JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2025

PhD 1st Semester (CE)

COURSE CODE (CREDITS): 24P1WCE232 (3)   MAX. MARKS: 25

COURSE NAME: CHARACTERIZATION OF MATERIALS

COURSE INSTRUCTORS: DR SAURAV   MAX. TIME: 1 Hour 30 Min

Note: (a) All questions are compulsory.

(b) The candidate is allowed to make Suitable numeric assumptions whenever required for solving problems

(c) Use of Non Programmable Scientific Calculator is allowed

Q.No	Question	CO	Marks
Q1	A researcher observes a sharp mass loss near 400°C in TG but no corresponding peak in DTA. Suggest possible causes and corrective measures. Discuss how combined TG–DSC analysis can be used to monitor the thermal behavior of blended cements containing fly ash or slag.	3	5
Q2	Differentiate between constant heating rate, gradually isothermal, and isothermal temperature–time programs used in thermal analysis. Explain how simultaneous DTA–TG data can be used to identify conversion reactions in calcium aluminate cement. A DSC analysis of hydrated CAC shows: **Reaction 1:** $CAH_{10} \rightarrow C_3AH_6 + AH_3$, , $\Delta H_1 = -45$ J/g **Reaction 2:** $C_2AH_8 \rightarrow C_3AH_6 + AH_3C_2$, $\Delta H_2 = -20$ J/g If the total sample mass is 1.0 g, and 60% of the heat arises from Reaction 1 and 40% from Reaction 2, compute the total heat released.	3	7
Q3.	Explain how DSC helps in evaluating durability and sulfate resistance of cementitious systems. Compare stepwise and tangential methods for quantifying phases from TG data.	3	7

	The DSC curve of a hydrated OPC sample shows an endothermic peak at 530°C for $Ca(OH)_2$ decomposition with $\Delta H = 120$ J/g. Calculate the total heat absorbed by a 2.5 g sample.		
Q4.	a. Explain how heating rate, sample mass, and furnace atmosphere influence the shape and position of peaks in DTA/TG curves. b. With appropriate examples, describe how DTA can identify phase transformations in cementitious materials such as OPC and CAC. c. A TG test on a 10 mg hydrated OPC sample shows the following data: 100–250°C: 1.1 mg loss 250–450°C: 0.6 mg loss 450–600°C: 0.4 mg loss (i) Calculate the percentage loss in each interval. (ii) Identify the hydration products decomposing in each stage.	3	6