JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

MAKEUP 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 wherever required for solving problems

(c) Use of Non Programmable Scientific Calculator is allowed.

Q.No	Question	CO	Marks
Q1	A Differential Scanning Calorimetry (DSC) test is performed on a hydrated cement sample. The thermogram shows an endothermic peak at 120°C and another at 450°C. (a) Identify the hydration products responsible for these two peaks. (b) If the sample mass is 15 mg and the total heat absorbed between 100°C–550°C is 2.25 J, calculate the specific enthalpy change (J/g). (c) Discuss how DSC results help in understanding hydration kinetics.	2	6
Q2	The Thermogravimetric Analysis (TGA) curve of a blended cement shows three distinct mass losses in different temperature ranges: 25°C –200°C: 6.2%, 400°C –500°C: 4.8%, 650°C –750°C: 2.5% (a) Assign each mass loss to the corresponding phase or compound. (b) Estimate the total bound water percentage in the sample.	2	5
Q3.	Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Diffraction (XRD) are often combined in cement chemistry research. (a) Explain the working principle of FTIR. (b) Compare the type of information obtained from FTIR and XRD for a	2	5

(18)

	hydrated cement system. (c) Justify why FTIR can detect amorphous C–S–H phases better than XRD		
Q4.	A sample of Portland slag cement (PSC) contains 30% slag by mass. The pure cement exhibits a total heat of hydration of 420 J/g after 7 days, while slag contributes only 50% of that heat at the same age. (a) Calculate the total heat of hydration of PSC after 7 days. (b) Explain how this partial replacement influences temperature rise and shrinkage in large concrete pours.	3	6
Q5.	During a TG test, the total mass loss up to 1000°C is 10%, and portlandite decomposition contributes 2.8% of this total loss. (a) Determine the mass of portlandite ($Ca(OH)_2$) in the sample. (b) Estimate the remaining bound water associated with other hydration products (excluding portlandite).	3	3