

## M.TECH MATERIAL ENGG FIRST YEAR SECOND SEMESTER – 2018

## SUBJECT: HIGH TEMPERATURE MATERIALS

Time: Three Hours

Full Marks: 100

( Use separate Answer Script for each part )

Part-1(Answer Question 1 and any three of the rest)

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|----|---|-----|
| 1. | Draw and explain the structure of Kaolinite.  | 10  |
| 2. | (a) Draw schematically DTA plots of china clay, fire clay and bentonite and explain.  | 12  |
|    | (b) Define apparent porosity and discuss the determination of apparent porosity.  | 2+6 |
| 3. | (a) Discuss the classification of refractory materials.   | 10  |
|    | (b) Explain what is black heart and what's its effects on fire clay refractories?   | 5   |
|    | (c) CaO is more severe slagging agent than FeO; explain.  | 5   |
| 4. | (a) Discuss the characteristics of 'Displacive transformation'  | 5   |
|    | (b) Take a typical composition of a silica brick and explain the temperature dependent phase transformation upto about 1450°C | 10  |
|    | (c) High temperature strength of silica bricks is excellent above 600°C; explain  | 5   |
| 5. | (a) What is the hydration problem of magnesite brick and explain how this could be overcome.                                  | 2+5 |
|    | (b) Define dihedral angle. Explain how the impurities affect the high temperature strength of magnesite bricks.               | 8   |
|    | (c) Explain how you stabilize the dolomite bricks.  | 5   |
| 6. | (a) Discuss the properties of high temperature oxide materials  | 10  |
|    | (b) RUL is more important than PCE; Explain   | 5   |
|    | (c) From the point of view of corrosion resistance Magcarb performs better than magnesite; Explain                            | 5   |

[ Turn over

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**PART – II****(Use separate answerscript)****Answer any two from the following:**

- Q1. (a)** Give a detail description about different types of alloy steels along with their nominal composition and microstructure which are used for high temperature applications. 10
- (b)** Draw Schaeffler diagram and explain the importance of this diagram. 5
- Q2. (a)** Discuss the physical metallurgical principle, processing and microstructure of Nickel base superalloys with reference to the role of different alloying elements and strengthening mechanism. 10
- (b)** What is the purpose of coatings of gas turbine engine components? Write a short note on "thermal barrier coating". 5
- Q3. (a)** Why gas turbine blades are used in cast form?
- (b)** What are ODS alloys and what is the importance of ODS alloys for high temperature applications?
- (c)** Arrange in increasing order with justification the creep resistance of materials in the following cases
- i) Directionally solidified alloy
  - ii) Coarse grained alloy with randomly oriented polycrystal
  - iii) Alloy with single crystal
  - iv) Fine grained alloy with randomly oriented polycrystal
- 5+5+5 = 15