Syllabus for Multi-Disciplinary Minor (MDM) Degree
in
Mechanical Engineering

Under the National Education Policy-NEP 2020
in
(2023-2024)

Offered by

DEPARTMENT OF GENERAL ENGINEERING

INSTITUTE OF CHEMICAL TECHNOLOGY
(University Under Section-3 of UGC Act, 1956)
Elite Status and Center for Excellence
Government of Maharashtra

Nathalal Parekh Marg, Matunga, Mumbai 400 019 (INDIA)
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A. Preamble:

The mechanical engineering minor is tailored to students who want to understand the fundamentals of mechanical engineering other than courses covered in engineering sciences. The students will develop abilities in design, analysis and experimentation through foundation of math, physics, chemistry including modelling, energy engineering, mechanics of materials, product design and hydraulics.

The students can combine the skills and technological expertise of this minor with a major in technology of aligned branch and chemical engineering to prepare for a wide variety of opportunities in industrial fields and in demand careers.

B. Programme Specific Outcomes:

Programme Specific Outcomes (PSOs) for Mechanical Engineering (MDM) as per course outcomes

PSO1	Use of Mechanical engineering knowledge in the design of chemical process equipment's, energy conservation systems.
PSO2	To provide specialized aspects of mechanical engineering to enhance their skill set and capabilities within their discipline specific field.
PSO3	To expand the working knowledge of Mechanical engineering principles to broader engineering activities.

C. Structure of the MDM course:

Subject Code	Semester	Subject	Credits	Hrs./Week			Marks for various Exams			
				L	T	P	CA	MS	ES	Total
GEP1132	III	Workshop Practice	2	0	0	4	50	-	50	100
GET1133	IV	Advanced strength of Materials	2	1	1	0	20	30	50	100
GET1134	V	Energy Engineering & Management	4	3	1	0	20	30	50	100
GET1135	VI	Mechanical design of chemical process equipment's.	2	1	1	0	20	30	50	100
GET1136	VII	Industrial Hydraulics	2	1	1	0	20	30	50	100
GET1137	VIII	Product Design and Development	2	1	1	0	20	30	50	100
		Total	14							600

D. Intake: Minimum 15 and maximum 35 students

E. **Duration:** 3 years (6 semesters)

F. **Eligibility criteria:** Students enrolled in B. Chem. Engg and B. Tech programme are eligible. The allotment of minor degree programme will be as per the policy of the Institute.

G. **Pedagogy/Teaching Method:**

Lecture/Discussions: These sessions will discuss the subject matters of the course.
Experiential Learning: The sessions will involve hands-on training.
Tutorials: Problem solving / case studies / relevant real-life applications / student presentations / home assignments / individual or group projects.

H. Method of Evaluation/Delivery

Subject Code	Semester	Course	Method of Evaluation	Methods of Delivery
GEP 1132	III	Workshop Practice	a) Continuous internal Evaluation on assigned Job. b) Skill based end exam.	a) Hands on Training
GET 1133	IV	Advanced strength of Materials	a) Minimum 2 class tests b) Assignments c) Seminar/ Presentation d) Report submission	a) Lectures/Face to face training b) Tutorials c) Case study d) Presentation (PPT) e) Group Projects
GET 1134	V	Energy Engineering & Management	a) Minimum two class test b) Assignments c) Seminar/ Presentation d) Report submission	a) Lectures/Face to face training b) Tutorials c) Case study d) Presentation (PPT) e) Group Projects
GET 1135	VI	Mechanical design of chemical process equipment's.	a) Minimum two class tests b) Assignments c) Seminar/ Presentation d) Report submission	a) Lectures/Face to face training b) Tutorials c) Case study d) Presentation (PPT) e) Group Projects
GET 1136	VII	Industrial Hydraulics	a) Minimum two class test b) Assignments c) Seminar/ Presentation d) Report submission	a) Lectures/Face to face training b) Tutorials c) Case study d) Presentation (PPT) e) Group Projects
GET 1137	VIII	Product Design and Development	a) Minimum two class tests b) Assignments c) Seminar/ Presentation d) Report submission	a) Lectures/Face to face training b) Tutorials c) Case study d) Presentation (PPT) e) Group Projects

I. Faculty/Instructor for the course

Subject Code	Semester	Course	Instructor/Faculty
GEP 1132	III	Workshop Practice	Dr. Sachin Solanke
GET 1133	IV	Advanced strength of Materials	Prof. Dilip Sarode
GET 1134	V	Energy Engineering & Management	Dr. D. Biswas

GET 1135	VI	Mechanical design of chemical process equipment's.	Prof. Suresh Deshmukh/Prof V. R. Gaval
GET 1136	VII	Industrial Hydraulics	Prof. R.S.N. Sahai
GET 1137	VIII	Product Design and Development	Dr Vikram Korpale

J. Detailed syllabus:

	Course Code: GEP 1132	Course Title: Workshop Practice	Credits = 2 L	T	P
	Semester: III	**Total contact hours: 60**	**0**	**0**	**4**
List of Prerequisite Courses					
	Engineering Graphics (GEP1127)				
List of Courses where this course will be prerequisite					
	Equipment Design and Drawing (GEP1138), Design and fabrication of Molds (PET1609)				
	Course Contents (Topics and subtopics)		**Reqd. hours**		
1	Introduction to various Production Processes		5		
2	Study of Construction, Mechanism and Application of Lathe Machines, Drilling Machine, Milling etc.		16		
3	One composite job using a minimum of four Machining operations such as plane turning, taper turning, external threading and knurling etc. with its process sheet.		16		
4	Classification of various Joining and metal forming processes and their applicability such as adhesive bonding, mechanical fastening, welding, and allied processes.		10		
5	Industrial visit to Chemical process equipment fabricators demonstrating use of forming, bending, rolling, and welding processes.		8		
6	Basics of CNC Machines and 3D Printing technology.		5		
List of Textbooks/ Reference Books					
1	Mechanical Workshop Practice by K C John, PHI Learning 1. Workshop Technology Vol. 1 and 2 by Raghuvanshi B. S. Dhanpat Rai & Sons,1998.				
2	Workshop Technology by Chapman W.A. J and Arnold E. Viva low priced, student edition, 1998.				
3	Workshop Practices, H S Bawa, Tata McGraw-Hill, 2009.				
4	Workshop Practices and Materials, B J Black, CRC Press.				
5	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.				
Course Outcomes (students will be able to….)					
CO1	Understand different operations performed using Lathe, drilling, and milling machine		K2		
CO2	Apply knowledge of lathe operations to fabricate engineering part		K3		
CO3	Justify the choice between joining and forming process for a suitable application.		K4		
CO4	Understand fabrication methods such as forming, bending, rolling and CNC machines		K2		

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)			
	PSO1	PSO2	PSO3
CO1	1	3	3
CO2	1	3	2
CO3	3	2	1
CO4	3	2	2

	Course Code: GET 1133	**Course Title:** Advanced Strength of Materials	**Credits = 2**		
			L	**T**	**P**
	Semester: IV	**Total contact hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					
	Structural Mechanics (GET1123), Basic Mechanical Engineering (GET1306), Applied Mathematics I (MAT1101), Applied Mathematics II (MAT1102)				
List of Courses where this course will be prerequisite					

	Equipment Design and Drawing I (GEP 1111) and II (GEP 1112), Design and fabrication of Molds (PET1609), Home paper I (CEP 1709) and II (CEP 1711)	
	Course Contents (Topics and subtopics)	**Reqd hour**
1	Thick and Thin cylinders - concept of radial, longitudinal stresses, behavior of thin cylinders. Problems on thin cylindrical and spherical shells. Behavior of thick cylinders (theory only).	3
2	Torsion of a circular shaft - concept, basic derivation, shear stress distribution, simple problem.	3
3	Short and Long columns (Struts) - Basic concept, crippling load, end conditions. Euler's and Rankine's approach (without derivations)	3
4	Advance stresses and strains – Representation of stress and strain at a point, Stress stain relationship, plane stress and plane strain. Transformation of stresses and its importance, Principal stresses and strains, maximum shearing stress, Mohr's circle its use and construction.	6
5	Basics of Engineering Design - Steps in the engineering design, Importance of analysis, 1-D, 2-D and 3-D analysis and interpretation of results. Force displacement relationship, Strain deformation relationship, Introduction to finite element Analysis. Computer aided analysis and design.	5
6	Different types of loads, load factor, factor of safety, Design philosophies, Working stress approach, Ultimate stress approach and Limit state theory. Performance based design Approach.	2
7	Natural Materials, Manmade materials, Alloys, Composite Materials – Types of composite materials, Cement and its varieties, cement composites, properties, recycling of waste, Sustainable materials	4
8	Advance materials for industrial applications - Advances in materials, Materials used for coatings, anticorrosive coatings, special purpose floorings, water proofing compounds, Various polymers and epoxies used for industrial applications.	3
9	Different types of performance enhancing and special purpose construction chemicals. Plasticizers and super-plasticizers, air entraining agents, accelerators and retarders, viscosity modifying agents, corrosion inhibitors	4
	List of Textbooks/ Reference Books	
	1. Engineering Materials by Rangwala 2. Strength of Materials by Ferdinand Singer and Andrew Pytel, Harper Colins Publishers 3. Introduction to Mechanics of Solids by Egor Popov, Prentice Hall of India Pvt. Ltd Strength of Materials by S. Timoshenko and D. H. Young, McGraw Hill Publications. 4. Concrete Technology by A. M. Neville, Pearson Education ltd 5. Concrete Technology – Theory and Practice by M. S. Shetty, S. Chand & Co. 6. Fundamental of Fibre reinforced composite materials by A. R. Busell and J. Renard, 7. Taylor & Corrosion and Corrosion Protection Handbook by Philip A. Schweitzer, CRC press	

Course Outcomes (students will be able to….)		
CO1	Understand stresses induced in thin cylinders, shafts and columns.	K2
CO2	Apply knowledge of equilibrium for analysis of complex stress situations.	K3
CO3	Analyse different complex problems in engineering design.	K3

CO4	Understand Force displacement relationship, Strain deformation relationship.	K2
CO5	Apply knowledge of materials for various engineering applications.	K3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)			
	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	1	2
CO3	3	2	2
CO4	1	1	2
CO5	2	2	2

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution

<table>
<tr><td rowspan="2"></td><td>Course Code: GET 1134</td><td>Course Title:
Energy Engineering and Management</td><td colspan="3">Credits = 4</td></tr>
<tr><td></td><td></td><td>L</td><td>T</td><td>P</td></tr>
<tr><td></td><td>Semester: V</td><td>Total contact hours: 60</td><td>3</td><td>1</td><td>0</td></tr>
<tr><td colspan="6">List of Prerequisite Courses</td></tr>
<tr><td></td><td colspan="4">Elements of Mechanical Engineering (GET1128), Basic Mechanical Engineering (GET1306), Applied Mathematics I (MAT1101), Applied Mathematics II (MAT1102)</td><td></td></tr>
<tr><td colspan="6">List of Courses where this course will be prerequisite</td></tr>
<tr><td></td><td colspan="4">Heat Transfer Equipment design (CET1175), Chemical Project Economics (CET1180)</td><td></td></tr>
<tr><td></td><td colspan="4">Course Contents (Topics and subtopics)</td><td>Reqd. hours</td></tr>
<tr><td>1.</td><td colspan="4">Energy Scenario:
• Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security
• Energy Conservation and its Importance, Features of Energy Conservation Act-2001,
• Basics of Energy and its various forms, Material and Energy balance.</td><td>06</td></tr>
<tr><td>2.</td><td colspan="4">Energy Audit Principles:
• Definition, Energy audit- need, Types of energy audit, Energy audit and management, approach-understanding energy costs, Bench marking, Energy performance, maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution.
• Elements of monitoring & targeting: Energy audit Instruments; Data and information-analysis.
• Financial analysis techniques: Simple payback period, NPV.</td><td>16</td></tr>
<tr><td>3.</td><td colspan="4">Energy Management and Energy Conservation in Electrical Systems
• Electricity billing, Electrical load management and maximum demand Control, Energy efficient equipment and appliances, star ratings.
Energy efficiency measures in lighting system, Lighting control
• Occupancy sensors, daylight integration, and use of intelligent controllers, Energy conservation opportunities in water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.</td><td>16</td></tr>
<tr><td>4.</td><td colspan="4">Energy Management and Conservation in Thermal Systems
• Steam Power Plant: Rankine cycle, Reheat cycle, Regenerative cycle.
• Boilers and furnaces: Classification, Study of various Boilers such as Babcock & Wilcox Boiler, Cochran Boiler, La-Mount Boiler, Benson Boiler, Boiler Mountings and Accessories, Boiler Performance
• Steam Turbine: Classification, Calculation of Power Developed by Steam Turbine, Compounding of Steam Turbine
• Elements of Steam condenser, various types of steam condenser, Condenser Efficiency
• Waste heat recovery, use of insulation- types and application.</td><td>16</td></tr>
<tr><td>5.</td><td colspan="4">Non-Conventional Energy Sources:
• Role and importance of non-conventional and alternate energy sources such as solar thermal, solar Photo-voltaic, Cooling techniques to cool Photovoltaic cells, wind, ocean, bio-mass and geothermal.</td><td>06</td></tr>
<tr><td colspan="6">List of Textbooks/ Reference Books</td></tr>
</table>

	1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science 2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System 3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons 4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI). 5. Energy Management Principles, C. B. Smith, Pergamon Press 6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press 7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press 8. Thermodynamics by P.K. Nag 9. Power plant by Morse 10. Heat Engines by P.L. Balani 11. Renewable Energy resources by Tiwari and ghosal, Narosa publication. 12. Non-conventional energy sources, Khanna publications	
Course Outcomes (students will be able to ….)		
CO1	To identify and describe the present state of energy security and its importance.	K2
CO2	To identify and describe the basic principles and methodologies adopted in energy audit.	K3
CO3	To describe the energy performance evaluation of electrical and thermal installations and identify the energy saving opportunities.	K3
CO4	To analyse the data collected during performance evaluation and recommend energy saving measures.	K4
CO5	Discuss the steam formation process, working of steam boilers, mountings, and accessories and their properties.	K2
CO6	Explain the need for and importance of various renewable energy sources.	K2
CO7	Employ this knowledge for energy saving in various devices.	K3

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)

	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	1	2
CO3	3	1	2
CO4	3	1	1
CO5	1	1	2
CO6	3	1	1
CO7	3	1	2

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution

	Course Code: GET 1135	Course Title: Mechanical Design of Chemical Process equipment	Credits = 2		
			L	T	P
	Semester: VI	Total contact hours: 30	1	1	0
List of Prerequisite Courses					
	Structural Mechanics (GET1123), Basic Mechanical Engineering (GET1306), Advanced Strength of Materials (GET 1303E), Engineering Graphics (GEP1127)				
List of Courses where this course will be prerequisite					
	Chemical Process Equipment Design and drawing (GEP1138), Home paper I (CEP 1709) and II (CEP 1711), Internship/ On Job Training Project (CEP 1710)				
	Course Contents (Topics and subtopics)		Reqd. hour		
1	Introduction to Basic Design concepts		2		
2	Design of Pressure Vessel Introduction to Pressure vessels used in process Industries. Design consideration for pressure vessels Design criterions, Design stresses, factor of Safety, Types of stresses on Vessels Vessels operating at Elevated and low temperatures. Cyclic loading and consideration for corrosion for design Design of vessel Shell for Internal pressure, combined loading and for external stresses, Use of reinforcement rings for shells Design of various types of head or cover Design and types of Nozzles, Design and types of Flange Joints for shell and nozzles Various types of supports for pressure vessels		16		
3	Design of Storage Vessel, Types and uses of storage Vessels used for storing various fluids and gases. Loss mechanism in storage vessels. Design of Rectangular tank Design of Vessel shell, Design of bottom Plate Wind girders, roof top angle curbs, Design of self-supporting tank roof Use of support columns for roof		12		
List of Textbooks/ Reference Books					
	1. Process Equipment Design by, V. V. Mahajani 2. Equipment Design by Dawande 3. Equipment Design by Young 4. Welding Technology by O. P. Khanna				
Course Outcomes (students will be able to….)					
CO1	Understand Basic Design concepts.		K2		
CO2	Design of Pressure Vessel and Storage Vessel		K4		
CO3	Design with real time data		K5		

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)			
	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution

	Course Code: GET 1136	Course Title: Industrial Hydraulics	Credits = 2

			L	T	P
	Semester: VII	**Total contact hours: 30**	**1**	**1**	**0**
List of Prerequisite Courses					
	Applied Physics (PYT1251), Basic Mechanical Engineering (GET1306)				
List of Courses where this course will be prerequisite					
	Instrumentation and process control, Home paper I (CEP 1709) and II (CEP 1711)				
	Course Contents (Topics and subtopics)		**Reqd. hours**		
1.	**Introduction to Hydraulics:** Basics of hydraulics, Pascal law, Advantages of Hydraulic drives, Quality requirement of hydraulic fluids and its requirements, Standard symbols for hydraulic lines, pumps, valves, motors, Check valves, its functions, various types and its applications, Directional control valve, two way and four way, Two positions and three positions direction valve, Rotary valve		8		
2.	**Valves:** Pilot operated check valve, working and its applications, Flow control valve, its functions, various types and its applications, Pressure compensated flow control valve, Relief valve, simple and compound, Balanced Piston relief valve, Sequence valve and its applications. Study of various types of filters.		9		
3.	**Pumps and Hydraulic motors**: Pumps, Gear pumps, vane pumps, Positive displacement axial piston pump, Pressure intensifier, Accumulator, Hydraulic motors		5		
4.	**Hydraulic circuits**: Study of various Hydraulic circuit used in industry; Study of various Hydraulic circuit used in Polymer processing		4		
5.	**Pneumatic systems & components:** Compressor, Receiver / Reservoir Tank, Starting Unloader & Controller, Filters, Regulators / Valves, Lubricators, Mufflers / Silencer, After Cooler, Air Dryers, and Indicators (Pressure, Temperature etc.)		4		
List of Textbooks/ Reference Books					
	1. Hydraulics by Vickers 2. Esposito A, Fluid Power with application, Prentice Hal 3. Majumdar S.R, Oil Hydraulic system- Principle and maintenance, Tata McGraw Hill 4. Majumdar S.R, Pneumatics Systems Principles and Maintenance, Tata McGraw Hill 5. Stewart H. L, Hydraulics and Pneumatics, Taraporewala Publications				
Course Outcomes (students will be able to….)					
CO1	Understand basics of hydraulics.		K2		
CO2	Analyse applications of valves in hydraulics.		K5		
CO3	Applications of pumps in hydraulics.		K3		
CO4	Design hydraulic circuits for industrial applications.		K6		
CO5	Applications of pneumatics in industry.		K3		

Mapping of Course Outcomes (COs) with Programme Outcomes

(PSOs)			
	PSO1	PSO2	PSO3
CO1	1	2	2
CO2	1	2	2
CO3	2	2	1
CO4	1	1	1
CO5	3	2	1

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution

Course Code: GET 1137	Course Title: Product Design and development	Credits = 2		
		L	T	P
Semester: VIII	Total contact hours: 30	1	1	-

	List of Prerequisite Courses	
	Engineering Graphics (GEP1127), Structural Mechanics (GET1123), Elements of Mechanical Engineering (GET1128)	
	List of Courses where this course will be prerequisite	
	Internship/ On Job Training Project (CEP 1710)	
	Course Contents (Topics and subtopics)	**Reqd. hours**
1	**Basics of Design:** Design definitions and attributes, Product configurations and component matrix, Understanding and analysing product contexts, Modularity, and design of modular systems, understanding design situations-parallel and future	08
2	**Product design aspects:** Design issues, Selection of materials and technical requirements, Dimensional accuracy and functional requirements, Surface finish, Making a product specification etc.	04
3	**General Design features:** Effect of wall thickness, corner radius, drafts, shrinkage, and warpage, inserts and parting lines. Design of ribs, bosses, threads etc., Cost economics.	06
4	**Design thinking:** Steps in design thinking, relevance of design thinking with product development	06
5	**Product design procedures:** Product design of engineering load bearing components such as gears, bearings, filament wound storage tanks, pipes etc.	06
	List of Textbooks/ Reference Books	
1.	Plastic product design handbook by Edward Miller	
2.	Product design and development by Karl T. Ulrich	
3.	Change by Design by Tim Brown	
	Course Outcomes (students will be able to….)	
CO1	Understand the product design and development procedure	K2
CO2	Apply the product design concepts to prepare industrial product	K3
CO3	Analyse basics of plastic product design	K4
CO4	Design engineering plastic products based on technical requirements	K6

Mapping of Course Outcomes (COs) with Programme Outcomes (PSOs)

	PSO1	PSO2	PSO3
CO1	1	1	2
CO2	3	2	1
CO3	2	1	2
CO4	1	2	3

3-Strong Contribution; 2-Moderate Contribution; 1-Low Contribution