

Government of Karnataka
Department of Collegiate and Technical Education
Board of Technical Examinations, Bangalore

Course Code	20AT11T	Semester	I
Course Title	MECHANICAL SCIENCE & ENGINEERING	Course Group	Core
No. of Credits	4	Type of Course	Lecturing & Practice
Course Category	PC	Total Contact Hours	4Hrs. Per Week
			52Hrs. Per Semester
Prerequisites	Basic sciences at matriculation level	Teaching Scheme	(L: T:P) = 4:0:0
CIE Marks	50	SEE Marks	50

RATIONALE:

Mechanical Sciences and Engineering play a critical role in manufacturing technologies, from cars to airplanes to refrigerators. It applies the principles of engineering to the design, analysis, manufacturing and maintenance of machines. It paves the way to have a lucrative career that benefits the society. Therefore, an engineering diploma student must be conversant with the behavior and mechanism of the materials from the point of view of reliability, sustainability and performance of the product. The study of basic concepts of mechanical sciences and engineering will help the students in understanding engineering subjects where the emphasis is laid on the application of these materials.

1. COURSE SKILL SET

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

- i. Select engineering materials based on properties, behavior and environmental effect for given engineering application.
- ii. Explore different shafts, keys, couplings, bearings and illustrate various types of drives and fastenings used in engineering/automobile application.
- iii. Understand different engine terminologies and working of 2-stroke and 4-stroke engine used in an automobile.

2. COURSE OUTCOMES

On successful completion of the course, the students will be able to demonstrate industry-oriented COS associated with the above-mentioned competency:

CO1	Discuss the various engineering materials with their properties and also different heat treatment processes
CO2	Explore the different types of shafts, keys, couplings and bearings
CO3	Describe different types of belt drives, chain drives and gear drives
CO4	Illustrate the different types of fastenings used in machine parts
CO5	Explain various engine terminologies of IC engines, different powers and efficiencies
CO6	Classify IC engines on various parameters and demonstrate working of 2 and 4 stroke SI and CI engines.

3. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

SL. No.	CO's	Units Mapped	Teaching Hours	Distribution of Theory Marks			
				R Level	U Level	A Level	Total
1	CO1 - Discuss the various engineering materials with their properties and also different heat treatment processes	1	12	25	10	10	45
2	CO2 - Explore the different types of shafts, keys, couplings and bearings	2	12	15	25	5	45
3	CO3 - Describe different types of belt drives, chain drives and gear drives	3	10	10	20	10	40
4	CO4 - Illustrate the different types of fastenings used in machine parts	4	06	5	10	5	20
5	CO5- Explain various engine terminologies of IC engines, different powers and efficiencies	5	06	10	10	5	25
6	CO6 - Classify IC engines on various parameters and demonstrate working of 2 and 4 stroke SI and CI engines.	6	06	5	15	5	25
		Total	52	70	90	40	200

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

4. DETAILS OF COURSE CONTENT

The following topics/subtopics is to be taught and assessed in order to develop Unit Skill sets for achieving CO to attain identified skill sets

UNIT NO.	Unit skill set (In cognitive domain)	Topics/Subtopics	Hours L-T-P
UNIT-1 ENGINEERING MATERIALS AND THEIR PROPERTIES	1. Classify engineering materials with their properties. 2. Identify and compare ferrous and nonferrous materials. 3. Select relevant cast iron for the given job with justification. 4. Select relevant steel for the given application. 5. Describe the properties and application of the given copper alloy. 6. Compare and explain different heat treatment processes. 7. Select relevant Heat treatment process for the given material with justification.	1.1 Classification of engineering materials. 1.2 Selection of materials for engineering purposes. 1.3 Physical properties of metals. Mechanical properties of metals. 1.4 Ferrous metals - Cast Iron- Types of Cast Iron- Alloy cast iron. Effect of impurities on cast iron. 1.5 Steel - Effect of impurities on steel-alloy steels. Stainless Steel - Types of stainless steel. 1.6 Non-ferrous Metals - Types- Aluminum - Aluminum alloys. 1.7 Copper - Copper Alloys, types. Bearing Metals – Types, properties. 1.8 Non-metallic Materials - Rubber, glass, ceramics, polymers, composite materials - properties and application of each. 1.9 Heat treatment - Aim of heat treatment. Heat treatment techniques. 1.10 Annealing and its types. Normalising, hardening, tempering. 1.11 Martempering, austempering, hardenability, surface hardening. 1.12 Carburizing, nitriding, cyaniding, flame hardening and induction hardening.	12-0-0

<p align="center">UNIT-2 SHAFTS, KEYS, COUPLINGS AND BEARINGS</p>	<ol style="list-style-type: none"> Describe the materials used for shafts and type of shafts used for specific application. Describe the applications of different types of keys used in automobile application. Explain different applications of couplings used for specific application. Describe the properties and application of the given bearing material. Demonstrate different types of bearings used in automobile. 	<ol style="list-style-type: none"> Introduction to shafts - Material used for shafts. Types of Shafts. Standard sizes of transmission shafts. Introduction to Keys - Types of Keys – Sunk keys - Types of Sunk keys. Saddle keys, tangent keys, round keys Construction and working of each type with neat sketch. Woodruff keys and splines –Construction and working of each type with sketch. Introduction to shaft couplings – Requirements of a good shaft coupling - Types of shaft couplings. Sleeve or Muff couplings - Construction and working with sketch. Flange Coupling - Construction and working with sketch. Introduction to bearings. Classification of bearings. Types of sliding contact bearings with advantages and disadvantages. Shell bearings - Roller contact bearings - Advantages and disadvantages. Ball bearings - Construction and working. Roller bearings - Construction and working. Thrust bearings - Construction and working. 	<p align="center">12-0-0</p>
<p align="center">UNIT-3 BELT DRIVES, CHAIN DRIVES AND GEAR DRIVES</p>	<ol style="list-style-type: none"> Select a belt drive system for specific application. Calculate the velocity ratio for the given belt drive. Describe the application of chain drive in automobile. Conceptualize with sketches the different gear trains used. 	<ol style="list-style-type: none"> Introduction to belt drives - Selection of belt drives - types of belt drives - types of belts- Materials used for belts. Types of flat belt drives - open belt drive, crossed or twist belt drive, belt drive with idler pulleys and compound belt drive. Velocity ratio of belt drive - Slip and creep of belt. V- belt drives Cross section of a V-belt with sketch - advantages and disadvantages of V-belt over flat belt drives. Chain drives - Advantages and disadvantages. Gears or Toothed wheels- advantages and disadvantages of gear drives. Types of gears- spur gears, bevel gears, helical gears, worm and worm wheel, rack and pinion with simple sketches. Velocity ratio in gear drive. Gear trains- Types of gear trains-, simple and compound gear trains Simple line sketch-speed ratio or velocity ratio of simple and compound gear trains. 	<p align="center">10-0-0</p>
<p align="center">UNIT-4 FASTENERS</p>	<ol style="list-style-type: none"> Distinguish between temporary and permanent fasteners with specific applications. 	<ol style="list-style-type: none"> Introduction to Fasteners - Types- Temporary and permanent. Screwed joint- advantages and disadvantages of screwed joint. Screw thread terminology or terms used in screw threads - Types of screw fastenings. Locking devices - Types of locking devices 	<p align="center">06-0-0</p>

	<ol style="list-style-type: none"> Analyze the different types of locking devices used in automobiles. Distinguish between Lap joint and Butt joint with their specific applications. 	<p>or lock nuts with sketches.</p> <ol style="list-style-type: none"> Permanent fastenings - Types of riveted joints. Lap joint - types- single riveted –double riveted-simple sketch. Butt joint-types-single strap-double strap butt joint with simple sketch. 	
UNIT-5 ENGINE TERMINOLOGIES	<ol style="list-style-type: none"> Compare EC and IC engines with specific applications. Discuss engine terminologies used in different vehicles. Differentiate between speed and torque with their units. Explain BP, IP, FP & Mechanical efficiency. 	<ol style="list-style-type: none"> Definition - types - IC and EC engines-comparison. Engine terminologies - bore – stroke– TDC – BDC - mean effective pressure. Clearance volume - swept volume - total volume - compression ratio. Mean effective pressure – indicated power – brake power - friction power. Engine speed engine torque, specific fuel consumption. Brake thermal efficiency, indicated thermal efficiency and mechanical efficiency. 	06-0-0
UNIT-6 I.C. ENGINES	<ol style="list-style-type: none"> Classify IC engines based on different parameters. Demonstrate working of stroke SI₂ engine using section model. Demonstrate working of 2-stroke CI engine using section model. Demonstrate working of 4-stroke SI engine using section model. Demonstrate working of 4-stroke CI engine using section model. Explain the advantages of 2-stroke and 4-stroke engines considering specific example. 	<ol style="list-style-type: none"> Classification of IC engines with respect to different parameters. Two stroke SI Engine - Construction and working. Four stroke SI Engine - Construction and working. Two stroke & Four stroke CI engines - construction – working. Comparison of SI and CI engines. Comparison of Two stroke and Four stroke engines. 	06-0-0

5. SUGGESTED PRACTICAL SKILL EXERCISES

The suggested practical activities (TABLE-I) in this section are demonstrated for the attainment of the competency. These practical activities can also be used for the student assessment in portfolio mode for awarding CIE marks.

TABLE-I

SL.No.	Practical Outcomes/Practical exercises	Unit No.	PO	CO
1	Prepare specimen of a given material for Microscopic examination (This may be covered during industrial visit).	1	1,4	1
2	Analyze content of ferrous/nonferrous material using photo spectrometer. (This may be covered during industrial visit).	1	1,4	1
3	Analyze the properties of nonmetallic materials & prepare and chart by performing Google search.	1	2	1
4	Analyze the various types of shafts and keys used in an automobile (This may be covered by visiting a nearest workshop)	2	1,4	2
5	Explain different types of belt, chain and gear drives employed in different machines (This may be covered during nearby workshop visit).	3	1,4	3
6	Demonstrates various types of fastenings in an automobile (This may be demonstrated on a vehicle present in Automobile workshop).	4	1,4	4
7	Explain the different engine terminologies with the help of a given engine (This may be explained with the help of already dismantled engine/cut-section model in Automobile workshop).	5	1,4	5
8	Demonstrate working of a 2-stroke SI/CI engine with the help of a cut-section model (This may be demonstrated using a cut-section model in Automobile workshop).	6	1,4	6
9	Demonstrate working of a 4-stroke SI/CI engine with the help of a cut-section model (This may be demonstrated using a cut-section model in Automobile workshop).	6	1,4	6
10	PROBLEM BASED LEARNING: Group of 4-5 students will identify and collect five machine / product components which are made from different engineering materials and which are also failed in their applications. Students will measure and sketch the components (free hand or orthographic views) with dimensions. Students in group will also discuss the reasons of failure and will note down the discussion and outcome.	ALL		

NOTES:

1. It is compulsory to prepare logbook of exercises. It is also required to get each exercise recorded in logbook, checked and duly dated signed by the teacher.
2. Student activities are compulsory and are also required to be performed and noted in logbook.
3. Term work report includes term work, objects taken for identification for laboratory work, student activity; parts experimented as student activity and logbook along with student activities.
4. Term work report is compulsory part to be submitted at the time of practical ESE.
5. Term work report must not include any photocopy/ printed manual/pages, lithos, etc. It must be hand written / hand drawn by student only.
6. For CIE, students are to be assessed for Skills/competencies achieved. Students are to be asked to identify materials, select proper materials, etc.

CO	Course Outcome	PO Mapped	UNIT Linked	Cognitive Level R/U/A	Tutorial & Practical Sessions in Hrs	TOTAL
CO1	Discuss the various engineering materials with their properties and also different heat treatment processes	PO1, PO4	1	A	12	
CO2	Explore the different types of shafts, keys, couplings and bearings	PO1, PO4	2	A	12	
CO3	Describe different types of belt drives, chain drives and gear drives	PO1, PO4	3	A	10	
CO4	Illustrate the different types of fastenings used in machine parts	PO1, PO4	4	A	6	
CO5	Explain various engine terminologies of IC engines, different powers and efficiencies	PO1, PO4	5	A	6	
CO6	Classify IC engines on various parameters and demonstrate working of 2 and 4 stroke SI and CI engines.	PO1, PO4	6	A	06	
					52	

Course	CO's	Programme Outcomes (PO's)						
		1	2	3	4	5	6	7
FUNDAMENTALS OF MECHANICAL SCIENCES AND ENGINEERING	CO1	3	0	0	0	1	0	0
	CO2	3	0	0	0	0	0	0
	CO3	3	0	0	0	0	0	0
	CO4	3	0	0	0	0	0	0
	CO5	3	0	0	0	1	0	0
	CO6	3	0	0	0	1	0	
Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped								

6. INSTRUCTIONAL STRATEGY

These are sample strategies which teacher can use to accelerate the attainment of the various course outcomes:

1. Massive Open online courses (MOOCS) may be used to teach various topics/subtopics.
2. Lecturer method(L) does not mean only traditional lecture method, but different type of teaching method and media that are employed to develop the outcomes
3. About 15 to 20% of the topics/subtopics which is relative simpler or descriptive in nature is to be given to the students for self-directed learning
4. Arrange visits to nearby Industries/Workshops/Academic institution having research center facility or research labs for understanding of the workflow process/assembly/servicing/testing of vehicles.
5. Show Video/animation films to explain the construction and working of different engines.
6. Use different instructional strategies in classroom teaching.

7. SUGGESTED LEARNING RESOURCES:**A. List of Books:**

S. No.	Author	Title of Books	Publication/Year
1	R.S.Khurmi J.K.Gupta	A Textbook of Machine Design	S. Chand & Co
2	R.S.Khurmi J.K.Gupta	Theory of Machines	S. Chand & Co
3	Dr. Kirpal Singh	Automobile Engineering vol 2	Standard publishers Distributors
4	Mathur & Sharma	I C Engines	Danapat Rai & Sons
5	V. Ganeshan	I C Engines	Tata McGraw-Hill
6	K.R.Gopalkrishana	Mechanical engineering Science	
7	K.R.Gopalkrishana	Machine Drawing	
8	Anil chikara	Automobile Engineering Vol I	Satya Prakashan
9	K.M.Gupta	Automobile Engineering Vol I	Umesh publications
10	Er.A.K.BabuEr.Ajitpal Singh	Automobile Engineering	S. Chand & Co

B. List of Major Equipment/Instruments:

1. Metallurgical Microscope.
2. Standard specimens.
3. Furnaces to perform heat treatment process.
4. Hardness testers-to check Rockwell hardness-scales A,B and C.
5. Cut-section models of 2-stroke and 4-stroke (Diesel and Petrol) engines.
6. A dismantled 2-stroke/4-stroke engine.
7. Other consumables.

C. List of Software/Learning Websites

1. <http://vimeo.com/32224002>
2. http://www.substech.com/dokuwiki/doku.php?id=iron-carbon_phase_diagram
3. <https://www.youtube.com/watch?v=S8Qmy4fGnnE>
4. <https://www.youtube.com/watch?v=Mybf-XCA4H4>
5. <https://www.youtube.com/watch?v=WoWzUPIR8i0>
6. <https://www.youtube.com/watch?v=cFdmnvIP-PI>
7. <https://www.youtube.com/watch?v=SvJM4e1OotE>
8. <https://www.youtube.com/watch?v=rIK7JIAz9WY>
9. <https://www.youtube.com/watch?v=xiGIMmB2NyE>
10. <https://www.youtube.com/watch?v=rIK7JIAz9WY>
11. https://www.youtube.com/watch?v=KFIw_zVKspQ

8. SUGGESTED LIST OF PROPOSED STUDENT ACTIVITIES

Note: the following activities or similar activities for assessing CIE (IA)

1. Select any five objects (3 metallic and 2 non-metallic) which will be used in laboratory and list the material of selected objects.
2. Prepare the material list of given tools and commonly used consumable items such as spanners, screw drivers, various types pliers, cotton waste, oil, grease, etc. Also give reason(s) for using such material and discuss your answers with the teacher.
3. Take dilute acid which is commonly used at our home for cleaning purpose and put one scrap iron piece and one nonferrous metal piece in it for minimum 12 hours. Take out these two pieces by following all safety norms/steps (without touching acid) and observe the changes. Discuss with your teacher.
4. Group of 3-5 students will visit LOCAL AUTOMOBILE REPAIR SHOP and will identify at least 5 different types of fasteners and locking devices used for a given AUTOMOBILE / assembly. Also list the material of identified machine / assembly components.
5. List atleast three questions individually which you would like to ask for followings:
 - i. Comparison of iron and fiber reinforced plastic.
 - ii. Comparison for strength of wood and cast iron.
 - iii. Technical specification of any vehicle.
 - iv. Materials used for construction of any two-wheeler.
 - v. Materials used for construction of any automobile.
 - vi. Any other relevant activity added by teacher including preparing industrial visit report.

9. COURSE ASSESSMENT AND EVALUATION CHART

Method	What		To whom	When/Where (Frequency in the course)	Max Marks	Evidence collected	Course outcomes
DIRECT ASSESSMENT	CIE (Continuous Internal Evaluation)	Models	Students	Three Unit Tests (Average of all units will be Computed)	30	Blue Books	1,2,3,4,5,6
				MCQ/Quiz + Open book test + Activity	20	-	-
				TOTAL	50		
	SEE (Semester End Examination)	End Exam		End of the course	50	Answer Scripts by BTE	1,2,3,4,5,6
INDIRECT ASSESSMENT	Student Feedback on course		Students	Middle of the course		Feedback forms	1,2,3,4,5,6 delivery of course
	End of Course Survey			End of the course		Questionnaires	1,2,3,4,5,6 Effectiveness of demonstrations& Assessment Methods

Assessment Methodology

Lecture: Practice sessions shall begin only after two weeks of Induction Program in First semester. The schedule of assessment week shall be counted only after 2 weeks of Induction Program.

Sl.No	Assessment	Mode of Assessment	Schedule of Assessment	Duration	Max marks	Conversion after taking Average
1	CIE Assessment 1	Written Test-1	End of 3 rd week	80 minutes	30	30
2	CIE Assessment 2	Written Test-2	End of 7 th week	80 minutes	30	
3	CIE Assessment 3	Written Test-3	End of 13 th week	80 minutes	30	
4	CIE Assessment 4	MCQ/Quiz	End of 5 th week	60 minutes	20	20
5	CIE Assessment 5	Open Book Test	End of 9 th week	60 minutes	20	
6	CIE Assessment 6	Student Activity / Assignment	End of 11 th week	-	20	
Total Continuous Internal Assessment (CIE) Marks						50
7	SEE- Semester End Examination	Written Examination	As per BTE	3 Hours	100	50
Total Marks						100

Note:

1. Assessment of student activity / Assignment is to be evaluated through appropriate rubrics by the respective course coordinator.

RUBRICS FOR ACTIVITY -Example only (Faculty need to develop appropriate rubrics for assessment)						
Dimension	Unsatisfactory	Developing	Satisfactory	Good	Exemplary	Student Score
	2	4	6	8	10	
Collection of data	Does not collect any information relating to the topic	Collects very limited information; some relate to the topic	Collect much information; but very limited relate to the topic	Collects some basic information; most refer to the topic	Collects a great deal of information; all refer to the topic	8
Fulfil team's roles & duties	Does not perform any duties assigned to the team role	Performs very little duties but unreliable.	Performs very little duties	Performs nearly all duties	Performs all duties of assigned team roles	6
Shares work equally	Always relies on others to do the work	Rarely does the assigned work; often needs reminding	Usually does the assigned work; rarely needs reminding	Normally does the assigned work	Always does the assigned work without having to be reminded.	8
Listen to other Team mates	Is always talking; never allows anyone else to speak	Usually does most of the talking; rarely allows others to speak	Talks good; but never show interest in listening others	Listens, but sometimes talk too much	Listens and speaks a fair amount	8
Average / Total Marks: (8+6+8+8)/4						7.5 = 8 marks

**Model Question Paper
I A Test (CIE)**

Programme:		Semester: I			
Course	:	Max Marks : 30			
Course Code	:	Duration : 1 Hr 20 minutes			
Name of the course coordinator:		Test : I/II/III			
Note: Answer one full question from each section. One full question carries 10 marks.					
Qn.No	Question	CL	CO	PO	Marks
Section-1					
1.a)					
b)					
c)					
2.a)					
b)					
c)					
Section-2					
3.a)					
b)					
c)					
4.a)					
b)					
c)					
Section-3					
5.a)					

b)					
c)					
6.a)					
b)					
c)					

**Model Question Paper
Semester End Examination**

Programme: Semester: I	
Course :	Max Marks: 100
Course Code:	Duration: 3 Hrs

Instruction to the Candidate:

Answer one full question from each section. One full question carries 20 marks.

Qn.No	Question	CL	CO	Marks
Section-1				
1.a)				
b)				
2.a)				
b)				
Section-2				
3.a)				
b)				
4.a)				
b)				
Section-3				
5.a)				
b)				
6.a)				
b)				
Section-4				
7.a)				
b)				
8.a)				
b)				
Section-5				
9.a)				
b)				
10.a)				
b)				