comprehensive project phase plans with Project scheduling, financial planning, risk evaluation, and quality assurance.

	Course Contents	CO
Unit 1	**General Guidelines – Major Project :** **1. Project Scope :** The major project shall involve the planning, development, and execution of a substantial engineering system or solution. It may include a wide range of technical activities such as: • **Design Projects:** Creating innovative solutions such as new devices, systems, or processes. • **Experimental Studies:** Conducting research through experiments, collecting and analysing data, and drawing conclusions. • **Computer Simulations:** Using computational models and simulations to investigate and analyse engineering problems. All projects must align with the department's specialization and maintain strong relevance to core curriculum and industry practices. **2. Project Components:** Successful completion of the major project requires integration of the following key elements: • **Problem Identification & Definition:** Clearly identifying and defining the engineering problem or challenge within the project scope. • **Literature Review:** Conducting a thorough review of existing knowledge, methodologies, and best practices related to the project. • **Problem Formulation:** Translating the identified problem into well-defined engineering objectives and constraints. • **Design & Development:** Designing, developing, and implementing solutions, including: o Conceptual design and idea generation o Detailed design and prototyping o System integration and testing • **Use of Modern Tools & Techniques:** Applying relevant contemporary tools and technologies such as: o Computer-Aided Design (CAD) software o Simulation and analysis tools (e.g., FEA, CFD) o Data acquisition and analysis tools o Project management software 3. Project Synopsis Submission	**CO1, CO2, CO3, CO4,**

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Students must submit a **Project Synopsis** containing the following details:

- **Project Scope:** Clear and concise description of project, objectives, boundaries, and relevance.
- **Project Objectives:** Specific, measurable, achievable, relevant, and time-bound (SMART) objectives.
- **Methodology:** Detailed project approach including:
  - Research methods (literature review, experimentation, simulation, etc.)
  - Design and development process (if applicable)
  - Data collection and analysis methods
- **Resources & Tools:** List of required resources, including:
  - Software (CAD, simulation, data analysis)
  - Equipment and materials
  - Facilities (laboratories, workshops, etc.)
- **Expected Results:** Anticipated project outcomes such as:
  - Measurable performance results
  - Design specifications
  - Research findings
  - Potential impact and contributions
- **Project Timeline:** A realistic and detailed schedule with milestones and completion deadlines.

The synopsis serves as a critical planning document that must be approved before project work begins.

4. Project Duration

The project work shall be carried out over **four semesters (Semesters 6–7)**. The same student group shall continue under the guidance of the assigned project guide throughout this duration.

5. Group Formation

Students shall work in groups of **2 to 4 members** for the major project. The maximum group size shall not exceed four members.

6. Assessment Scheme

Evaluation of the project will be based on the following components:

- **Project Synopsis & Progress Presentations:** Regular evaluations using established assessment rubrics.
- **Project Diary & Report:** Continuous assessment of the project diary maintained throughout the project duration. The final project report will be evaluated in the End-Semester Examination (ESE).
- **Project Presentations:** Oral presentations before the project evaluation committee, assessed collectively.

7. Submission Requirements

A. Project Work Diary

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- **Maintenance:** Must be carefully maintained by the group throughout the project duration.
- **Entries:** Weekly documentation of project activities including literature review, experimental work, data analysis, and other relevant tasks.

- **Countersignature:** Must be verified and countersigned by the assigned project guide regularly.

B. Project Synopsis

Format must include:

- Project title
- Student names and University Registration Numbers (URN)
- Guide's name and department
- Project relevance and significance
- Comprehensive literature review (minimum **10 peer-reviewed journal articles**)
- Proposed work: objectives, methodology, and approach
- Expected outcomes
- Detailed budget estimation
- References (in prescribed format)

Approvals required:

- Signatures of all group members
- Approval by project guide
- Endorsement by Head of Department (HOD)

C. Project Report

Format Guidelines:

- Typed report of **minimum 50 pages and maximum 100 pages**
- Must follow standard formatting for page size, margins, fonts, and spacing
- Properly cited references (journals, books, etc.) in the specified format

D. Project Presentations

- **Presentation Schedule:** Students must present project progress during scheduled reviews.
- **Submission:** Soft copy of presentation files (PowerPoint/PPT) must be submitted to the project guide.

E. Project Documentation

The Project Coordinator shall maintain a separate file containing:

- Approved project synopses
- Project review schedules
- Soft copies of all presentation slides (stored in Google Drive)
- Assessment marks for each review along with corresponding rubrics

*PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

**PBE- II Project-based Examination (For Laboratory End Semester Performance)

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Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	0	0	0	0	3	0	0	3	0
CO 2	3	3	3	0	2	0	0	0	0	0	0
CO 3	0	3	2	3	0	0	0	0	0	0	0
CO 4	0	0	0	0	0	2	0	0	0	3	0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	PBEI	PBEII
Remember	5	-
Understand	5	-
Apply	10	10
Analyse	10	10
Evaluate	10	15
Create	10	15
TOTAL	50	50

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Course Syllabi for

Mechanical Engineering

Double Minor

Government College of Engineering, Karad				
Minor: Semester – V (Major: Semester – VII) B. Tech. Mechanical Engineering Double Minor				
MEDO-0701: Energy Conservation and Management				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		FA	50
Tutorials	--		SA	50
Total Credits	02		Total	100

Prerequisite :

Course Outcomes (CO): Students will able to

CO1	Understand energy scenario, different energy sources and its importance.
CO2	Conversant with energy monitoring and targeting.
CO3	Apply knowledge of energy conservation and management.
CO4	Understand and apply the concept of Energy audit.

	Course Contents	CO	Hours
Unit 1	Energy scenario Current global energy scenario-coal, oil and natural gas reserve- statistical data-energy consumption in various sectors in India, Energy resources its classification - Renewable and non-renewable. Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE)	**CO1**	**(04)**
Unit 2	Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM)	**CO2**	**(04)**
Unit 3	Energy Conservation - Energy conservation- definition, need, importance, principles. Energy conversion methods and energy efficiency, Energy conservation approach, co-generation, waste heat utilization Energy conservation in buildings, energy saving tips, domestic sector, commercial sector energy conservation activities in buildings HVAC system-components- energy conservation opportunities in HVAC system-thermal insulation and energy efficiency, thermal energy conservation opportunities in buildings, Energy conservation techniques in lighting systems-general energy saving opportunities in lighting	**CO3**	**(07)**
Unit 4	Energy management: Definition, objectives, functions, importance of energy management, energy management techniques- self-knowledge and awareness-reengineering and evaluation -technology upgradations. Energy efficiency-concept, benefits, elements of energy efficiency, efficient energy, usage energy, conversion efficiency, energy conservation Star labelling-need – benefits, types of label, comparative label, endorsement label-criteria for selection of home appliances --BEE (Bureau of Energy Efficiency) star rating-list of appliances covered under Standards & Labelling program.	**CO3**	**(07)**
Unit 5	Energy Audit: Definition, energy audit, need, types of energy audit. understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	**CO4**	**(04)**

Assignments - One assignment on each unit.

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Text Books

1.	"*Industrial Energy Management and Utilization*" LC Witte, PS Schmidt and DR Brown, Hemisphere Publishing Corporation, Washington, 1998 (Unit 1 to 5)
2.	"*Energy Management and Conservation*" K V Sharma P Venkataseshaiah, I K International Publishing 2020 (Unit 1, 2, 3)
3.	"*Non-conventional Energy Sources*" G D Rai, Khanna Publication 6th ed, 2015. (Unit 4)

Reference Books	
1.	"*Energy Management Handbook*", WC Turner and Steve Doty, Fairmont Press , Seventh Edition, 2007
2.	"*Electrical Energy Efficiency- Technologies and Applications*" Sumper Andreas and Baggini Angelo, John Wiley 2012.
Useful Links	
1	https://nptel.ac.in/courses/112105221 "Energy Conservation and Waste Heat Recovery", Prof. Prasanta Kumar Das, Prof. A Bhattacharya, IIT Kharagpur.
2	https://youtu.be/kWcVVbXPTtk?si=iPZOuJkO0JmD7-0T "Energy Conservation & Management", Hemang Dhamelia, LJIET University
3	https://www.beeindia.gov.in "Energy Conservation & Management", Government of India, Ministry of Power

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	1	1	2		1		1	1	1	1	1
CO 2	2	2	2	2	1	1				2	1	2	2	2
CO 3	2	2	2	1	1	1				1	1	2	1	1
CO 4	2	2	2	2	1	1		1	1	2	1	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	FA	SA
Remember	5	-
Understand	5	-
Apply	10	10
Analyse	10	10
Evaluate	10	15
Create	10	15
TOTAL	50	50

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Government College of Engineering, Karad				
Minor: Semester – VI (Major: Semester – VIII) B. Tech. Mechanical Engineering Double Minor				
MEDO-0801: Mechanical System Design				
Teaching Scheme			**Examination Scheme**	
Lectures	02 Hrs/week		PBE I	50
Tutorials	--		PBE II	50
Total Credits	02			

Prerequisite :

Course Outcomes (CO): Students will able to

CO1	Understand broad perspective and design process, standards and codes used in design practice.
CO2	Apply principles of aesthetics and ergonomics design principles in design.
CO3	Apply principles of design for manufacture in casting, forging machining & welding components.
CO4	Analyze and Apply design principles in real life engineering applications.

	Course Contents	CO	Hours
Unit 1	**Mechanical Engineering Design in broad perspective:** Definitions, skills needed in mechanical design, Basic procedure of machine design, basic requirements of machine elements in a machine. Traditional design methods, Design synthesis. Use of standards and codes in design, selection of preferred sizes (Numerical treatment also).	**CO1**	**(04)**
Unit 2	**Aesthetics and Ergonomics considerations in design** Aesthetics in product design, basic types of product forms, designing for appearance. Ergonomics in design, man-machine closed loop systems, design considerations in displays, design considerations in controls, layout of panels. Characteristics of human, general workplace environment	**CO2**	**(04)**
Unit 3	**Design for Manufacture, assembly and safety (casting & forging)** Introduction, principles for design for manufacture and assembly, design principles in casting, design principals in forging. Design principles in machining, design principles in welding. Selective Assembly, Design for safety.	**CO3**	**(07)**
Unit 4	**Statistical considerations in design** Statistics and design, variance, standard deviation and standard variable. Normal distribution and Gaussian distribution, confidence intervals, design and natural tolerances, statistical considerations for factor of safety.	**CO3**	**(07)**
Unit 5	**Other aspects of Design** (at basic level only) Mechanical Reliability and uncertainty, break even analysis, concurrent engineering, reverse engineering, Design for patents.	**CO4**	**(04)**

Assignments - One assignment on each unit.

Text Books

1.	"*Design of Machine Elements*" by V. B. Bhandari, McGraw Hill Education (India) Pvt Ltd, New Delhi, 5th Edition, 2021. (Unit 1 to 6)
2.	"*Shigley's Mechanical Engineering Design*" by J. Keith Nisbett and Richard. G. Budynas, McGraw Hill, 12th Edition, 2024. (Unit 1 to 6)
3.	"Mechanical system design", Farazdak Haideri, Nirali Publication (Tech-Neo Pub), Pune, 4th edition, 2023.

Reference Books

1.	"*Machine Elements in Mechanical Design"* by Robert. Mott, Pearson publication, 6th ed. 2018 (Unit 1 to 6)
2.	"*Fundamentals of Machine Component Design*" by Robert C. Juvinall and Kurt. M. Marshek, Wiley Ltd., 6th Edition, 2017. (Unit 1 to 6)

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Useful Links

1	nptel.ac.in/courses/107103004 "Ergonomics for beginners: Industrial design perspective", Prof. Debkumar

	Chakrabarti, IIT Guwahati
2	nptel.ac.in/courses/107103012 "Design for Manufacture and Assembly(DFMA)", Abinash Kumar Swain, IIT Guwahati

Mapping of COs and POs

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	1		1					2	2	2	2
CO 2	2	2	3	1		1					2	2	2	2
CO 3	2	2	2	2	2	1					2	2	2	2
CO 4	2	3	3	2	2	1					2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern (with revised Bloom's Taxonomy)

Knowledge Level	PBEI	PBEII
Remember	5	-
Understand	5	-
Apply	10	10
Analyse	10	10
Evaluate	10	15
Create	10	15
TOTAL	50	50

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Government College of Engineering, Karad				
Minor: Semester – VI (Major: Semester – VIII) B. Tech. Mechanical Engineering Double Minor				
MEDO-0802: Major Capstone Project (Design & Development)				
Teaching Scheme			**Examination Scheme**	
Lectures	06 Hrs/week		PBE-I	50
Tutorials	--		PBE-II	50
Total Credits	03			
			TOTAL	100

Prerequisite : Machine Tools & Processes

Course Outcomes (CO): Students will be able to

CO1	Make proper decision and plan for capstone project with evaluating practicability, resources, limitations, and ethical considerations.
CO2	Apply engineering principles and theoretical knowledge to analyze and solve complex problems under project constraints.
CO3	Perform effective research to critically analyze results that support decision-making, and optimize engineering solutions.
CO4	Establish and manage comprehensive project phase plans with Project scheduling, financial planning, risk evaluation, and quality assurance.

	Course Contents	**CO**
Unit 1	**General Guidelines – Major Project :** **1. Project Scope :** The major project shall involve the planning, development, and execution of a substantial engineering system or solution. It may include a wide range of technical activities such as: • **Design Projects:** Creating innovative solutions such as new devices, systems, or processes. • **Experimental Studies:** Conducting research through experiments, collecting and analysing data, and drawing conclusions. • **Computer Simulations:** Using computational models and simulations to investigate and analyse engineering problems. All projects must align with the department's specialization and maintain strong relevance to core curriculum and industry practices. **2. Project Components:** Successful completion of the major project requires integration of the following key elements: • **Problem Identification & Definition:** Clearly identifying and defining the engineering problem or challenge within the project scope. • **Literature Review:** Conducting a thorough review of existing knowledge, methodologies, and best practices related to the project. • **Problem Formulation:** Translating the identified problem into well-defined engineering objectives and constraints. • **Design & Development:** Designing, developing, and implementing solutions, including: o Conceptual design and idea generation o Detailed design and prototyping o System integration and testing • **Use of Modern Tools & Techniques:** Applying relevant contemporary tools and technologies such as: o Computer-Aided Design (CAD) software o Simulation and analysis tools (e.g., FEA, CFD) o Data acquisition and analysis tools o Project management software 3. Project Synopsis Submission	**CO1, CO2, CO3, CO4,**

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Students must submit a **Project Synopsis** containing the following details:

- **Project Scope:** Clear and concise description of project, objectives, boundaries, and relevance.
- **Project Objectives:** Specific, measurable, achievable, relevant, and time-bound (SMART) objectives.
- **Methodology:** Detailed project approach including:
  - Research methods (literature review, experimentation, simulation, etc.)
  - Design and development process (if applicable)
  - Data collection and analysis methods
- **Resources & Tools:** List of required resources, including:
  - Software (CAD, simulation, data analysis)
  - Equipment and materials
  - Facilities (laboratories, workshops, etc.)
- **Expected Results:** Anticipated project outcomes such as:
  - Measurable performance results
  - Design specifications
  - Research findings
  - Potential impact and contributions
- **Project Timeline:** A realistic and detailed schedule with milestones and completion deadlines.

The synopsis serves as a critical planning document that must be approved before project work begins.

4. Project Duration

The project work shall be carried out over **four semesters (Semesters 6–7)**. The same student group shall continue under the guidance of the assigned project guide throughout this duration.

5. Group Formation

Students shall work in groups of **2 to 4 members** for the major project. The maximum group size shall not exceed four members.

6. Assessment Scheme

Evaluation of the project will be based on the following components:

- **Project Synopsis & Progress Presentations:** Regular evaluations using established assessment rubrics.
- **Project Diary & Report:** Continuous assessment of the project diary maintained throughout the project duration. The final project report will be evaluated in the End-Semester Examination (ESE).
- **Project Presentations:** Oral presentations before the project evaluation committee, assessed collectively.

7. Submission Requirements

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A. Project Work Diary

- **Maintenance:** Must be carefully maintained by the group throughout the project duration.
- **Entries:** Weekly documentation of project activities including literature review, experimental work, data analysis, and other relevant tasks.

- **Countersignature:** Must be verified and countersigned by the assigned project guide regularly.

B. Project Synopsis

Format must include:

- Project title
- Student names and University Registration Numbers (URN)
- Guide's name and department
- Project relevance and significance
- Comprehensive literature review (minimum **10 peer-reviewed journal articles**)
- Proposed work: objectives, methodology, and approach
- Expected outcomes
- Detailed budget estimation
- References (in prescribed format)

Approvals required:

- Signatures of all group members
- Approval by project guide
- Endorsement by Head of Department (HOD)

C. Project Report

Format Guidelines:

- Typed report of **minimum 50 pages and maximum 100 pages**
- Must follow standard formatting for page size, margins, fonts, and spacing
- Properly cited references (journals, books, etc.) in the specified format

D. Project Presentations

- **Presentation Schedule:** Students must present project progress during scheduled reviews.
- **Submission:** Soft copy of presentation files (PowerPoint/PPT) must be submitted to the project guide.

E. Project Documentation

The Project Coordinator shall maintain a separate file containing:

- Approved project synopses
- Project review schedules
- Soft copies of all presentation slides (stored in Google Drive)
- Assessment marks for each review along with corresponding rubrics

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*PBE-I– Project-based Examination (For Laboratory Mid Semester Performance)

**PBE- II Project-based Examination (For Laboratory End Semester Performance)

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CO 2	3	3	3	0	2	0	0	0	0	0	0
CO 3	0	3	2	3	0	0	0	0	0	0	0
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