

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

Course Code	20ME11T	Semester	I
Course Title	MATERIALS FOR 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

1. COURSE RATIONALE

Materials for engineering play an important role as the vital tool for solving the problems of material selection and application in the production and manufacturing of equipment/machines, devices, tools, etc. Therefore, an engineering diploma student must be conversant with the properties, composition and behavior of materials from ***the point of view of reliability, sustainability and performance of the product***. The study of basic concepts of materials will help the students understanding engineering subjects where the emphasis is laid on the application of these materials.

2. 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

1. Select Engineering materials based on properties, behavior and environmental effect for given engineering application.
2. Identify microstructure and alloying elements of given alternative materials for suitable application

3. COURSE OUT COMES

CO1	Able to understand the various properties of materials u in engineering
CO2	Able to Select relevant ferrous materials and cast iron, non-ferrous metals and advanced materials for Engineering applications
CO3	Adopt International practice of material designation and coding system
CO4	Able to find relevant heat treatment process for altering the properties of metals
CO5	Able to Suggest relevant Surface treatment process for protecting the surface of materials

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

Unit	Unit Title	Teaching Hours
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No.		
I.	Basic of Engineering Materials.	06
II.	Steel and alloys	10
III.	Nonferrous Metals and alloys	08
IV.	Nonmetallic and Advanced materials.	10
V.	Heat treatment process.	10
VI	Surface treatment for Materials	08
	Total	52

5. 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 Learning outcomes (In cognitive domain)	Topics/Subtopics	Hours L-T-P
UNIT-1 BASICS OF ENGINEERING MATERIALS	1. Identify the crystal structure of the given material 2. Explain specimen preparation procedure 3. Distinguish various engineering properties of materials	1.1 Classification of Engineering Material 1.2 Structure of metal-unit cell, BCC, FCC and HCP structures 1.3 Types of microscopes 1.4 Specimen preparation procedure 1.5 Properties of metals-Physical-mechanical-Thermal properties	06-0-0
UNIT-2 STEELS AND ALLOYS	1. Select relevant cast iron for the given job with justification 2. Select relevant steel for the given application 3. Able to designate different plain and alloy steel, cast iron as per BIS, ASME	2.1 Types of cast iron-White-grey-Nodular-malleable - Selection of appropriate cast iron for engineering application 2.2 Broad classification of steels I. Plain carbon steels-Definition-types-properties-composition and applications of low-medium-high carbon steels II. Alloy steels-definition-effect of alloying elements on properties of alloy steel III. Tool steel-cold worked-Hot work tool steel-High speed steel(HSS) IV. Stainless steel-Types and application V. Spring steel-composition and application 2.3 Steels for following-shaft -axes-bolts-nuts-Agriculture Equipment's-household utensils-Antifriction bearings. 2.4 Designation and coding (as per BIS, ASME) of plain & alloy steel and cast iron.	10-0-0

<p align="center">UNIT-3 NON FERROUS METALS AND ALLOYS</p>	<ol style="list-style-type: none"> Describe the properties and application of the given copper alloy Describe the properties and application of the given Aluminum alloy Describe the properties and application of the given Nickel alloy Describe the properties and application of the given Bearing material Select relevant non ferrous material for specified application with justification 	<ol style="list-style-type: none"> Copper and its alloys-Brasses-Bronzes-Chemical composition-Properties and applications Aluminum and its alloys-Y-Alloy-Hindalium-duralium with their -Chemical composition-Properties and applications. Nickel and its alloys with their -Chemical Composition-Properties and applications Bearing materials like White metal (Sn based), Aluminum Bronzes-Self-lubricating Bearings 	<p align="center">08-0-0</p>
<p align="center">UNIT-4 NON METALIC AND ADVANCED MATERIALS</p>	<ol style="list-style-type: none"> Distinguish between metallic and non metallic materials on the basis of given composition Select relevant non metallic material for the given job with justification Select relevant Composite material for the given job with justification Select relevant Alternative material for the given job with justification 	<ol style="list-style-type: none"> Polymeric materials-Polymer-types-characteristics Classification of Polymers on basis of Thermal behavior -Thermo plastics and thermo setting plastics-Properties -uses Ceramics-types of ceramics-properties and applications Composite materials-properties and application of laminated and fiber reinforced materials Advanced engineering materials-properties and application of, Biomaterials, nano materials and smart materials Designation and coding of important non metallic materials as per BIS 	<p align="center">10-0-0</p>
<p align="center">UNIT-5 HEAT TREATMENT PROCESSES</p>	<ol style="list-style-type: none"> Interpret Iron-carbon equilibrium diagram of Mild steel Identify the given phase diagram and reactions with justification Conceptualize with sketches the specified heat treatment process Select relevant Heat treatment process for the given material with justification 	<ol style="list-style-type: none"> Concept of phase-pure metal-alloy -Solid solution Iron-carbon equilibrium diagram indicating various phases-Critical temperature and its significance-Reactions on Iron carbon equilibrium diagram of Mild steel Heat treatment-Definition- purpose of heat treatment--Mechanism of heat treatment Types of heat treatment process Annealing-purposes of annealing-Annealing temperature range-applications. Normalizing- purposes of Normalizing-temperature range-Broad applications Tempering-Purposes of tempering-Types of tempering-Applications Hardening -purposes of hardening -temperature range- Broad applications of hardening Case hardening- Carburizing-Nitriding-Cyaniding 	<p align="center">10-0-0</p>

UNIT-6 SURFACE TREATMENT FOR MATERIALS	1. Describe corrosion and its prevention 2. Select proper electrolysis process for surface coating	6.1 Corrosion-types and reasons for corrosion, protection from corrosion 6.2 Surface protection treatments-Methods of Surface treatments. 6.3 Electrolytes and Non-electrolytes - definition-Types of electrolytes 6.4 Construction and working of electro chemical cell 6.5 Electro-chemical series, galvanic series. 6.6 Surface coating through electrolysis-setup and working.	08-0-0
	TOTAL		52-0-0

6. SUGGESTED PRACTICAL SKILL EXERCISES (DEMONSTRATIVE)

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	1-4
2	Use Metallurgical microscope to interpret Microstructure of steels and alloy steels on standard specimen (This may be covered during industrial visit).	2	1,4	1-4
3	Analyze content of ferrous/nonferrous material using photo Spectrometer. (This may be covered during industrial visit).	2,3	1,4	1,2
4	Use Brinells hardness tester to determine the hardness of a given sample (This may be covered in Mechanical testing lab of institute).	1,2,3	1,4	1,2
5	Use Rockwell hardness tester to determine the hardness of a given sample (This may be covered in Mechanical testing lab of institute).	1,2,3	1,4	1,2
6	Use relevant hardness tester determine hardness of Mild steel specimen before heat treatment and compare the same with another specimen of same grade after heat treatment (This may be covered in Mechanical testing lab of institute).	1,2,3	1,4	1,2
7	Use relevant hardness tester to determine hardness of pure Copper Specimen (This may be covered in Mechanical testing lab of institute).	3	1,4	1,2
8	Use relevant hardness tester determines hardness of any one copper alloy (This may be covered in Mechanical testing lab of institute).	3	1,4	1,2
9	Study corrosive materials to identify different types of corrosion of Metals.	6	1,4	1,2
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 (freehand-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 end semester examination.
5. Term work report must not include any photocopy/ printed manual/pages, lithos, etc. It must be handwritten / 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.

7. MAPPING OF CO WITH PO (Suggestive only)

CO	Course Outcome	PO Mapped	UNIT Linked	Cognitive Level R/U/A	Tutorial & Practical Sessions in Hrs
C01	Able to understand the various properties of materials u in engineering	PO1,PO4	1	A	06
C02	Able to Select relevant ferrous materials and cast iron, non-ferrous metals and advanced materials for Engineering applications	PO1,PO4	2,3,4	A	18
C03	Adopt International practice of material designation and coding system	PO1,PO4	4	A	10
C04	Able to find relevant heat treatment process for altering the properties of metals	PO1,PO4	5	A	10
C05	Able to Suggest relevant Surface treatment process for protecting the surface of materials	PO1,PO4	6	A	08
TOTAL					52

Course	CO's	Programme Outcomes (PO's)						
		1	2	3	4	5	6	7
MATERIAL FOR ENGINEERING	C01	3	1	1	2	0	0	0
	C02	3	1	1	2	0	0	0
	C03	3	1	1	2	0	0	0
	C04	3	1	1	2	0	0	0
	C05	3	1	1	2	0	0	0
Level 3- Highly Mapped, Level 2-Moderately Mapped, Level 1-Low Mapped, Level 0- Not Mapped								

8. 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 Metallurgical labs/Industries/ Academic institution having research centre facility /Research labs for various understanding of metallurgical microscopic examination of materials and various heat treatment process
5. Show Video/animation films to explain functioning of various application of materials in Engineering domain
6. Use different instructional strategies in classroom teaching.

9. SUGGESTED LEARNING RESOURCES:

Sl.N o.	Author	Title of Books	Publication/Year
1	J. W. Martin	Materials for engineering	WOODHEAD PUBLISHING LIMITED Cambridge England
2	GBS Narang	Materials science	Khanna Publishers, New Delhi.
3	R.K.Rajput	Materials science	Laxmi Publication, Dariyaganj, New Delhi.
4	R.S.Khurmi &R.S.Sedha	Materials science	S.Chand
5	D.S.Nutt	Materials science and metallurgy	S.K.Katariya and sons, Delhi.
6	V.Raghavan	Materials science and Engineering	EEE Edition, Prentice Hill, New Delhi.
7	Sidney Avner	Physical Metallurgy	Tata McGraw-Hill Education (2011).

List of Major Equipment/Instrument

1. Metallurgical Microscope.
2. Standards specimens.
3. Furnaces to perform heat treatment process.
4. Sorted/required quenching mediums.
5. Hardness tester-to check Rockwell hardness-scales A,B and C.
6. Other hardness testers like scleroscope, etc.
7. Polishing machine to prepare specimens with necessary consumables.
8. Hand grinder – specifically to prepare specimens and for spark testing.
9. 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. <http://www-g.eng.cam.ac.uk/mmg/teaching/typd/>
4. <http://www.ironcarbondiagram.com/>
5. <http://www.youtube.com/watch?v=fHt0bOfj3T0&feature=related>
6. <http://www.youtube.com/watch?v=cN5YH0iEvTo>
7. <http://www.youtube.com/watch?v=m9l1tVXyFp8>
8. <http://www.youtube.com/watch?v=98lh5Q0M0cg>
9. <http://www.youtube.com/watch?v=KlyGr-1snMY>
10. http://en.wikipedia.org/wiki/Materials_science
11. <http://www.studyvilla.com/electrochem.aspx>

10. SUGGESTED LIST OF PROPOSED STUDENTS ACTIVITIES

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

1. Select any five objects (3 metallic and 2 nonmetallic) which will be used in laboratory and list the material of selected objects.
2. Prepare the material list of given tools and commonly used items such as razor blade, knife, scissor, hacksaw blade, carpentry chisel, fix spanner, 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 nonmetallic components for a given AUTOMOBILE / assembly. Also list the material of identified machine / assembly components.
5. List at least 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. Annealing-heat treatment process.
 - iv. Materials used for construction of any bike.
 - v. Materials used for construction of any home appliance, like mixer, washing machine, iron, etc.
 - vi. Any other relevant activity added by teacher including preparing industrial visit report.

11. COURSE ASSESSMENTS AND EVALUATION CHART

Sl.No	Assessment	Type	Time frame in semester	Duration	Max marks	Conversion
1.	CIE Assessment 1	Written test-1	- At the end of 3 rd week	80 minutes	30	Average of three written tests-1,2,3 for 30
2	CIE Assessment 2	Written test-2	- At the end of 7 th week	80 minutes	30	
3	CIE Assessment 3	Written test-3	- At the end of 13 th week	80 minutes	30	
4	CIE Assessment 4	MCQ/Quiz	- At the end of 5 th week	60 minutes	20	Average of three Assessment 4,5,6 For 20
5	CIE Assessment 5	Open book test	- At the end of 9 th week	60 minutes	20	
6	CIE Assessment 6	Student activity&presentation	- At the end of 11 th week	60 minutes	20	
Total Continuous Internal Evaluation (CIE) Assessment						50
Semester End Examination (SEE) Assessment (Written Test-Pen-paper Mode), conduction for 100 marks and converted for 50				3 Hours	100	50
Total Marks						100

Note:

- SEE is conducted for 100 Marks.
- I.A. test shall be conducted as shown in the above table.
- Assessment of assignment and student activity is evaluated through appropriate rubrics by the respective course coordinator.

RUBRICS FOR ACTIVITY						
Appropriate rubrics to be developed by the faculty as per the activity						
Dimension	Beginning 2	Developing 4	Satisfactory 6	Good 8	Exemplary 10	Student Score
	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	6
	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	8
	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	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)				