Model Answer: Winter - 2019

Subject: Concrete Technology

Sub. Code: 22305

Important Instructions to Examiners

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills.)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by the candidate and those in the model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and the model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1		**Attempt any FIVE of the following:**		**10**
	(a)	**Define fineness of cement.**		
	Ans.	**Fineness of cement:** It is the degree of grinding of cement particles during its manufacturing process, called as fineness of cement. **OR** It is the measurement of size of particles, called as fineness of cement.	**2**	**2**
	(b)	**State any four properties of fine aggregate.**		
	Ans.	**Properties of fine aggregate:** The properties of fie aggregate are stated as follows. 1. Size 2. Source 3. Shape 4. Specific gravity 5. Bulk density 6. Fineness Modulus 7. Cleanliness 8. Silt content 9. Bulking	**½ each (any four)**	**2**
	(c)	**State water cement ratio law.**		
	Ans.	**Duff Abraham's water cement ratio law:** For workable concrete, the strength of concrete depends only on its water-cement ratio.	**2**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.1	(d)	**State principle of ultrasonic pulse-velocity test on concrete.**		
	Ans.	**Principle of ultrasonic pulse-velocity test:** The working principle of ultrasonic pulse velocity test is as follows: The electronically generated mechanical pulses of specific frequency pass though concrete mass and travel time of waves is measured to determine the ultrasonic pulse velocity and related quality of concrete.	**2**	**2**
	(e)	**Enlist any two methods of transportation of concrete.**		
	Ans.	**Methods of transportation of concrete**: There are three methods of transportation of concrete listed below. **1. Manual method**- Transportation through the hands of labour in the ghamela, wheel barrow. **2. Semi-manual method**- Transpiration using belt conveyor, skip and hoist arrangement. **3. Mechanical Method**- Transportation using truck, dumper, RMC vehicle.	**1 each (any two)**	**2**
	(f)	**List any two precautions to be taken in cold weather concreting.**		
	Ans.	**Precautions to be taken in cold weather concreting:** In extreme weather, following precautions should be taken. 1. Concreting work should be done during day time or on sunny days. 2. Warm water should be added for mixing of ingredients of concrete. 3. Before placing of concrete, the formed ice, snow or frost should be removed from formwork. 4. The accelerating admixtures should be used to increase hardening of concrete. 5. A protective cover should be used over casted concrete to avoid cold winds and snow fall. 6. Aggregates (fine and coarse) should be heated before its use. 7. Rapid hardening or quick setting cement should be used for fast setting of concrete.	**1 each (any two)**	**2**
	(g)	**State the meaning of 43 grade and 53 grade cement.**		
	Ans.	**Meaning of 43 grade cement:** It means that, this type of cement shows minimum 43 N/mm^2 compressive strength after 28 days complete curing, when tested on CTM. **Meaning of 53 grade cement:** It means that, this type of cement shows minimum 53 N/mm^2 compressive strength after 28 days complete curing, when tested on CTM.	**2**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2		**Attempt any <u>THREE</u> of the following:**		**12**
	(a)	**Explain the procedure for determination of compressive strength of cement in laboratory.**		
	Ans.	**Procedure for determination of compressive strength of cement in laboratory:** 1. Take 200 gm cement, 600 gm standard sand and add water ((p/4)+3) % to that of combined weight of cement and sand. Prepare homogenous mortar. 2. Fill the prepared mortar in the cube mould of size 7.07 cm side by proper compaction. Compact the filled mould on vibrating machine for 3-5 minutes. 3. Keep filled moulds at room temperature for 24 hours and 90% humidity for initial hardening. 4. Remove cube moulds and keep cement cubes under fresh water for curing for 7, 14, 21, 28 days. 5. Remove cube from water after curing period and keep it under compression testing machine (CTM) for testing. 6. Apply compressive load at a rate of 35 N/mm^2 till failure of cube. 7. Note down the failure load in kN shown by red pointer of dial gauge. 8. Calculate compressive strength of cement cube by dividing failure load in N to cross sectional area of cube in mm^2. 9. Calculate average compressive strength of three test cubes in N/mm^2.	**4**	**4**
	(b)	**Explain procedure to find specific gravity of the fine aggregate in laboratory.**		
	Ans.	**Procedure to find specific gravity of fine aggregate in laboratory:** 1. Take 2000 gm. aggregate sample in wire basket. Immerse the basket in water completely and take it out to remove entrapped air. Repeat it 20-25 times. 2. Keep this aggregate basket in water for 24 hours. Weigh the aggregate and basket when still immersed in water as B_1 gm. 3. Now, remove the basket. Take out aggregate and weigh empty basket in water as B_2 gm. 4. Calculate the mass of saturated surface dry aggregate in water as $B= (B_1- B_2)$ gm. 5. Keep the aggregate exposed to air for 10 minutes and take the weight of air dried aggregate as 'A' gm. 6. Now, keep the air dried aggregate in oven at temperature of 110^0C for 24 hours. Take the weight of complete oven dried aggregate as 'C' gm. 7. Calculate the specific gravity of given aggregate as $G_a= C / (A-B)$. 8. Repeat all above steps for two more samples to get average specific gravity of aggregate.	**4**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.2	(c)	**Calculate fineness modulus for the given data of fine aggregate. Total weight of C.A. = 1000 gm.**		

Sieve size in mm	4.75	2.36	1.18	600µ	300 µ	150 µ	Pan
Wt. retained in gm	20	75	210	274	305	106	10

Ans.

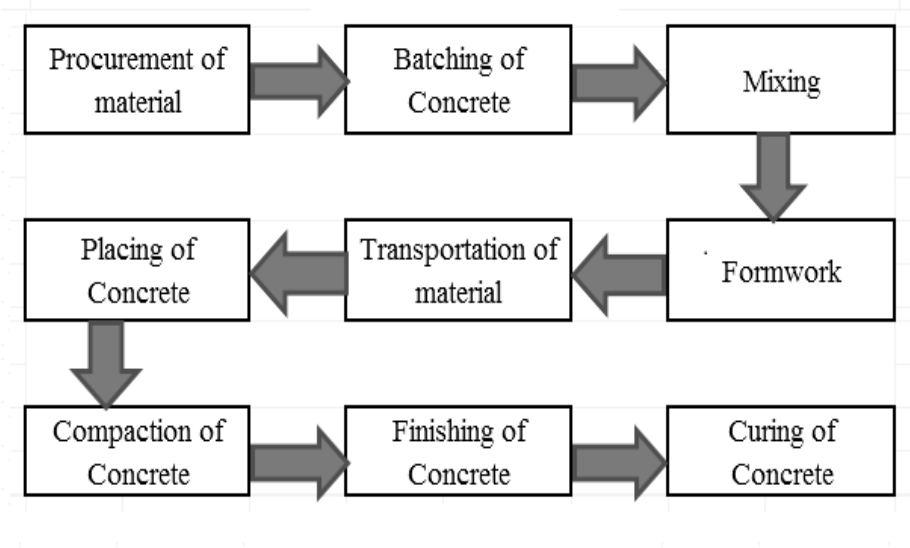
Sieve size (mm)	Weight retained (gm)	Cumulative weight retained (gm)	% Cumulative weight retained (%)
4.75	20	20	2
2.36	75	95	9.5
1.18	210	305	30.5
600 µ	274	579	57.9
300 µ	305	884	88.4
150 µ	106	990	99
Pan	10	--	--
∑ % cumulative wt. retained upto 150µ IS sieve			**287.3**

2

F. M.= ∑ % cumulative wt. retained upto 150µ IS sieve / 100 — **1**
F.M. = 287.3/100
F.M. = 2.873 — **1**

4

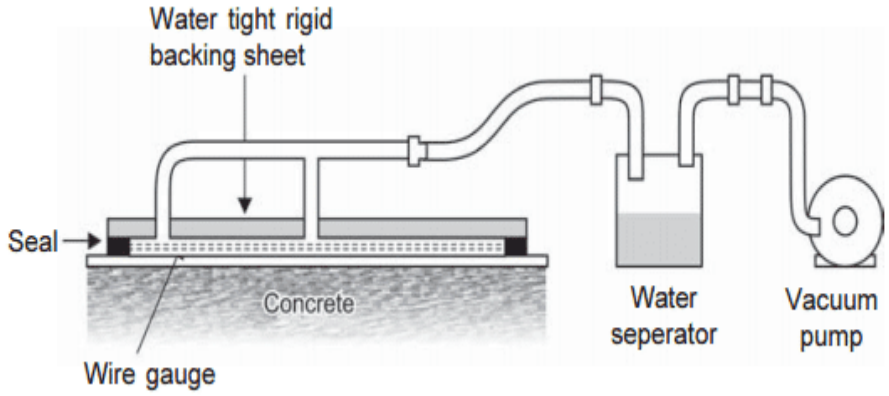
	(d)	**Explain flakiness index and elongation index in detail.**		
	Ans.	**Flakiness Index:** It is the percentage by weight of particles whose least dimension (thickness) is less than $(3/5)^{th}$ of its mean dimension passing through thickness gauge.		
		It is determined by testing minimum 200 aggregate particles on thickness gauge. All the particles of initial weight W_1 gm are passed through various sizes along its thickness. The weight of aggregate particles passed through various sizes is taken as W_2 gm. Finally flakiness index of given aggregate sample is calculated by using formula Flakiness Index = (W_2/ W_1) x100 %.	**2**	
		Elongation Index: It is the percentage by weight of particles whose greatest dimension (length) is more than $(14/5)^{th}$ of its mean dimension retained on length gauge.		
		It is determined by testing minimum 200 aggregate particles on length gauge. All the particles of initial weight W_1 gm are passed through various sizes along its length. The weight of aggregate particles retained through various sizes is taken as W_2 gm. Finally elongation index of given aggregate sample is calculated by using formula Elongation Index = (W_2/ W_1) x100 %.	**2**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3		**Attempt any THREE of the following:**		12
	(a)	**Calculate quantity of water to be added for casting cubes in laboratory by 12.5 kg cement if w/c ratio 0.45.**		
	Ans.	As w/c = (weight of water / weight of cement)	1	
		w/c = (Ww / Wc)	1	
		0.45 = (Ww / 12.5)		
		Ww = (0.45x12.5)	1	
		Ww = 5.625 kg or 5.625 Litres	1	4
	(b)	**Suggest the minimum grade of concrete for following exposure condition.** **i) RCC work** **ii) Water retaining structure** **iii) Sea water construction** **iv) Pre-stressed concrete**		
	Ans.	**Minimum grade of concrete for following exposure condition:** i) RCC work = M 20 ii) Water retaining structure = M 25 iii) Sea water construction = M 20 for PCC and M 30 for RCC iv) Pre-stressed concrete = M 30	1 each	4
	(c)	**Draw concreting operation chain in sequence.**		
	Ans.	**Sequential chain of Concreting Operations:**  **Fig.: Concreting Operations in Sequence**	4	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.3	**(d)**	**Describe the procedure for determination of workability by compaction factor method.**		
	Ans.	**Procedure for determination of workability by compaction factor method**: The procedure of determining the workability of concrete using compaction factor as per IS: 1199-1959 is as follows. 1. Take the freshly mixed concrete of any specific grade and fill it in upper hopper of compaction factor test apparatus with trap door 1 (TD1)in closed position. 2. After filling the upper hopper, open the TD1 and allow the concrete to free fall from upper hopper into lower hopper through dropping height 200mm with TD2 in closed position. 3. Now, immediately open TD2 and allow to free fall the concrete again from lower hopper into cylinder through same dropping height. 4. Repeat above steps till the cylinder fills with concrete completely. Take the weight of this partially compacted concrete as W_1 gm. 5. Remove the concrete from the cylinder and fill it with same grade of concrete by properly compacting with vibration. 6. Take the weight of this fully compacted concrete as W_2 gm. 7. Calculate the compaction factor of given concrete by using $CF = (W_1 / W_2)$ 8. Depending upon calculated C.F., the degree of workability can be designated as follows.	**4**	**4**

Sr. No.	Compaction Factor	Degree of Workability
1	0.78	Very low
2	0.85	Low
3	0.92	Medium
4	0.95	High

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.4		**Attempt any THREE of the following:**		**12**
	(a)	**Define bleeding. Suggest any two ways by which bleeding can be avoided.**		
	Ans.	**Bleeding:** It is one form of segregation in which water gets accumulated over settled concrete mass, called as bleeding. **Prevention of Bleeding:** The bleeding can be avoided by following ways. 1. Bleeding can be prevented by selecting appropriate w/c ratio as per IS 456:2000, so that water content w.r.t. other materials can be maintained. 2. It can be also avoided by adopting proper CA/FA ratio; so that fine aggregate will not be more than coarse aggregate causing bleeding. 3. Mixing of concrete should be done using mixers to achieve homogeneity. Homogeneous mixture avoids chances of bleeding. 4. Excessive compaction by over vibration should be avoided to reduce bleeding effect.	**2** **1 each (any two)**	**4**
	(b)	**Write any four factors affecting concrete mix design.**		
	Ans.	**Factors affecting concrete mix design:** The concrete mix design procedure affects by the following factors. 1. Maximum water-cement ratio 2. Minimum cement content 3. Maximum nominal size of aggregate 4. Workability in terms of slump 5. Exposure conditions 6. Maximum temperature at the pouring point 7. Early age and ultimate strength requirement 8. Grading zone of fine aggregate 9. Type of admixture to be used 10. Specific gravity of all ingredient materials	**1 each (any four)**	**4**
	(c)	**Explain the significance of water reducing admixture in concrete with respect to properties of concrete.**		
	Ans.	**Significance of water reducing admixture in concrete:** Water reducing admixtures are essential for several purposes. The effect of using such admixtures on concrete properties is described below. 1. Water reducing admixtures maintain required w/c ratio by reducing excess water upto 10-30% from concrete. 2. These admixtures are significant in preventing segregation of concrete mixture and maintaining flow ability of pumped concrete. 3. Mid-range water reducing admixtures are important to increase workability in terms of slump beyond the regular water reducers.	**1 each (any four)**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		4. Water reducing admixtures reduces the tendency of surface cracking. 5. It also ensures the good bonding between steel and concrete mass. 6. These admixtures help to increase early strength and develop better ultimate strength. 7. The durability of concrete structures can be ensured by using these admixtures.		
	(d)	**Write the procedure of vaccum dewatering concreting for construction of floors.**		
	Ans.	**Procedure of vaccum dewatering concreting for construction of floors:** The concreting using vaccum dewatering for floor construction is done as follows. 1. Concrete is places uniformly on the spread of concrete floor and level it approximately. 2. Vibration by using suitable vibrators is applied to remove voids from concrete mass. The surface vibration is done using double beam surface vibrator. 3. Levelling of vibrated is done by using suitable straight edge. 4. The magnitude of applied vacuum is usually about 0.08 MPa and the water content is reduced by upto 20-25%. The reduction is effective upto a depth of about 100 to 150 mm only. 5. Vacuum pump is a small but strong pump of 5 to 10 HP. Water is extracted by vacuum and stored in the water separator. The mats are placed over fine filter pads, which prevent the removal of cement with water. 6. Proper control on the magnitude of the water removed is equal to the contraction in total volume of concrete. About 3% reduction in concrete layer depth takes place. 7. Finally the floating and towelling is done to achieve better finishing of surface.	**3**	
		 **Fig.: Vaccum Dewatering for Concreting**	**1**	**4**

<table>
<tr><th>Que. No.</th><th>Sub. Que.</th><th>Model Answer</th><th>Marks</th><th>Total Marks</th></tr>
<tr><td>Q.4</td><td>(e)

Ans.</td><td>
State four point of differences between reinforced concrete and fibre reinforced concrete.

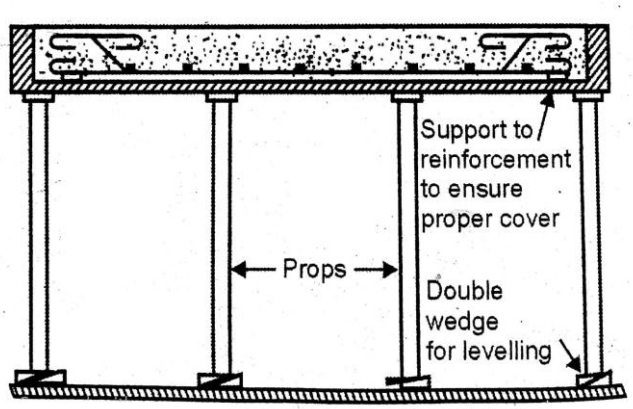
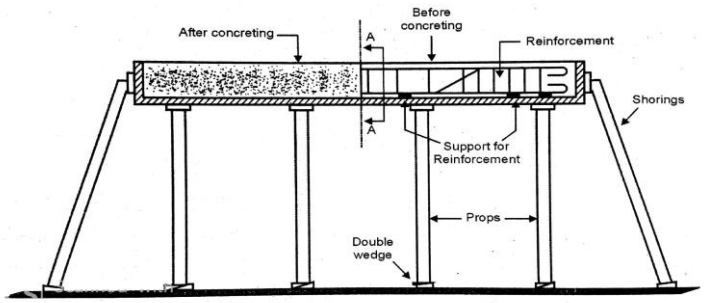
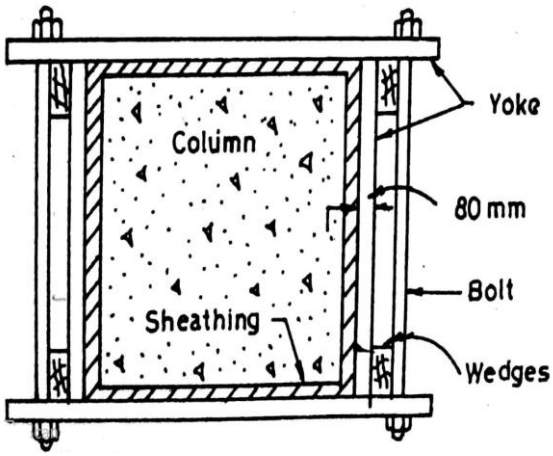
Differences between reinforced concrete and fibre reinforced concrete:
<table>
<tr><th colspan="2">Reinforced concrete (RCC)</th><th colspan="2">Fibre reinforced concrete (FRC)</th></tr>
<tr><td>1</td><td>In this concrete, steel bars are used as reinforcement.</td><td>1</td><td>In this fibers are added as additional reinforcement in addition with steel bars.</td></tr>
<tr><td>2</td><td>Generally, load is taken by steel reinforcement.</td><td>2</td><td>Load is equally distributed in concrete though fibers.</td></tr>
<tr><td>3</td><td>RCC possess less fire resistance than fiber reinforced concrete.</td><td>3</td><td>FRC has more fire resistance than reinforced concrete.</td></tr>
<tr><td>4</td><td>RCC is susceptible to formation of surface cracks.</td><td>4</td><td>FRC resist formation of micro-cracks, as fibers act as crack arrester.</td></tr>
<tr><td>5</td><td>RCC gives ordinary finishing.</td><td>5</td><td>FRC gives extra smooth finishing.</td></tr>
<tr><td>6</td><td>RCC has more weight resulting difficulty in handling.</td><td>6</td><td>FRC is light in weight, hence easy to handle.</td></tr>
<tr><td>7</td><td>RCC has better workability.</td><td>7</td><td>FRC has poor workability due to improper mixing of fibers.</td></tr>
<tr><td>8</td><td>RCC has less shear and torsional strength.</td><td>8</td><td>FRC has more shear and torsional strength.</td></tr>
<tr><td>9</td><td>RCC is costlier than FRC.</td><td>9</td><td>FRC is cheaper than RCC.</td></tr>
<tr><td>10</td><td>RCC is used in all type of ordinary construction i.e. building, road, etc.</td><td>10</td><td>FRC is used in tunnel lining, runway, aircraft parking, repair of dams, etc.</td></tr>
</table>
</td><td>1 each (any four)</td><td>4</td></tr>
</table>

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5		**Attempt any <u>TWO</u> of the following:**		**12**
	(a)	**Explain the method of concrete mix design procedure by I.S. method as IS-10262.**		
	Ans.	**Procedure of IS method of concrete mix design:** The concrete mix design is done by IS 10262-2009 using following steps- **1. Calculation of target mean strength:** The concrete mix design is done for specific target strength which is calculated first by using formula, $f'_{ck} = f_{ck} + t.S$ where, f'_{ck} = target mean strength after 28 days f_{ck} = characteristics compressive strength at 28 days S = standard deviation from IS 456 t = tolerance factor from IS 456 **2. Selection of water-cement ratio:** The w/c ratio is selected from the graph of generalized relationship between w/c ratio and compressive strength. The selected w/c ratio is checked against the limiting w/c ratio and lower of two is adopted. **3. Selection of water content:** The maximum water content per cubic meter of concrete with nominal maximum size of aggregate s finalized in this step. The water content adopted is used for computing cement content in next step. **4. Calculation of cementitous material content:** From adopted w/c ratio and selected maximum water content the quantity of cementious materials is calculated. It is checked against the minimum cementitous content for durability requirement ad larger of the two values is adopted as cement content. **5. Calculation of coarse aggregate proportion:** The volume of coarse aggregate per unit volume of total aggregate is chosen in this step based on nominal maximum size of aggregate **6. Selection of combination of coarse aggregate fractions:** The different sizes viz. 10 mm , 20 mm , 25 mm are taken in proportion from grading , confirming in table 2 of IS 383 **7. Calculation of fine aggregate proportion:** From above steps, absolute volume of all ingredients of concrete the mix proportion is calculated for said mix design of concrete.	**6**	**6**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.5	(b)	**Explain the procedure to determine compressive strength of concrete in lab.**		
	Ans.	**Procedure to determine compressive strength of concrete in lab:** The following steps are essential to determine the compressive strength of concrete in the laboratory. 1. Take three cube moulds of 15 cm side and apply oil to its inner surface. Prepare the concrete mixture of required grade and fill it in each mould in three layers. 2. Compact each layer evenly spaced 25 times strokes with 16 mm. diameter standard tamping rod. Compaction of concrete is done by using table vibrator to remove air completely from concrete. 3. Keep all the moulds at room temperature for 24 hrs for initial hardening and at relative humidity 90%. 4. Remove cube moulds and keep concrete cubes under fresh water for curing for 7, 14, 21, 28 days. 5. Remove cube from water after curing period and keep it under compression testing machine (CTM) for testing. 6. Apply compressive load at a rate of 4 tones / min for 10 minutes or till failure of cube. Note down the failure load in kN shown by red pointer of dial gauge. 7. Calculate compressive strength of each cube. Take failure load in N and cross sectional area of cube in mm^2. 8. Calculate average compressive strength of three test cubes in N/mm^2.	**6**	**6**
	(c)	**State the importance of NDT and state working principle of Rebound hammer.**		
	Ans.	**Importance of NDT:** 1. The strength can be tested without physical breaking of concrete; hence it is safe. 2. It can give internal flaws, cavities and homogeneity details of concrete within short period. 3. It avoids wastage of concrete, hence becomes economical up to certain extent. 4. It is applicable in any type and position of concrete members shows wide applicability. 5. Its results are simple and easy to interpret. **Working principle of Rebound hammer:** Rebound hammer test method is based on the principle that the rebound of an elastic mass attached to plunger i.e. rebound number depends on the hardness of the concrete surface against which the mass strikes. If the rebound of hammer is more, it indicates surface is hard, solid and dry. But if rebound of hammer is less, then tested concrete may be soft, porous and moist.	**1 each (any four)** **2**	**6**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6		**Attempt any <u>TWO</u> of the following:**		**12**
	(a)	**Classify the methods of curing of concrete with detail explanation of any one method.**		
	Ans.	**Methods of curing:** A. Water curing B. Membrane curing C. Application of heat D. Miscellaneous methods	**2**	
		1. Water curing: i) This is the best method of curing, because it satisfies all the requirements of curing. ii) The precast concrete items are normally immersed in curing tanks for certain duration. Pavement slab, roof slab etc. are covered under water by making small pond. iii) Water curing can be done in following ways: Immersion, Ponding method, Spraying or fogging, wet covering. **2. Membrane curing:** i) Sometimes concrete works are carried out in places where there is acute shortage of water. Therefore lavish application of water for water curing is not possible for the reason of economy. ii) Water from concrete gets evaporated, which is covered with membrane which will effectively seal the concrete. iii) A membrane will prevent the evaporation of water from the concrete. The membrane can be either in solid or liquid form, known as sealing compound. Other membrane curing sealing compounds are: Rubber latex emulsion, emulsion of resins, varnishes etc. **3. Application of heat:** i) The development of strength is not only a function of time but also that of temperature. ii) Concrete subjected to higher temperature accelerates the hydration resulting in faster development of strength. Prefabricated members are normally steam cured. iii) In this method the ingredients of concrete heated and the strength is gained at very fast rate. This can be done in following manner: Steam curing**,** Curing by infra-red radiation**,** Electrical curing **4. Miscellaneous method:** i) Calcium chloride is used either as a surface coating or as an admixture. It has been satisfactorily used as a curing medium. ii) Both of these based on the fact that calcium chloride, being a salt shows affinity for moisture. The salt not only absorbs moisture from atmosphere but also retains it at the surface. iii) The moisture held at the surface prevents the mixed water from evaporation and thereby keeps the concrete wet for a long time.	**4 (any one)**	**6**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	**(b)**	**State the requirement of good form work and state the stripping time of form work as per IS 456-2000.** **i) Slab** **ii) Beam** **iii) Column** **with labelling on sketch.**		
	Ans.	**Requirement of good form work:** 1. It should be strong enough to resist the weight of concrete, workers and machinery. 2. It should be economical compared to total cost of construction. 3. It should be possible to use the formwork for more number of times. 4. It should give smooth finish and shape to concrete faces. 5. It should be possible to erect and dismantle the formwork very easily. 6. It should be easily and locally available. 7. It should be rigid enough to retain its shape without any deflection.	**1 each (any three)**	
		Stripping time of form work as per IS 456-2000. **i) Slab:** **1.** Soffit formwork – 3 days **2.** Span up to 4.5m – 7 days **3.** Span more than 4.5m – 14 days **ii) Beam:** **1.** Soffit formwork for beam – 7 days **2.** Beam and arch of span up to 6m – 14 days **3.** Beam and arch of span more than 6m – 21 days **iii) Column:** Vertical formwork – 16 to 24 hours	½ ½ ½	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	(b)	**Form work for the following:** **i) Slab**  **ii) Beam**  **iii) Column**  	½ ½ ½	6

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
Q.6	**(c)**	**Explain the procedure for joining old and new concrete work, also state any two material used for filling joints.**		
	Ans.	**Procedure of joining old and new concrete:** When new concreting is done in continuation with old concrete after a gap of some days, months or even years, then the new and old concrete must have a strong bond with each other. Hence some points should be kept in mind for joining old and new concrete. **Procedure:** 1. **Cleaning**: The old concrete surface is first thoroughly cleaned with wire brush. Loose material if any, should be clean first. 2. **Chiseling:** The old concrete surface is made rough by denting it with a chisel for a strong bond with new concrete. 3. **Application of cement slurry or paste with some admixtures:** The surface is then wetted with rich cement slurry. Sometimes an admixture has to be added to give additional strength to the joints. Then fresh concrete is placed over the old concrete. 4. **Providing overlap:** To give homogeneity to the reinforcing bars, overlap is provided and the overlap portion is bound tightly with high tensile wire. **Material used for filling joints:** 1. Asphalt, tar, bituminous materials 2. Fibre and fibre products 3. Sponge rubber 4. Cork 5. Polymer 6. Thermoplastic and thermo-col 7. Glass	**4** **1 each (any two)**	**6**