SUMMER– 18 EXAMINATION

Subject Name: CONSTRUCTION MATERIALS **Model Answer** Subject Code: 17209

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.	Answers	Marking Scheme
Q.1		***Attempt any ten of the following:***	***(20)***
	(a) Ans	***Give physical classification of rocks.*** Physical classification of rocks are as follow, **1) Stratified Rocks:** These rocks are having layered structure. They possess planes of stratification or cleavage. They can be easily split along these planes. Sand stones, lime stones, slate etc. **2) Unstratified Rocks:** These rocks are not stratified. They possess crystalline and compact grains. They cannot be split in to thin slab. Granite, trap, marble etc. are the examples of this type of rocks. ***3)*** **Foliated Rocks:** These rocks have a tendency to split along a definite direction only. The direction need not be parallel to each other as in case of stratified rocks. This type of structure is very common in case of metamorphic rocks.	02 M
Q.1	(b) Ans	***Enlist four basic areas of civil engineering.*** Areas of civil engineering are as follow, 1) Surveying 2) Construction Engineering 3) Transportation Engineering 4) Irrigation Engineering 5) Structural Engineering 6) Geo-Technical Engineering 7) Environmental Engineering 8) Quantity Surveying 9) Earthquake Engineering 10) Fluid Mechanics	Any four 1/2 M for each
Q.1	(c) Ans	***Explain igneous rocks in brief.*** Igneous rocks are rocks formed from molten magma. The material is made liquid by the heat inside the Earth's mantle. When magma comes out into the surface of the Earth, it is called lava. Lava cools down to form rocks such as tuff and basalt. Intrusive	02 M

		rocks are made when the magma slowly cools to form rocks under the surface. Granite is one of these.	
Q.1	(d) Ans	***What is meant by dressing of stone?*** Stones obtained from quarrying do not contain required shapes and sizes. So, they are cut into required sizes and shapes with suitable surfaces. This process is called dressing of stones. It is preferable that the stones should be dressed at quarry site which reduces cost of transportation. The weight also gets reduced which is easy for transportation.	02 M
Q.1	(e) Ans	***What are different brand names under which cement is produced in India?*** Different brand names of cement, **1)** Ambhuja **2)** Ultra tech **3)** Banger **4)** Manikgarh **5)** ACC **6)** Shree Cements **7)** Binani Cement ***8)*** Jaypee Cement ***9)*** Birla cement ***10)*** Relience cement and any others.	Any four 1/2 M for each
Q.1	(f) Ans	***Give the standard dimensions for*** ***i) Conventional brick ii) standard brick.*** **i. Conventional Brick:** Length 21 to 25 cm, width 10 to 13 cm and thickness 7.5 to 10 cm. **ii. Standard Brick:** Length 19 cm, width 9 cm and thickness 9 cm	01 M for each
Q.1	(g) Ans	***Enlist major ingredients of cement.*** Following are the major ingredients of cement. 1. Lime (CaO) 2. Silica (SiO_2) 3. Alumina (Al_2O_3) 4. Iron oxide (Fe_2O_3) 5. Magnesia (MgO) 6. Gypsum ($CaSO_4 . 2H_2O$)	Any four 1/2 M for each
Q.1	(h) Ans	***Explain jute as a construction material with uses.*** The natural jute fiber can be the effective material to reinforce concrete strength which will not only explore a way to improve the properties of concrete; it will also explore the use of jute and restrict the utilization of polymer which is environmentally detrimental. Uses: 1) Construction site compounding, scaffold tying, privacy screens 2) Reinforcement material, in stucco work ***3)*** Insulation material.	01 M 01 M
Q.1	(i) Ans	***Define 'damp proofing' and 'water proofing'.*** **Damp Proofing:** Damp proofing in construction is a type of moisture control applied to building walls and floors to prevent moisture from passing into the interior spaces. **Water Proofing:** it is the process of preventing the entry of water in various building elements like terrace, floors, water retaining structures, sanitary blocks etc.	01 M 01 M
Q.1	(j) Ans	***State the names of thermal insulating materials.*** Following are the thermal insulating materials, **1)** Asbestos **2)** Aluminum Foil	

		3) Thermocol **4)** Saw dust **5)** Cork board ***6)*** Foam glass and any other.	Any four 1/2 M for each
Q.1	(k) Ans	***Name any four finishing materials used in building construction.*** Following are the finishing materials used in building construction. **1)** All type of mortar. **2)** Plaster of Paris. **3)** Gypsum **4)** Paints, Distemper and Varnish **5)** Tiles **6)** Glass blocks ***7)*** Cladding materials and any others.	Any four 1/2 M for each
Q.1	(l) Ans	***Give any four properties of plastic paint.*** Following are the properties of plastic paint, **1)** It is quick drying paint. **2)** It has large surface speeding capacity. **3)** It has decorative appearance. **4)** It has good adhesion property to the surface being painted. ***5)*** It is available in market in wide range of shades.	Any four 1/2 M for each
Q.1	(m) Ans	***Give any two uses of granite and marble polishing waste.*** Following are the use of granite and marble polishing waste. **1)** It is used in manufacturing of brick and tiles **2)** It is used for flooring purpose. ***3)*** It is used in self-compacting concrete.	Any two 01 M for each
Q.1	(n) Ans	***Explain any two properties of blast furnace slag.*** Following are properties of blast furnace slag, **1)** It has good abrasion resistance. **2)** It has good soundness characteristics. **3)** It has high load bearing strength. ***4)*** It has lower thermal conductivities.	Any two 01 M for each
Q.2	(a) Ans	***Attempt any four of the following: ,*** ***Write any four criteria for selection of construction materials.*** Following are the factors for selection of construction materials. **1) Carry prescribed loads:** The most significant requirement of a material used in civil engineering project is that it be able to carry the design loads. In other words, the material should have adequate strength. **2) Durability:** Selection of material should be such that it should sustained designed load for design duration or period. It should resist the weathering action causes by wind, rain, snow etc. **3) Economical:** In most of the cases, the cost of raw material account about the finished cost. Obviously the cost of the material is a major factor which influences the choice of the material or process. **4) Environmental friendly:** A construction material should satisfy all strength, serviceability, and architectural requirement and at the same time, must not cause environmental problem. **5) Aesthetically pleasing:** Although most nonstructural materials such as floor coverings, paints, and doors and window are chosen based on aesthetic consideration.	***(16)*** Any four 01 M for each

Q.2	(b) Ans	***Explain the role of transportation engineering in human life.*** Following are the role of civil engineer in the field of transportation engineering. 1) The quality of society is directly depends on the quality of its transportation system. 2) Civil engineer work to move people, goods and materials safely and efficiently from one place to another place. 3) Civil engineer design, construct and maintain all types of transportation facilities, including airport, highway. Railway track and docks and harbors. 4) Civil engineers are also involved in the construction of bridge tunnels etc. 5) Remote areas and rural areas become accessible and communicable if connected by proper means of transport.	Any four 01 M for each
Q.2	(c) Ans	***What is quarrying of stone and explain different methods of quarrying from bedrock?*** The process of removing stones from the natural rock beds is called as quarrying of stones. The process of removing the stones depends on mode of the occurrence, strength, hardness and shape of desired product. Methods of Quarrying **1) Digging:** When the quarry consists of small and soft pieces of stones, then digging method is preferably used to remove the stones. For removing the stones, tools like pick-axe, hammer and crowbar etc. are mainly used. **2) Heating:** When the natural rock bed is horizontal and small in thickness, then rock are splitted up into small pieces by the process of heating. **3) Wedging:** When the hard rock consists of natural fissures, cracks, then wedging method is used to remove the stones from the hard rocks. When natural fissures are absent, then artificial fissure are made by drilling holes. Rocks like marble, sandstone, and laterite are treated by the method of wedging. **4) Blasting:** When the rock are much hard, compacted and fissure less, then it is very difficult to remove the stones by the method of heating and wedging. That time, the method of blasting with the help of explosives is preferable employed so as to covert the rock mass into smaller pieces of stones.	02 M Any two 01 M for each
Q.2	(d) Ans	***Enlist properties of bituminous materials used in civil engineering works.*** Following are the properties of bituminous materials, 1) It is mostly solid or semi-solid available in state. 2) It is completely soluble in Carbone-bisulphide. 3) It is black or brownish black in colure. 4) It has adhesive properties when comes in contacted with heat. 5) When heated, it undergoes malting and gives distinctive odour.	Any four 01 M for each
Q.2	(e) Ans	***What' is soil? Explain suitability of sand and clay in the construction work.*** **Soil:** The loose unconsolidated, inorganic material on the earth's crust produced by disintegration of rocks, overlaying hard rock with or without organic matter is called soil. **Suitability of sand and clay:** - **Sand:** Sand can be obtained from the natural river bed. Now-a-days artificial sand also termed as crushed sand is also being used in various building construction work. Sand is more suitable martials for making mortar and concrete. Hence sand is one of the important ingredients of mortar and concrete. **Clay:** Clay has particle size range from 4 to 200 micron clay is more suitable in embankment fills and retaining pond beds. Clay is also suitable for foundation but require compaction. Clay provides the moderate supports.	02 M 01 M for each
Q.2	(f) Ans	***Give the procedure of field slaking of lime for plaster or white washing.*** Field slacking as per the IS: 1635-1992.	

		It is important that in tank slacking, lime should be added to water and not water to lime. As lime slacks with evolution of heat, water being to boil. More lime and water may be added till the requisite quantity of lime has been slacked. After the apparent slacking is over, stirring should be continued for the some further to sure that the whole of the lime has been fully slacked.	04 M
Q.3		***Attempt any four of the following:***	***(16)***
	(a)	***Give in detail the following constituents of brick clay:***	
		i) Useful constituents ii) Harmful constituents.	
	Ans	**i) Useful Constituents:**	
		a) **Silica:** Brick earth should contain about 50 to % of silica. It is responsible for preventing cracking, shrinking and warping of raw bricks. It also affects the durability of bricks. If present in excess, then it destroys the cohesion between particles and the brick becomes brittle.	
		b) **Alumina:** Good brick earth should contain about 20% to 30% of alumina. It is responsible for plasticity characteristic of earth, which is important in moulding operation. If present in excess, then the raw brick shrink and warp during drying.	Any two 01 M for each
		c) **Lime:** The percentage of lime should be in the range of 5% to 10% in a good brick earth. It prevents shrinkage of bricks on drying. It causes silica in clay to melt on burning and thus helps to bind it. Excess of lime causes the brick to melt and brick loses its shape.	
		d) **Iron Oxide:** A good brick earth should contain about 5% to 7% of iron oxide. It gives red colour to the bricks. It improves impermeability and durability. It gives strength and hardness. If present in excess, then the colour of brick becomes dark blue or blackish. If the quantity of iron oxide is comparatively less, the brick becomes yellowish in colour.	
		e) **Magnesia:** Good brick earth should contain less a small quantity of magnesia about1% Magnesium in brick earth imparts yellow tint to the brick. It is responsible for reducing shrinkage. Excess of magnesia leads to the decay of bricks.	
		ii) Harmful Constituents:	
		a) **Lime:** A small quantity of lime is required in brick earth. But if present in excess, it causes the brick to melt and hence brick loses its shape. If lime is present in the form of lumps, then it is converted into quick lime after burning. This quick lime slakes and expands in presence of moisture, causing splitting of bricks into pieces.	
		b) **Iron Pyrites:** The presence of iron pyrites in brick earth causes the brick to get crystallized and disintegrated during burning, because of the oxidation of the iron pyrites. Pyrites discolourise the bricks.	Any two 01 M for each
		c) **Alkalis:** These are existing in the brick earth in the form of soda and potash. It acts as a flux in the kiln during burning and it causes bricks to fuse, twist and warp. Because of this, bricks are melted and they lose their shape.	
		d) **Pebbles:** Pebbles in brick earth create problem during mixing operation of earth. It prevents uniform and through mixing of clay, which results in weak and porous bricks. Bricks containing pebbles will not break into shapes as per requirements.	
Q.3	(b)	***Explain any four common field tests on bricks.***	
	Ans	Following are field test carried out for brick.	
		1) In this test, the brick must be well burnt, copper coloured or reddish in colour, free from cracks and with sharp edges.	Any four 01 M for each
		2) In this test, a scratch is made on brick surface with the help of a finger nail. If no impression is left on the surface, brick is treated as to be sufficiently hard.	

		3) In this test, two bricks are struck with each other, then it should give a clear metallic ringing sound, it indicated brick is well burnt. 4) In this test, the burnt clay bricks are dropped flat on hard ground from a height of about 1m, it should not crush into pieces, it indicate good strength of brick. 5) In this test, the bricks are soaked for 24 hours, no white salts deposits should be seen after drying; indicates free lime in the bricks.	
Q.3	(c) Ans	***State the importance of flooring files and roofing tiles in building and give two names of flooring and roofing files.*** **1) Flooring tiles:** These tiles have very attractive look and available in various shade of colour. They have very light weight as compare to mosaic tiles or marble or granite. They are scratch proof and anti-slip. Popular names of tiles are ceramic, marbonite, granomite etc. **2) Roofing tiles:** These tiles are mostly used for covering the pitched roof or slope roof. Various types of roof tiles are available in market in the name of Allahabad tiles, corrugated tiles, Guna tiles, Mangalore tiles, Flemish tiles, Flat tiles, Pan tiles, Pot tiles etc.	02 M 02 M
Q.3	(d) Ans	***What are different properties of glass?*** Following are properties of glass: 1) Glass absorbs, refracts light. 2) Glass transmits light. 3) Glass is harder but extremely brittle. 4) Glass is transparent and translucent. 5) Glass can take up high polish. 6) Ordinary chemical does not easily effect on glass. 7) Glass is available in plenty and beautiful colours and shades. 8) Glass is an excellent electrical insulator in solid state.	Any four 01 M for each
Q.3	(e) Ans	***Define aggregate and give the properties of fine aggregate and course aggregate.*** **Aggregate:** It is a granular material, such as sand, gravel, crushed stone, crushed hydraulic-cement concrete, or iron blast-furnace slag, used with a hydraulic cementing medium to produce either concrete or mortar. **Properties of Fine Aggregate:** 1) Size: The largest size which comes under the range of fine aggregate is 4.75 mm. 2) Shape: Fine aggregate should have a rounded shape. 3) Surface texture: Generally smooth in surface texture. 4) Water absorption: Water absorption is kept low. **Properties of Course Aggregate:** 1) Size: The smallest size which comes over the range of course aggregate is 4.75 mm. 2) Shape: In general, angular aggregate is preferable to rounded and smooth aggregate. 3) Surface texture: The surface of the aggregate may be smooth, polished, rough or dull *4)* Water absorption: Water absorption is kept low. The water absorption is depending upon the porosity of aggregate.	02 M Any two 1/2 M for each Any two 1/2 M for each
Q.3	(f) Ans	***State the advantages of artificial sand over natural sand (any four).***	01 M for each

Sr. No.	Natural Sand	Artificial Sand
1.	Sand obtained from pits, shores, river beds, sea bed is known as natural sand.	Sand obtained by crushing natural stone and grading properly through sieves is known as artificial sand.
2.	Silt in present in more percentage.	Silt is negligible.

		3.	Natural sand is not available during rainy season, when river are flooded.	It is available during rainy season also, when river are flooded.
		4.	It gives less compressive strength than artificial sand.	It gives more compressive strength.
Q.4		***Attempt any four of the following:***		***(16)***
	(a) Ans	***Explain any two different artificial timber based products.*** **1) Plywood:** Plywood is made by gluing together the thin sheet of veneers. The sheets are kept one over the other such that the grains of one layer are at right angle to the other. So that the movement in the both direction is reduced when the load is applied on sheet. ***2)*** **Particle Board:** In the manufacturing of particle board, chips or particles of low grade wood, smaller logs obtained from the top of tress are randomly mixed with strong adhesive and then compressed together under high pressure to from a particle board.		02 M 02 M
Q.4	(b) Ans	***Define: i) Asphalt ii) Tar; State their applications*** **i) Asphalt:** The asphalt is a mixture which consists of alumina, lime, silica and asphaltic bitumen. At low temperatures, it is in solid state and at high temperatures it is in liquid state. **Application:** The primary use (70%) of asphalt is in road construction, where it is used as the glue or binder mixed with aggregate particles to create asphalt concrete. Its other main uses are for bituminous waterproofing products, including production of roofing felt and for sealing flat roofs. **ii) Tar:** A dark, thick flammable liquid distilled from wood or coal, consisting of a mixture of hydrocarbons, resins, alcohols, and other compounds. **Application:** It is used in road-making and for coating and preserving timber. For bituminous water proofing product like production of roofing felt and for sealing of flat roofs. It is used in marine industries.		01 M 01 M 01 M 01 M
Q.4	(c) Ans	***State the requirements of good building stone.*** Following are requirement of building stone. **1)** It should have high crushing strength should be greater than 100 N/mm2. **2)** The structure of the stone should be unstratified. **3)** It should have equigranular structure. **4)** It should have high specific gravity ranges from 2.4 to 2.8 **5)** It should have low water absorption. **6)** It should have better resistance abrasion. **7)** It should be durable. **8)** It should be easily carved and dressed. **9)** It should be polished properly. ***10)*** It should have better appearance and colour.		Any four 01 M for each
Q.4	(d) Ans	***Suggest the treatment for the following:*** ***i) Water leakages in the slab ii) Building to save from white ants*** ***iii) To reduce unwanted heat iv) To reduce noise in particular area.*** **1)** Water leakage in the slab: Water proofing treatment. **2)** Building to save from white ants: Termite proofing treatment. **3)** To reduced unwanted heat: Thermal insulation treatment. **4)** To reduce noise in particular area: Sound insulation treatment.		01 M for each

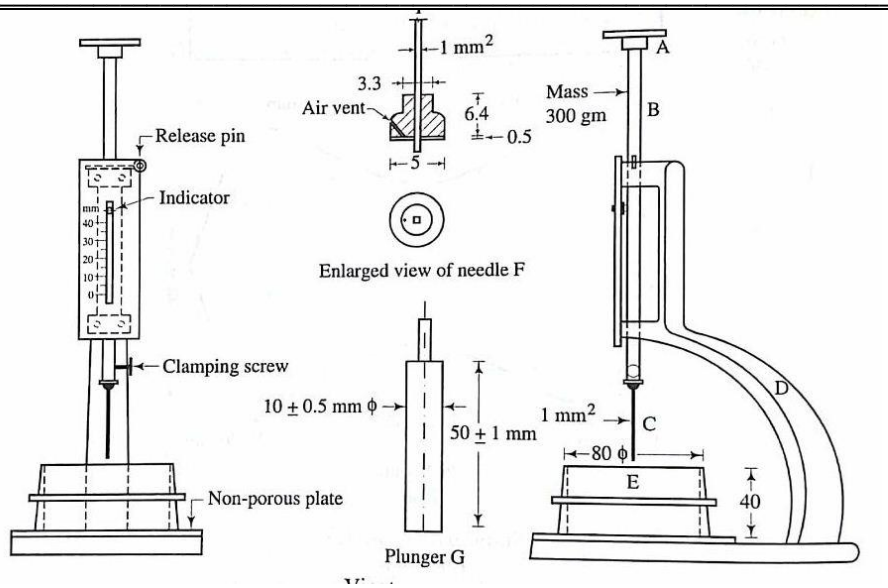
Q.4	(e) Ans	***Write the needs of termite proofing and sound insulating materials*** **Need of termite proofing materials:** Termite proofing is need to prevent or to control the growth of dry wood termite which cause great damage to buildings in coastal areas. They live in dry wood building nest and destroy the wood gradually. Door window which is made by wood will not get affected, concrete will not get damaged and furniture will not get damaged. **Need of sound insulating materials:** When the sound intensity is more and if it is great nuisance to the particular area, then area or room duly sound insulated. Sound insulation plays a vital role in the building construction. Especially in studio, cinema theater and reading hall, class room and where the more concentration is required.	02 M 02 M
Q.4	(f) Ans	***Explain any four properties of geosynthetic material and its application in construction*** **Properties of Geo-synthetic:** **1)** Good flexibility **2)** Excellent filtration characteristics **3)** High water permeability **4)** Excellent mechanical properties **5)** Can be welded together **6)** Does not form by-products **7)** High resistance to climate condition **8)** High resistance to chemical and biological attack **9)** Chemically ultraviolet stabilized. **Application of Geo-synthetic materials:** **1) Road Works:** The basic principles of incorporating geotextiles into a soil mass are the same as those utilized in the design of reinforced concrete by incorporating steel bars. The fabrics are used to provide tensile strength in the earth mass in locations where shear stress would be generated. Moreover, to allow rapid dewatering of the roadbed, the geotextiles need to preserve its permeability without losing its separating functions. Its filtration characteristics must not be significantly altered by the mechanical loading. **2) Railway Works:** The development of the railway networks is being greatly boosted by the present state of economy because of their profitability in view of increasing cost of energy and their reliability as a result of the punctuality of trains even in the adverse weather conditions. The woven fabrics or non-woven are used to separate the soil from the sub-soil without impeding the ground water circulation where ground is unstable. **3) River Canals and Coastal Works:** Geotextiles protect river banks from erosion due to currents or lapping. When used in conjunction with natural or artificial enrockments, they act as a filter. For erosion prevention, geotextile used can be either woven or nonwoven. The woven fabrics are recommended in soils of larger particle size as they usually have larger pore size. Nonwovens are used where soils such as clay silt are formed. Where hydrostatic uplift is expected, these fabrics must be of sufficiently high permeability. **4) Drainage:** In civil engineering, the use of geotextiles to filter the soil and a more or less single size granular material to transport water is increasingly seen as a technically and commercially viable alternative to the conventional systems. Geotextiles perform the filter mechanism for drainages in earth dams, in roads and highways, in reservoirs, behind retaining walls, deep drainage trenches and agriculture. **5) Agriculture:** It is used for mud control. For the improvement of muddy paths and trails those used by cattle or light traffic, nonwoven fabrics are used and are folded by overlapping to include the pipe or a mass of grit.	Any four 1/2 M for each Any four 1/2 M for each

		6) Stabilization: The geotextile is then able to allow water from the soft soil to pass into a more freely draining material. This consolidates the bottom layer, which strengthens it and makes it a more reliable base. **7) Reinforcement:** The geotextile is a source of strength rather than strengthening the bottom soil as in stabilization. That also means that rather than being placed on top of a layer that needs to be strengthened, reinforcement applications are accomplished by placing the layer within the weak layer. In this way, reinforcement through geotextiles is similar to reinforcement techniques for other materials, like concrete.	
Q.5		***Attempt any four of the following:***	***(16)***
	(a) Ans	***What are the ingredients of good mortar and explain how you decide good mortar.*** **The good mortar consists of the following material:** 1) Good quality Cement 2) Good quality Sand 3) Good quality water free from clay, earth and other impurities. 4) Lime (according to need) 5) Surkhi (according to need) **The mortar may be decided as good mortar, if possesses the following properties:** 1) It should be capable of developing good adhesion with the building units such as bricks, stones, etc. 2) It should be capable of developing the designed stresses. 3) It should be capable of resisting penetration of rain water. 4) It should be cheap. 5) It should be durable. 6) It should be easily workable. 7) It should not affect the durability of materials with which it comes into contact. 8) It should set quickly so that speed in construction may be achieved. ***9)*** The joints formed by mortar should not develop cracks and they should be able to maintain their appearance for a sufficiently long period.	Any four 1/2 M for each Any four 1/2 M for each
Q.5	(b) Ans.	***State the properties of good timber.*** Following are the characteristics or qualities of a good timber: 1) Appearance: A freshly cut surface of timber should exhibit hard and shining appearance. 2) Colour: The colour of timber should preferably be dark. 3) Defects: A good timber should be free from serious defects such as dead knots, flaws, shakes etc. 4) Durability: A good timber should be durable. 5) Elasticity: This is the property by which timber returns to its original shape when load causing its deformation is removed. 6) Fibres: The timber should have straight fibres. 7) Fire resistance: The timber is a bad conductor of heat. A dense wood offers good resistance to the fire and it requires sufficient heat to cause a flame. 8) Hardness: A good timber should be hard i.e. it should offer resistance when it is being penetrated by another body. 9) Mechanical Wear: A good timber should not deteriorate easily due to mechanical wear or abrasion. 10) Shape: A good timber should be capable of retaining its shape during conversion or seasoning. 11) Smell: A good timber should have sweet smell.	Any four 01 M for each

		12) Sound: A good timber should give out a clear ringing sound when struck. A dull heavy sound, when struck, indicates decayed timber. 13) Strength: A good timber should be strong for working as structural member such as joist, beam, rafter etc. 14) Structure: I be should be uniform. 15) Toughness: A good d be should be tough i.e. it should be capable of offering resistance to the shocks due to vibrations 16) Water permeability: A good timber should have low water permeability which is measured by the quantity of water filtered through a unit surface area of specimen of wood. 17) Weathering effects: A good timber should be able to stand reasonably the weathering effects. 18) Weight: The timber with heavy weight is considered to be sound and strong. ***19)*** Working condition: The timber should be easily workable. It should not clog the teeth of saw and should be capable of being easily planed or made smooth.	
Q.5	(c) Ans.	***What are the types of paints used? State suitability of each.*** Following are the different types of paints depending upon their constituents: 1) Aluminium paint: It contains finely ground aluminium in spirit or oil varnish. It is widely used for painting gas tanks, water pipes and oil tanks. 2) Oil Paint: This is ordinary paint and it is generally applied in three coats of varying compositions. The oil paints are used in generaly for all types of surfaces, such as wood work, walls, ceiling, metal work etc. 3) Enamel Paint: It contains white lead, oil, petroleum spirit and resinous material. It can be used for both external and internal walls. 4) Bituminous paint : This type of paint is manufactured by dissolving asphalt or vegetable bitumen in oil or petroleum. It is used for painting iron works under water. 5) Emulsion Paint: It contains binding materials such as polyvinyl acetate, synthetic resins etc. This paint is recommended for use on stucco, bricks and masonry surfaces which contain free alkali. ***6)*** Cement Paint: This paint consists of white cement, pigment, accelerator and other additives. Cements paints are being extensively used for painting plastered brickwork, stone masonry and concrete.	Any four 01 M for each
Q.5	(d) Ans.	***Explain; why you need, agro and industrial waste as construction materials.*** Every kind of material used in construction practices is having specific characteristics. They possess special properties of their own and that is why they are useful in a specific situations. With the development, of construction technological practices, the demand of building materials is increasing day by day. Data shows that there is a considerable amount of shortage of conventional and traditional building materials in India. The building sector and construction industry in increasing tremendously in most of parts of the country. The shortage of building materials can be fulfilled by changing the paradigms of building materials use and nature of technology to be adopted. Over a period of time there arises a shortage of building materials which has led to development of alternate materials from agro-industrial wastes. Introduction of appropriate and innovative technologies for utilizing alternate to basic building materials like bricks, steel and cement, in an effective, efficient and economic manner produced from agricultural and industrial wastes may be the right	01 M 01 M 01 M

		approach to meet the requirement of building materials. These alternate materials are innovative, cost effective and sustainable and more eco-friendly and energy sensitive. That is why we need agro and industrial waste as construction materials.	01 M
Q.5	(e) Ans.	***Write any four applications of construction waste.*** Following are the uses of construction waste: 1) Waste generated from the construction should be recycled and reused. 2) The pieces of bricks, hardened mortar and concrete can be used in the manufacturing of concrete blocks. 3) Waste from the timber, such as saw dust can be used for making light weight concrete. ***4)*** Metal and plastic pieces should be recycled and sent to metal and plastic industries for manufacturing of new product.	01 M for each
Q.5	(f) Ans.	***What is meant by fly ash and state any four properties of fly ash?*** Fly ash is one of the residues generated in combustion and comprises the fine particles that rise with the gas. It is the residue from the combustion of pulverized coal. Fly ash is generally captured by electrostatic precipitators or other particle filtration equipment. **Following are the properties of fly ash:** 1) Fly ash possesses pozzolanic property. 2) Fly ash particles are almost totally spherical in shape. 3) The "Ball-bearing" effect of fly ash particles creates a lubricating action when concrete is in its plastic state. 4) Long term pozzolanic action of fly ash decreases permeability of concrete. ***5)*** Lubricating action of fly ash reduces water content and drying shrinkage of concrete.	02 M Any four 1/2 M for each
Q.6	(a) Ans.	***Attempt any four of the following:.*** ***What are the characteristics of good brick earth?*** Following are the constituents or characteristics of good brick earth: **1) Alumina:** It is the chief constituent of every kind of clay. A good brick earth should contain about 20% to 30% of alumina. This constituent imparts plasticity to the earth so that it can be moulded. If alumina is present in excess, with inadequate quantity of sand, the raw bricks shrink and warp during drying and burning and become too hard when burnt. **2) Silica:** It exists in clay either as free or combined. As free sand, it is mechanically mixed with clay and in combined form, it exists in chemical composition with alumina. A good brick earth should contain about 50% to 60% of silica. **3) Lime:** A small quantity of lime not exceeding 5% is desirable in good brick earth. It should be present in a very finely powdered state because even small particles of the size of a pin-head cause flaking of the bricks. The lime prevents shrinkage of raw bricks. **4) Oxides of Iron:** A small quantity of oxide of iron to the extent of about 5% to 6% is desirable in good brick earth. It helps as lime to fuse sand. It also imparts red colour to the bricks. **5) Magnesia:** A small quantity of magnesia in brick earth imparts yellow tint to the bricks and decreases shrinkage. But excess of magnesia leads to the decay of bricks.	***(16)*** Any four 01 M for each
Q.6	(b) Ans.	***Enumerate laboratory test for cement and explain in brief anyone.*** Following are the standard laboratory tests for cement 1) Chemical composition of cement 2) Fineness test of cement	

		3) Compressive strength of cement 4) Consistency test of cement 5) Setting Time of cement (Initial setting time and Final Setting time) 6) Soundness test of cement. **A) <u>FINENESS OF CEMENT:</u>** Fineness of cement indicates the size of grains or particles of cement. Lesser the grain size, fine the cement. Due to small grain size, more surface area is available for contact with water and the reaction of hydration becomes faster, gaining of strength is more rapid and rate of evolution of heat increases. **<u>DETERMINATION OF FINENESS OF CEMENT:</u>** **<u>SIEVE TEST (IS4031, Part I , 1996):</u>** This is a very simple test. The procedure is given below: 1. Weigh 100 gm of cement correctly and take it on a standard IS sieve number 9, i.e. a sieve size 90 microns. 2. Break down any air-set lumps in the sample with fingers. 3. Continuously sieve the sample giving circular and vertical motion of a period of 15 minutes. Mechanical sieving devices may also be used. 4. Weigh the residue left on the sieve. 5. This residue shall not exceed by the limit given below. OPC …… 10 gm Rapid Hardening Cement ……. 5 gm **B) <u>STANDARD CONSISTENCY TEST:</u>** This test must be performed before other remaining tests as the value of standard consistency is required to determine water content to be used in other tests. Consistency of cement refers to the thickness of thinness of cement paste when cement is mixed with water. ***"Standard consistency is defined as that consistency which will permit a standard Vicat's plunger to penetrate a depth of 33 to 35 mm from the top of the mould in a standard Vicat's apparatus"*** The standard Vicat apparatus with its three attachments is shown in fig. The Vicat apparatus is used for three tests, namely; standard consistency test, initial setting time test and fine setting time test by changing the attachments.	01 M Any one 03 M



PROCEDURE:

Procedure of standard consistency test is given below:

1. Take about 500 gm of cement and prepare a paste with known weight of water say about 20- 25% of weight of cement.
2. Fill the paste in Vicat mould within 3 to 5 minutes. Level the top surface.
3. Shake the mould to expel any air bubbles.
4. Attach the plunger with the screw provided on the rod of the sliding weight.
5. Bring down the weight till plunger just touches the top surface of paste.
6. Release the weight so that the plunger penetrates the paste. Measure the penetration. This can be measured by the pointer attached to the sliding weight and moving on the scale.
7. If the penetration is less than 33 to 35 mm from the top of mould, increase the water percentage to make a fresh paste. If the penetration is more, increase the water percentage to make a fresh paste.
8. In this manner, by making a fresh trial paste a number of times, find the water percentage by weight, which will give the penetration of the plunger up to 33 to 35 mm depth from the top of the mould.
9. This water percentage is known as standard consistency of the given cement and is denoted by P.

C) SETTING TIME OF CEMENT:

INITIAL SETTING TIME (IS 4031, Part 5, 1988, 2000)

"Initial setting time is the time elapsed between the moment when water is poured in cement to the moment when the cement paste start losing its plasticity"

It is very difficult to exactly know the moment when cement paste starts losing plasticity; hence a convenient but arbitrary limit is defined by the initial setting time test. This test is also performed on the Vicat's apparatus, only this time the plunger is removed and initial setting time needle is attached in its place, as shown in fig.

PROCEDURE:

The procedure of the test is given below:

1. Take about 500 gm cement and mix it with 0.85 P percent of water where P is the water where P is the water percentage required for standard consistency to make a smooth paste. Start a stopwatch at the moment when water is added to cement.
2. Fill and shake the Vicat mould with the paste within 3 to 5 minutes after adding water.
3. Lower the initial setting time needle till it touches the surface of the cement paste in the mould.
4. Release the weight so that the needle penetrates the paste. Initially, it will penetrate the complete depth, i.e. 40 mm, of the mould.
5. Take readings after every 1 or 2 minutes and when the penetration decrease, take readings after every 20 seconds and then after every 10 seconds, moving the mould to take reading at different place every time.
6. Record the time on the stop watch when the penetration is 33 to 35 mm from the top surface.
7. This time is known as the initial setting time.

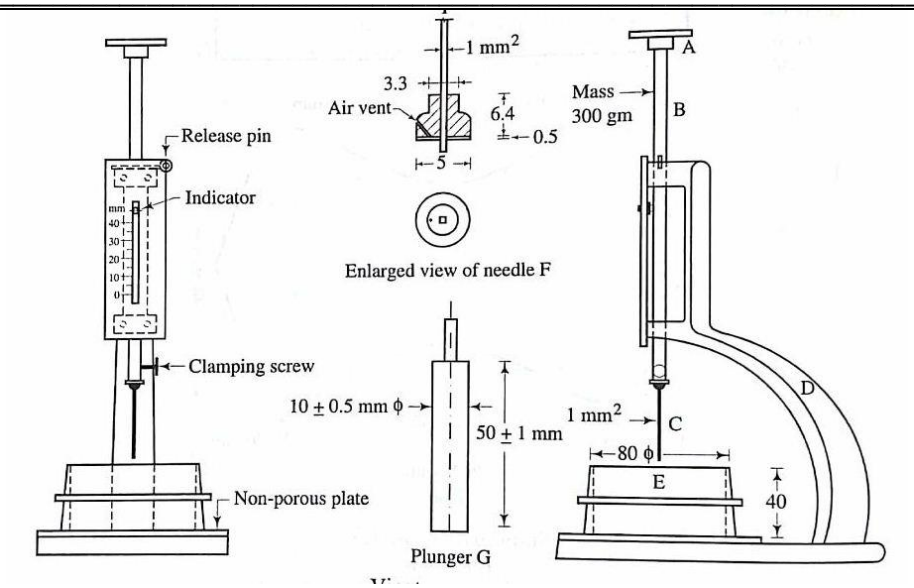
FINAL SETTING TIME (IS 4031, Part 5. 1988, 2000):

"*Final setting time is defined as the time elapsed between the moment when water is added to cement and the moment when the paste has completely lost its plasticity.*"

Final setting time test is conducted as a continuation of the initial setting time test and the same mould of cement is used for the test.

PROCEDURE:

1. Remove the initial setting time needle and attach the final setting time needle, which is very similar to the initial setting time needle only it has a collar with a rim attached to it. The central needle projects 0.5 mm more than the rim. The collar has a hole known as air-vent through which trapped air in the rim can escape so that is does no interfere with the reading.
2. Lower the final setting time needle till it gently touches the paste and releases it.
3. Observe the impression made by the attachment on the paste.
4. Initially, both the rim and central needle will make the impression. Turn the mould around and after every few minutes; take the reading on a different place on the surface of the paste.
5. When the impression of the rim stars becoming faint, take readings at very short time intervals.
6. Record the time when only central needle makes an impression but the surrounding rim does not make an impression at all. (as shown in fig.)



D) COMPRESSIVE STRENGTH (I.S. 4031, Part 6, 1988, 2000)

- Compressive strength of cement is the most important parameter and hence this test is one of the most important tests.
- This test could not perform on neat cement paste due to excessive shrinkage and subsequent cracking of neat cement paste. Instead, a standard mortar is prepared by mixing standard sand confirming to IS 650- 1960.
- This sand is generally supplied from Ennore from Tamilnadu hence it is also known as Ennore sand or Madras sand.
- **PROCEDURE:**
  1. Take 555 grams of standard sand and 185 grams of cement and mix it in dry condition for one minute.
  2. Add water of (P/4 + 3.5) when ordinary sand is used and (P/4 + 3.5) when standard sand is used percent of combined weight of cement and sand. Where 'P' is the standard consistency of cement.
     Mix the three ingredients thoroughly till mixture is of uniform color. The mixing time should be between 3 to 4 minutes. The mould is fitted on the table of the vibrating machine immediately, after mixing and compacted at least for two minutes. This process should be completed within five minutes after mixing.
  3. Immediately fill the mortar thus prepared into cube moulds of size 7.06 cm is placed on non porous base plate which is oiled from inside. Compact the mortar by standard means.
  4. Keep the mould in 90% humidity and at 27± 2 ^{o}C for 24 hours. Where humidity room is not available. Mould can be kept under wet gunny bag for 24 hours.
  5. Remove the cubes from moulds after 24 hours and keep immersed under clean water till the moment of testing.
  6. Test the cubes under UTM for compressive strength.

The table shows the number of cubes to be tested and the respective minimum strength for different period for some types of cement.

COMPRESSIVE STENGTH OF CEMENT

Sr.	Type of Cement	Number of	1 Day	3 Day	7 Day	28 Day

No.		cubes tested	Strength N/ mm2	Strength N/ mm2	Strength N/ mm2	Strength N/ mm2
1	Ordinary Portland Cement	2 Cubes 3 and 7 days	6	22	----	----
2	Rapid Hardening Cement	2 cubes, 1 day & 3 days	16	28	----	----
3	Low Heat Cement	3 cubes ,3, 7 & 28 day	----	10	16	35

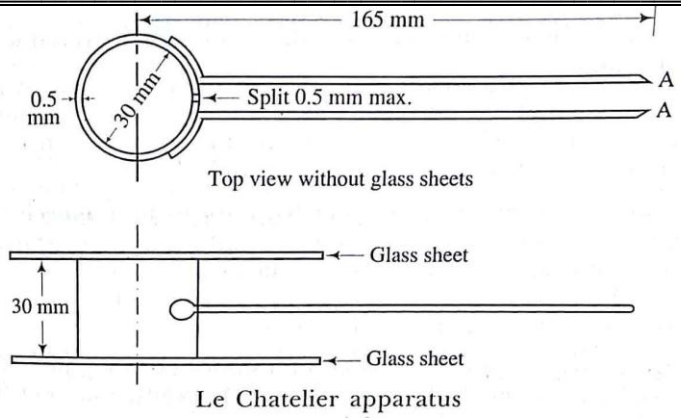
E) <u>SOUNDNES OF CEMENT (I.S. 4031, Part 3, 1988, 2000)</u>

- If the cement contains excess lime, or is insufficiently burnt during manufacture, it is responsible to remain uncombined and be over burnt in kiln and the mortar prepared from such cement is liable to expand after setting action is complete. It is one of the causes of cracing of cement concrete called unsoundness of cement as it shown large volume changes with change in temperature, after setting and hardening.
- Such changes are undesirable as they will cause disruption of hardened mass. Unsoundness may also be due to excessive proportion of Magnesia or of sulphates.
- The soundness test ensures that the cement does not show excessive thermal expansion and if it does, it can be rejected.
- This test is performed with the Le Chatelier's Apparatus. It consists of a brass cylinder, cut along its height with two pointers welded along each side of the cut.
- Due to thermal expansion the cement in the cylinder expands and this expansion is measured by the pointers attached to the cylinder.

<u>PROCEDURE:</u>

The procedure for soundness is given below

1) Take 100 gm of cement. This is mixed with 0.78P time's water, where P is the water required for standard consistency and it is mixed thoroughly for about 3 minutes.
2) The paste is filled in the split cylinder, which is covered on the top and bottom with glass plates and is kept in water at 27^{o}C to 32 ^{o}C for 24 hours with a small weight on the top glass plate for stability.
3) The distance between the pointers is measured and mould is submerged in boiling water for 3 hours.
4) The mould is removed, allowed to cool and again the distance between the pointers is measured again.
5) The difference these two distances represents the expansion of cement. This must not exceed 10 mm for OPC, Rapid hardening and low heat cements. If it exceeds 10 mm, then the cement is said to be unsound.



Le Chatelier apparatus

Q.6	(c)	***What types of aggregates are used for making good concrete? State their geological names.***	
	Ans.	Aggregate provide the concrete with its body and strength and act as a filler material to give the homogenous mass of concrete along with cement paste. Now it is recognized that many types of aggregates form chemical bond with cement paste. Mainly two types of aggregates are used for making good concrete i.e. Fine Aggregate and coarse aggregate. According to size they are classified. The maximum size used is 80 mm and the range 80mm to 4.75 mm is known as coarse aggregate and the aggregate in between the size 4.75 mm to 150 micron is termed as fine aggregate. The size 4.75 mm is common to both the fine and coarse fractions.	02 M
		For making good concrete shape of aggregate is an important characteristic as it affects the workability of concrete. It also affects the strength. In general, angular aggregate is preferable to rounded and smooth aggregate because they have better interlocking effect which gives a superior concrete. The total surface area of rough angular aggregate is more than smooth rounded aggregate; hence bond formation is enhanced giving greater bond strength.	01 M
		The geological names of these types of aggregate according to which they are formed or prepared are: i) Rounded aggregate ii) Irregular aggregate or partly rounded aggregate iii) Angular aggregate iv) Flaky aggregate.	01 M
Q.6	(d)	***Write short notes on :*** ***i) White cement ii) Coloured cement.***	
	Ans.	**White Cement:** This is just a variety of ordinary cement and it is prepared from such raw materials which are practically free from colouring oxides of iron, manganese or chromium. For burning of this cement, oil fuel is used instead of coal. It is white in colour and it is used for floor finish, plaster work, ornamental work etc. It should not set earlier than 30 minutes. It should be carefully transported and stored in closed containers only. It is costly than ordinary cement because of specific requirements imposed upon the raw materials and the manufacturing process. It gets quickly dried, possessing high strength and has superior aesthetic values. The miscellaneous applications of white cement are in swimming pools tiles finishing work, for moulding sculptures and statues, for painting garden furniture etc. It is also used for ready mixed concrete and precast concrete blocks and also for fixing marble and glazed tiles.	02 M
		Coloured Cement: The trade name of coloured cement is colour-crete. Coloured cement is produced by mixing the mineral pigment with ordinary cement. Any desired colour can be obtained by adding and mixing the mineral pigments into the ordinary cement. Coloured cement is used for decorative works in external surfaces of buildings. It is also	

		used for decorative works in flooring and walls. It is widely used for decorative works in monumental buildings. Following branded cements are available in market i.e. Birla super cement, Silver-crete cement, Ultra-Tech cement, Jaypee cement etc.	02 M
Q.6	(e) Ans.	***List any four properties of thermal insulating materials.*** Thermal insulation in building to keep insulation reduces unwanted heat loss or gain and can decrease the energy demands of heating and cooling systems thus giving comfort for its occupants. Following are some of the properties of thermal insulating material 1) They are incombustible. 2) They are fire retardants or reasonably fire proof 3) These materials neither cause nor accelerate corrosion. 4) They are chemically inert. 5) These materials are easy to handle. 6) They possesses better insulation properties. 7) They are mostly impermeable 8) They are resistant to the attack of insects ***9)*** They have low thermal conductivity.	Any four 01 M for each
Q.6	(f) Ans.	***Write any four required properties of waterproofing materials.*** Following are the properties of waterproofing material 1) It should be impervious i.e. water proof 2) It should be durable enough to keep various components of building leak proof against water. 3) It should be able to resist loads to which it will be subjected. 4) It should be in position to accommodate some structural movement without fracture. 5) It should withstand temperature variations and prevent formation of cracks. ***6)*** It should get easily mixed with cement, sand and aggregates to form a homogeneous paste.	Any four 01 M for each