**Subject: Concrete Technology** **Subject Code**: **17504**

**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.

# Model Answer

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **A)** | Attempt **any three** of the following: | | **12** |
| | **a)** | **Enlist any four physical properties of OPC. Explain how fineness of cement is determined by method of sieving.**<br>**Ans.**<br><u>Physical properties of OPC:</u><br>1. Fineness<br>2. Standard consistency or Normal consistency<br>3. Initial and Final setting time<br>4. Soundness<br>5. Compressive Strength<br><br><u>Determination of fineness of cement by method of sieving:</u><br>1. Take 100 gm of cement sample as W1 gm.<br>2. Put it on 90 micron IS Sieve with lid and pan at top and bottom respectively.<br>3. Shake the sieve manually for 10 – 15 minutes for complete sieving.<br>4. Take the weight of cement retained on sieve as $W_2$ gm.<br>5. Calculate % fineness of given cement as $(W_2/W_1)$ X 100. | **½ mark each (Any four)**<br><br>**2 marks** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.1** | **A)** | | | |
| | **b)** | **State three different grades of cement and where it is used.**<br>**Ans.** Grades of cement – 33, 43 and 53 grades.<br><br>1. <u>33 grade cement</u> –<br>i. Plastering work by producing cement mortar.<br>ii. Masonry work of brick, block or stone materials.<br><br>2. <u>43 grade cement</u> –<br>i. Pre – cast and prestressed concrete.<br>ii. Ready mix concrete.<br>iii. PCC and RCC work of buildings and bridges.<br>iv. Construction of silos, chimneys and slip – form works.<br><br>3. <u>53 grade cement</u> –<br>i. Precast concrete sleepers for railways.<br>ii. Industrial building, roads and runways.<br>iii. Pre-stressed girders and RCC bridges.<br>iv. RCC long span bridges and lofty buildings. | **1 mark**<br><br>**1 mark (Any one)**<br><br>**1 mark (Any one)**<br><br>**1 mark (Any one)** | **4** |
| | **c)** | **Compare the properties of rapid hardening cement and low heat cement.**<br>**Ans.**<br>**Sr. No. / Property / RHC / LHC**<br>1. / Fineness / Maximum 10% or 3250 $cm^2/gm$ / Maximum 10% or 3000 $cm^2/gm$<br>2. / Soundness / Maximum 10 mm for aerated cement / Maximum 10 mm for aerated cement<br>3. / Setting time / IST = 20 mins (minimum)<br>FST = 600 mins (maximum) / IST = 30 mins (minimum)<br>FST = 600 mins (maximum)<br>4. / Compressive strength / 3 days = 210 $kg/cm^2$ (Ordinary sand)<br>3 days = 275 $kg/cm^2$ (Standard sand) / 3 days = 70 $kg/cm^2$ (Ordinary sand)<br>3 days = 100 $kg/cm^2$ (Standard sand) | **1 mark each** | **4** |
| | **d)** | **Explain the step by step procedure of standard consistency test on cement.**<br>**Ans.**<br>Procedure of standard consistency test on cement:<br>1. Take 400 gm cement sample and add 20% water by weight to prepare cement paste within gauge time.<br>2. Fill this cement paste in Vicat's mould completely, having height 40 mm. | **cont…** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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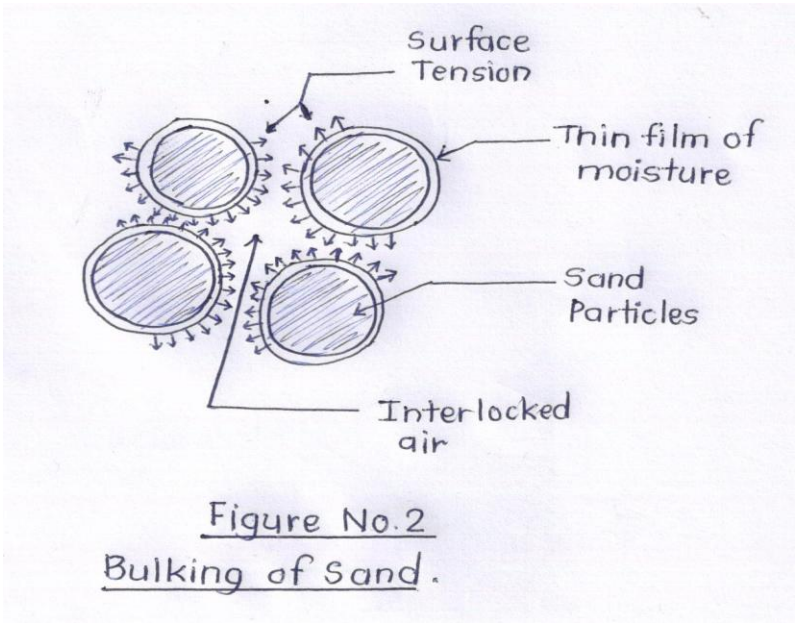
| **Q.1** | **A)** | 3. Now, attach the plunger of 10 mm dia to Vicat's apparatus and take the initial reading '$d_1$' mm by keeping the plunger touching to top surface of cement.<br>4. Allow the penetration of plunger in cement paste by releasing dash-pot.<br>5. Take the final reading on graduated scale as '$d_2$' mm.<br>6. Calculate total penetration of plunger as $(d_1 - d_2)$ mm. if it is not 33-35 mm, then repeat all above steps by increasing water % in cement.<br>7. Note down the % water, which gives exact 33-35 mm penetration from top of mould. This water % should be taken as standard consistency of cement. | **4 marks** | **4** |
| | **B)** | Attempt **any one** of the following: | | **6** |
| | **a)** | **Explain the phenomenon of bulking of sand. State the effects of bulking of sand on concrete.**<br>**Ans.**<br>As bulking is a phenomenon of increasing total volume of sand due to surface moisture present on sand particles; it takes place due to surface tension between adjacent sand particles.<br>The thin film of moisture gets formed around the surface of particles. During formation some air get interlocked between film and particle, which exerts surface tension as shown in fig. 2.<br>Due to this surface tension is developed. Each particle tends to push or move away from each other. This results in increase in total volume of sand ultimately.<br>  <br><br>Figure No.2<br>Bulking of Sand. | **2 marks**<br>**2 marks**<br>**cont…** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.1** | **B)** | Effects of bulking of sand on concrete:<br>1. The bulking of sand increases water content in concrete. It affects water – cement ratio and workability of concrete.<br>2. The bulking of sand may give segregation and bleeding in concrete mixture.<br>3. The bulked sand in concrete results in reducing strength and durability of concrete ultimately. | **1 mark each (Any two)** | **6** |
| | **b)** | **State any four properties of coarse aggregate and explain the method to determine abrasion value of coarse aggregate.**<br>**Ans.**<br>Properties of coarse aggregate:<br>1. Bulk density<br>2. Specific gravity<br>3. Flakiness index<br>4. Elongation index<br>5. Water absorption<br>6. Alkali – aggregate reaction<br>7. Impact strength<br>8. Crushing strength<br>9. Abrasion strength | **1 mark each (Any four)** | |
| | | Method to determine abrasion value of coarse aggregates:<br>1. Take 1.25 to 5 kg oven dried clean aggregate as per grading of concrete, which can be taken as initial weight $W_1$ gm.<br>2. Put it in drum of Los Angeles abrasion testing machine through opening with abrasive charge balls.<br>3. Now rotate the drum at a rate of 20 to 33 rev/min for 500 – 1000 total revolutions as per grading of aggregates so that aggregate will break down.<br>4. Take out crushed aggregate from drum and sieve it through 1.7 mm IS Sieve.<br>5. Take the weight of aggregate fraction passing through 1.7 mm IS sieve as $W_2$ gm.<br>6. Calculate % aggregate abrasion value of given aggregate as $(W_2/W_1)$ X 100. | **2 marks** | **6** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.2** | | Attempt **any four** of the following: | | **16** |
| | **a)** | **State the necessity of supervision for concreting operation (any four).**<br>**Ans.**<br>Necessity of supervision for concrete operation :<br>1. Supervision is necessary to complete all concreting operations in standard manner.<br>2. It is necessary to avoid any type of delay in concrete work.<br>3. It is also beneficial to reduce wastage of concrete during concreting.<br>4. It is required to get overall quality in concrete work at site<br>5. Supervision becomes essential in maintaining smooth flow of concreting operations at each stage of project.<br>6. It found very effective in controlling bad workmanship. | **1 mark each (Any four)** | **4** |
| | **b)** | **Explain the 3 grades of concrete as per the provisions of IS 456 - 2000**<br>**Ans.**<br>There are three categories of concrete grades as follows depending upon compressive strength obtained after 28 days curing;<br>1. Ordinary concrete –<br>In this category, low to medium strength concrete grades are included i.e. M10, M15 and M20. The lean concrete M7.5 is also included in it. It is useful for ordinary PCC and RCC works.<br>2. Standard concrete –<br>In this, medium to high strength concrete grades are taken i.e. M25, M30, M35, M40, M45, M50 and M55. Such concrete requires concrete mix design. It is useful in mega projects, mass concrete works, etc.<br>3. High strength concrete –<br>In this, very high strength concrete grades are considered i.e. M60, M65, M70, M75 and M80. It also requires special concrete mix design. It is useful in special type of works like atomic power stations, launching stations, etc. | **1 mark**<br>**1 mark**<br>**1 mark**<br>**1 mark** | **4** |
| | **c)** | **State any four factors affecting the workability of concrete.**<br>**Ans.** Factors affecting the workability of concrete are as follows;<br>1. Water – cement ratio<br>2. Size of aggregate<br>3. Shape of aggregate<br>4. Use of admixtures<br>5. Grading of aggregate<br>6. Surface texture of aggregate<br>7. Water absorption of aggregate<br>8. Temperature | **1 mark each (Any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.2** | **d)** | **State any four precautions to be taken to avoid segregation.**<br>**Ans.** Precautions to be taken to avoid segregation are as follows;<br>1. To avoid segregation, water – cement ratio should be appropriate as per IS requirement.<br>2. The segregation can be reduced by homogeneous mixing of concrete mixture done by mechanical means.<br>3. During transportation, concrete mixture should not allow top set by continuous revolving carriers.<br>4. By keeping low dropping height i.e. less than 1m, segregation can be avoided.<br>5. Segregation may be reduced by reducing coarse aggregate content upto certain extent.<br>6. Excessive vibration should be avoided to minimize segregation. | **1 mark each (Any four)** | **4** |
| | **e)** | **State any four objectives of concrete mix design.**<br>**Ans.**<br>Concrete Mix design is done for following objectives;<br>1. To achieve a specified compressive strength of concrete.<br>2. To reduce wastage of concrete by correct proportioning.<br>3. To achieve economy by selecting appropriate concrete ingredients.<br>4. To maintain workability of concrete mix throughout work.<br>5. To obtain maximum possible yield per bag of cement. | **1 mark each (Any four)** | **4** |
| | **f)** | **State the importance of NDT of concrete and explain rebound hammer test.**<br>**Ans.**<br><u>Importance of NDT :</u><br>1. The strength can be tested without physical breaking of concrete; hence it is safe.<br>2. It can give internal flaws, cavities and homogeneity details of concrete within short period.<br>3. It avoids wastage of concrete, hence becomes economical up to certain extent.<br>4. It is applicable in any type and position of concrete members shows wide applicability.<br>5. Its results are simple and easy to interpret.<br><br><u>Rebound Hammer Test:</u><br>1. It consists of spring control hammer that slides on a plunger within a tubular housing.<br>2. When the plunger is pressed against the surface of concrete, the mass is rebound from the plunger.<br>3. The hammer impacts against the concrete and the spring control mass rebound, taking the rider along with the guide scale. | **1 mark each (Any two)**<br><br>**cont…** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.2** | | 4. By pushing a button the rider can be held in position to allow the reading to be taken. The distance travelled by the mass is called rebound hammer.<br>5. The test can be conducted horizontally, vertically, upwards or downward or at any intermediate angle. | **2 marks** | **4** |
| **Q.3** | | Attempt **any four** of the following: | | **16** |
| | **a)** | **Explain flakiness index and elongation index.**<br>**Ans.**<br>**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. | **2 marks** | **4** |
| | | **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. | **2 marks** | |
| | **b)** | **What is meant by grading of aggregates? Explain:**<br>**i.Well graded ii. Gap graded and iii. Poor graded aggregates.**<br>**Ans.**<br>Grading of aggregates – It is the analysis of size of aggregate particles available in given sample by sieving method. | **1 mark** | **4** |
| | | i. Well graded aggregate – The aggregate sample which contains particles of all sizes (i.e. finer to coarser) in it, such sample is said to be well graded aggregate. | **1 mark** | |
| | | ii. Gap graded aggregate – It is the aggregate in which particles of any specific sizes are available and other sizes are totally absent, such sample may be termed as gap graded aggregate. | **1 mark** | |
| | | iii. Poorly graded aggregate – It is the aggregate sample which contains excess amount of any specific size and deficiency of other sizes of aggregate, hence called as poorly graded aggregate. | **1 mark** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.3** | **c)** | **Crushing value test was conducted on coarse aggregate in the laboratory and the observations are recorded as given below. Find average crushing value of coarse aggregate and state its suitability.**<br>**SI. No. / Sample No. / I / II / III**<br>**1. Weight of oven dried sample ($W_1$) in gms / 3150 / 3085 / 3212**<br>**2. Weight of fraction passing 2.36 mm ($W_2$) sieve in gms / 570 / 582 / 602**<br>**Ans.**<br>To find aggregate crushing value;<br>$\%\,ACV = \frac{Weight\ of\ agg.passing\ through\ 2.36\ mm\ IS\ sieve}{Weight\ of\ oven\ dried\ aggregate} \times 100$<br>For observation I:<br>$\%\,ACV = \frac{570}{3150} \times 100 = 18.09\ \%$<br>For observation II:<br>$\%\,ACV = \frac{582}{3085} \times 100 = 18.86\ \%$<br>For observation III:<br>$\%\,ACV = \frac{602}{3212} \times 100 = 18.74\ \%$<br>To find average crushing value of given agg.,<br>$Average\ \%\,ACV = \frac{18.09 + 18.86 + 18.74}{3}$<br>$Average\ \%\,ACV = 18.56\ \%$<br><u>Suitability</u> – The given sample of aggregate is suitable for wearing as well as non – wearing surfaces. | **1 mark**<br>**1 mark**<br>**1 mark**<br>**1 mark** | **4** |
| | **d)** | **Define Bulk density of aggregates. State three factors that affect the bulk density.**<br>**Ans.**<br><u>Bulk density of aggregate</u> – It is the ratio of weight of aggregate to volume of aggregate.<br><u>Factors affecting bulk density</u> –<br>1. Size of aggregate<br>2. Shape of aggregate<br>3. Cleanliness of aggregate<br>4. Specific gravity of aggregate | **1 mark**<br>**1 mark (Any three)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.3** | **e)** | **Explain the procedure to determine impact value of coarse aggregate.**<br>**Ans.**<br>1. Take oven dried aggregate passing through 12.5 mm IS Sieve and retained on 10 mm IS sieve.<br>2. Fill this aggregate in impact mould within 3 layers. Compact each layer 25 times using tamping rod.<br>3. Calculate the weight of aggregate filled by subtracting empty weight of mould as $W_1$ gm.<br>4. Put the mould under aggregate impact testing machine and give 15 successive blows by lifting handle of it; so that aggregate gets crushed.<br>5. Take out sample from mould and sieve it through 2.36 mm IS sieve. Take weight of aggregate fraction passing through 2.36 mm IS sieve as $W_2$ gm.<br>6. Calculate % aggregate impact value of given coarse aggregate as $(W_2/W_1)$ X 100. | **4 marks** | **4** |
| **Q.4** | **A)** | Attempt **any three** of the following. | | **12** |
| | **a)** | **What is meant by batching? Explain the two types of batching.**<br>**Ans.**<br>Batching – It is the measurement of materials required as per grade of concrete, called as batching.<br><br>Types of batching –<br>Batching is done in following two ways;<br><br>**i. Volume batching:**<br>a. In volume batching the ingredients to produce the concrete mix are measured by volume.<br>b. It is not good method for proportioning the material because of the difficulty it offers to measure angular materials in terms of volume.<br>c. This type of batching may be adopted for any small work.<br><br>**ii. Weight batching**<br>a. In weight batching the ingredients to produce concrete mix are measured by weight.<br>b. Weight batching of aggregate is generally preferred because it is the correct method of measuring the materials.<br>c. This method of batching is much more accurate than volume batching.<br>d. This type of batching is adopted where high quality concrete is required. | **1 mark**<br><br>**1 ½ marks**<br><br>**1 ½ marks** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.4** | **A)** | | | |
| | **b)** | **State any four advantages of compaction by vibrators.**<br>**Ans.**<br>1. Vibrators can compact very stiff concrete mixture very easily.<br>2. It gives economy in big projects which is not possible by hand compaction.<br>3. Vibrators can give more smooth finish to concrete surface by reducing chances of honeycombing.<br>4. Vibratory compaction is advantageous in cube compaction, slab compaction, pavement compaction where ordinary compaction becomes ineffective. | **1 mark each (Any four)** | **4** |
| | **c)** | **State any four differences between steel formwork and timber formwork.**<br>**Ans.** | | |

| | **Steel formwork** | | **Timber formwork** |
|---|---|---|---|
| **1** | The formwork is in the form of steel plates, girders, props, etc. | **1** | This formwork includes plywood, timber battens, ballies, supports, wedges. |
| **2** | It is difficult to handle due to heavy weight. | **2** | It is light in weight, hence easy to handle. |
| **3** | It requires high initial cost. | **3** | It requires low initial cost. |
| **4** | It is more durable and hence can be repeatedly useful. | **4** | It is less durable, hence limited use. |
| **5** | It is economical for large projects. | **5** | It is economical for small scale works and unsuitable for mega projects. |
| **6** | It gives smooth finish. | **6** | It gives comparatively less smooth finish. |
| **7** | It is strong enough to resist load of concrete. | **7** | It has less strength as compared to steel formwork. |
| **8** | It is useful for casting of slabs, pavement, etc. | **8** | It is widely useful in casting of beam, column, wall, etc. |

| Marks | Total Marks |
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| **1 mark each (Any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.4** | **A) d)** | **Explain the two different methods of water proofing.**<br>**Ans.**<br>1. Waterproofing by use of pore fillers – In this method, pore filler materials like silicate of soda, aluminum and zinc sulphates and aluminum and calcium chloride are used. These chemically active pore fillers accelerate setting time which results impermeability in concrete at early stage.<br>Some chemically inactive pore filler materials like chalk, fuller's earth, talc reduces water without disturbing workability to give imperviousness in concrete.<br>2. Waterproofing by use of water repellents – The water repellent materials like soda, potash soaps, resins, vegetable oils, fats and coal tar residues are useful in this method. Some water proofing admixture, inorganic salts of fatty acids, calcium or ammonium stearate repels water from concrete. Lime can be added in concrete for waterproofing. Calcium chloride accelerates strength and helps in curing for making impervious concrete. | **2 marks**<br><br>**2 marks** | **4** |
| | **B)** | Attempt **any one** of the following. | | **6** |
| | **a)** | **What are the precautions to be taken during transportation of concrete?**<br>**Ans.**<br>1. Establish mixing plant nearest possible to the construction site to reduce time of transportation.<br>2. Select higher w/c ratio, if distance between mixing plant and working site is more.<br>3. Maintain cold or humid condition around the concrete mixture during transportation.<br>4. Use retarding admixture, to avoid early setting and hardening of concrete.<br>5. Cover the concrete mixture, if it is transported in open trucks to avoid direct sunlight.<br>6. Due care should be taken to avoid leakage and wastage of concrete mix during transportation | **1 mark each** | **6** |
| | **b)** | **What are the precautions to be taken while placing the concrete in formwork?**<br>**Ans.** Precautions to be taken while placing of concrete are;<br>1. While placing of concrete, the mixture should reach at all corners uniformly and not intensively at one place.<br>2. Placing thickness for mass concrete should be less than 30-45 cm and for RCC work should be less than 15-30 cm.<br>3. Before placing of concrete the formwork joints should be checked to avoid bleeding.<br>4. Concrete mixture should not be dropped from the height more than 1 m.<br>5. Before placing of concrete, oiling to inner face of formwork should be done properly.<br>6. Flow of placing of concrete should be continuous and joints should be left at appropriate position. | **1 mark each** | **6** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.5** | | Attempt **any four** of the following. | | **16** |
| | **a)** | **Define admixtures. State any four types of admixtures and their use.**<br>**Ans.** Admixture – It is the fifth ingredient of concrete, which is purposefully added to modify one or more specific properties of concrete, which is called as admixtures.<br><br>Types of admixture and their uses;<br>1. Accelerating admixture – To increase the rate of setting of the concrete and for early removal of formwork in cold climate.<br>2. Retarding admixtures – To reduce the rate of hardening of the concrete in hot weather.<br>3. Water reducing admixtures – To maintain appropriate water in concrete for deep beams, thin walls and tremy concrete.<br>4. Air entraining admixtures – To modify the properties of concrete in stage plastic concrete like workability, segregation and of hardened concrete like impermeability and resistance to frost action.<br>5. Super plasticizers – To reduce water upto 30% without reducing workability.<br>6. Pozzolanic admixture – To reduce heat of hydration and alkali-aggregate reaction.<br>7. Grouting agents – To increase pumpability and rate of setting of grouting cement.<br>8. Bonding admixtures – To join old and new concrete at construction joints. | **1 mark**<br><br>**3 marks (Any four)** | **4** |
| | **b)** | **State the advantages of ready mix concrete.**<br>**Ans.** Advantages of Ready Mix Concrete (RMC):<br>1. Bulk amount of concrete can be produced at a time to avoid delay in construction.<br>2. Wastage of materials can be avoided due to mechanized operations at plants.<br>3. RMC give higher quality mix than ordinary concrete due to computerized working of plant.<br>4. It can be easily transported longer distance without hardening, hence suitable even in congested urban area. | **1 mark each** | **4** |
| | **c)** | **State the effects of hot weather on concrete and explain the precautions to be taken during hot weather concreting.**<br>**Ans.** Effect of hot weather on concrete:<br>1. Due to hot weather, concrete shows rapid rate of hardening, which results difficulty in transportation of concrete.<br>2. Water from concrete mix gets evaporated fastly, which results on w/c ratio and less workability of concrete.<br>3. Water may get absorbed by formwork, aggregate or ground due to excessive heat.<br>4. More shrinkage cracks get developed on concrete surface due to incomplete hydration with less water in concrete. Hence, early finishing becomes more essential. | **cont…** | |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.5** | **c)** | 5. Continuous curing is required to keep humidity and to avoid further development of cracks.<br>6. Air entrained in concrete may get expelled due to temperature, hence workability may reduce additionally.<br><br><u>Precautions to be taken during hot weather concreting:</u><br>1. During hot weather, transportation of concrete should be done quickly, without delay to avoid hardening of concrete.<br>2. Concrete should be covered with polythene before and after concreting work to minimize defects.<br>3. Before placing, water should be sprinkled on ground and formwork to avoid water absorption from concrete mix.<br>4. Concreting work should be done during night time only.<br>5. Retarding admixtures should be used to reduce rate of setting.<br>6. Low heat cement should be preferred to minimize heat evolution.<br>7. High w/c ratio and ice crystals should be used to maintain workability. | **½ mark each (Any four)**<br><br>**½ mark each (Any four)** | **4**<br><br>**4** |
| | **d)** | **State any four properties of fibre reinforced concrete.**<br>**Ans.** Properties of fibre reinforced concrete are as follows;<br>1. Very high tensile strength<br>2. Crack arrester<br>3. Uniform load distribution through matrix<br>4. More fire resistance<br>5. High shear and torsional strength<br>6. Resistance to freezing and thawing damage<br>7. More resistance to shocks and vibration<br>8. Self-weight is less<br>9. Smooth finishing | **1 mark each (Any four)** | **4** |
| | **e)** | **Compare accelerating admixtures with retarding concrete.**<br>**Ans.**<br>**<u>Accelerating Admixture</u>** / **<u>Retarding Admixture</u>**<br>1 It is useful to increase rate of setting of concrete. / 1 It is useful to decrease rate of hardening of concrete.<br>2 It is widely used in cold weather concreting. / 2 It is mostly used in hot weather concreting.<br>3 It contains more amounts of $C_2S$ and $C_3S$ compounds in it. / 3 It includes more % of $C_3A$ and $C_4AF$ in it.<br>4 These admixtures reduce water from concrete by generating heat of hydration. / 4 These admixtures restrict water evaporation from concrete.<br>5 It facilitates quick removal of formwork and increases speed of construction. / 5 It is beneficial in safe, easy transportation and minimizing crack formation. | **1 mark each (Any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
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| **Q.5** | **f)** | **List any four types of special concretes. Explain the properties and limitations of light weight concrete.**<br>**Ans.** Types of special concretes:<br>1. Ready mix concrete<br>2. Pre-cast concrete<br>3. Pre-stressed concrete<br>4. High strength concrete<br>5. High performance concrete<br>6. Self-compacting concrete<br>7. Light weight concrete<br><br>Properties of Light weight concrete:<br>1. Very less weight density ranging 300 – 1850 kg/m3.<br>2. Low self-weight reduces dead load.<br>3. Low thermal conductivity.<br>4. Economical due to use of industrial waste.<br>5. Reduces material haulage and handling cost.<br><br>Limitations of Light weight concrete:<br>1. It gives harshness to concrete.<br>2. It reduces workability upto certain extent.<br>3. Mix design procedures for LWC are not standardized.<br>4. It undergoes corrosion due to porosity. | ½ **mark each (Any four)**<br><br>½ **mark each (Any two)**<br><br>½ **mark each (Any two)** | **4** |
| **Q.6** | | Attempt **any four** of the following: | | **16** |
| | **a)** | **What are the precautions to be taken during mixing of concrete?**<br>**Ans.**<br>1. Fine materials i.e. sand and cement should be spread over coarse aggregates.<br>2. Water should be added in stages to get uniform cement slurry.<br>3. The mixture should be homogenous without any signs of segregation.<br>4. The mixing should be by mechanical means i.e. concrete mixers and manual mixing should be avoided.<br>5. The mixing procedure should be completed within gauge time of cement to avoid start of hardening of concrete mix. | **1 mark each (Any four)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.6** | **b)** | **Explain the method of joining old and new concrete.**<br>**Ans.**<br>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.<br><br>Method of joining old and new concrete:<br>1. Cleaning:<br>The old concrete surface is first thoroughly cleaned with wire brush. Loose material if any, should be removed.<br><br>2. Chiseling:<br>The old concrete surface is made rough by denting it with a chisel for a strong bond with new concrete.<br><br>3. Application of cement slurry or paste with some admixtures:<br>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.<br><br>4. Providing overlap:<br>To give homogeneity to the reinforcing bars, overlap is provided and the overlap portion is bound tightly with high tensile wire. | **1 mark**<br><br>**1 mark**<br><br>**1 mark**<br><br>**1 mark** | **4** |
| | **c)** | **What are super plasticizers? State the properties and uses of super plasticizers.**<br>**Ans.** Super plasticizers – These are the water reducing admixtures added in concrete.<br><br>Properties of Super plasticizers –<br>1. It reduces water upto 30% without reducing workability.<br>2. It produces more workable concrete at the same w/c ratio and same workability.<br>3. It gives homogeneity to mixture without segregation and bleeding.<br>4. It facilitates good pumpability to concrete with less w/c ratio.<br><br>Uses of super plasticizers –<br>1. It is useful in self-leveling and self-compacting concrete.<br>2. It is helpful to produce pumped concrete for high rise buildings, long span bridges, etc.<br>3. It is also used in ready mix concrete and in high performance concrete. | **1 mark**<br><br>**1 mark each (Any two)**<br><br>**½ mark each (Any two)** | **4** |

| Que. No. | Sub. Que. | Model Answers | Marks | Total Marks |
|---|---|---|---|---|
| **Q.6** | **d)** | **State the properties of High performance concrete and its uses.**<br>**Ans.**<br>Properties of High performance concrete –<br>1. High workability<br>2. High strength<br>3. High modulus of elasticity<br>4. More density<br>5. More dimensional stability<br>6. Low permeability<br>7. High resistance to chemical attack<br><br>Uses of High performance concrete –<br>1. Construction of special structures like atomic power stations, satellite launching station, heavy duty runway, etc.<br>2. Mass concrete structures like dams, bridges, etc. | **½ mark each (Any four)**<br><br>**2 marks** | **4** |
| | **e)** | **State any four factors affecting durability and impermeability of concrete.**<br>**Ans.** Factors affecting durability and impermeability of concrete are as follows;<br>1. Appropriate water cement ratio<br>2. Well graded aggregate<br>3. Method of mixing<br>4. Method of compaction<br>5. Sufficient and continuity in curing<br>6. Overall quality of ingredients on concrete<br>7. Atmospheric conditions<br>8. Workmanship during concreting | **1 mark each (Any four)** | **4** |
| | **f)** | **Define mix design and enlist the different methods of mix design of concrete.**<br>**Ans.** Mix design – Process of selecting the type and quantity of materials to produce economical, workable and durable concrete is known as mix deign.<br><br>Methods of mix design;<br>1. Arbitrary proportion method<br>2. Maximum density method<br>3. Fineness modulus method<br>4. ACI Committee 211 method<br>5. Road note no. 4 method (Grading Curve Method)<br>6. IRC 44 method<br>7. High strength concrete mix design method<br>8. Indian Standard method (IS 10262: 2009)<br>9. Trial and error method<br>10. Surface area method<br>11. Mix design based on flexural strength<br>12. DOE method | **1 mark**<br><br>**½ mark each (Any six)** | **4** |