



**Government Of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION**

Curriculum Structure

II Semester Scheme of Studies – Mechanical Engineering

Sl. No.	Teaching Department	Course Code	Course Name	Hours per week			Total Contact Hours/week	Credits	CIE Marks		Theory SEE Marks		Practice SEE Marks		Total Marks
				L	T	P			Max	Min	Max	Min	Max	Min	
Integrated Courses															
1	SC	25SC21I	Engineering Mathematics-II	4	0	4	8	6	50	20	50	20	-	-	100
2	CS	25CS01I	IT Skills	3	0	4	7	5	50	20	-	-	50	20	100
3	EE	25EE01I	Fundamentals of Electrical & Electronics Engineering	3	0	4	7	5	50	20	-	-	50	20	100
4	ME	25ME21I	Concepts of Mechanical Engineering -II	4	0	4	8	6	50	20	50	20	-	-	100
Audit Course															
5	ME	25ME22T	Indian Constitution	2	0	0	2	2	50	20	-	-	-	-	50
6	Personality Development		NCC/NSS/YOGA/SPORTS...	Students are expected to engage in any one of these activities from 1 st semester to 6 th semester (No Credits)											
Total				16	0	16	32	24	250	-	100	-	100	-	450



Government of Karnataka
DEPARTMENT OF TECHNICAL EDUCATION

Program	Mechanical Engineering	Semester	II
Course Name	Concepts of Mechanical Engineering -II	Type of Course	Integrated
Course Code	25ME21I	Contact Hours	104 hrs/Sem
Teaching Scheme	L: T:P :: 4:0:4	Credits	6
CIE Marks	50	SEE Marks	50 (Theory)

1. Rationale:

Material Science and Surface treatment are the fundamental concepts that equip diploma students with knowledge of various materials, their properties, applications and surface modification techniques. Understanding these concepts is crucial for students pursuing careers in engineering, manufacturing and construction. Diploma Engineers are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various manufacturing processes is essential.

Understanding the basics of **Metal forming and Machine tool techniques** are essential for mechanical engineers that equip students with knowledge of various metal forming and machining processes, tool design, and manufacturing methods. This requires training the students with a focus on **Casting and Sheet metal works**, operations provide essential skills, knowledge, and experience about the various manufacturing processes. Hence this integrated course is introduced to provide strong foundation in practical skills, safety awareness, and problem-solving abilities essential for success in mechanical engineering and related fields.

2. Course Outcomes: At the end of the Course, the student will be able to:

CO-01	Identify and apply suitable heat treatment and surface treatment processes for specific applications.
CO-02	Prepare castings using appropriate patterns, molds, and metal pouring techniques.
CO-03	Select and perform suitable metal forming processes such as forging, rolling, and extrusion.
CO-04	Develop and fabricate sheet metal components for various applications.
CO-05	Operate drilling and grinding machines to perform accurate machining and finishing operations.

3. Details of Course Content

WEEK	CO	PO	Theory	Practice
1	1	1,2	Crystal structure - Types of crystal structures – Crystalline & Non-crystalline - Structure of metal –unit cell, BCC, FCC and HCP structures, Mechanical Properties. - Atomic Packing factor for BCC, FCC and HCP crystal structure (no derivations)	- Types of Microscopes (SEM and TEMs) -Use virtual lab web link https://emb-iitk.vlabs.ac.in/exp/sembasics/simulation.html - Study the different crystal structures by using ball and stick or wire models. - Study the Iron Carbon diagram for phase changes.
2	1	1,2,4	Heat Treatment of Steel - Objectives, Types - Annealing (Ductility) - Normalizing (Machinability) - Hardening (Hardness) - Tempering (reduce hardness/ brittleness) Case Hardening – Carburizing, Nitriding, Cyaniding. Surface hardening- Induction Hardening, Flame hardening <i>*These concepts shall be thought by using the following Examples</i> Annealing: steel and steel alloys, Normalizing: carbon steels and alloy steels, Tempering: steel in construction, automotive, and machinery applications, Carburizing: gears, camshafts, Nitriding: tools, dies, and engine components *	Heat Treatment - Safety precautions to be followed in Heat Treatment shop. - Compare hardness of the work piece before and after heat treatment process by using Hardness Testing Machine. (BHN/RHN)
3	1	1,2,4	Surface treatment Corrosion - Types, Methods of reduction of corrosion Surface coating processes - Traditional methods - Painting, electroplating, Galvanizing, Spraying. Advanced coating technologies - Physical vapor deposition, Chemical Vapor deposition, Laser treatment. <i>* These concepts shall be thought by using the following Examples</i> Electroplating: Zinc plating on	Surface treatment - Coat an Iron key with copper and Copper sulphate using the electroplating - Coat the brass plate with copper and Copper sulphate using the electroplating

			<i>steel, Gold or silver plating on jewelry, watches, and decorative items, Nickel plating on machinery parts, Gold plating on connectors and circuit boards, Silver plating on medical devices</i> Galvanizing: <i>steel beams and columns, steel poles for power lines, brackets, bolts, and nuts, steel pipes for plumbing,*</i>	
4	1	1,2,4	Advanced materials • Biomaterials- Properties and applications • Smart Material - Piezoelectric materials (Quartz, PZT and PVDF), Shape memory alloys (Nitinol, Ni-Mn-Ga)- Properties and applications • Energy Materials- Solar Energy, Battery- Properties and applications • Nano-Materials-Classification, properties and applications, Carbon – based CNT and Graphene. <i>* These concepts shall be thought by using teaching aids such as</i> Biomaterials - Bone cement, Stitches, Stents, Bone plates, Piezoelectric - Stoves, gas burners. SMAs- shower heads, Stents. Energy Materials – Silicon, Lithium-Ion. Nano-materials – Face Cream, Nano Filters, Baseball Bat*	• Display different components made up of advanced materials • Students shall identify minimum 10 components and prepare the chart showing the component diagram, material type, properties and application
5	2	1,2,4	Additive Manufacturing • Introduction to Additive Manufacturing, Materials - metal, polymer, ceramic, and glass materials used in Additive Manufacturing, and its properties & limitations. • Types of Additive manufacturing Technologies- Overview of FDM, SLA & SLS technologies • Step-by-step additive manufacturing process • Applications of Additive Manufacturing	• Prepare a solid modeling of a simple component and convert into STL format. • Prepare the component by Additive Manufacturing process.

6	2	1,2,4	Casting process - Types of casting process - Pattern and Mould making: Patterns – Materials, types, Pattern allowances - Mould – Molding sand types, properties. - Core making - Defects in casting processes, - Modern Casting processes. <i>* This concept shall be thought by using the teaching aids such as Piston, Engine blocks, Wheels, Valve bodies, etc*</i>	Foundry - Safety precautions to be followed in Foundry shop. - Prepare a pattern (carpentry or 3D printed process), check the pattern for dimensional accuracy, Inspect the pattern for defects - Prepare sand mold using pattern and core - Pour metals (Al, Cu, Tin etc) into the mold - Inspect the casting for defects.
7	3	1,2,4	Metal Forming Processes - General classification of metal forming processes Bulk deformation processes Forging – Introduction, classification, Applications Rolling – Introduction, Classification, Applications. Extrusion – Introduction, Classification, Applications Wire & Bar Drawing – Introduction, Applications <i>* This concept shall be thought by using the teaching aids such as Forging – Tractor plows, combine harvesters, Crankshafts, connecting rods, turbine discs, blades, Surgical & Dentistry tools. Extrusion – Bars, tubes, gear blanks, aluminum cans, cylinders, frames, doors, windows, Medical tubes, bags. Rolling – Structural steel I-Beams, Angle stock, bar stock, rail track, sheet metal. Wire and Bar drawing - Electrical wires, cables, springs, paper clips, musical instrument strings*</i>	Forging - Safety precautions to be followed in forging shop. - Demonstrate the Forging tools and equipments. - Convert Round rod into square rod.
8	4	1,2,4	Development and Preparation of surfaces - Development of Cone, Cylinder, Prism and Pyramid. - Development of Frustum of cone. - Prepare the development drawing of a cylindrical box. - Prepare the development drawing of a Funnel	
9	4	1,4	Sheet metal work - Introduction - IS Standard gages and	Sheet Metal work

			Specifications of sheet metal ● Sheet metal operations- Shearing, Bending, Forming. ● Applications of sheet metal work <i>* This concept shall be thought by using the teaching aids such as Automobile components, Car body building, Aircraft body building*</i>	● Prepare the sheet metal cylindrical box and Join end surfaces by means of Seam Joint and soldering. ● Prepare the sheet metal Funnel and Join end surfaces by means of Seam Joint and soldering.
10	4	1,2,4	Press Work ● Overview ● Types of Presses ● Press Components ● Press Operations <i>* This concept shall be thought by using the teaching aids such as mechanical, hydraulic, pneumatic presses and their applications such as Washers, brackets, and automotive body components, frames, brackets, and enclosures, automotive components*</i>	Press work ● Safety precautions to be followed in press work. ● Perform the simple operation in Press tool by using punch and Die.
11	5	1,4	Cutting tools and Abrasives: ● Cutting tool – classification of Cutting tools, Characteristics and selection of tool materials. ● Nomenclature of single point cutting tools, milling tools ● Surface finishing processes – Grinding, Polishing, Coating. ● Abrasives used in grinding wheels and its designations	Surface grinding operations ● Safety precautions to be followed in surface grinding operation. ● Demonstration of surface grinding of machine parts. ● Students shall perform surface grinding operation on the given job.
12	5	1,4	Drilling Machine ● Introduction to drilling Machine ● Classifications of drilling machine. ● Drilling operations - List ● Nomenclature of Twist drill.	Drilling machine operations ● Safety precautions to be followed in drilling machine operation ● Demonstration of drilling machine parts ● Demonstration and perform of drilling, reaming and tapping operation ● Measure the diameter of drilled hole by using Go and No Go gauge
13	5	1,2,4	Lathe and Milling machines ● Introduction to Lathe Machine ● Classifications of Lathe machines, Lathe operations - List ● Introduction to Milling Machine ● Classifications of Milling machines, Milling operations - List	Lathe and Milling machine operations ● Safety precautions to be followed in machine operations ● Demonstration of Lathe parts ● Demonstration of Lathe operations ● Demonstration of milling machine parts ● Demonstration of milling machine operations

4. References:

Sl. No	Author	Title of Books	Publication/Year
1.	J. W. Martin	Materials for Engineering	Woodhead Publishing Limited, 3 rd Edition, 2006
2.	William D. Callister Jr.	Material Science and Engineering	Wiley Publications, 10 th Edition, 2020
3.	V K Manchanda, GBS Narang, J S Narang	Materials science and Metallurgy	Khanna Publishers, 1 st Edition, 2021
4.	R.K. Rajput	Materials science and Engineering	S.K. Kataria & Sons, 5th Edition 2016, Reprint 2024
5.	V. Raghavan	Materials science and Engineering	PHI, 6 th Edition, 2016
6.	Sidney H. Avner	Introduction to Physical Metallurgy	Tata McGraw-Hill Education, 2 nd Edition 2017
7.	Parashivamurthy K I	Material Science and Metallurgy	Pearson Education India, 1 st Edition, 2012
8.	K R Gopalakrishna	Elements of Mechanical Engineering	2019
9.	S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirijhar Roy	Elements of Workshop Technology Vol-I Manufacturing Processes	Media Promoters & Publishers Private Limited - 2008
10.	S. K. Hajra Choudhury, Nirijhar Roy	Elements of Workshop Technology Vol-II Machine Tools	Media Promoters & Publishers Private Limited - 2010
11.	R. B. Gupta	Workshop Practice	Stay Prakashan - 2024
12.	Taylon Altan Erman Tekkaya	Forming Fundamentals	Arm International - 2012
13.	Rahul Shivaji Autade	Sheet Metal Engineering	Nirali Prakashan - 2023

5. CIE Assessment Methodologies

CIE Assessment Methodologies					
Sl.No	CIE Assessment	Test Week	Duration (minutes)	Max Marks	Average of all CIE=50 Marks
1.	CIE-1 Theory Test	4	90	50	
2.	CIE-2 Practice Test	7	180	50	
3	CIE-3 Theory Test	10	90	50	
4.	CIE-4 Practice Test	13	180	50	
5	CIE-5 Portfolio evaluation of all practices and activities through Rubrics.	1-13		50	
Total					50 Marks

6. SEE - Theory Assessment Methodologies

Sl. No	SEE - Theory Assessment	Duration	Exam Paper Max marks	Exam Paper Max Marks scale down to (Conversion)	Min marks to pass
1.	Semester End Examination-Theory	3 Hours	100	50	20

7. CIE Theory Test model question paper

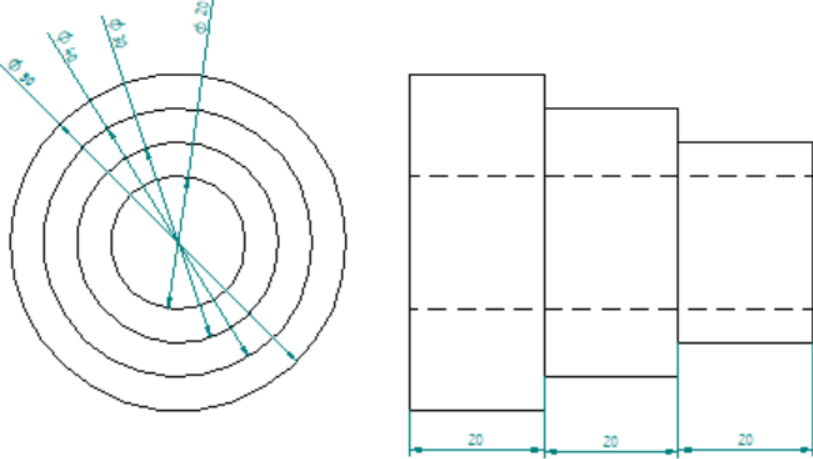
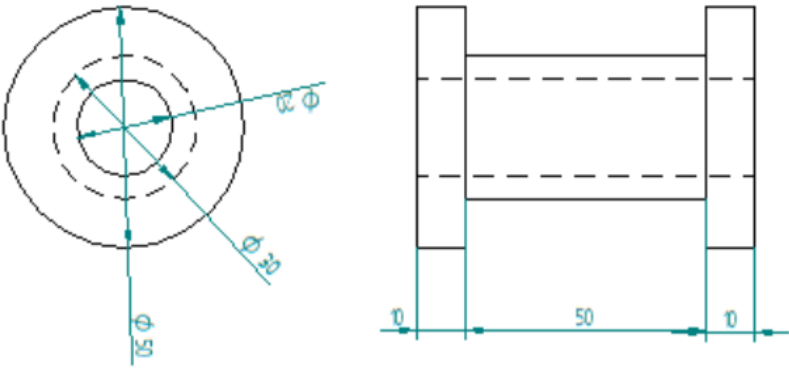
Program		Mechanical Engineering	Semester- II		
Course Name		Concepts of Mechanical Engineering - II	Test	I	
Course Code		25ME21I	Duration- 90 min		
			Marks-50		
Name of the Course Coordinator:					
Note: Answer any one full question from each section. Each full question carries equal marks.					
Q. No	Questions		CL	CO	Marks
Section - 1					
1	a) Identify the mechanical properties found in BCC Crystal structure . Suggest any 2 materials which exhibit BCC Crystal structure. b) Appreciate the importance of Atomic Packing factors (APF) in crystal structures. Outline the APF of different crystal structures. c) Identify the mechanical properties found in FCC Crystal structure . Outline any 2 materials which exhibit BCC Crystal structure. d) Highlight the Characteristics of Crystalline and Non-Crystalline structures with examples. e) Identify the mechanical properties found in HCP Crystal structure . Outline any 2 materials which exhibit BCC Crystal structure.		Apply	CO1	5X5= 25
2	a) Suggest an appropriate heat treatment process to improve the wear and fatigue properties of machine tool guide ways . Describe the process in detail. b) Substantiate why normalizing is more commonly used than annealing after performing cold work on hardenable steels . c) Identify the appropriate surface hardening process for the Stainless steels used in various industrial applications d) Identify the heat treatment process suitable for a steel shaft used in a high – speed turbine. Highlight the properties improved after heat treatment. e) Why is annealing crucial for copper components used in electrical applications? Justify your answer.		Apply	CO1	5X5 = 25
Section - 2					
3	a) Suggest the best coating technique for the parts used in marine applications to prevent corrosion and enumerate the coating process. b) Identify any 5 metals which corrode into its oxides/sulphides when subjected to harsh corrosive environment. c) Suggest the best surface coating technique to prevent corrosion in AC ducts used in multistoried buildings and enumerate the coating process. d) Identify the best coating/surface treatment technique available to arrest corrosion of nuts and bolts . Highlight the coating process in detail. e) Identify the Advanced coating techniques for electronic and optical applications . Justify your selection.		Apply	CO1	5X5 = 25
4	a) Suggest the advanced material used for the manufacturing of Stents . Highlight its properties. b) Identify the Properties required for the production of Energy materials such as batteries. c) Discuss how Nano filters can benefit water purification through filtration? d) Which material is suitable for solar panels ? Justify your answer. e) Nano materials are used in Face cream applications . What are the benefits of using it over traditional materials? Suggest a suitable nano material.		Apply	CO1	5X5 = 25
Note for the Course coordinator: Each question may have two, three, four or five subdivisions. Optional questions in each section carry the same weightage of marks, cognitive level and course outcomes.					

Signature of the Course Coordinator

Signature of the HOD

Signature of the IQAC Chairman

8. CIE Practice Test model question paper

Program	Mechanical Engineering			Semester	II
Course Name	Mechanical Engineering Practices - II			Test	II
Course Code	25ME21I	Duration	180 min	Marks	50
Name of the Course Coordinator:					
Note: Answer any one full question from the following					
Questions				CO	Marks
1. a. Explain the Safety precautions used in Foundry shop. b. Prepare the mould using the pattern as per the diagram. 2. a. Outline the steps involved in Casting process b. Prepare the mould using the pattern as per the diagram.  Q . No - 1 (b)  Q. No - 2 (b)				CO2	10+15+25 = 50 Marks
Scheme of Assessment					
Q No.1& 2					
a. Identify safety outfits, usage of appropriate safety method	10 Marks				
b. Listing of tools & operations required for performing job	10 Marks				
Preparation of Mould	15 Marks				
Operation performed (Mould cavity)	10 Marks				
Finishing and Dimensional accuracy of the Mould	05 Marks				
Total					50 Marks

Signature of the Course Coordinator

Signature of the HOD

Signature of the IQAC Chairman

9. Suggestive Activities for Tutorials:

- The students shall do minimum of one suggested activities
- List is an Example and not inclusive of all possible activities of the course.
- Student and Faculty are encouraged to choose activities that are relevant to the topic.

Sl.No.	Suggestive Activities for Tutorials
01	Prepare simple aluminum castings such as washers, Nuts and bolts used in automobiles
02	Prepare a bracket by using sheet metal operations.
03	Coat Zinc into Mild steel surface by using surface treatment technique.

10. Rubrics for Assessment of Graded Exercise (Qualitative Assessment)

Sl. No.	Dimension	Unsatisfactory	Need Improvement	Satisfactory	Good	Excellent	Student Score
		(0-10)	(11-20)	(21-30)	(31-40)	(41-50)	
1	Preparation	Not prepared at all	Lacks several important materials or tools	Adequately prepared but missing key items	Mostly prepared with minor omissions	Fully prepared with all necessary materials and tools	40
2	Execution/Implementation	Task not executed	Major errors affecting results or functionality	Some inconsistencies or inaccuracies present	Minor errors in execution, but overall effective	Test or task performed flawlessly with precision and accuracy	40
3	Quality of Work	No quality demonstrated	Poor quality, major flaws impacting functionality	Acceptable quality with noticeable defects	Good quality with minor flaws	High-quality output, meets or exceeds standards	30
4	Use of Tools/Techniques	No proper tool use demonstrated	Weak use of tools, significant risks noted	Basic use of tools, some inefficiencies	Good use of tools, minor issues with technique	Mastery of tools and techniques demonstrated safely and effectively	40
5	Practical Record	Major sections are not addressed.	Major sections are missing or poorly addressed.	Some sections are included, but lack detail.	Most sections are complete with minor omissions.	All required sections are included and thoroughly detailed.	50
Average Marks=(40+40+30+40+50)/5=40							40

Note: Dimension and Descriptor shall be defined by the respective course coordinator as per the activities

11. Equipment/software list with Specification for a batch of 30 students

Sl. No.	Particulars	Specification	Qty
01	Standard specimens	Hardness testing specimens (ASTM E18 for Rockwell)	05
02	Hardness Tester	Rockwell hardness-scales A,B and C.	01
03	Hardness Tester	Brinell Hardness tester	01

04	Desktop Computers	Latest Configurations	20
05	CAD Software	Any latest Authorized Computer Aided Drafting Software	20
06	FDM 3D Printer	Any PLA/ABS 3D printers	02
Foundry Shop			
01	Moulding Box	300*300*100mm	20
02	Moulding Rammer	Standard Size	20
03	Moulding Tool kit	Standard Size	20
04	Electric furnace for melting (Wax/Low melting point metal with crucible and ladder for pouring)	Standard Size	04
05	Portable grinder for cleaning of casting	Standard Size	02
06	Sand Blaster	Standard Size	04
07	Ball peen Hammer	½ lb	05
08	Pattern Making Tool kit	Standard size	10
09	Furnace	Furnace	01
Sheet Metal Shop			
01	Sheet shearing Machine(Manual or M/c type)	Standard size	04
02	Sniper for cutting sheet	Standard size	20
03	Metal stake	Standard size	10
04	Wooden mallet	Standard size	20
05	Plastic Hammer	Standard size	20
06	Bench vice for Bending of sheet	Standard size	05
07	Brazing Gun	Standard size	10
Press Work			
01	Power press	Power house 10 ton	01
02	Hand power press	Hydraulic shop press with gauge	04
03	Progressive die	Standard size	04
04	Bending die	Standard size	04
05	Combination die	Standard size	01 Set
Machine Shop			
01	Drilling Machine	Radial Drilling Machine	01
02	Surface Grinding Machine	Surface Grinding Machine	01

03	Tool grinding machine	Tool grinding machine	01
04	lathe	Centre lathe	15
05	Milling Machine	Milling Machine	01