SCHEME OF VALUATION

Revision (15) 6015	Course Title : **Concrete Technology**			
Qst No	Scoring indicator	Split up score	Sub total	Total
	PART A			
I.1	The increase in the volume of sand due to increase in moisture content is known as ***bulking of sand***. A film of water is created around the sand particles which forces the particles to get a side from each other and thus the volume is increased.	2	2	10
I.2	Modular ratio is the ratio of modulus of elasticity of steel to modulus of elasticity of concrete. m = Es/Ec Poisson's ratio is the ratio of lateral strain to linear strain.	1 1	2	
I.3	i. To achieve the designed/ desired workability in the plastic stage. ii. To achieve the desired minimum strength in the hardened stage. iii. To achieve the desired durability in the given environment conditions. iv. To produce concrete as economically as possible.	2	2	
I.4	1. IS (Indian standard) recommended method 2. IRC- 44(Indian Road Congress) method 3. Arbitrary Method of Proportioning Concrete 4. Fineness Modulus Method 5. Minimum Void Method 6. Maximum Density Method 7. Water - Cement Ratio Method 8. Surface area method	Any two 2×1 = 2	2	
I.5	• Improving quality of concrete. • Increasing depth of concrete cover to steel. • Concrete coating and sealers. • Galvanizing steel. • Coating of reinforcements (paint, epoxy etc.) • Proper storage and stacking reinforcement.	Any two 2×1 = 2	2	
	PART B			
II.1	1. **Cement Color:** The color of cement should be uniform. It should be typical cement color i.e. gray color with a light greenish shade. 2. **Whether hard lumps are formed:** Cement should be free from hard lumps. Such lumps are formed by the absorption of moisture from the atmosphere. 3. **Temperature inside Cement Bag:** If the hand is plunged into a bag of cement, it should be cool inside the cement bag. 4. **Smoothness Test:** When cement is touched or rubbed in between fingers, it should give a smooth feeling.			

	5. **Water Sinking Test:** If a small quantity of cement is thrown into the water, it should float some time before finally sinking. 6. **The smell of Cement Paste:** A thin paste of cement with water should feel sticky between the fingers. If the cement contains too much-pounded clay and silt as an adulterant, the paste will give an earthy smell. 7. **Glass Plate Test:** A thick paste of cement with water is made on a piece of a glass plate and it is kept under water for 24 hours. It should set and not crack.	Any six $6\times1=6$	6	
II.2	**Classification of Aggregates based on** • Grain Size • Density • Shape • Geographical Origin **Classification of aggregates based on Grain Size** Based on the grain size, the aggregates are classified into two types. • Fine Aggregate • Coarse Aggregate Fine aggregates are the particle whose size is less than 4.75mm. Coarse aggregates are the particle whose size is greater than 4.75mm. **Classification of aggregates based on density** The aggregates are classified according to the density as • Lightweight Aggregates • Normal Weight Aggregates • Heavy Weight Aggregates **Lightweight Aggregates** The density of lightweight aggregates ranges between 800 to 1100 Kg/Cum. **Normal Weight Aggregates** The density of normal weight aggregates in ranges between 1520 to 1680 Kg/Cum. **Heavy Weight Aggregates** The density of heavyweight aggregates range between 2100 to 2900 Kg/Cum. **Classification of aggregates based on the shape** • Rounded Aggregate The rounded aggregates are completely shaped by attrition and available in the form of seashore gravel. • Irregular Aggregates The irregular or partly rounded aggregates are partly shaped by attrition and these are available in the form of pit sands and gravel.	1.5 1.5 1.5		

- Angular Aggregates

The angular aggregates consist well defined edges formed at the intersection of roughly planar surfaces and these are obtained by crushing the rocks.

- Flaky Aggregates

When the aggregate thickness is small when compared with width and length of that aggregate it is said to be flaky aggregate.

- Elongated Aggregates

When the length of aggregate is larger than the other two dimensions then it is called elongated aggregate

Classification of aggregates based on Geographical Origin

Based on the source of aggregates, it can be classified

- Natural aggregates
- Artificial aggregates.

Natural aggregates

The natural aggregates are available in river banks, seashore, & pits mines.

Artificial Aggregates

Artificial aggregates means the natural aggregates are processed to produce new size & quality aggregates.

1.5 6

II.3 **Difference between segregation and bleeding**

S.N	Segregation	Bleeding
1	It is the separation of concrete ingredients from each other.	It is the Separation of cement water from the remaining mass of concrete.
2	It is caused due to improper mixing of concrete materials and placing of concrete from a height above 1.5 m.	It is caused due to over-compaction of concrete and excessive water in concrete.
3	It makes concrete porous and decreases its strength of concrete.	It leads to creating a honeycomb in concrete and decreases the strength.
4	It can be repaired after formation.	It can not be repaired after formation.
5	Segregation weakens the durability and strength of the concrete	Bleeding results in surface scaling, weakened bonds, and poor surface finish

6 6

II.4

1. Strength
2. Durability
3. Shrinkage
4. Creep

	5. Impermeability 6. Porosity 7. Elasticity 8. Fire resistance 9. Impact resistance 10. Thermal expansion	Any six 6×1 = 6	6
11.5	(table below)	Any six 6×1 = 6	6

No	Nominal mix	Design mix
1.	Arbitrary Volumetric Proportions	Weight Proportions
2.	Fixed Ratio (Ex. 1:1.5:3)	No Fixed Ratio. Based on the requirement, it would change.
3.	Concrete strength varies every time because of volumetric proportions	Concrete strength never vary because of controlled design mix calculations
4.	Individual characteristics of aggregates will not be considered	Individual characteristics of aggregates will be considered
5.	Suitable for lower grade concrete	Ideal for Higher Grade concrete
6.	Entrapped air content would be considered	Entrapped air content considered according to the size of the aggregates.
7.	Low Quality Control	High Quality Control
8.	Water cement ratio will differ based on guidance	Water cement ratio will vary based on the performance of trial mixes
9.	Used up to M20 Concrete Mix	Used for High grade concrete (above M20)

11.6

Precautions in hot weather concreting

- **Cooling of aggregates:** Cooling aggregates can reducethe temperature of concrete. This can be done by ;
  - Sprinkling water on aggregate before using.
  - Adding broken pieces of ice as a part of mixing water.
  - Blowing of cold air.
- **Mixing water:** Water can be used to control the temperature of concrete mass easily than that of aggregates.
  - Cold water can added during mixing.
  - If temperature is too high, calculated quantity of ice pieces can be added directly into the mixer, insteadof mixing water.
- **Production and delivery :** Following factors has to be considered during production and delivery of concrete;
  - The temperature of ingredients should be maintained in such a way that the **final mix temperature is below 40° C while placing.**
  - Concrete should be mixed in minimum possible time.
  - Reinforcement, formwork etc. should be

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<td>sprinkled with cooled water prior to concrete placing.
• Concrete should be placed in thin layers with sufficient time between successive lifts.
• Immediately after finishing, concrete surfaces should be covered with plastic sheets, gunny bags etc.
• Continuous curing has to be ensured.</td>
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<td>II.7</td>
<td><u>Polymer concrete</u>

Concrete in which monomers added into the pores of hardened concrete, and then getting it polymerized by thermal process is called polymer concrete.
• By this polymerization, the strength of the concrete is much improved.
• Following are the monomers used;
i. Methyl-methacrylate
ii. Styrene
iii. Acrylonitrile
iv. T-butyl styrene
v. Thermoplastic monomer.
<u>ADVANTAGES OF POLYMER CONCRETE</u>
• High impact resistance.
• High compressive strength.
• High resistance to freezing and thawing.
• Low permeability
• High resistance to chemical attack.
<u>APPLICATIONS OF POLYMER CONCRETE</u>
• Nuclear power plant
• Precast slabs and bridge decks
• Marine works
• Prestressed concrete
• Irrigation and sewage works.
• Water proofing of buildings.</td>
<td>4

2</td>
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<td>Any five $5 \times 6 = 30$</td>
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PART C				
UNIT I				
III.a	Lime (CaO) 60 to 67% Silica (SiO2) 17 to 25% Alumina (Al2O3) 3 to 8% Iron oxide (Fe2O3) 0.5 to 6% Magnesia (MgO) 0.1 to 4% Sulphur trioxide (SO3) 1 to 3% Soda and/or Potash (Na2O+K2O) 0.5 to 1.3%	4		
	i. Lime (CaO) Calcium oxide acts as the primary component responsible for cement's strength and binding properties. ii. Silica (SiO_2) Silica imparts hydraulic properties to cement, allowing it to harden and set when mixed with water. It also contributes to the cement's overall durability and resistance to external elements. iii. Alumina (Al_2O_3) Alumina provides the cement with increased resistance to chemical attacks, such as those caused by sulphates and acids. It also enhances the cement's ability to withstand high temperatures. iv. Iron Oxide (Fe_2O_3) Iron oxide gives cement its characteristic grey colour. It contributes to the cement's strength and acts as a flux. v. Magnesia (MgO) Magnesia should not be present more than 2% in cement.Excess magnesia will reduce the strength of the cement.	4	8	

III.b	**Soundness Test on Cement** **Apparatus** 1. Le- chatelier mould. The mould consists of a small split cylinder of spring brass or other suitable metal of 0.5mm thickness forming of a mould 30mm internal diameter and 30mm height. On either side of the split are attached to indicators with pointed ends. 2. Glass sheets 3. Mixing pan 4. Trowel Procedure 5. Prepare a cement paste as in consistency test with 0. 78 times the water required to give a paste of standard consistency 6. Fill the cement paste in the Le- chatelier mould taking care to keep the edges of the mould gently together during the operation. 7. Cover the mould with another piece of a glass plate and place a small weight over the cover plate. 8. Submerge the whole assembly immediately in water at a temperature of 27o+/-2 deg C and keep it there for 24 hours. 9. Take out the assembly and the distance between the indicator points are measured as A. 10. Submerge assembly again in water at 27 +/- 2 deg C 11. Bring the water to boiling in 25 to 30 minutes and keep at boiling for 3 hours. The assembly should be immersed in water during this process. 12. Remove the mould from water and allow it to cool to 27 +/- 2 deg C 13. Measure the distance between the indicator points as B 14. Calculate the expansion= B- A	7	7	15

IV.a

Apparatus

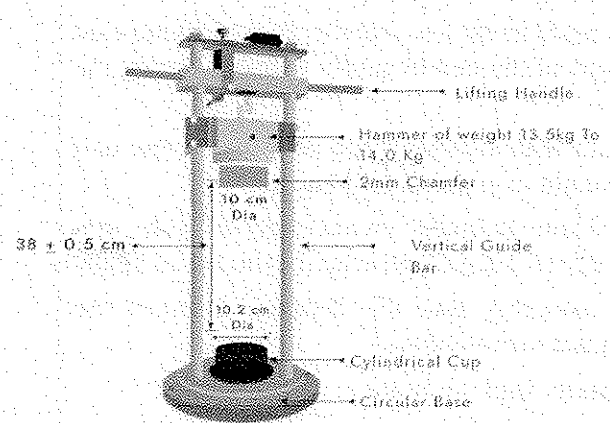
1. An impact testing machine weighing between 45kgs to 60 kgs with a metal base.

2. A cylindrical steel cup having an internal diameter of 102mm, depth of 50mm, and thickness of 6.3mm.

3. A metal hammer with the cylindrical lower end and weighing 13.5 to 14kgs.

4. A cylindrical metallic measure with 75mm internal diameter and 50mm depth.

5. A tamping rod of 10mm diameter and 230mm long.



Procedure

1. First, the aggregate sample sieve through 12.5mm sieve and collect it which is retained in 10mm sieve.
2. Then, the aggregate sample should be filled in the metal cup by 3 layers. Each layer should be tamped 25 times by the tamping rod. Remove the excess sample from the metal cup.
3. The net weight of the aggregate sample, which is in the metal cup, should be measured as W1.

	4. Then the metal cup is placed horizontally in the impact machine and locks it to ensure that it does not oscillate. 5. Release the hammer of the Impact test machine, which falls freely on the sample. It should be done 15 blows at less than 1-sec interval. 6. Then remove the metal cup from the machine & sieve the aggregate through 2.36mm sieve. 7. Now weigh the fraction passing through 2.36mm sieve as W2. **Result** Ratio of Impact Value = (W2/W1) x 100	8	8	
IV.b	Functions of Admixtures • To accelerate the initial set of concrete, i.e. to accelerate the rate of strength development at an early age. • To dim the initial set i.e. to keep the concrete in a working position for a longer time for placement. • To enhance workability. • To improve the flowability and permeability of concrete. • Increasing the strength of concrete by decreasing the water content and increasing the density of concrete. • To increase the durability of concrete. • To reduce the capillary flow of water through concrete and increase its imperviousness. • To control alkali-aggregate expansion or alkali-silica reactivity (ASR). • Prevents corrosion of reinforcement in concrete and to increase resistance to the chemical attack. • To reduce the heat of hydration. • To enhance the bond of concrete to the steel reinforcement.	Any seven $7\times1=7$	7	15
	UNIT II			
V.a	Methods of compaction i. Hand compaction • **Rodding** In this method of hand compaction, concrete is compacted by using the rod of 16 mm dia. and 2 m length between the reinforcement and edges. Rodding is done continuously to effectively pack the concrete and remove entrapped air. • **Ramming** Ramming by steel or wooden rammer is essentially done in the case of unreinforced concrete on the ground floor only • **Tamping** The surface is compacted by wooden crossbeams or steel beam or section 10 x 10 cm. Tamping is adopted at a place			

	where the thickness is concrete is comparatively less and the surface is required to be finished smooth and level. ii. <u>Compaction by vibrators</u> • **Internal vibrators** It is the most commonly used vibrator also known as needle vibrator, poker vibrator, and immersion vibrator. It consists of a power unit, a shaft and a needle can be powered by electricity, or petrol or by an air compressor. An eccentric weight is attached either to the shaft or motor which creates the vibration. • **External vibrators** This method of compaction by vibration is used in the case of columns, thin walls and ni precast construction works. The vibrator is attached to the external wall surface of the formwork and vibration is given to the formwork. • **Table vibrator** It is a special vibrator where vibrator is attached to the table. It is used mostly used in laboratories to compact the concrete cubes and in small <u>precast</u> unit fabrication. • **Surface vibrator** Also known as screed board vibrator. In this type of vibrator a small vibrator is attached to the screed board. It is used for the compaction of thin concrete member like slab, floor, pavement and can be employed for a maximum thickness of 15 cm. • **Compaction by spinning** This method of compaction is used for the fabrication of concrete pipes. Plastic concrete when spun at high speed gets compacted by the effect of centrifugal force. • **Vibratory roller** In this method of compaction, a heavy roller that vibrates while rolling is employed for the compaction of concrete dams, concrete and earthen roads.	8	8	
V.b	<u>**Factors Affecting Strength of Concrete**</u> 1. **Water / Cement Ratio** 2. **Compaction of Concrete** 3. **Coarse / fine aggregate ratio** 4. **Aggregate / Cement Ratio** 5. **Shape and size of aggregate** 6. **Grade of aggregate** 7. **Curing**			

1. Water / Cement Ratio

The ratio of the weight of water to the weight of cement is called Water/Cement ratio. The lower w/c ratio leads the higher strength of concrete. Generally, Water/Cement ratio is inversely proportional to the strength of concrete. When the w/c ratio is increased the strength of concrete gets decreased and when w/c ratio is decreased then the strength of concrete increases.

2. Compaction of Concrete

Compaction of concrete increases the density of the concrete because it is the process in which air voids are removed from freshly placed concrete which makes the concrete compact and dense. The presence of air voids in concrete greatly reduces its strength .Approximately 5 % of air voids can reduce the strength by 30 to 40 %. In the fully compacted concrete, strength is higher than the insufficiently compacted concrete.

3. Coarse / fine aggregate ratio

- If the proportion of fines is increased in relation to the coarse aggregate, the overall aggregate surface area will increase.
- If the surface area of the aggregate has increased, the water demand will also increase.
- Assuming the water demand has increased, the water cement ratio will increase.
- Since the water cement ratio has increased, the compressive strength will decrease.

4. Aggregate / Cement Ratio

- If the volume remains the same and the proportion of cement in relation to that of sand is increased the surface area of the solid will increase.
- If the surface area of the solids has increased, the water demand will stay the same for the constant workability.
- Assuming an increase in cement content for no increase in water demand, the water cement ratio will decrease.

	• If the water cement ratio reduces, the strength of the concrete will increase 5.Shape and size of aggregate Rounded aggregates give good strength as they have more surface area as compared to flaky aggregates.In addition, larger the size of aggregate more will be the surface area, so the bonds will be low and eventually result in low strength. 6.Grade of aggregate Well graded aggregate gives the best strength as well-graded aggregates consist of both coarse and fine aggregates that fill the voids and facilitate good bonding to cement. 7.Curing Curing facilitates better interlocking in concrete and it maintains temperature and moisture. Higher the curing, higher is the strength of concrete.	7	7	15
VI.a	1. **<u>Slump test</u>** **Procedure** 1. Clean the internal surface of the mould and apply oil. 2. Place the mould on a smooth horizontal non- porous base plate. 3. Fill the mould with the prepared concrete mix in 4 approximately equal layers. 4. Tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mould. 5. Remove the excess concrete and level the surface with a trowel. 6. Raise the mould from the concrete immediately and slowly in vertical direction. 7. Measure the slump as the difference between the height of the mould and that of height point of the specimen being tested.	4		

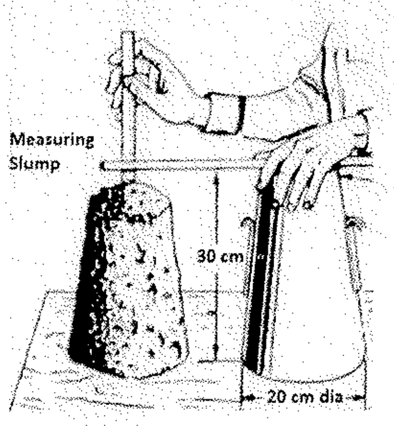
2. **Compaction factor test**

Procedure

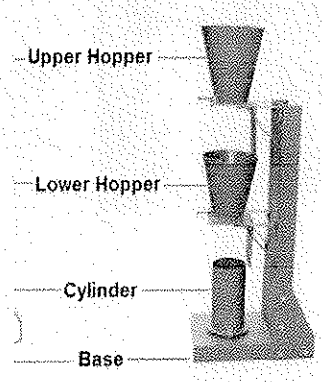
Place the concrete sample gently in the upper hopper to its brim using the hand scoop and level it.

1. Cover the cylinder.
2. Open the trapdoor at the bottom of the upper hopper so that concrete fall into the lower hopper. Push the concrete sticking on its sides gently with the road.
3. Open the trapdoor of the lower hopper and allow the concrete to fall into the cylinder below.
4. Cut of the excess of concrete above the top level of cylinder using trowels and level it.
5. Clean the outside of the cylinder.
6. Weight the cylinder with concrete to the nearest 10 g. This weight is known as the weight of partially compacted concrete **(W1)**.
7. Empty the cylinder and then refill it with the same concrete mix in layers approximately 5 cm deep, each layer being heavily rammed to obtain full compaction.
8. Level the top surface.
9. Weigh the cylinder with fully compacted. This weight is known as the weight of fully compacted concrete (**W2**).
10. Find the weight of empty cylinder (**W**).

Compaction Factor Value= (W1-W) / (W2-W)



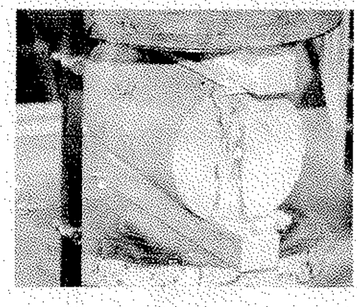
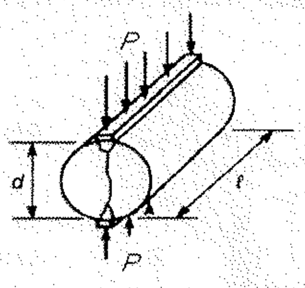
Slump test



compaction factor test

4

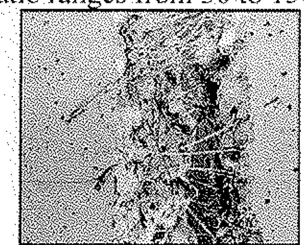
8

VI.b	• Take the wet specimen from water after 7, 28 of curing; or any desired age at which tensile strength to be estimated. • Then, wipe out water from the surface of specimen • After that, draw diametrical lines on the two ends of the specimen to ensure that they are on the same axial place. • Next record the dimension of the specimen. • Set the compression testing machine for the required range. • Place plywood strip on the lower plate and place the specimen. • Align the specimen so that the lines marked on the ends are vertical and centered over the bottom plate. • Place the other plywood strip above the specimen. • Bring down the upper plate so that it just touch the plywood strip. • Apply the load continuously without shock at a rate within the range 0.7 to 1.4 MPa/min. • Finally note down the breaking load(P) • Split tensile strength of concrete , $T = \frac{2P}{\pi LD}$ Where T = splitting tensile strength, MPa P = maximum applied load in N D = diameter of the specimen in mm L = length of the specimen in mm  	7	7	15

UNIT III				
VII .a	**1. MEAN STRENGTH ($\bar{x}$)** • Average strength obtained by dividing the sum of strength of all the cubes ($\sum x$) by the number of cubes (n). $\bar{x} = \frac{\sum x}{n}$ $\bar{x}$: Mean Strength $\sum x$: Sum of strength of all cubes n : Number of cubes	2		
	2. VARIANCE • Variance is the measure of variability or difference of each data from the mean strength. Variance of particular strength = $(x - \bar{x})$ $\bar{x}$: Mean Strength x : Strength of particular cube	2		
	3. STANDARD DEVIATION (s or σ) • This is the root mean square variation of all results. $s \text{ or } \sigma = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$ s : Standard Deviation $\bar{x}$: Mean strength x : Strength of particular cube n : No. of cubes	2		
	4. COEFFICIENT OF VARIATION (v) • Alternative method to express variation of results. • Expressed as ratio of standard deviation to mean strength. $v = \frac{s}{\bar{x}} * 100$ V : Coefficient of Variation s : Standard Deviation $\bar{x}$: Mean strength	2	8	
VII.b	**1. WATER CEMENT RATIO** – Strength of concrete decreases with increase in water content. **2. AGGREGATE CEMENT RATIO** – Higher the aggregate cement ratio , higher will the strength. **3. GRADATION OF AGGREGATES** – Both fine and coarse aggregates if are well graded, can fill their voids by themselves and thus reduce the cement content. **4. CONSISTENCY** – Concrete should have sufficient fluidity to make it workable at the same time should not cause shrinkage, bleeding or segregation due to excess water.	7	7	15

VIII	**<u>Procedural steps of mix design as per IS code 10262</u>**			
	1. TARGET STRENGTH FOR MIX PROPORTIONING f'ck =fck + 1.65 s where f'ck = target average compressive strength at 28 days fck = characteristic compressive strength at 28 days, s = standard deviation	2		
	2. SELECTION OF WATER-CEMENT RATIO From Table 5 of IS 456, select maximum water-cement ratio	1		
	3. SELECTION OF WATER CONTENT From Table 2 select maximum water content. The table is used when only angular shaped aggregates are used in concrete as well as the slump should be 25 to 50mm. If the shape of aggregate or slump value is differing from above, then some adjustments are required	2		
	4. CALCULATION OF CEMENT CONTENT Calculate the cement content from w/c ratio and compared with minimum cement content from Table 5 of IS 456	2		
	5. PROPORTION OF VOLUME OF COARSE AGGREGATE AND FINE AGGREGATE CONTENT	3		
	6. MIX CALCULATIONS a) Volume of concrete = $1m^3$ b) Volume of cement = $\frac{mass\ of\ cement}{specific\ gravity\ of\ cement} \times \frac{1}{1000}$ c) Volume of water = $\frac{mass\ of\ water}{specific\ gravity\ of\ water} \times \frac{1}{1000}$ d) Volume of admixture= $\frac{mass\ of admixture}{specific\ gravity\ of\ admixture} \times \frac{1}{1000}$ e) Volume of all in aggregate = [a-(b+c+d)] f) Mass of coarse aggregate = e x Volume of coarse aggregate x Specific gravity of coarse aggregate x 1 000 g) Mass of fine aggregate = e x volume of fine aggregate x Specific gravity of fine aggregate x 1000	5	15	15

UNIT IV				
IX. a	• **Increase in volume of cement paste** due to chemical action between products **of hydrates of cement** and **solution containing sulphates** is sulphate attack. • In hardened concrete, **calcium alumino hydrate** (C-A-H) reactes with **sulphates** forming **calcium sulpho aluminate,** which increases volume of concrete. • Appearance of white patches is an indication of sulphate attack on concrete. • **Effects of sulphate attack** are ***spalling of concrete, cracks, reduction in strength etc.***	4		
	SOURCES OF SULPHATES • Cement, aggregates and admixtures having more Sulphur content • Industrial waste water. • Soil having sulphates. • Groundwater. • Sulphate in water used for curing, mixing etc.	2		
	CONTROL OF SULPHATE ATTACK • Use of sulphate resisting cement. • Use of quality concrete with low water cement ratio and lower permeability. • Use of air entrainment. • Use of pozzolonas. • High pressure steam curing. • Use of high alumina cement.	2	8	
IX.b	Self compacting concrete (SCC) can be defined as fresh concrete that flows under its own weight and does not require external vibration to undergo compaction.Filling and passing ability, segregation resistance are theproperties of self compacting concrete. • **Filling Ability:** The ability to flow under its own weight without any vibration provided intentionally. • **Passing Ability:** The ability of the concrete to maintain its homogeneity. • **Segregation resistance:** This is the resistance of the concrete not to undergo segregation when it flows during			

	the self compaction process Following are the constituents of SCC ; • Cement : OPC 43 or 53m grade • Coarse Aggregate : 10 mm -20 mm preferred. • Fine aggregate : Natural sand smaller than 0.125mm. • Mineral admixtures. • Chemical admixtures to improve flowability. *APPLICATIONS OF SCC* • Used where inserting vibrator is difficult. • For structures with complicated reinforcement. • For structures with congested reinforcement. • Raft and pile foundations. • Used for repair and restoration of construction. *ADVANTAGES OFSCC* • The permeability of the concrete structure is decreased. • The SCC construction is faster. • The problems associated with vibration is eliminated. • The quality of the construction is increased. • Noise from vibration is decreased. • More durable than normal concrete.	7	7	15
X. a	Fibre Reinforced Concrete (FRC) can be defined as a composite material consisting of mixtures of cement, aggregate and uniformly dispersed fibres. Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular or flat. The fiber is often described by a convenient parameter called "aspect ratio". The aspect ratio of the fiber is the ratio of its length to its diameter. The typical aspect ratio ranges from 30 to 150. 			

	<u>The necessity of Fiber Reinforced Concrete</u> 1. It increases the tensile strength of the concrete. 2. It reduces the air voids and water voids the inherent porosity of gel. 3. It increases the <u>durability of the concrete</u>. 4. Fibers such as graphite and glass have excellent resistance to creep, while the same is not true for most resins. Therefore, the orientation and volume of fibres have a significant influence on the creep performance of rebars/tendons. 5. The addition of small, closely spaced and uniformly dispersed fibers to concrete would act as crack arrester and would substantially improve its static and dynamic properties. *<u>Following are the usual fibres used</u>* • Steel Fiber • Polypropylene Fiber • GFRC Glass Fiber • Asbestos Fibers • Carbon Fibers • Organic Fibers • Natural fibre (Coir fibre, Cotton fibre, Sisal fibre,Jute fibre and Wool fibre)	4 4	8	
X.b	1. Cement with low C_3A content should be preferable to make concrete. 2. Prepare rich concrete with low water cement ratio which makes the concrete impervious. Then the pores in concrete are very small and they cannot hold seawater results in the prevention of expansion by freezing of water and crystallization of salt in the pores. 3. The concrete is of low water cement ratio. To make it workable for construction, Water reducing admixtures can be added to the concrete. 4. The admixtures should not contain chloride in any form otherwise corrosion of reinforcement takes place. 5. Adequate cover should be provided for reinforcement in concrete structure to enhance durability.			

	6. Good compaction and well-made construction joints in the structure helps the concrete structure to withstand against expansion caused by seawater. 7. Use of pozzolanic material in the preparation of concrete is good against salt water. 8. For better durability, High pressure steam cured concrete elements can be used for construction of structure in marine conditions. 9. Suitable air entraining agents can be used to prevent the effect of seawater on concrete. 10. Aggregates used for making concrete should be thoroughly washed with fresh water to reduce the chloride ion concentration in it.	Any seven $7 \times 1 = 7$	7	15