



WINTER– 18 EXAMINATION

Subject Name: Construction Materials

Model Answer

Subject Code:

22204

**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 candidate and 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 model answer.
- 6) In case of some questions credit may be given by judgement 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.

Q. No.	Sub Q.N.	Answer	Marking Scheme
Q.1		<b><i>Attempt any FIVE of the following</i></b>	<b>(10)</b>
Q.1	(a) Ans.	<p><b><i>State the factors affecting selection of construction materials.</i></b></p> <p>Following are the various factors being considered for selection of construction material.</p> <ol style="list-style-type: none"> <li>1) Prescribed load: It is a design load which can be taken by the construction material. The material should have sufficient strength to carry prescribed loads.</li> <li>2) Serviceability: Material should be selected in such a way that it should provide the optimum serviceability</li> <li>3) Aesthetically pleasing: The material used for the construction purpose should be aesthetically pleasing in appearance. It should be attractive to look at, or pleasing to experience, determine its aesthetic appeal.</li> <li>4) Economical: Cost the material used for construction should be low as possible.</li> </ol> <p>Environmentally friendly: Material should be selected in such way that it should not disturb the eco-system of environment and the required material should be eco-friendly or environmentally friendly.</p>	Any two factors – 01 M for each
Q.1	(b) Ans.	<p><b><i>Define slaking of lime.</i></b></p> <p>It is the process of chemical combination of quick lime with required quantity of water for killing the heat and getting into powder form for use.</p> $\begin{array}{ccccccc} \text{CaO} & + & \text{H}_2\text{O} & = & \text{Ca(OH)}_2 \\ \text{(Quick Lime)} & & & & \text{(Hydrate of Lime)} \end{array}$	02 M



Q.1	(c) Ans.	<b>State any two types of glass along with its uses.</b> Following are the types of Glass and its uses 1) Silica Glass : It is used for fibrous glass, rod, tubing, optical windows, laboratory ware and ultra violet transmitting filters. 2) Soda-Lime-Silica Glass : It is used for window and plate glass, glass blocks, bottles of all kinds, inexpensive table wares, fluorescent and incandescent light bulbs and innumerable other articles. 3) Lead Glass : It is used for optical systems, for the finest tableware and for objects. It is also used in electric tubes, neon tubing. 4) Borosilicate Glass : It is used for industrial piping, cooking utensils and high temperature thermometers, laboratory ware	Any two 01 M for each
Q.1	(d) Ans.	<b>List the materials used for water proofing.</b> Following materials are used for water proofing... Water proofing materials based on bitumen and tar binders are 1) Emulsions and pastes 2) Mastics.... Hot and Cold Mastics Bitumen , Rubber bitumen, Tar and Petroleum Asphalt. 3) Roll and Sheet Material i) Coated impregnated roll materials ii) Non Coated impregnated cardboard rolled materials 4) Sealing materials	02 M
Q.1	(e) Ans.	<b>Enlist the types of paints.</b> Different types of paints are : 1) Oil paint 2) Water Paint 3) Cement Paint 4) Plastic Paint 5) Aluminium Paint 6) Velvet Finish Paint 7) Elastic Paint The paints are also divided based on purposes: a) Decorative and Building paints: i) Flat wall paints for interior decoration, ii) Exterior house paints, iii) Masonry finish paints, iv) Floor paints, v) White line paints for factories and road linings, vi) Heat and fire resistant paints, vii) Aluminium paints. b) Industrial and Marine Paints : i) Chlorinated rubber paints which are resistant to water and chemicals, ii) Urethane oils, iii) Ship paints, iv) Anticondensation paints, v) Antifouling paints.	02 M
Q.1	(f) Ans.	<b>Define bagasse. State its uses.</b> Bagasse is the fibrous residue left after sugar cane stalks are crushed to extract juice. It is a waste by – product of sugarcane production process. Uses: i) Sugarcane bagasse ash can replace cement in concrete due to its excellent binding properties. This improves the quality and cost of material ii) It is mixed with mortars to be used in making concrete pavers, roof tiles etc. iii) When mixed with lime, it acts as a chemical stabilizer in compacted soil blocks. iv) It improves the mechanical properties in concrete formulation.	01 M  Any two 01 M
Q.1	(g) Ans.	<b>Enlist any two natural and artificial construction materials.</b> Natural construction materials- Stone, Timber, Lime , Soil Artificial Construction Materials – Bricks, Tiles, Cement, Aggregate, Artificial Sand, Plywood and Glass	01 M 01 M
Q.2		<b>Attempt any THREE of the following</b>	<b>(12)</b>



Q.2	(a)	<b>Explain the criteria for selection of construction materials for different civil engineering Structures on basis of their strength and durability.</b>	
	Ans.	The material must be selected for their ability to support the loads imposed by the building over the whole life of the building. An appropriate structural system and correct selection of structural materials can reduce excess material use and waste and increase the building adaptability for other uses. Highly durable material may provide the most sustainable solution if it reduces maintenance or replacement requirements but a material should also be appropriate to the expected life of the building. The construction material should have sufficient strength to carry the prescribed load.	02 M  02 M
Q.2	(b)	<b>State the requirements of a good building stone.</b>	
	Ans.	1) It should have high crushing strength more than 100 N/mm <sup>2</sup> . 2) It should have high durability. 3) Hardness should be more than 14. 4) It should have pleasing appearance and should retain its colour for longer time. 5) Water absorption should be less than 0.6% by weight after 24 hours. 6) It should be easy for cutting and dressing. 7) It should have good fire resistance. 8) Specific gravity should be more than 2.7. 9) It should be economical and easily available. 10) It should have good weathering resistance. 11) It should have high impact value and high toughness index.	Any four 01 M for each
Q.2	(c)	<b>Describe the scope of construction material in environmental engineering.</b>	
	Ans.	The goal of environmental engineering is to ensure the community development and the sensible use of water, land and air resources to make them sustainable. This goal is achieved by managing these resources so that environmental pollution and degradation is minimized. For managing various construction activities related to environmental engineering for water supply and sewerage, water treatment, sewage treatment, solid waste management practices, various types of material are required. In addition, other activities of wastewater treatment facilities in municipalities and industries, disposal and reuse of waste water and the collection, transportation, processing and disposal of solid wastes various types of construction material such cement, sand, aggregate, stone, lime, iron, glass, artificial sand, waterproofing and damp proofing material of required quality and quantity is used.	04 M
Q.2	(d)	<b>Define lime and explain manufacturing of lime by continuous kiln with neat sketch.</b>	
	Ans.	<b>Lime:</b> The moisture and carbon dioxide are removed from the limestone by the process of calcination and the product which is remained after removing the moisture and carbon dioxide is termed as lime. The chemical composition of lime is CaO i.e. Calcium oxide <b>Manufacturing of Lime by Continuous Kiln:</b> These kilns are used when lime is to be manufactured on large scale. The is kiln is a vertical structure line with fireclay bricks. It is usually built on a slope to facilitate continuous removal of lime. Alternate layers of limestone and coal (sometimes wood) are charged from the top and lime is removed from an opening at the ground level. Limestone free from earth or impurities are broken into small pieces to about 5 cm gauge. Alternate layers of 75 mm stone and 6mm coal dust are fed into the kiln. Fire is lighted in the kiln and as the calcination progresses lime is continuously withdrawn	01 M  02 M

and fresh charge is fed from the top. Air is required for combustion enters the same opening through which lime is removed; thus it gets heated while the lime is cooled. Burnt material is drawn out daily and fresh charge of limestone and fuel is added from the top. Over burnt pieces are discarded whereas the under burnt ones reloaded into the kiln. Lime obtained from such kiln is not of high purity as it gets mixed with as of fuel. Its thermal efficiency is however higher than of other furnaces.

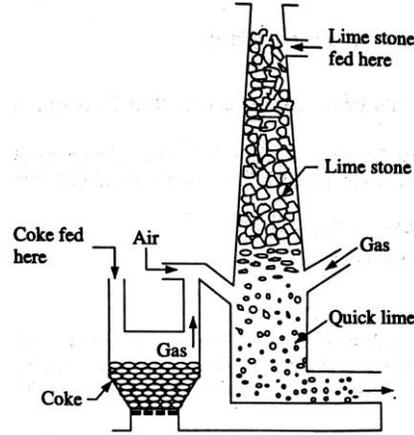


Fig. : Continuous kiln

01 M

Q.3

**Attempt any THREE of the following**

(12)

Q.3

(a)  
Ans.

**Explain the manufacturing of burnt clay brick.**

Manufacturing of Burnt Clay Brick consists of a) Preparation of clay. B) Moulding c) Drying d) Burning.

**a) Preparation of Clay:**

- Unsoiling of clay consists of removal of vegetations and organic matter.
- Clay is manually excavated or mechanically up to certain height above ground level.
- For obtaining better quality of bricks additions of chalk and sand is done.
- The heap of clay is exposed to atmospheric agent and bacteria for at least a month.
- A homogenous mass of clay is prepared with uniform consistency.

**b) Moulding: -**

- The clay is either hand moulded or machine moulded.
- In hand moulding a mould of wood or iron are used.
- Hand moulding is used in case of soft clay and is done on ground on the table.
- In table moulding the bricks are laid on pallet board and the bricks are prepared.

**c) Drying: -**

In drying the moisture is removed from bricks without damaging the bricks. Bricks are dried by natural drying or by artificial drying.

**i) Natural drying:** - Wet bricks are arranged in rows on ground on open air keeping space in between bricks for circulation of air.

**ii) Artificial Drying:** - It is used when large quantities of bricks are required in shortest time. In artificial drying special furnace are built or hot flue gases from cooling chamber are used

**d) Burning:-**

Burning is done to remove water from clay and to impart hardness and strength in bricks. Due to burning of the density of bricks is increased and water absorption capacity of bricks is decreased.

01 M for each

Burning can be done in two ways a) Clamps b) Kilns.  
A) Clamps: -In clamps, bricks and fuel are placed in alternate layers in open air and good quality of bricks are obtained.  
B) Kilns: - the bricks are stacked without any fuel and burnt from fire places and produces better quality of bricks.

Q.3 (b)  
Ans.

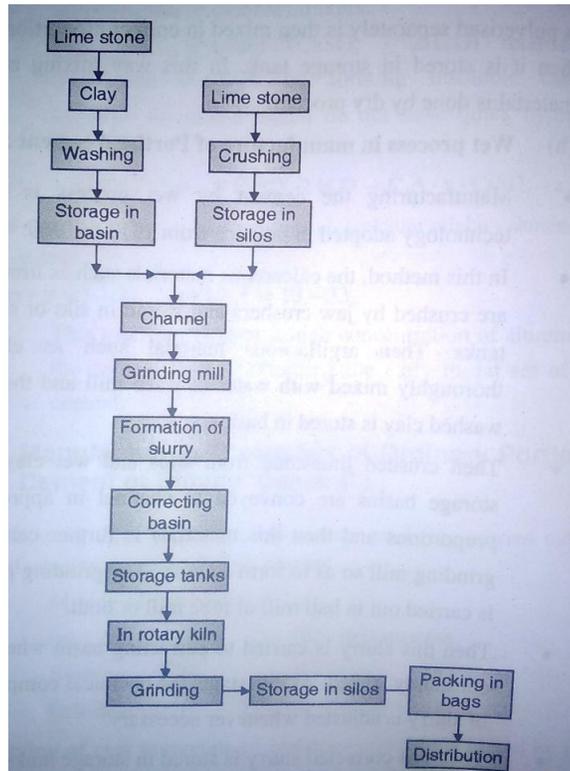
**Enlist the different sound insulating materials and also state their suitability.**  
**Different sound insulating materials:**  
1) Asbestos , 2) rock wool , 3)glass ,4)silk, 5)Han felt  
6) Mineral wool boards, 7)cane fibers. 8) Acoustical plaster boards and tiles  
9)Corkoustics 10) Celotex building boards.11) Glass fibers.  
**Suitability of sound insulating materials.**  
1) In Porous materials with a solid skeleton, sound is absorbed as a result of viscous friction inside the porous. Light weight concrete with porous aggregate, foam glass, mineral wool, glass wool in the form of strips, slabs, roll, mats and strips are suitable materials used in various constructions underneath the floor.  
2) Porous jagged structures, based on plastics, rubber are available in the form of strips and liners. They provide sound proofing of reinforced concrete floors.  
3) Loose composition, like artificial and natural sand, slag is used as fillers.  
4) Panel material like veneer panel, rigid wood fibre board, are suitable for interior finishing of buildings to improve acoustic properties by dampening noises.  
5) Baffle materials which includes, thin panels from veneer, solid card board are suitable for facing suspended ceilings to insulate noise.  
6) Acoustic tiles and acoustic plaster are suitable where absorption of sound required from tile to tile should be uniform.

02 M

Any four  
1/2 M  
for each

Q.3 (c)  
Ans.

**Draw the flow chart of manufacturing of cement by wet process.**  
Flow chart of manufacturing of cement by wet process.



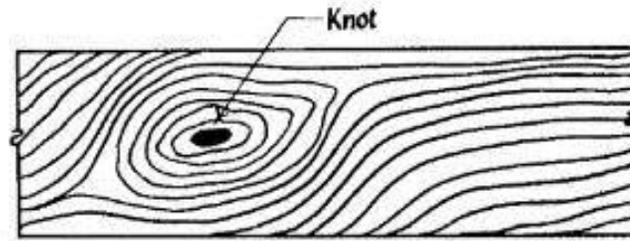
04 M



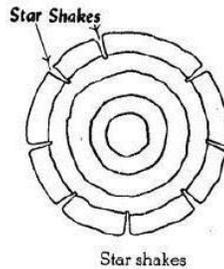
<b>Q.3</b>	(d) Ans.	<b>State the uses of veneers and Laminated Boards:</b> <b>Uses of Veneers:</b> 1) They are used for making plywood. 2) They are used for making particle boards. 3) They are used for making decorative laminates. 4) They are used for making sunmica and formica. <b>Uses of Laminated boards:</b> 1) It is used in kitchen and office furniture. 2) It is used to prepare table tops and door wardrobes. 3) It is used for making false ceiling. 4) It is used for wall cladding.	02 M  02 M
<b>Q.4</b>		<b>Attempt any THREE of the following</b>	<b>(12)</b>
<b>Q.4</b>	(a) Ans.	<b>Enlist the methods of quarrying and explain any one in brief.</b> The process of taking out stones from natural rock beds is known as quarrying of Stones. Methods of Quarrying of Stones: - 1. Digging 2. Heating 3. Wedging 4. Blasting 1. <b>Digging</b> – Digging or excavation of stones is carried out with the help of suitable tools such as hammer, shovels, crowbars and pick-axes Only those stones which occur in the form of detached nodules, buried in earth can be recovered by this method. 2. <b>Heating</b> –: In this method, the top surface of rock is heated, by placing pieces of wood, or by piling a heap of fuel over the surface for some hour. Due to unequal, upper layer of rock separates out. It is indicated by dull bursting noise. The detached portion of rock is then removed by suitable instruments This method is used, where stones are required in pieces like road metal, railway ballast. 3. <b>Wedging</b> – When rock bed consists of natural fissures or cracks wedging method is used. Sometimes artificial holes are drilled for wedging. In this method, if rock surface contains cracks or fissures then steel wedges or points are driven through such cracks by means of hammer. The blocks of stones are removed with the help of suitable instruments. Wedging is adopted for stratified rocks which are comparatively soft such as laterite, marble, limestone, sandstone. 4. <b>Blasting</b> - this method is used for hard fissure fewer rocks using explosives. In this method explosives are used convert rocks in to small pieces. The stones obtained by blasting are used in railways, concrete. Detonators and explosives like blasting powder or dynamites are commonly used in blasting. Large blocks of stones are obtained by using blasting powder but small blocks are obtained by using dynamite.	02 M  02 M for any one.
<b>Q.4</b>	(b) Ans.	<b>State the characteristics of good brick.</b> <b>Characteristics of good brick:</b> 1. The brick should have uniform size and plane, rectangular surfaces with parallel sides and sharp straight edges. 2. The brick should have a uniform deep red or cherry color. 3. The brick should have uniform texture. 4. The surface should not be too smooth to cause slipping of mortar. 5. Water absorption should not be more than 20% of its dry weight. 6. Crushing strength should not be less than 10N/mm <sup>2</sup> . 7. The brick should be so hard that when scratched by a finger nail no impression	1/2 M For each.



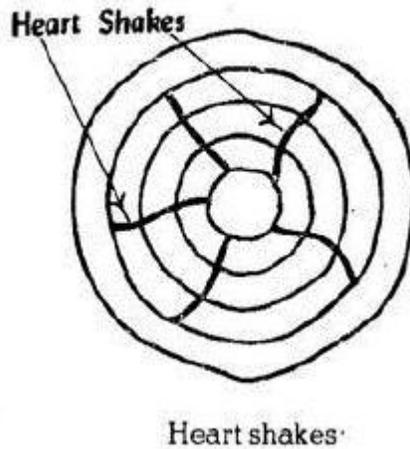
		is made. 8. When two bricks are struck together, a metallic sound should be produced.	
Q.4	(c) Ans.	<b>Describe in brief termite proofing.</b> <b>Termite proofing:</b> <ul style="list-style-type: none"><li>• In building construction, wooden materials are used for doors, window frames, furniture, electric boxes etc. These have tendency to be attacked by termites or white ants and make holes under the moist conditions, Hence to protect wooden items from such attack is known as termite proofing.</li><li>• Dry wood termites make their houses in wood in the form of tubes and damage the wooden articles.</li><li>• Subterranean termites live in soil in favorable conditions and damage building parts by building nest in the form of colonies. Their growth is very fast and special treatment is required to protect the building parts.</li><li>• To save wooden and building parts from attack of termites, anti-termite materials are available in the market like, DDT, BHC, Aldrin , Heptachlor, Chlordane etc.</li><li>• If there is a growth of termite in the soil below building, then the holes are made around the building and then termite proof chemicals are put into those holes.</li></ul>	Any four 01 M for each
Q.4	(d) Ans.	<b>Define plaster of Paris. State its uses.</b> A process which involves exposing the gypsum to very high temperature to create calcium sulphate and then grinding it into a fine white powder is known as plaster of Paris. <b>Uses of Plaster of Paris:-</b> <ul style="list-style-type: none"><li>• It is used as architectural decoration for formation of columns, and other decorative</li><li>• Features in interior finish.</li><li>• It is used by orthopedic surgeon for setting bones.</li><li>• It is used for wall plaster, wall boards, structural tiles, statue etc.</li><li>• It is used for metal filling etc.</li></ul>	02 M  02 M
Q.4	(e) Ans.	<b>State the advantages and disadvantages of pre-cast concrete.</b> <b>Advantages of precast concrete products:</b> <ol style="list-style-type: none"><li>1. The concrete of superior quality is produced by strict quality control.</li><li>2. It is not necessary to provide joints in the pre-cast construction.</li></ol> <b>Disadvantages of precast concrete products:</b> <ol style="list-style-type: none"><li>1. If not properly handled, the pre-cast concrete may be damaged during transport.</li><li>2. It becomes difficult to produce satisfactory connections between the pre-cast members.</li></ol>	02 M  02 M
Q.5		<b>Attempt any THREE of the following</b>	<b>(12)</b>
Q.5	(a) Ans.	<b>Explain defects in timber with neat sketch.</b> Types of Defects in timber are grouped into the following divisions. The main natural forces responsible for causing defects in timber are abnormal growth and rapture of tissues. <ol style="list-style-type: none"><li>1. <b>Knots:</b> Bases of branches or limbs which are broken or cut off from the tree as shown in the figure.</li></ol>	



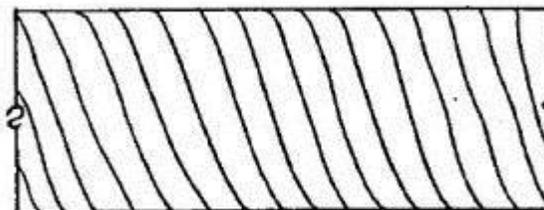
2. **Star Shake:** These are radial splits or cracks widest at the circumference and get diminishing towards the center of the tree. These may arise mostly from severe frost and fierce heat of sun.



3. **Heart Shakes:** These are the splits or cracks widest at the center and diminishing towards the outside circumference, this defect usually occurs in over-matured trees and is probably caused due to the shrinkage of heart wood.



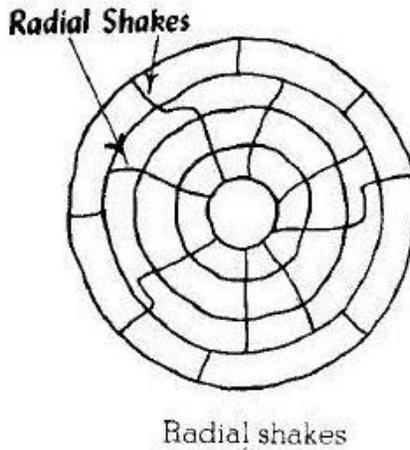
4. **Twisted fibers:** caused by twisting of young trees by fast blowing wind as shown in figure.



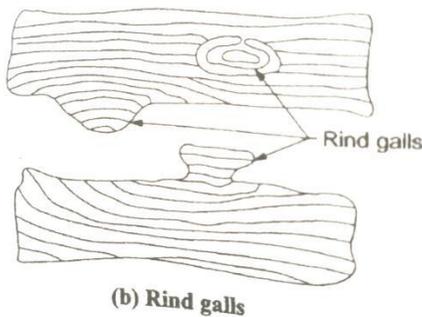
Twisted fibres

Any four  
01 M for  
each

5. **Radial Shake:** These are similar to star shakes but they are fine, irregular and numerous. They usually occur when tree is exposed to sun for seasoning after being felled down.



6. **Rind galls:** Rind means bark and gall indicates abnormal growth and peculiar curved swellings found on the body of a tree.



**Q.5** (b) *Explain various types of Cement and also state the uses.*

Ans. Following are the various types of cement:

**1. Ordinary Portland Cement:-**

This Cement is the basic Portland cement and is used in general for most of the construction work. this cement is used at situations when there is no exposure to Sulphates in the soil or ground water. This is the most common type of cement used for all types of construction works.

**Uses:**

- 1) It is used in important structures, where great strength is required such as heavy buildings and bridges etc.
- 2) It is used for plastering and painting.
- 3) It is used for drainage & water supply works.
- 4) It is used for making cement mortar, plain concrete, reinforced concrete etc.

**2. White Cement:-**

White cement can be produce similar to O.P.C. except by restricting the amount of iron oxide by keeping it as low as possible. this can be archived by proper selecting the raw materials like chalk and limestone having low iron and white clay content.

**Uses:**

Any two  
02 M for  
each



- 1) It is used for floor finishing.
- 2) It is used for ornamental works.
- 3) It is used for plastering.
- 2) In swimming ponds white cement is used to replace glazed tiles. It is used for fixing marbles and glazed tiles.

**3.Coloured cement:**

Coloured cement can be produced by adding color pigments into the ordinary Portland cement.in this type of cement white cement or OPC is used as a base and the coloured pigments varying from 2% to 10% depends upon the darkness of the cement added into it.

**Uses:**

- 1) It is used for finishing of floors.
- 2) It is used for painting.
- 3) It is used for finishing of walls, roofs and window sills.

**4.quick setting cement:**

This cement is produce by adding a small percentage of aluminum sulphate and by finely grinding the cement. the addition of aluminum sulphate and fineness of grinding are responsible for accelerating the setting action of cement. The setting action of cement starts within five minutes after addition of water and it becomes hard like stone within 30 minutes.

**Uses:**

- 1) It is used in under water concreting work.
- 2) It is used in repairing as well as maintenance work.

**5. Rapid hardening Cement:**

The initial and final setting time of this cement is same as ordinary cement. but it attains high strength in early days. It contains high percentage of tricalcium silicate.

**Uses:**

- 1) It is used when higher strength at early stage is required and formwork is to be removed earlier.
  - 2) It is generally used for construction of road pavement so that road can be opened for traffic without delay.
  - 3) It is used for manufacturing of precast elements like slab panels, blocks, fencing posts, electric poles etc. So that moulds can be released quickly and reused.
  - 4) It also can be used for cold weather concreting to protect concrete from freezing.
- This cement should not be used for massive concrete structures like dams, bridge abutments, retaining walls etc. because it evolves much heat.

**6.Expanding cement:**

This type of cement is produced by adding an expanding medium like sulpho-aluminate and a stabilizing agent to the ordinary cement.

**Uses:**

It is used for making pre cast products.

**Q.5** (c) **Define artificial Sand. State the Uses of artificial Sand.**

Ans.

**Definition of Artificial Sand:**

The sand which is obtained from stone crusher after crushing the natural stone.

**Uses of Artificial Sand:**

- 1.It is used in manufacturing of concrete.

02 M





Q.6	(a) Ans.	<p><b>Define lime mortar. Explain its Properties.</b></p> <p><b>Lime Mortar:-</b>Lime Mortar is a paste prepared by adding required quantity of water to a mixture of lime and fine aggregate like sand.</p> <p><b>Properties of Lime Mortar :</b></p> <ol style="list-style-type: none"><li>1) It should be capable of developing good adhesion with the building units such as Bricks, stones, etc.</li><li>2) It should be capable of developing the designed stresses.</li><li>3) It should be capable of resisting penetration of rain water.</li><li>4) It should be cheap.</li><li>5) It should be durable.</li><li>6) It should be easily workable.</li><li>7) It should not affect the durability of materials with which it comes into contact.</li><li>8) It should set quickly so that speed in construction may be achieved.</li><li>9) The joints formed by mortar should not develop cracks and they should be able To maintain their appearance for a sufficiently long period.</li></ol>	02 M  Any four ½ M for each
Q.6	(b) Ans.	<p><b>State the uses of fly ash and blast furnace slag.</b></p> <p><b>I) Fly ash</b> The various uses of fly ash are:</p> <ol style="list-style-type: none"><li>1) Concrete production, as a partial substitute material for Portland cement.</li><li>2) For the construction of embankments and other structural fills.</li><li>3) For grouting and flow able fill production.</li><li>4) Waste stabilization and solidification.</li><li>5) For cement clinkers production.</li><li>6) For mine reclamation.</li><li>7) For stabilization of soft soils.</li><li>8) For the road sub base construction.</li><li>9) As fine aggregate substitute material.</li><li>10) For the manufacturing of bricks.</li></ol> <p><b>II) Blast furnace slag-</b> Blast furnace slag can be used for –</p> <ol style="list-style-type: none"><li>1) As a supplementary cementations material either by premixing the slag with Portland cement or hydrated lime to produce blended cement or by adding the slag to Portland cement concrete as mineral admixture.</li><li>2) Air cooled blast furnace slag is used as aggregate material</li><li>3) It is used as a concrete aggregate in construction of bridges.</li><li>4) It is used as an aggregate with asphalt for construction of damp proof course and water proofing.</li><li>5) It is used as insulation in mineral wool, in rail road ballast etc.</li></ol>	Any four 01 M for each  Any four 01 M for each
Q.6	(c) Ans.	<p><b>State the properties and uses of varnishes.</b></p> <p><b>Properties of varnishes:</b></p> <ol style="list-style-type: none"><li>1) It should render the surface glossy.</li><li>2) It should dry rapidly or quickly.</li><li>3) It should not shrink or show cracks after drying.</li><li>4) The protecting film developed by varnish should be tough, hard and durable.</li><li>5) The color of varnish should not fade away when the surface is exposed to atmospheric actions.</li></ol> <p><b>Uses of varnishes.</b></p>	02 M



		1. Protecting of articles against corrosion. 2. Brightening coats of the painted surface. 3. Improving appearance and ornamental gains of wood surfaces.	02 M
Q.6	(d) Ans.	<b>Define rice husk. State the uses of rice husk.</b> <b>Rice Husk:</b> - The outer most layer of paddy grain is called as rice husk. It is separated from Brown rice in rice mill. It has high silica content. Rice Husk is highly resistant to moisture Penetration and fungal decomposition. <b>Uses –</b> 1) In the manufacturing of bricks. 2) In thermal insulation of building, rice husk can be used. 3) The ash produced after the husks have been burned is high in silica, which is Used in production of aggregates and fillers for concrete and board. 4) Used in generation of heat energy, steam energy and electricity generation.	02 M  1/2 M for each