M. Sc. Engg. (CEE)   17 February, 2023 (2:00 PM – 3:30 PM)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TERM   : MID SEMESTER EXAMINATION   SUMMER SEMESTER: 2021-2022
COURSE NO.   : CEE 6109   TIME   : 1.5 Hours
COURSE TITLE: Advance Concrete Technology   FULL MARKS: 75

There are (Three) questions. Answer ALL questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. The Symbols have their usual meaning.

1   The specified FM of fine aggregate of a bridge project is 2.6. The sieve   25
    analysis data of a fine aggregate sample collected for the bridge project are
    summarized below:

ASTM Sieve	Materials Retained (g)
3 inch	0
1.5 inch	0
1.0 inch	0
¾ inch	0
½ inch	0
3/8 inch	0
#4	40
#8	70
#12	60
#16	30
#30	50
#40	0
#50	0
#100	40
#200	20
Pan	90

(i)   Calculate the FM of the sample.
(ii)   Draw the grading curve of the sample.
(iii)   Make a brief discussion on the FM, sieve analysis data, and grading curve.
(iv)   What measures are necessary to improve the grading of the sand sample?
(v)   In what ratio the sand sample is to be mixed with another sand sample of FM 2.0 to obtain the required fineness modulus of 2.6?

Sieve openings for ASTM sieves are provided in the attached table.

2(a) Discuss about the environmental problems related to construction materials 10
(cement, steel, coarse and fine aggregate, brick). Also discuss the possible
steps that are to be taken into consideration to reduce these problems.

(b) What types of tests are necessary to examine the reactivity of aggregate? 5

(c) Write hydration reactions of cement. Explain how gypsum controls setting of 5
cement.

(d) What types of information you can obtain from ASTM C150, ASTM C595, 5
ASTM C1157, BDS EN 197-1-2010.

3 If 110 g of water is added with 200 g of cement, calculate the following for 25
0%, 50%, and 100% of hydration:

(i) Amount of water chemically bonded,
(ii) Amount of water in gel pores of cement,
(iii) Amount of free water in capillary,
(iv) Volume of empty capillary,
(v) Volume of cement gel,
(vi) Gel-to-space ratio.

Make a brief discussion on the results.

Table   Traditional American and British Sieve Sizes

Aperture mm or μm	Approximate Imperial equivalent in.	Previous designation of nearest size	
		BS	ASTM
125 mm	5	--	5 in.
106 mm	4.24	4 in.	4.24 in.
90 mm	3.5	3½ in.	3½ in.
75 mm	3	3 in.	3 in.
63 mm	2.5	2½ in.	2½ in.
53 mm	2.12	2 in.	2.12
45 mm	1.75	1¾ in.	1¾ in.
37.5 mm	1.50	1½ in.	1½ in.
31.5 mm	1.25	1¼ in.	1¼ in.
26.5 mm	1.06	1 in.	1.06
22.4 mm	0.875	⅞ in.	⅞ in.
19.0 mm	0.750	¾ in.	¾ in.
16.0 mm	0.625	⅝ in.	⅝ in.
13.2 mm	0.530	½ in.	0.530 in.
11.2 mm	0.438	--	⁷⁄₁₆ in.
9.5 mm	0.375	⅜ in.	⅜ in.
8.0 mm	0.312	⁵⁄₁₆ in.	⁵⁄₁₆ in.
6.7 mm	0.265	¼ in.	0.265 in.
5.6 mm	0.223	--	No. 3½
4.75 mm	0.187	³⁄₁₆ in.	No. 4
4.00 mm	0.157	--	No. 5
3.35 mm	0.132	No. 5	No. 6
2.80 mm	0.111	No. 6	No. 7
2.36 mm	0.0937	No. 7	No. 8
2.00 mm	0.0787	No. 8	No. 10
1.70 mm	0.0661	No. 10	No. 12

(continued)

Aperture mm or μm	Approximate Imperial equivalent in.	Previous designation of nearest size	
		BS	ASTM
1.70 mm	0.0661	No. 10	No. 12
1.40 mm	0.0555	No. 12	No. 14
1.18 mm	0.0469	No. 14	No. 16
1.00 mm	0.0394	No. 16	No. 18
850 μm	0.0331	No. 18	No. 20
710 μm	0.0278	No. 22	No. 25
600 μm	0.0234	No. 25	No. 30
500 μm	0.0197	No. 30	No. 35
425 μm	0.0165	No. 36	No. 40
355 μm	0.0139	No. 44	No. 45
300 μm	0.0117	No. 52	No. 50
250 μm	0.0098	No. 60	No. 60
212 μm	0.0083	No. 72	No. 70
180 μm	0.0070	No. 85	No. 80
150 μm	0.0059	No. 100	No. 100
125 μm	0.0049	No. 120	No. 120
106 μm	0.0041	No. 150	No. 140
90 μm	0.0035	No. 170	No. 170
75 μm	0.0029	No. 200	No. 200
63 μm	0.0025	No. 240	No. 230
53 μm	0.0021	No. 300	No. 270
45 μm	0.0017	No. 350	No. 325
38 μm	0.0015	--	No. 400
32 μm	0.0012	--	No. 450