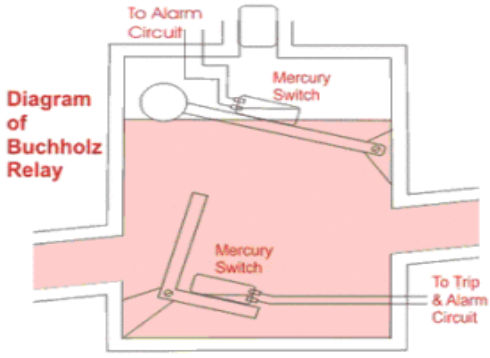
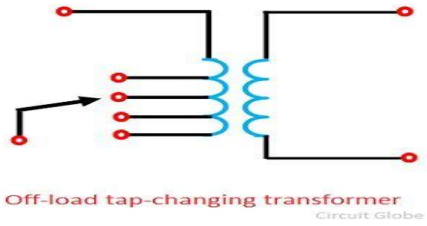
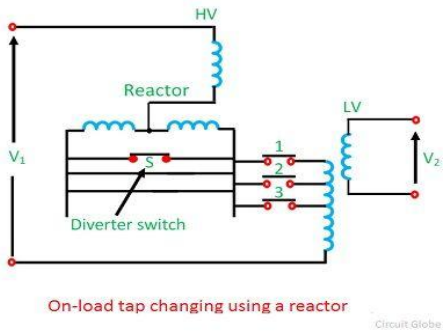
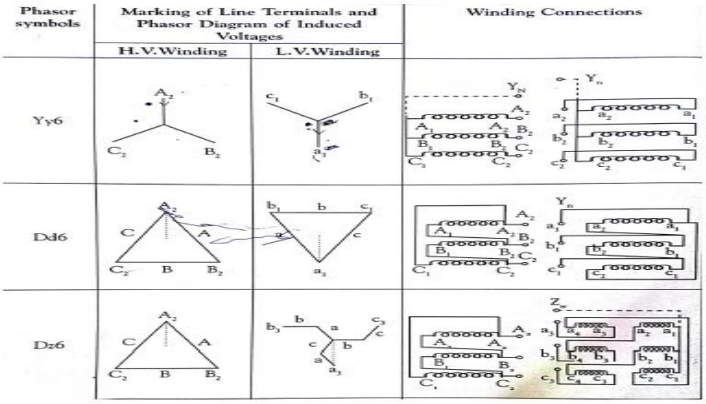
Scheme Of Evaluation
Internal Assessment Test 1 – Sept.2019

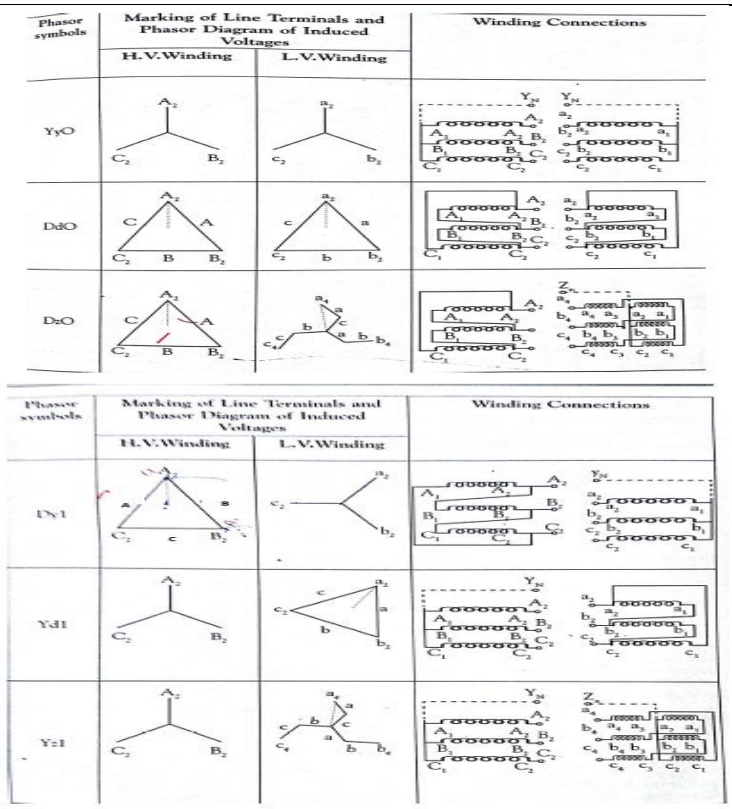
Sub:	Testing and Commissioning of Power System Apparatus							Code:	15EE752
Date:	23/09/2019	Duration:	90mins	Max Marks:	50	Sem:	VII	Branch:	EEE

Note: Answer Any Five Questions

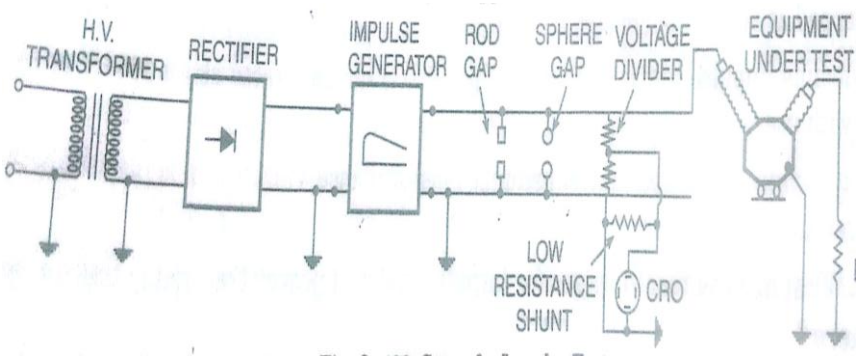
Question #		Description	Marks Distribution		Max Marks
1	a)	**Enumerate the protective devices and accessories fitted on the power transformer.** • List of all the devices and accessories Flow /Oil Level Indicator Pressure Relief Valve Buchholz Relay Sudden Pressure Relay Conservator Breather Oil Temperature Indicator Winding Temperature Indicator Marshalling Kiosk/Control Cabinet Surge Arrestor • Elaborate any 4 devices and accessories (each 2 marks)	2 M 8M	10 M	10 M
2	a)	**Explain the working of a Buchholz relay with the help of a diagram** • Neat diagram  • Purpose Buchholz relay is a safety device which is generally used in large oil immersed transformers (rated more than 500 kVA). It is a type of oil and gas actuated protection relay. It is used for the protection of a transformer from the faults occurring inside the transformer, such as	4 M 1 M 5 M	10 M	10 M

		impulse breakdown of the insulating oil, insulation failure of turns etc • Working principle Whenever a minor fault occurs inside the transformer, heat is produced by the fault currents. The produced heat causes decomposition of transformer oil and gas bubbles are produced. These gas bubbles flow in upward direction and get collected in the buchholz relay. The collected gas displaces the oil in buchholz relay and the displacement is equivalent to the volume of gas collected. The displacement of oil causes the upper float to close the upper mercury switch which is connected to an alarm circuit. Hence, when minor fault occurs, the connected alarm gets activated. The collected amount of gas indicates the severity of the fault occurred. During minor faults the production of gas is not enough to move the lower float. Hence, during minor faults, the lower float is unaffected. During major faults, like phase to earth short circuit, the heat generated is high and a large amount of gas is produced. This large amount of gas will similarly flow upwards, but its motion is high enough to tilt the lower float in the buccholz relay. In this case, the lower float will cause the lower mercury switch which will trip the transformer from the supply, i.e. transformer is isolated from the supply.			
3	a)	**What is the? Explain the principle of off-circuit tap changer and on-load tap changer?** • Function of tap changer The change of voltage is affected by changing the numbers of turns of the transformer provided with taps. For sufficiently close control of voltage, taps are usually provided on the high voltage windings of the transformer. There are two types of tap-changing transformers • Principle of off-circuit tap changer with neat diagram In this method, the transformer is disconnected from the main supply when the tap setting is to be changed. The tap setting is usually done manually. The off load tap changing transformer is shown in the figure below  Off-load tap-changing transformer Circuit Globe • Principle of on- load tap changer with neat diagram In order that the supply may not be interrupted, on-load tap changing transformer are sued. Such a transformer is known as a tap-changing under load transformer. While tapping, two essential conditions are to be fulfilled. The load circuit should not be broken to avoid arcing and prevent the damage of contacts. No parts of the windings should be short–circuited while adjusting the	2 M 2+2 M 2+2 M	10 M	10 M

		tap.  On-load tap changing using a reactor The tap changing employing a center tapped reactor R show in the figure above. Here S is the diverter switch, and 1, 2, 3 are selector switch. The transformer is in operation with switches 1 and S closed. To change to tap 2, switch S is opened, and 2 is closed. Switch 1 is then opened, and S closed to complete the tap change. It is to be noted that the diverter switch operates on load, and no current flows in the selector switches during tap changing. It is to be noted that the diverter switch operates on load, and no current flows in the selector switches during tap changing. During the tap change, only half of the reactance which limits the current is connected in the circuit.			
4	a)	**Explain phasor diagram and phasor groups adopted for standard connection of a transformer.** • Mention all the phasor groups Table 1.1: Standard Phasor Groups Group / Phase displacement / Connections I / 0° / Yy0, Dd0, Dz0 II / 180° / Yy6, Dd6, Dz6 III / 30° lag / Dy1, Yd1, Yz1 IV / 30° lead / Dy11, Yd11, Yz11 • Explain any 3 phasor groups with phasor diagram (each 3 marks)  	1 M 9 M	10 M	10 M

					
5	a)	**Explain the different drying techniques used in transformers / power transformers.** • Name the techniques Different methods of drying out: i) Drying of core and coils with oil by oven ii) Drying of core and coils with oil by short circuit method iii) Drying with oil removed by using external heat iv) Drying with oil removed by using both external and internal heat. • Explain any 3 techniques (each 3 marks) **Drying with oil:** **i)Drying of core and coils with oil by using oven.** The core and coils can be effectively dried in a suitable oven, by raising the temperature to a value not exceeding 8o°e. A large volume of air should pass through -the oven to remove moisture and vapors. Insulation resistance check will indicate when the coils are dry. **ii)Drying by short circuit method:** The transformer can also be dried by heating the coils by short circuiting the low voltage winding and supplying a reduced voltage at the terminals. Current should not exceed 70% of the rated current and oil temperature should not exceed 75°e. The winding temperature under no condition should exceed 90°e. This method is more effective in drying the insulation at site. **Drying without oil:** **By external heat:** The transformer may be placed in its own tank without oil. Externally heated air is blown into the tank at the bottom through the main oil valve. A small blower or fan should be used to get the proper circulation. It is desired to-force as much of the heated air as possible through the ducts in the transformer windings. To accomplish this, baffles	1 M 9 M	10 M	10 M

		should be placed between the core and the case, closing off as much of the space as possible. The convenient way to get the heated air is by passing air through grid resistors. The resistors are in fire proof box. The temperature of the air should not exceed 115°C. The heat may also be obtained by direct combustion but care is to be taken to avoid the products of combustion entering into the transformer tank. **By both external and internal heat:** This is a combination of the hot air circulation and short circuit method. The current circulated in the windings should, of course, be less than that when drying out is done by the method of short circuit alone.			
6	a)	**Explain installation, inspection upon arrival at site and storage facility at site.** • Installation procedure **Installation:** **Location, site preparation and foundation details:** The location may be indoor or outdoor. For indoor installation, the following aspects should be considered. ✓ Ventilation ✓ Noise level ✓ Space required for movement, maintenance etc ✓ Trenches for cables Minimum clearances between the transformer and the walls should be as follows. ✓ Clearance on all four sides of wall: 1.25 m ✓ Clearance on all three sides of wall: 1 m ✓ Clearance on a wall on backside only: 0.5 m ✓ The clearance of 0.5 m (minimum) should be provided between the top most point of the conservator and the roof. Ventilation area: The ventilation area required is as follows. ✓ Outlet: 2m2 per 1000 KVA ✓ Inlet : 1m2 per 1000 KVA minimum • Inspection procedure **Inspection upon arrival at site:** Immediately after arrival at site, it should be inspected for possible damages during transit. The nitrogen gas pressure should be checked. Positive pressure if not found, indicates that there is leakage, and there is a possibility of the moisture entering the tank during transit. This can be ascertained by dew point measurement which indicates the amount of surface moisture content in transformer insulation. Internal inspection should be carried out to the extent possible through inspection covers. Particular attention should be paid to the connections, bolt links, coil clamping bolts, tap changers. Current transformers and the general insulation. Break down strength of oil of transformer tank and drums containing transformer oil should be examined carefully. An inspection of the transformer on arrival at site is to be carried out preferably in the presence of the representative of the manufacturer. • Storage conditions and procedure **Storage:** The transformers arrived at site and likely to be installed immediately do not need elaborate storage. In case of delayed installation, it requires proper storage to avoid influx of moisture, effect of rain / dust etc. It is preferable to store the transformers indoor on proper flooring with	2 M 2 M	5 M	10 M

		protective covering. The oil should not be drained unless there is a provision of filling inert gas.	1 M		
	b)	**Explain the test setup for impulse testing of power transformer with neat diagram** • Impulse testing purpose To ensure the effectiveness of the insulation system of a transformer, it must confirms the dielectric test. But the power frequency withstand test alone can not be adequate to demonstrate the dielectric strength of a transformer. That is why **impulse test of transformer** performed on it. Both **lightning impulse test** and **switching impulse test** are included in this category of testing. • Circuit diagram Impulse generator is used to produce the specified voltage impulse wave of 1.2/50 micro seconds wave. One impulse of a reduced voltage between 50 to 75% of the full test voltage and subsequent three impulses at full voltage. For a three phase transformer, impulse is carried out on all three phases in succession. The voltage is applied on each of the line terminal in succession, keeping the other terminals earthed. The current and voltage wave shapes are recorded on the oscilloscope and any distortion in the wave shape is the criteria for failure.  • Explanation of test conduct	1 M 2 M 2 M	5 M	
7	a)	**Enumerate the various tests carried out on transformer before commissioning.** • Basic classification of tests Typical Tests carried out before commissioning General inspection a) Control and relay panels, etc. b)Junction boxes and marshalling kiosks. On all transformer protection relays a)Tests on operation and stability of earth fault relays on high voltage side. b)Tests on line directional elements of high voltage line relays.	2 M 8 M	10 M	10 M

		c)Tests on high speed neutral circuit breaker d)Tests on over current relays on low voltage side. e)Tests on operation and stability of earth fault relays on low-voltage side. f)Tests on operation of standby earth fault relay on low-voltage side. g)Tests on over current relay on high voltage side (when current transformer are not in transformer) bushings h)Voltage compensation i)With 415 V applied on high-voltage side, measure the voltage between all phases on the low voltage side for every tap position. j)To check phasing, measure volts: A to a, band c B to a, band c (to a, b and c where A, Band (are the terminals of three phases on high voltage side and a, band c are the corresponding terminals on low voltage side. k) Magnetic balance test. • Explanation any 8 (each carries 1 mark)			