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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -2 EXAMINATION- 2025

Ph D (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 wherever required for solving problems

(c)Use of Non Programmable Scientific Calculator is allowed

Q.No	Question	CO	Marks
Q1	**i.** Define Thermal Analysis and explain its importance in characterizing construction materials. **ii.** Differentiate between Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) based on their measurement principles and outputs. **iii.** A DSC experiment shows a peak area of 50 mJ for a 5 mg sample. If the calibration coefficient K = 0.8 J/mJ, calculate the heat of transition per gram of sample.	3	5
Q2	**i.** Describe how heating rate and sample mass influence the DTA and TG curves. **ii.** With the help of examples, discuss how DTA can identify phase transformations in cementitious materials. **iii.** During a TG test, a 12 mg hydrated OPC sample shows the following mass losses: 100 – 250 °C: 1.5 mg , 250 – 450 °C: 0.7 mg and 450 – 600 °C: 0.5 mg (a) Calculate the percentage mass loss in each interval and the total mass loss. (b) Interpret the likely phases corresponding to each stage of loss.	3	5
Q3	**i.** Explain the phenomena causing mass change in thermo gravimetric analysis. **ii.** Draw a schematic TG–DTG curve and label key transitions for Portland cement paste. **iii.** Given that the total mass loss between 105°C and 1000°C is 8%, and portlandite accounts for 25% of the total loss, calculate the bound water content and portlandite content (in % of total mass).	3	5

Q4.	**i.** Discuss the application of DSC in assessing the durability of cementitious systems exposed to sulfate attack. **ii.** Compare stepwise and tangential methods used for phase quantification in TG analysis. **iii.** If the DSC curve of a hydrated OPC sample shows an endothermic peak at 530°C corresponding to $Ca(OH)_2$ decomposition, and the enthalpy change is 115 J/g, calculate the energy absorbed by a 3 g sample.	3	5
Q5.	**i.** Explain the difference between constant heating rate, gradually isothermic, and isothermal temperature–time programs used in thermal analysis. **ii.** Explain how DTA and TG data together can be used to identify conversion reactions in calcium aluminate cement. **iii.** A DSC analysis of a hydrated calcium aluminate cement sample shows two overlapping exothermic peaks: Peak 1: Dehydration of $CAH_{10} \rightarrow C_3AH_6 + AH_3$, $\Delta H_1 = -40$ J/g Peak 2: Minor exothermic conversion of $C_2AH_8 \rightarrow C_3AH_6 + AH_3$, $\Delta H_2 = -18$ J/g The total sample mass is **0.8 g**, and experimental deconvolution of peaks shows that Peak 1 contributes 70% and Peak 2 contributes 30% of the total sample mass loss. Find the total heat released from both reactions.	3	5