



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

## MECHANICAL ENGINEERING TUTORIAL QUESTION BANK

|                           |                                                                                        |
|---------------------------|----------------------------------------------------------------------------------------|
| <b>Course Name</b>        | <b>METALLURGY AND MATERIAL SCIENCE</b>                                                 |
| <b>Course Code</b>        | <b>AME005</b>                                                                          |
| <b>Class</b>              | III Semester                                                                           |
| <b>Branch</b>             | Mechanical Engineering                                                                 |
| <b>Year</b>               | 2018-2019                                                                              |
| <b>Course Coordinator</b> | Mr. M Prashanth Reddy, Assistant Professor                                             |
| <b>Course Faculty</b>     | Mr. M.V. Aditya Nag, Assistant Professor<br>Mr. M Prashanth Reddy, Assistant Professor |

### COURSE OBJECTIVES:

The course should enable the students:

|     |                                                                                                   |
|-----|---------------------------------------------------------------------------------------------------|
| I   | Understanding of metallurgical engineering concepts and properties.                               |
| II  | Analyze microstructures of metals and alloys and relationship to heat treatment.                  |
| III | Compare the properties of ceramics, glasses, composites and polymers for industrial applications. |

### COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

|            |                                                                                                                                                                              |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CAME005.01 | Analyze the structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, Atomic packing factor, Coordinate number etc. |
| CAME005.02 | Explain the necessity of alloying, types of solid solution and intermediate alloy phases.                                                                                    |
| CAME005.03 | Explain the concept of phase and phase diagram and understand the basic terminologies associated with metallurgy.                                                            |
| CAME005.04 | Construction of phase diagrams and identification of different phases and invariant reaction.                                                                                |
| CAME005.05 | Understand and suggest the heat treatment processes and types, and significance of mechanical and metallurgical properties with respect to microstructures.                  |
| CAME005.06 | Explain the concept of Hardenability and demonstrate the test used to find the Hardenability of steels.                                                                      |
| CAME005.07 | Analyze the microstructure of metallic materials using phase diagram and modify the microstructure and properties using different heat treatment processes.                  |
| CAME005.08 | Define and differentiate engineering materials on the basis of structure and properties for engineering applications.                                                        |
| CAME005.09 | Explain features, classification, and application of materials like polymers like thermosetting, thermoplastics.                                                             |
| CAME005.10 | Explain features, classification, and application of materials like ceramics.                                                                                                |
| CAME005.11 | Explain features, classification, and application of materials like composites.                                                                                              |
| CAME005.12 | Differentiate the properties and application of various materials like ceramics, composites and polymers.                                                                    |
| CAME005.13 | Make the students conversant with ISO and IS standards of the material composition and mechanical properties.                                                                |
| CAME005.14 | Design and develop materials for high temperature applications and understand mechanical properties at elevated temperatures.                                                |
| CAME005.15 | Familiarize on different international standards for composite materials and its applications                                                                                |
| CAME005.16 | Design the materials for strength to weight ratio applications.                                                                                                              |

**UNIT – I****STRUCTURE OF METALS****Part - A (Short Answer Questions)**

| <b>S No</b>                             | <b>QUESTION</b>                                                                                               | <b>Blooms Taxonomy Level</b> | <b>Course Learning Outcomes</b> |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------|------------------------------|---------------------------------|
| 1                                       | Define Crystallography and Explain Unit Cell                                                                  | Understand                   | CAME005.01                      |
| 2                                       | Define unit cell and Space lattice with a neat diagram.                                                       | Understand                   | CAME005.01                      |
| 3                                       | Define space lattice with a neat diagram.                                                                     | Remember                     | CAME005.01                      |
| 4                                       | Define alloy. Explain necessity of alloy elements with few examples.                                          | Remember                     | CAME005.02                      |
| 5                                       | What is grain? Explain the concept of grain boundary.                                                         | Remember                     | CAME005.01                      |
| 6                                       | Explain miller indices. Draw the miller indices plane for (100).                                              | Understand                   | CAME005.01                      |
| 7                                       | Explain miller indices. Draw the miller indices plane for (101).                                              | Understand                   | CAME005.01                      |
| 8                                       | Define miller indices. Draw the miller indices plane for (110).                                               | Understand                   | CAME005.01                      |
| 9                                       | Explain miller indices. Draw the miller indices plane for (111).                                              | Understand                   | CAME005.01                      |
| 10                                      | Define miller indices. Draw the miller indices plane for $(\bar{1}10)$ .                                      | Understand                   | CAME005.01                      |
| 11                                      | What are imperfections in crystals? Explain Point defect with a diagram?                                      | Remember                     | CAME005.01                      |
| 12                                      | What is defect? Explain Line defect with a neat diagram?                                                      | Remember                     | CAME005.01                      |
| 13                                      | Classify the line defects. Define Surface defect?                                                             | Remember                     | CAME005.01                      |
| 14                                      | What is Volume defect? Explain volume defect with neat sketch.                                                | Remember                     | CAME005.01                      |
| 15                                      | Define Dislocation?                                                                                           | Remember                     | CAME005.01                      |
| 16                                      | Define the term Alloy. Name the alloys with their properties.                                                 | Understand                   | CAME005.02                      |
| 17                                      | What is Phase? Explain with a phase diagram.                                                                  | Understand                   | CAME005.03                      |
| 18                                      | Define the term Solid solution.                                                                               | Remember                     | CAME005.03                      |
| 19                                      | Define the term Intermediate phase.                                                                           | Understand                   | CAME005.03                      |
| 20                                      | Explain the term Electron compound.                                                                           | Understand                   | CAME005.03                      |
| <b>Part - B (Long Answer Questions)</b> |                                                                                                               |                              |                                 |
| 1                                       | Define grain and grain boundary? Explain about are the characteristics of grain boundary?                     | Understand                   | CAME005.01                      |
| 2                                       | Define grain size? Explain about methods for determining grain size?                                          | Remember                     | CAME005.01                      |
| 3                                       | Explain effect of grain size on properties.                                                                   | Remember                     | CAME005.01                      |
| 4                                       | State and explain Hume Rothery rules for the formation of solid solutions.                                    | Understand                   | CAME005.03                      |
| 5                                       | Explain about intermediate phases? Explain about are the various types of intermediate phases?                | Understand                   | CAME005.03                      |
| 6                                       | Explain about crystalline material? Distinguish between single crystal material and polycrystalline material? | Understand                   | CAME005.03                      |
| 7                                       | Define the terms (i) Space lattice (ii) Unit cell (iii) Solid solution and monotectic solution.               | Remember                     | CAME005.01                      |
| 8                                       | Explain the procedure to find out the miller indices with an example.                                         | Understand                   | CAME005.01                      |

| 9                                                                 | Draw the miller indices for (i) (100) (ii) (110) (iii) (111).                                                                                                                                  | Remember              | CAME005.01               |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------|
| 10                                                                | List out and draw various bravias lattice structures and their primitives.                                                                                                                     | Remember              | CAME005.01               |
| 11                                                                | Write about relation between a, b, c and $\alpha$ , $\beta$ , $\gamma$ in cubic crystal system, tetragonal crystal system, orthorhombic crystal system and Hexagonal crystal system.           | Remember              | CAME005.01               |
| 12                                                                | Define packing factor? Explain about is the packing factor for (i) Simple cubic crystal (ii) Body centred cubic crystal.                                                                       | Understand            | CAME005.01               |
| 13                                                                | Explain about effective number of atoms? Calculate the effective number of atoms in SC structure, FCC structure, and BCC structure.                                                            | Understand            | CAME005.01               |
| 14                                                                | Explain about relation between lattice constant (a) and atomic radius(r) in SC structure, FCC structure, BCC structure, HCP structure?                                                         | Understand            | CAME005.01               |
| 15                                                                | Define coordination number. Explain about is the coordination number for BCC, FCC, HCP (Explain with proper procedure)?                                                                        | Understand            | CAME005.01               |
| 16                                                                | Discuss about necessity of alloying?                                                                                                                                                           | Remember              | CAME005.02               |
| 17                                                                | Write briefly about Humme Rothery rules.                                                                                                                                                       | Remember              | CAME005.02               |
| 18                                                                | Explain about solid solutions?                                                                                                                                                                 | Remember              | CAME005.02               |
| 19                                                                | Explain about types of solid solutions?                                                                                                                                                        | Remember              | CAME005.02               |
| 20                                                                | Describe about linear atomic density? Calculate the linear atomic density in [110] direction in the cooper crystal lattice in atoms per mm. copper is FCC and has a lattice constant of 0.351. | Understand            | CAME005.01               |
| <b>Part - C (Problem Solving and Critical Thinking Questions)</b> |                                                                                                                                                                                                |                       |                          |
| 1                                                                 | Compare simple cubic and body centred cubic crystal. Explain atomic packing factor.                                                                                                            | Understand            | CAME005.01               |
| 2                                                                 | Explain about coordination number?                                                                                                                                                             | Understand            | CAME005.01               |
| 3                                                                 | Explain about atomic packing factor? Explain atomic packing factor for SC, BCC & FCC structures.                                                                                               | Understand            | CAME005.01               |
| 4                                                                 | Explain covalent and ionic bonding. Compare covalent and ionic bond.                                                                                                                           | Remember              | CAME005.01               |
| 5                                                                 | Describe about metallic bond? Compare covalent and metallic bond.                                                                                                                              | Remember              | CAME005.01               |
| 6                                                                 | What is grain structure? Compare coarse and fine grain structure.                                                                                                                              | Remember              | CAME005.01               |
| 7                                                                 | Explain defects. Compare point and line defects with diagrams.                                                                                                                                 | Understand            | CAME005.01               |
| 8                                                                 | Compare pure metals and alloys. Give the examples.                                                                                                                                             | Understand            | CAME005.02               |
| 9                                                                 | Compare substitutional and interstitial solid solutions. Give the examples.                                                                                                                    | Remember              | CAME005.02               |
| 10                                                                | Describe about melting range in alloys?                                                                                                                                                        | Remember              | CAME005.02               |
| <b>UNIT - II</b>                                                  |                                                                                                                                                                                                |                       |                          |
| <b>PHASE DIAGRAMS</b>                                             |                                                                                                                                                                                                |                       |                          |
| <b>Part – A (Short Answer Questions)</b>                          |                                                                                                                                                                                                |                       |                          |
| S No                                                              | QUESTION                                                                                                                                                                                       | Blooms Taxonomy Level | Course Learning Outcomes |
| 1                                                                 | Explain the term Binary alloy.                                                                                                                                                                 | Understand            | CAME005.04               |

|                                         |                                                                                |            |            |
|-----------------------------------------|--------------------------------------------------------------------------------|------------|------------|
| 2                                       | Define phase and Gibbs Rule.                                                   | Understand | CAME005.04 |
| 3                                       | Define Gibbs Rule, levers rule.                                                | Remember   | CAME005.04 |
| 4                                       | What is gibb's phase rule? Explain its importance.                             | Remember   | CAME005.04 |
| 5                                       | Define the term coring.                                                        | Understand | CAME005.04 |
| 6                                       | What is Isomorphous system Define?                                             | Understand | CAME005.04 |
| 7                                       | Define Eutectic system.                                                        | Understand | CAME005.04 |
| 8                                       | Define Partial eutectic system.                                                | Remember   | CAME005.04 |
| 9                                       | Explain Peritectic system.                                                     | Understand | CAME005.04 |
| 10                                      | Define Monotectic system.                                                      | Understand | CAME005.04 |
| 11                                      | Explain about is melting range?                                                | Remember   | CAME005.04 |
| 12                                      | Define Phase Diagram.                                                          | Understand | CAME005.04 |
| 13                                      | Explain about are the types of substitutional solid solutions?                 | Remember   | CAME005.04 |
| 14                                      | Explain about is Substitutional solid solution?                                | Understand | CAME005.04 |
| 15                                      | Define cooling curve.                                                          | Understand | CAME005.04 |
| 16                                      | Define Eutectoid reaction.                                                     | Understand | CAME005.04 |
| 17                                      | Write about Thermal Equilibrium Diagram?                                       | Remember   | CAME005.04 |
| 18                                      | Draw the stages of structures from Solid to Liquid formation in binary system. | Understand | CAME005.04 |
| 19                                      | Explain about intermediate phases using examples?                              | Remember   | CAME005.04 |
| 20                                      | Discuss about use of cooling curves?                                           | Understand | CAME005.04 |
| <b>Part - B (Long Answer Questions)</b> |                                                                                |            |            |
| 1                                       | Explain with the help of a diagram the cooling curve of pure metals.           | Understand | CAME005.04 |
| 2                                       | State and explain levers rule.                                                 | Remember   | CAME005.04 |
| 3                                       | Explain with the help of a diagram the cooling curve of alloys.                | Understand | CAME005.04 |
| 4                                       | State and explain Gibbs phase rule.                                            | Understand | CAME005.04 |
| 5                                       | Explain the construction of phase diagram.                                     | Remember   | CAME005.04 |
| 6                                       | Explain about non equilibrium cooling.                                         | Understand | CAME005.04 |
| 7                                       | Write in brief about the binary phase diagram.                                 | Remember   | CAME005.04 |
| 8                                       | Write about purposes of phase diagrams?                                        | Understand | CAME005.04 |
| 9                                       | Define the term isomorphism and polymorphism.                                  | Understand | CAME005.04 |
| 10                                      | Explain about the isomorphous system with a Ni-Cu diagram.                     | Understand | CAME005.04 |
| 11                                      | Write a brief note about eutectic system.                                      | Remember   | CAME005.04 |
| 12                                      | Explain the phase change in a eutectic system with an example.                 | Understand | CAME005.04 |
| 13                                      | Write a short note on eutectoid system.                                        | Understand | CAME005.04 |
| 14                                      | Explain with an example the eutectoid system.                                  | Remember   | CAME005.04 |
| 15                                      | Write about dendrites?                                                         | Understand | CAME005.04 |
| 16                                      | Explain the formation of dendrites.                                            | Understand | CAME005.04 |
| 17                                      | Write about most common types of phase diagrams explain in brief?              | Remember   | CAME005.04 |
| 18                                      | Draw and explain the Cd-Bi phase diagram.                                      | Understand | CAME005.04 |
| 19                                      | Explain about the levers rule and write its application.                       | Understand | CAME005.04 |
| 20                                      | Draw and explain the cooling curves for pure metals.                           | Remember   | CAME005.04 |

| <b>Part – C (Problem Solving and Critical Thinking)</b> |                                                                               |                              |                                 |
|---------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------|---------------------------------|
| 1                                                       | Compare eutectic and peritectic reaction.                                     | Understand                   | CAME005.04                      |
| 2                                                       | Compare eutectic and eutectoid reaction.                                      | Remember                     | CAME005.04                      |
| 3                                                       | Explain about peritectoid reaction?                                           | Understand                   | CAME005.04                      |
| 4                                                       | Compare peritectoid and eutectoid reaction.                                   | Understand                   | CAME005.04                      |
| 5                                                       | Explain about phase in detail?                                                | Remember                     | CAME005.04                      |
| 6                                                       | Explain about Gibbs phase rule?                                               | Understand                   | CAME005.04                      |
| 7                                                       | Compare phase and component.                                                  | Remember                     | CAME005.04                      |
| 8                                                       | Compare isomorphous and eutectic system.                                      | Understand                   | CAME005.04                      |
| 9                                                       | Explain about coring?                                                         | Understand                   | CAME005.04                      |
| 10                                                      | Explain about intermediate phases?                                            | Understand                   | CAME005.04                      |
| <b>UNIT-III</b>                                         |                                                                               |                              |                                 |
| <b>ENGINEERING MATERIALS-I</b>                          |                                                                               |                              |                                 |
| <b>Part - A (Short Answer Questions)</b>                |                                                                               |                              |                                 |
| <b>S No</b>                                             | <b>QUESTION</b>                                                               | <b>Blooms Taxonomy level</b> | <b>Course Learning Outcomes</b> |
| 1                                                       | Define alloy. Explain different types of alloys.                              | Understand                   | CAME005.04                      |
| 2                                                       | Define phase and draw the phase diagram.                                      | Understand                   | CAME005.04                      |
| 3                                                       | Define Gibbs Rule.                                                            | Understand                   | CAME005.04                      |
| 4                                                       | Explain levers rule.                                                          | Remember                     | CAME005.04                      |
| 5                                                       | Define ferrite and austenite.                                                 | Understand                   | CAME005.04                      |
| 6                                                       | Explain Isomorphous system.                                                   | Understand                   | CAME005.04                      |
| 7                                                       | Explain Eutectic system                                                       | Remember                     | CAME005.04                      |
| 8                                                       | Define Partial eutectic system.                                               | Understand                   | CAME005.04                      |
| 9                                                       | Write about Peritectic, eutectoid system.                                     | Remember                     | CAME005.04                      |
| 10                                                      | Define Monotectic system.                                                     | Understand                   | CAME005.04                      |
|                                                         |                                                                               |                              |                                 |
| 11                                                      | Explain about Critical Temperature?                                           | Remember                     | CAME005.04                      |
| 12                                                      | Define Phase Diagram.                                                         | Understand                   | CAME005.04                      |
| 13                                                      | Explain about are the types of substitutional solid solutions?                | Understand                   | CAME005.04                      |
| 14                                                      | Explain about Substitutional solid solution?                                  | Remember                     | CAME005.04                      |
| 15                                                      | Define cooling curve.                                                         | Understand                   | CAME005.04                      |
| 16                                                      | Define continuous cooling transformation curves.                              | Remember                     | CAME005.04                      |
| 17                                                      | Explain about is use of Thermal Equilibrium Diagram?                          | Remember                     | CAME005.04                      |
| 18                                                      | Draw the stages of structures from Solid to Liquid formation in binary system | Remember                     | CAME005.04                      |
| 19                                                      | Describe about formation of intermediate phases in detail.                    | Remember                     | CAME005.04                      |
| 20                                                      | Explain about is the use of Jominy end Quenching Machine.                     | Understand                   | CAME005.07                      |
| <b>Part – B (Long Answer Questions)</b>                 |                                                                               |                              |                                 |
| 1                                                       | Explain allotropic forms of iron and give lattice structure of each.          | Understand                   | CAME005.04                      |

|                                                         |                                                                                                                       |            |            |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------|------------|
| 2                                                       | Define ferrite, pearlite, and austenite.                                                                              | Understand | CAME005.04 |
| 3                                                       | Explain about peritectic reaction and explain with diagram?                                                           | Understand | CAME005.04 |
| 4                                                       | Explain about eutectic reaction in iron-carbide system and explain with neat diagram?                                 | Understand | CAME005.04 |
| 5                                                       | Explain various phase reactions in iron-iron carbide system.                                                          | Understand | CAME005.04 |
| 6                                                       | With the help of neat sketch explain eutectoid reaction.                                                              | Understand | CAME005.04 |
| 7                                                       | Explain about hypo eutectoid steels and hyper eutectoid steels.                                                       | Understand | CAME005.04 |
| 8                                                       | Define ferrite, austenite, cementite and martensite.                                                                  | Understand | CAME005.04 |
| 9                                                       | Explain various effects of sulphur, phosphorous additions in steel.                                                   | Understand | CAME005.04 |
| 10                                                      | Explain in detail about isothermal transformation.                                                                    | Understand | CAME005.04 |
|                                                         |                                                                                                                       |            |            |
| 11                                                      | Draw time temperature transformation curves and identify products.                                                    | Understand | CAME005.04 |
| 12                                                      | Draw continuous transformation curves and explain.                                                                    | Remember   | CAME005.04 |
| 13                                                      | What is annealing heat treatment explain?                                                                             | Understand | CAME005.05 |
| 14                                                      | Explain normalizing heat treatment process.                                                                           | Understand | CAME005.05 |
| 15                                                      | Explain hardening and tempering heat treatment processes.                                                             | Remember   | CAME005.05 |
| 16                                                      | Compare stainless steels and tool steels.                                                                             | Remember   | CAME005.05 |
| 17                                                      | Explain Hardenability and the method of testing using Jominy end quench.                                              | Understand | CAME005.06 |
| 18                                                      | Classify stainless steels and mention their properties and applications.                                              | Understand | CAME005.12 |
| 19                                                      | Explain properties and applications of austenitic stainless steels.                                                   | Understand | CAME005.12 |
| 20                                                      | Explain applications of Tool steels, HSLA steels and Maraging steels.                                                 | Understand | CAME005.13 |
| <b>Part – C (Problem Solving and Critical Thinking)</b> |                                                                                                                       |            |            |
| 1                                                       | Explain about is allotropy in iron?                                                                                   | Understand | CAME005.04 |
| 2                                                       | Compare ferrite and austenite, ferrite and pearlite.                                                                  | Understand | CAME005.04 |
| 3                                                       | Draw Fe-C equilibrium diagram and label the temperatures, compositions and phases.                                    | Understand | CAME005.04 |
| 4                                                       | Compare ferrite and cementite.                                                                                        | Understand | CAME005.04 |
| 5                                                       | Differentiate between hypo and hyper eutectoid steels.                                                                | Understand | CAME005.04 |
|                                                         |                                                                                                                       |            |            |
| 6                                                       | Compare steels and cast irons as per carbon per percentage.                                                           | Understand | CAME005.04 |
| 7                                                       | Compare low and medium carbon steels.                                                                                 | Understand | CAME005.04 |
| 8                                                       | Explain following with neat diagram Peritectic transformations, Eutectic transformation and Eutectoid transformations | Understand | CAME005.07 |
| 9                                                       | Compare annealing and normalizing, annealing and hardening.                                                           | Remember   | CAME005.07 |
| 10                                                      | Explain following with neat diagrams Annealing, Normalising, Process annealing, Stress relieving and hardening.       | Understand | CAME005.15 |
| <b>UNIT-IV</b>                                          |                                                                                                                       |            |            |
| <b>ENGINEERING MATERIALS-II,III</b>                     |                                                                                                                       |            |            |
| <b>Part – A (Short Answer Questions)</b>                |                                                                                                                       |            |            |
| 1                                                       | What is cast iron? Classify the cast iron.                                                                            | Understand | CAME005.08 |
| 2                                                       | Explain about is gray cast iron?                                                                                      | Understand | CAME005.08 |



|                                         |                                                                              |            |            |
|-----------------------------------------|------------------------------------------------------------------------------|------------|------------|
| 3                                       | Define white cast iron. Explain its properties?                              | Understand | CAME005.08 |
| 4                                       | Explain about is Malleable cast iron?                                        | Remember   | CAME005.08 |
| 5                                       | What is spheroidal cast iron?                                                | Understand | CAME005.08 |
| 6                                       | Examine carbon % present in malleable cast iron?                             | Understand | CAME005.08 |
| 7                                       | Examine carbon % present in spheroidal cast iron?                            | Remember   | CAME005.08 |
| 8                                       | Examine carbon % present in Gray cast iron?                                  | Understand | CAME005.08 |
| 9                                       | Discuss about microstructure of gray cast iron?                              | Remember   | CAME005.08 |
| 10                                      | Draw the microstructure of white cast iron and explain.                      | Understand | CAME005.14 |
| 11                                      | Explain about microstructure of spheroidal cast iron?                        | Understand | CAME005.14 |
| 12                                      | Where is titanium alloys used?                                               | Remember   | CAME005.08 |
| 13                                      | Explain about microstructure of malleable cast iron?                         | Understand | CAME005.14 |
| 14                                      | What are the applications of aluminium alloys?                               | Remember   | CAME005.16 |
| 15                                      | Explain about are heat treatable alloys?                                     | Remember   | CAME005.08 |
| 16                                      | Explain about are non-heat treatable alloys?                                 | Understand | CAME005.08 |
| 17                                      | Classify aluminium alloys and explain their properties in detail.            | Understand | CAME005.08 |
| 18                                      | Explain about are the important copper alloys?                               | Understand | CAME005.08 |
| 19                                      | Classify Titanium alloys with their properties and applications.             | Remember   | CAME005.08 |
| 20                                      | Explain about the applications of copper alloys?                             | Remember   | CAME005.15 |
| <b>Part – B (Long Answer Questions)</b> |                                                                              |            |            |
| 1                                       | Explain types of cast irons and give applications for each.                  | Understand | CAME005.08 |
| 2                                       | Describe methods of making white cast iron? Explain properties.              | Understand | CAME005.08 |
| 3                                       | Justify “ ti-6al-4v alloys are useful for aerospace applications”            | Understand | CAME005.16 |
| 4                                       | Explain about gray cast iron and explain properties?                         | Understand | CAME005.08 |
| 5                                       | Discuss the advantages of steels over the family of cast iron.               | Remember   | CAME005.08 |
| 6                                       | Why nodular cast iron is ductile. Explain properties?                        | Understand | CAME005.08 |
| 7                                       | Discuss effect of Silicon, Manganese, Sulphur, and Phosphorous in cast iron. | Understand | CAME005.08 |
| 8                                       | Discuss Ni-resist and Ni-hard cast irons.                                    | Remember   | CAME005.08 |
| 9                                       | Explain heat treatable aluminium alloys and give applications.               | Understand | CAME005.08 |
| 10                                      | Discuss non-heat treatable aluminium alloys and give applications.           | Remember   | CAME005.16 |
| 11                                      | What are the different copper alloys and give applications for each.         | Understand | CAME005.16 |
| 12                                      | Explain about are types of brasses and explain properties?                   | Understand | CAME005.16 |
| 13                                      | Discuss precipitation hardening with an example.                             | Understand | CAME005.08 |
| 14                                      | Explain various bronzes and their properties.                                | Understand | CAME005.08 |
| 15                                      | Explain beta titanium alloys.                                                | Understand | CAME005.08 |
| 16                                      | Classify titanium alloys and give typical applications for each.             | Remember   | CAME005.14 |
| 17                                      | Explain about soldering alloys? Give typical applications.                   | Understand | CAME005.14 |
| 18                                      | Write the properties, applications of alpha titanium alloys.                 | Remember   | CAME005.13 |
| 19                                      | Explain properties and applications of duraluminum.                          | Remember   | CAME005.15 |
| 20                                      | Compare naval brass and muntz metal.                                         | Understand | CAME005.08 |

| <b>Part – C (Problem Solving and Critical Thinking)</b> |                                                                                                              |            |            |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------|------------|
| 1                                                       | Compare gray and white cast iron.                                                                            | Understand | CAME005.08 |
| 2                                                       | Explain about factors control structure of cast iron?                                                        | Understand | CAME005.08 |
| 3                                                       | Compare malleable and nodular cast iron.                                                                     | Understand | CAME005.08 |
| 4                                                       | Explain about dominant mechanical property of cast iron?                                                     | Remember   | CAME005.08 |
| 5                                                       | Compare brasses and bronzes.                                                                                 | Understand | CAME005.08 |
| 6                                                       | Describe the following cast irons White cast iron, Malleable cast iron, Gray cast iron and Nodular cast iron | Understand | CAME005.08 |
| 7                                                       | Explain about effects of adding Si, Mn, S, and P?                                                            | Remember   | CAME005.08 |
| 8                                                       | Compare heat treatable and non-heat treatable aluminium alloys.                                              | Understand | CAME005.08 |
| 9                                                       | Explain about effects of graphite flakes? Explain in detail about ductility nature of nodular cast iron.     | Understand | CAME005.08 |
| 10                                                      | Compare pure titanium and Ti-6Al-4 V.                                                                        | Remember   | CAME005.08 |

### UNIT-V

### ENGINEERING MATERIALS-IV

#### Part - A (Short Answer Questions)

| <b>S No</b> | <b>QUESTION</b>                                              | <b>Blooms Taxonomy level</b> | <b>Course Learning Outcomes</b> |
|-------------|--------------------------------------------------------------|------------------------------|---------------------------------|
| 1           | Classify ceramics. Give the examples.                        | Understand                   | CAME005.10                      |
| 2           | Explain about uses of alumina ceramics?                      | Understand                   | CAME005.10                      |
| 3           | Explain about uses of Zirconium ceramics?                    | Understand                   | CAME005.10                      |
| 4           | Explain about uses of Silicon nitride?                       | Remember                     | CAME005.10                      |
| 5           | Classify Glasses and give their properties and applications. | Understand                   | CAME005.10                      |
| 6           | Define glass. Explain properties of glass.                   | Understand                   | CAME005.10                      |
| 7           | Explain about glass transition temperature?                  | Remember                     | CAME005.10                      |
| 8           | Explain about borosilicate glass?                            | Understand                   | CAME005.10                      |
| 9           | Compare soft and hard glasses.                               | Remember                     | CAME005.10                      |
| 10          | Explain about thermal shock?                                 | Understand                   | CAME005.10                      |
| 11          | Classify polymers. Give the examples.                        | Understand                   | CAME005.09                      |
| 12          | Explain about polymerisation?                                | Understand                   | CAME005.09                      |
| 13          | What is a thermo plastic? Explain?                           | Understand                   | CAME005.09                      |
| 14          | Explain about thermo setting plastics?                       | Remember                     | CAME005.09                      |
| 15          | What are the different types of additives used in polymers?  | Understand                   | CAME005.09                      |
| 16          | What is FRP? Explain?                                        | Understand                   | CAME005.09                      |
| 17          | Define composites and advantages of composites.              | Remember                     | CAME005.11                      |
| 18          | Classify composites with examples.                           | Understand                   | CAME005.11                      |
| 19          | Explain about matrix in composite?                           | Remember                     | CAME005.11                      |
| 20          | Explain about fibre in composites?                           | Understand                   | CAME005.11                      |

#### Part - B (Long Answer Questions)

|   |                                                        |            |            |
|---|--------------------------------------------------------|------------|------------|
| 1 | Explain about general properties of ceramic materials. | Understand | CAME005.13 |
|---|--------------------------------------------------------|------------|------------|



|                                                         |                                                                         |            |            |
|---------------------------------------------------------|-------------------------------------------------------------------------|------------|------------|
| 2                                                       | Classify ceramics with examples and applications.                       | Understand | CAME005.14 |
| 3                                                       | Explain about properties and applications of alumina ceramics.          | Understand | CAME005.15 |
| 4                                                       | Discuss about properties and applications of zirconia ceramics.         | Remember   | CAME005.13 |
| 5                                                       | Explain about properties and applications of silicon carbide.           | Understand | CAME005.14 |
| 6                                                       | Discuss about properties and applications of silicon nitride.           | Understand | CAME005.15 |
| 7                                                       | Explain about properties and applications of tungsten carbide.          | Remember   | CAME005.16 |
| 8                                                       | Define glass and classify types of glasses and give applications.       | Understand | CAME005.16 |
| 9                                                       | Explain glass transition temperature and its importance in manufacture. | Remember   | CAME005.10 |
| 10                                                      | Compare properties of hard and soft glasses.                            | Understand | CAME005.10 |
| 11                                                      | Explain about is stabilization in zirconia ceramics?                    | Remember   | CAME005.10 |
| 12                                                      | Explain brittleness in ceramic materials.                               | Understand | CAME005.10 |
| 13                                                      | Define polymers. Classify them and give typical applications.           | Understand | CAME005.09 |
| 14                                                      | Discuss methods of polymerisation.                                      | Remember   | CAME005.08 |
| 15                                                      | Explain about are thermo plastics? Explain properties.                  | Understand | CAME005.13 |
| 16                                                      | Explain about are thermo setting plastics? Give their properties.       | Understand | CAME005.13 |
| 17                                                      | Classify composites. Explain their properties.                          | Remember   | CAME005.09 |
| 18                                                      | Discuss fibre reinforced plastics and their uses.                       | Understand | CAME005.16 |
| 19                                                      | Give properties of metal matrix composites.                             | Understand | CAME005.16 |
| 20                                                      | Explain ceramic matrix composites and give their properties.            | Understand | CAME005.16 |
| <b>Part – C (Problem Solving and Critical Thinking)</b> |                                                                         |            |            |
| 1                                                       | Explain alumina ceramics and glasses.                                   | Understand | CAME005.10 |
| 2                                                       | Compare CBN and silicon nitride.                                        | Remember   | CAME005.10 |
| 3                                                       | Differentiate Zirconia and alumina ceramics.                            | Understand | CAME005.10 |
| 4                                                       | Compare hard and soft glasses.                                          | Remember   | CAME005.10 |
| 5                                                       | Explain about various factors for thermal shock resistance?             | Understand | CAME005.10 |
| 6                                                       | Differentiate metal matrix and ceramic matrix composites.               | Understand | CAME005.10 |
| 7                                                       | Compare composites and polymers.                                        | Remember   | CAME005.16 |
| 8                                                       | Explain and differentiate FRP and PVC.                                  | Understand | CAME005.09 |
| 9                                                       | Compare polymer matrix and ceramic matrix composites.                   | Remember   | CAME005.09 |
| 10                                                      | Differentiate tungsten carbide and silicon nitride.                     | Understand | CAME005.10 |

**Prepared By:**

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**HOD, MECHANICAL ENGINEERING**