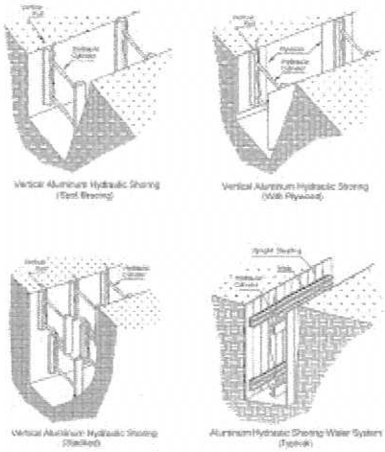
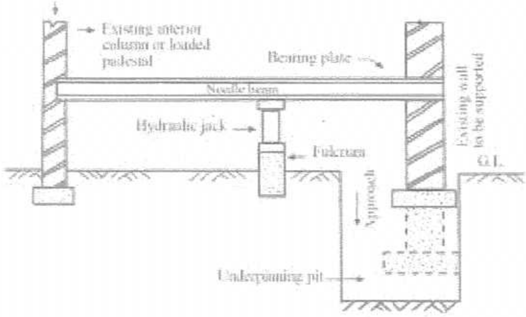
(15)

SCHEME OF VALUATION

(Scoring Indicators)

Revision:2015 **Course Title: BUILDING MAINTENANCE AND SERVICES**		**Course Code: 5011**		
Q.No.	**Scoring Indicator**	**Split up score**	**Sub Total**	**Total**
	Part A			
I(1)	Durability of concrete is defined as its ability to resist weathering action and chemical attack, while maintaining the desired engineering properties.		2	
I(2)	Gradual and slow time dependent deformation of concrete structure under sustained loads is known as creep.		2	
I(3)	Sullage is the wastewater that arises from domestic activities such as washing in bathrooms and kitchens, including water from food preparation and dishwashing; it does not contain human excreta.		2	
I(4)	In electric power distribution, a busbar is a metallic strip or bar, typically housed inside switchgear, panel boards, and busway enclosures for local high current power distribution.		2	
I(5)	Retrofitting is the modification of existing structures to make them more resistant to seismic activity, ground motion, or soil failure due to earthquakes.		2	10
	Part B			
II(1)	The maintenance of a structure is done to meet the following objectives: • Prevention of damages due to natural agencies and keep them in good appearance and working condition. • Repair of the defects occurred in the structure and strengthening • To preserve in good condition buildings & services • To make improvements whenever required • To sustain utility value • When deterioration occurs due to any reason it is inevitable to restore it to its original standard	1x6	6	6
II(2)	Preventive maintenance The maintenance work done before the defects occurred or damage developed in the structure is called preventive maintenance • It includes through inspection, planning the programs of maintenance and executing the work.	1		

	• It depends upon the specifications, condition and use of structure.	2		
	Remedial maintenance It is the maintenance done after the defects or damage occurs in the structure.	1		
	It involves the following steps • Finding the deterioration • Determining the causes • Evaluating the strength of the existing structure • Evaluating the need of the structure • Selecting and implementing the repair procedure	2	6	6
II(3)	Cracks could be broadly classified as structural or non-structural. Structural cracks are those which are due to incorrect design, faulty construction or overloading and these may endanger the safety of a building. Extensive cracking of an RCC beam is an instance of structural cracking. Principal causes of occurrence of structural cracks in buildings are as follows: a) Faulty design b) Faulty construction c) Overloading	3		
	Non-structural cracks are mostly due to internally induced stresses in building materials and these generally do not directly result in structural weakening. In course of time, however, sometime non-structural cracks may, because of penetration of moisture through cracks or weathering action, result in corrosion of reinforcement and thus may render the structure unsafe. Vertical cracks in a long compound wall due to shrinkage or thermal variation is an instance of non-structural cracking. Principal causes of occurrence of non structural cracks in buildings are as follows: a) Moisture changes, b) Thermal variations, c) Elastic deformation, d) Creep, e) Chemical reaction, f) Foundation movement and settlement of soil, g) Vegetation.	3	6	6
II(4)	The causes of various types of fire hazards are Electrical hazards: Damaged wiring, Damaged plugs, Damp or wet wires, Overloaded motors, Broken switches, outlets or sockets, etc Housekeeping hazards: Piles of scrap, waste materials, and trash; Sawdust, metal or plastic powder that can form an explosive mixture with air; Obstructed aisles, Blocked emergency exits, etc. Friction hazards: Hot bearings, Misaligned or broken machine parts, choking or jamming materials, Poor adjustment of moving parts, Inadequate lubrication. Storage hazards: Materials stacked too high blocking sprinkler heads, Flammable or combustible materials stored too close to heat sources; Flammable materials not stored in special containers and cabinets Inadequate ventilation in storage areas; etc. Smoking hazards: Ignoring "No Smoking" signs; Smoking around flammable or combustible materials; Throwing matches and cigarettes or cigars on tables or workbenches; Tossing butts on the floor or grass			

	without properly extinguishing them; Tossing lighted butts or matches out windows or doors; Smoking in bed; Leaving a cigarette/cigar unattended; Smoking in areas where there is an accumulation of sawdust, plastic or metal powders that may become explosive.	4x1½	6	6
II(5)	Water supply system consists of collection, transmission, treatment, storage, and distribution of water for homes, commercial establishments, industry, and irrigation, as well as for such public needs as firefighting and street flushing.	2	2	
	Common defects are • Rusting , leakage, cracks, blockage of water supply lines • Stoppage of water supply due to insufficient water pressure • Contamination of water • Insufficient water treatment leads to unsafe water supply	4x½	2	
	Prevention • Regular inspection for the sign of corrosion and leakage • Change the older pipes with new or anti corrosive pipes • Tighten the pipe connections • Inspection for possible blockage such as tree roots, rust, etc and removal of same immediately	4x½	2	6
II(6)	Shoring is the process of temporarily supporting a building, structure, or trench with shores (props) when in danger of collapse or during repairs or alterations. Shoring may be vertical, angled, or horizontal	1½		
		1½	3	
	Underpinning is the process of strengthening the foundation of an existing building or other structure.	1½		
		1½	3	6
II(7)	1. Central air conditioning			

	This is the most common type of cooling system as it is the most preferable for larger homes due to its ability to cool efficiently. Central air conditioners circulate cool air through supply and return ducts. Supply ducts and registers, which are in the wall or floors, carry cooled air into the home. Then, once the air becomes warm it circulates back into the supply ducts and registers where it will then be transported back to the air conditioner. 2. Ductless, mini- split air conditioner Ductless, mini-split systems are most common in parts of the home that have been retro-fitted. Like central air conditioning systems, these systems have an outdoor compressor/condenser and an indoor handling unit. 3. Window air conditioner This system is installed in the window of a room. Window units cool a room by emitting the warm air out the back of it and blowing cool air into it. These types of units are best for those who live in small spaces. 4. Portable air conditioner This type of air conditioning unit takes in air from the room and cools it, then directs it back into the room. The unit then vents any warm air outside by means of an exhaust hose that is installed in a window. Portable air conditioners are designed to cool only one room. They're easy to install, versatile, and an affordable option.	**4x1½**	**6**	**6**
III(a)	**Part- C** **Unit I** The durability of concrete is vital with regards to a structure's lifespan. The importance of concrete durability cannot be underestimated. Concrete durability is simply defined as its ability to resist weathering action and chemical attack, while maintaining the desired engineering properties. 1 - The Environment - It is to be seen the general environment to which the concrete be exposed during its working life classified into five levels of severity 2- The cement content and water/cement ratio of the concrete - minimum cement content and maximum w/c ratio may too affect the durability of concrete.	**3**	**3**	

	3- The type and quality of the material which is being used in the construction. 4- The shape and size of the member to ensure good drainage of water from the structure, thin sections of concrete can be deteriorated due to chemical and climatic attack. 5- Curing adequate curing of concrete is to be done for required period of time. 6- Compaction of concrete effective compaction is required to attain the maximum strength so that the structure could withstand against all odds.			
III(b)	Biological agents that can cause problems in buildings are: · insects (termites, borer beetles, triatomine bugs, cockroaches, mosquitoes, flies, etc.), which either attack and destroy building materials (such as timber, bamboo, some plastics, etc.), represent a health hazard or are simply a nuisance to the occupants; · animals (rats, bats, birds, snakes, etc.), which can nest in uncontrolled cavities, and can not only create health problems and disturb occupants, but also restrict important functions of the building, for example, by building nests which block ventilation openings or clog drains; · fungi (moulds, stains, rots, etc.), which develop in moist dark conditions on timber and other vegetable building materials, some fungi being non-destructive (blue stain), while others (dry rot, wet rot) lead to decay and destruction. Many methods of protecting buildings and occupants against these agents exist, but some protective measures can create new problems, if implemented without sufficient care and consideration of the consequences.	5x1	5	8
IV	Answer at last.			7
	Unit II			
V(a)	**Defects in Plastering** The following defects may arise in plaster work. 1. Blistering of plastered surface: This is the formation of small patches of plaster swelling out beyond the plastered surface, arising out of late slaking			

	of lime particles in the plaster 2. Cracking: Cracking consists of formation of cracks or fissures in the plaster work resulting from the following reasons. i. Imperfect preparation of background ii. Structural defects in building iii. Discontinuity of surface iv. Movements in the background due to its thermal expansion or rapid drying v. Movements in the plaster surface itself, either due to expansion or shrinkage. vi. Excessive shrinkage due to application of thich coat vii. Faulty workmanship. 3. Efforescene: It is the whitish crystalline substance which appears on the surface due to presence of salts in plaster making materials as well as building materials like bricks, sand, cement etc and even water. This gives a very bad appearance. It affects the adhesion of paint with wall surface. Efforescene can be removed to some extent by dry bushing and washing the surface repeatedly. 4. Flaking:It is the formation of very loose mass of plastered surface, due to poor bond between successive coats. 5. Peeling: It is the complete dislocation of some portion of plastered surface, resulting in the formation of a patch. This also results from imperfect bond. 6. Popping: It is the formation of conical hole in the plastered surface due to presence of some particles which expand on setting	**4x1**	**4**	
	Remedies for minimizing defects plastering work: • The brickwork and plastering should be carried out in the best workmanship manner. • The bond of brickwork should be maintained properly. • The efflorescence is removed by rubbing brushes on damaged surfaces. A solution of one part of HCl or H_2SO_4, and five parts of clean water is prepared and it is applied with the help of brushes on affected area. The surface is washed and cleaned with water. • The bricks of superior nature should only be used for the brick work. • The water free from salts should be used for brick work and plastering work • The surface to be plastered should be well watered so that it may not absorb water from plaster. • The damp- proof courses should be provided at convenient places in buildings.	**4x1**	**4**	**8**

V(b)	Techniques to repair cracks are: A) Epoxy Injection Epoxy injection is an economical method of repairing non-moving cracks in concrete walls, slabs, columns and piers .it is capable of restoring the concrete to its pre-cracked strength. The technique generally consists of establishing entry and venting ports at close intervals along the cracks, sealing the crack on exposed surfaces, and injecting the epoxy under pressure. B)Gravity Filling Low viscosity monomers and resins can be used to seal cracks widths of by gravity filling. High molecular weight methacrylates, urethanes, and some low viscosity epoxies have been used successfully. C) Routing And Sealing In this method, the crack is made wider at the surface with a saw or grinder, and then the groove is filled with a flexible sealant. This is a common technique for crack treatment and it is relatively simple in comparison to the procedures and the training required for epoxy injection. Initially clean the surface, the surface should be free from paint, dirt, oil, efflorescence or any bond inhibiting agents. Then apply epoxy. To prevent epoxy flowing out insert foam breaker or rod of suitable diameter and sealant is applied to it. D) Stitching This method is done to provide a permanent structural repairs solution for masonry repairs and cracked wall reinforcement. It is done by drilling holes on both sides of the crack, cleaning the holes and anchoring the legs of the staples in the holes with a non-shrink grout. E) Dry Packing It is the hand placement of a low water content mortar followed by tamping or ramming of the mortar into place and also helps in producing intimate contact between the mortar and the existing concrete. F) Underpinning This is the best solution whereby the footings of the building are underpinned with either concrete, masonry or piles to carry the load of the building down to a more stable stratum (eg rock or soils below the reactive zone).This solution is usually the most costly, particularly if there are access difficulties or if internal walls require underpinning, which may require lifting internal floors G)Polymer Impregnation Monomer systems can be used for effective repair of some cracks. A monomer system is a liquid consisting of monomers which will polymerize into a solid. The most common monomer used for this purpose is methyl methacrylate.	**7x1**	7	
VI	causes of cracks and its preventive measures			

A) Thermal Movement:
Most materials expand when they are heated, and contract when they are cooled. The expansion and contraction with changes in temperature occur regardless of the structure's cross-sectional area. It is one of the most potent causes of cracking in buildings which need attention.

Preventive Measures: Joints should be constructed like construction joints, expansion joints, control joints and slip joints. The joints should be planned at the time of design and be constructed carefully

B) Chemical Reaction:
Chemical reactions may occur due to the materials used to make the concrete or materials that come into contact with the concrete after it has hardened. Concrete may crack with time as the result of slowly developing expansive reactions between aggregate containing active silica and alkalis derived from cement hydration, admixtures or external sources

Preventive Measures: If sulphate content in soil exceeds 0.2 percent or in ground water exceed 300 ppm, use very dense concrete and either increase richness of mix to 1:1/5:3 and to prevent cracking due to corrosion in reinforcement it is desirable to specify concrete of richer mix for thin sections in exposed locations

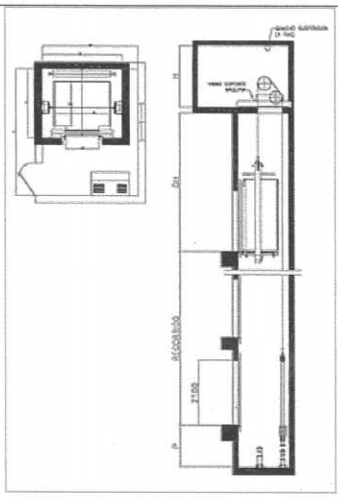
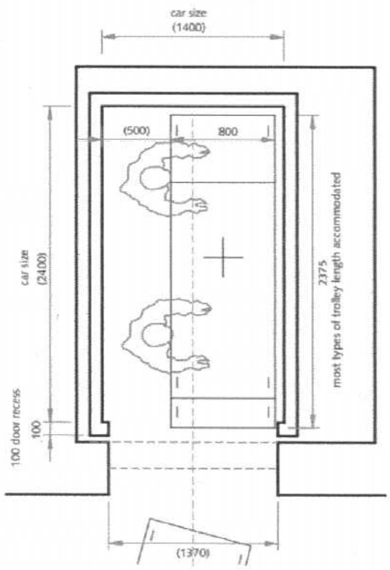
C) Shrinkage:
Most of the building materials expand when they absorb moisture from atmosphere and shrink when they are dry. Shrinkage can be of plastic or dry. The factors causing shrinkage in cement concrete and cement mortar and their preventions are as following.
1) Excessive Water: The quantity of water used in the mortar mix can cause shrinkage. Vibrated concrete has less quantity of water and lesser shrinkage than manually compacted concrete.

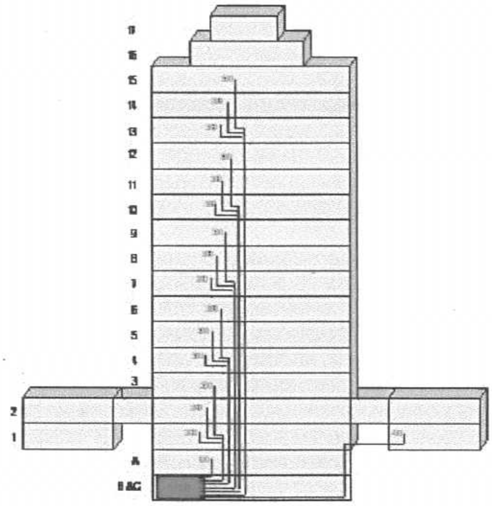
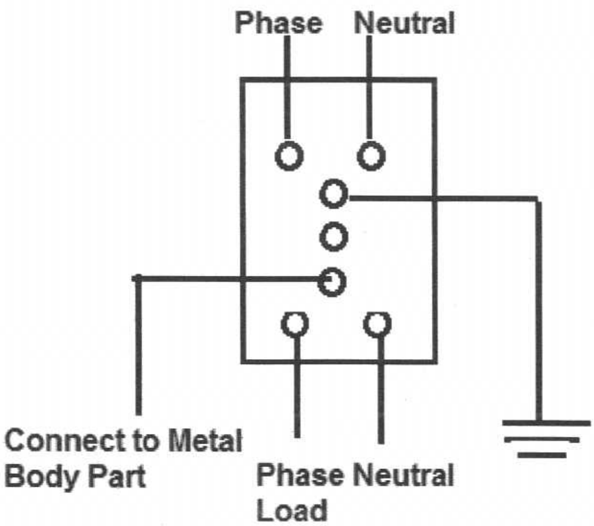
Preventive Measures: Use minimum quantity of water required for mixing cement concrete or cements mortar according to water cement ratio. Cement concrete is never allowed to work without mechanical mix and vibrator

D) Earthquake
Crack may occur due to sudden shift in lower layer of the earth. The voids in the earth might have suddenly collapsed and be filled with soil from the above. Many geological events can trigger earth movements but is continuous movement.

Preventive Measures:
Construct the foundation of buildings on firm ground while doing construction. Tie up the building with connecting beams at foundation level, door level and roof level.

	E) Vegetation: Fast growing trees in the area around the walls can sometimes cause cracks in walls due to expansive action of roots growing under the foundation. The cracks occur in clay soil due to moisture contained by roots Preventive Measure: Do not grow trees too close to the building. Remove any saplings of trees as soon as possible if they start growing in or near of walls F) Corrosion Cracks Under normal conditions, the pH level of concrete is high . The high pH ofconcrete allows an inactive layer of ferric oxide to form around the reinforcement, preventing rust .There are two major causes of corrosion in the reinforcing steel: chloride penetration and carbonation. Chloride penetration reduces the pH level of the concrete when oxygen, chlorides, and moisture all penetrate the concrete. Chlorides can be found in potable water, which should never be used to mix concrete. Carbonation occurs when carbon dioxide and moisture infiltrate the concrete, reducing the pH level of the concrete.Both causes of corrosion end similarly. The pH level is the concrete's last barrier against corrosion, so the reinforcement begins to rust. Rust expands the steel to 10 times the volume, which can cause major problems in the structure preventive measures: use enough cover as per IS code. No salt water is used for mixing (any 5 points)	5x3	15	
VII	(i) The car, cables, elevator machine, control equipment, counterweights, hoist way, rails, penthouse, and pit are the principle parts of a traction elevator installation. The car is a cage of some fire-resistant material supported on a structural frame, to the top member of which the lifting cables are fastened. By means of guide shoes on the side members, car is guided in its vertical travel in the shaft The car is provided with safety doors, operating-control equipment, floor-level indicators, illumination, emergency exits, and ventilation.	4		

		4	8	
	(ii) A stretcher lift is installed in hospitals, medical centers and clinics, ie. in buildings where escorted stretchers are to be transported. Actually this is a hydraulic or mechanical elevator used to transport escorted freight, which has been customized to conform with specific strength and reliability specifications. It it marked with top level parking accuracy and quality of motion, and it is possible to use electronic valves. The car is manufactured from highly resistant material. It is fitted with an external call blocking system and a two way calling system for communication with rescue services. The elevator is fitted with automatic shaft and car doors, whose motor operates via a VVVF system, with a view to ensuring smoother function.	3		
		4	7	15
VIII(a)	(i) It is a specially allocated space for electrical wiring to 'rise' up a building in an orderly, organised and safe way mostly in a vertical fashion. Sometimes they share the space together with telecom and IT cables and occasionally even together with city water, water supplying sprinkler &	2		

	fire protection systems, city gas, exhaust ducts etc. where the local building codes allow. 	2	4	
	(ii) An Earth-leakage circuit breaker **(ELCB)** is a safety device used in electrical installations with high Earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.	2		
		2	4	8
VIII(b)	Requirements of domestic gas pipe line are: 1. The piping system must be designed so that the gas meter provided by gas supplier can be properly located for the building of the owner or each customer. 2. Gas pipes should be located such that the location of isolation valves are easily accessible to the users to facilitate line isolation during emergency 3. Gas pipes should, as far as practicable, be run outside the building. 4. Gas pipes should should preferably enter the building aboveground and remain in an aboveground and ventilated location. 5. Gas pipes should be properly painted and labelled for identification			

	purposes. 6. The route should avoid any positions where the pipe could be liable to damage. 7. The fire resistance of the building must not be impaired. 8. Pipes may be concealed, but provision should be made for access. 9. Pipes must not be laid under or through foundations. (any 7)	7x1	7	7
IX(a)	**Unit IV** World heritage site in India are: 1. Taj Mahal, Agra 2.Khajaraho, Madhya Pradesh 3. Ajanta & Ellora Caves, Maharashtra 4. Bodh Gaya, Bihar 5. Sun Temple, Konark 6. Red Fort, Delhi 7. Chola Temples, Tamil Nadu 8. Jantar Mantar, Rajastan 9. Agra Fort, U.P 10. Fatehpur Sikri, U.P 1. Taj Mahal, Agra One of Seven Wonders of the World, **White Marble Mughal Architecture**, the Taj Mahal was build by emperor Shah Jahan in the memory of his wife Mumtaj Mahal. It is located at the bank of river Jamuna in Agra. It was completed in 1653 with then estimated cost of 32 million Indian rupees which would today stand upto 58 billion Indian rupees. It is considered as the best example of Mughal architecture worldwide and is called the "Jewel of Muslim Art in India". This is probably the monument that is most recognised the world over for its association with the heritage of India.	4		
	2. Khajaraho, Madhya Pradesh Located in Madhya Pradesh, Khajuraho is an important UNESCO World Heritage site in India. Khajuraho is unique heritage site which is famous for a group of Hindu and Jain Temples situated 175 km south-east of Jhansi. These sensuous stone carvings of human and animal form in erotic poses are very aesthetically portrayed and stand testimony to the rich cultural heritage of India. Most of these monuments were built between 950 to 1050 CE under the reign of the Chandella dynasty. It consists of total 85 Temples spread across an area of 20 square kilometres. The Kandariya temple is the most prominent of all of these temples in the Khajuraho complex. (explain any 2)	4	8	
IX(b)	Retrofitting methods are: 1. Retrofitting of concrete members – Continuous fiber reinforced plate bonding construction method: Bonding continuous fiber reinforced plates to the surface of the existing structure to restore or improve load-carrying capacity – Continuous fiber reinforced plate jacketing construction method: Jacketing			

	with continuous fiber reinforced plates around the periphery of the existing structure to restore or improve load-carrying capacity and deformation characteristics – Prestressed concrete jacketing construction method: Placing prestressing wires and prestressing stranded steel wires in place of lateral ties around the periphery of existing member sections and using mortar and concrete to bond them in order to reinforce the structure. To increase the restraining effect of the inner concrete, the prestressing steel is generally stressed during placement. This method is sometimes used together with the mortar spraying method and precast panel jacketing method. – Prestressing introduction (internal cable) construction method: Using internal cables for the existing concrete members to provide prestressing and restore or improve the load-carrying capacity of the members. - Repaving method: Replacing some or all of the existing concrete members with new members through the use of precast members or concreting on site to restore or improve load-carrying capacity. 2 Foundation retrofitting – Underground wall (beam) addition method: Connecting the foundations with cast-in-site diaphragm walls and underground connecting beams to distribute stress and ensure the stability of the entire system. – Pile/footing addition construction method: When pile foundations are damaged or there is residual displacement, adding piles or footings to increase the load-carrying capacity of the foundation. – Foundation improvement method: Improving the ground around the foundation with cement improvement materials to improve the ground bearing capacity and horizontal foundation resistance. Also prevents excessive pore water pressure and liquefaction. – Steel sheet-pile coffering construction method: Placing sheet-piles around the periphery of the footings and bonding them to the footings to improve bearing capacity and horizontal resistance. – Foundation compacting method: When insufficient foundation bearing capacity is a concern due to scouring or the like, using concrete or the like to compact the ground around the foundation in order to restore bearing capacity. 3. Repair of cracks and missing sections – Crack fill method: Forcing low viscosity resin and ultra-fine cement into the cracks in existing concrete members to seal the cracks. – Fill method: Filling cracks, rock pockets, cavities, peeling and other small-scale missing sections in existing concrete members with resin and mortar to repair sections. – Section repair method: Removing deteriorated or damaged portions of existing concrete members and then restoring these members to their original sectional status using materials with excellent bonding to existing concrete. (Write 7 points)	**7x1**	7	
X	Causes of structural deterioration are: 1. Natural disaster such as cyclone or earthquake			

	2. Act of sabotage 3. Corrosive action of the contact materials. 4. Uncontrolled vegetation growth 5. Natural deterioration due to aging 6. Change in land use.	**5x1**	**5**	
	Restoration techniques are: 1. Strengthening foundations: RCC foundation jackets are constructed along the masonry wall. It is connected to the walls using steel ties. 2. Flooring: timber floors are preserved. Steel supports are provided where ever needed 3. Steel structures: rust removed. Application of non corrosive treatment. Replacement of members beyond repair. 4. Masonry structures: Repointing the joints, injection of appropriate grouts. Vertical longitudinal or transverse reinforcements Insertion of headers through stones 5. Timber structures: anti termite coatings. Replacing damaged parts. Reconstruction. Providing brackets and braces. Stiffening. Polishing.	**5x2**	**10**	**15**
	Unit I			
IV	Following are the pre maintenance required in buildings: • Periodic cleaning of terrace • Drain pipes are checked so that there is no clogging • Balcony out let water is checked to ensure there is no blockage and water flows through. • Windows must be closed and checked periodically • Windows should be checked for any gaps and defective locking system • Walls to be checked for cracks • Basement should be checked if water out lets are sufficient and there is no blockage • Different types of door matting to control any slippery floor • To install lightning or thunder control • Avoid renovation work during monsoon , particularly painting and polishing works • The external façade paint can be sealed with a surface sealant paint before the onset of monsoon to prevent the seepage • Optimum use of air conditioners to studied and planned as weather is a cooler • Rain water harvesting • The house keeping staff should be alert to monitor any damages caused. Planning ahead The best way to avoid lightning, flash floods, and other dangerous conditions is by not being in danger in the first place. Many ways are available to gain weather information including:			

	• Watching current weather forecasts on TV or the internet • Listening to weather reports on the radio or Subscribing to lightning and severe weather notification services • Scanning the skies 360 degrees around and overhead before leaving a safe location Disaster Supply Kit Contents Every family should prepare a family disaster supply kit in the event of severe weather conditions. The disaster supply kit should contain essential items such as food, water, and sturdy clothing, to sustain a family for up to three days since electric power, gas and water services may be interrupted. • Three gallons of water in clean, closed containers for each person and pet • First aid kit • A stock of food that requires no cooking or refrigeration • Portable and working battery-operated radio, flashlights, and extra batteries (Candles and oil lamps are fire hazards) • Necessary medications • Back-up power source for life support or other medical equipment that requires electricity to function **Flash Flood Safety for Homeowners** • If you live in a flood prone area have an evacuation plan. • Store materials like sandbags, plywood, plastic sheeting and lumber for protection from floodwaters and to make quick repairs after a severe storm. • Store materials above flood levels. • Secure wanted objects to prevent them from floating away. • Learn where to find high ground, which is safe from flooding. In a flash flood seek high ground quickly. • Contact an insurance agent to discuss flood insurance coverage. Flood losses are not covered under normal homeowners' insurance policies. Flood insurance is available through the National Flood Insurance Program. Get coverage early-there is a waiting period before it takes effect. (Write 15 points)	**15x1**	**15**	