MANIPAL INSTITUTE OF TECHNOLOGY
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MANIPAL INSTITUTE OF TECHNOLOGY

SIXTH SEMESTER B.TECH (CIVIL ENGINEERING)

END SEMESTER EXAMINATION, MAY 2023

ADVANCES IN CONCRETE TECHNOLOGY (CIE 4051)

(– 05 - 2023)

TIME: 3 HRS. **MAX. MARKS: 50**

Note: 1. Answer all questions.
2. Any missing data may be suitably assumed.

Q. NO	QUESTION	MARKS	CO	BL
1A	Compare the salient features of standard and special concretes.	3	1	2
1B	With the help of a neat sketch, comment on the stress-strain behavior of aggregate, cement paste, and concrete.	3	1	2
1C	Describe the following, i) shrinkage of concrete, ii) creep of concrete, iii) grade of concrete, and iv) workability of concrete.	4	1	2
2A	Define the dimensional stability of concrete. Discuss its significance on hardened properties of concrete.	3	1	2
2B	Discuss how the properties of ITZ affects i) compressive and tensile strength, i) impact strength, and iii) bond strength of concrete. Interpret the area of the hysteresis loop in the fatigue strength test of concrete.	4	2	2
2C	List and discuss the undesirable fresh properties of concrete. Suggest possible remedy for the same.	3	2	2
3A	Compare the slump test with the compaction factor test on i) measure of workability, ii) applicability, and iii) limitations.	3	2	2
3B	Illustrate the role of 'statistical quality control' to balance the acceptance and risk in attaining the desired compressive strength of concrete.	3	3	3
3C	The test data for designing the M50 mix is below for severe exposure conditions and a 120 mm slump.	4	3	3

Cement	OPC 43
SCM	GGBS 25%, Silica fume 5% as replacement for cement
Maximum nominal size of aggregates	20 mm
Fine aggregate	Conforming to grading Zone-II
Chemical admixture	1% Plasticizer

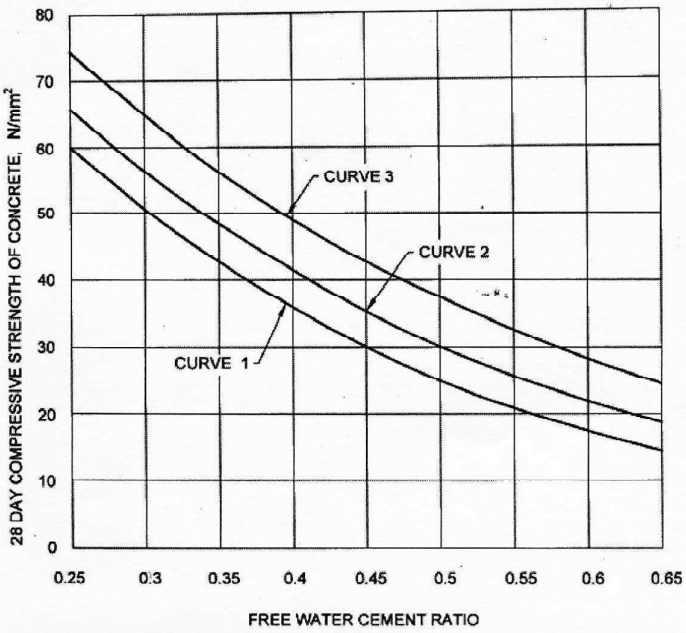
	Determine i) target mean strength, ii) cement and water content, iii) water-to-cementitious material ratio, and iv) course and fine aggregate content per unit volume of total aggregates.			
4A	Discuss the essential features of high-strength concrete. List any three advantages and limitations of lightweight concrete.	**5**	**3**	**2**
4B	Discuss the role of i) mineral admixtures and ii) viscosity-modifying admixtures in the design of self-compacting concrete.	**2**	**4**	**2**
4C	Define fiber-reinforced concretes (FRC). Identify the critical issue and how the introduction of fibers solves it. Illustrate with a sketch the mechanism of action.	**3**	**4**	**2**
5A	Discuss the essential fresh properties of self-compacting concrete.	**2**	**4**	**2**
5B	Discuss i) mechanism and ii) protective measures of corrosion of embedded steel in concrete.	**5**	**5**	**2**
5C	Compare rebound hammer test and ultrasonic test on i) method, ii) interpretation of results, and iii) applicability.	**3**	**5**	**2**

Table 1 Value of X
(*Clause* 4.2)

Sl No.	Grade of Concrete	Value of X
(1)	(2)	(3)
i)	*M*10, *M*15	5.0
ii)	*M*20, *M*25	5.5
iii)	*M*30, *M*35, *M*40, *M*45, *M*50, *M*55, *M*60	6.5
iv)	M65 and above	8.0

Table 2 Assumed Standard Deviation
(*Clause* 4.2.1.3)

Sl No.	Grade of Concrete	Assumed Standard Deviation N/mm²
(1)	(2)	(3)
i)	*M*10, *M*15	3.5
ii)	*M*20, *M*25	4.0
iii)	M30, M35, M40, M45, M50, M55, M60	5.0
iv)	*M*65, *M*70, *M*75, *M*80	6.0



Curve 1 : for expected 28 days compressive strength of 33 and < 43 N/mm².
Curve 2 : for expected 28 days compressive strength of 43 and < 53 N/mm².
Curve 3 : for expected 28 days compressive strength of 53 N/mm² and above.

Table 4 Water Content per Cubic Metre of Concrete For Nominal Maximum Size of Aggregate

(*Clause* 5.3)

Sl No.	Nominal Maximum Size of Aggregate mm	Water Content[1] kg
(1)	(2)	(3)
i)	10	208
ii)	20	186
iii)	40	165

[1]Water content corresponding to saturated surface dry aggregate.

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(*Clauses* 6.1.2, 8.2.4.1 *and* 9.1.2)

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
ii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40