Class test3 session 2017-18 Date : 10.4.2018

Subject: Basic Electrical Engineering EE203 Time 1 hr. Max. Mark 15

Time : 10.30 - 11.30 AM

Attempt any three question. All question carry equal marks.

Q1. State the insulating properties of hydrogen gas.

Q2. An alternating voltage is represented by e=400 sin 314t. Determine maximum, effective, & frequency of voltage

Q3. Derive Expression for RMS value of a sinusoidal wave.

Q4. Describe the method of measurement of power of R-L-C series circuit in laboratory with neat circuit diagram.

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Q1. State the insulating properties of hydrogen gas.

Ans. **Hydrogen, H2,** is a colorless, odorless gas. Hydrogen is easily ignited. Once ignited it burns with a pale blue, almost invisible flame. The vapors are lighter than air. It is flammable over a wide range of vapor/air concentrations. Hydrogen is not toxic but is a simple asphyxiate by the displacement of oxygen in the air.

properties of hydrogen: Values at 25°C (77°F, 298 K) and atmospheric pressure

Molecular Weight	2.016
Specific Gravity, air = 1	0.070
Specific Volume (ft^3/lb, m^3/kg)	194, 12.1
Density of liquid at atmospheric pressure (lb/ft^3, kg/m^3)	4.43, 71.0
Absolute Viscosity ($lb_m/ft\ s$, *centipoises*)	$6.05\ 10^{-6}$, 0.009
Specific Heat - c_p - (Btu/lb^oF *or* cal/g^oC, J/kgK)	3.42, 14310
Specific Heat Ratio - c_p/c_v	1.405
Gas constant - R - ($ft\ lb/lb^oR$, J/kg^oC)	767, 4126
Thermal Conductivity ($Btu/hr\ ft\ ^oF$, W/m^oC)	0.105, 0.182
Boiling Point - saturation pressure 14.7 psia and 760 mm Hg - (^oF, ^oK)	-423, 20.4
Freezing or Melting Point at 1 atm (^oF, ^oC)	-434.6, -259.1
Critical Temperature (^oF, ^oC)	-399.8, -240.0
Flammable	yes

Q2. An alternating voltage is represented by e=400 sin 314t. Determine maximum, effective, & frequency of voltage?

ANS: The standard equation of a.c wave form is $e = E_M \sin 2\pi f t$.

Comparing with given equation maximum value of voltage E_M= 400 volt,

$2\pi f = 314$ hence f=50 Hz
Effective value is $E = E_M/\sqrt{2} = 400/\sqrt{2} = 283.7$ volt

Q3. Derive Expression for RMS value of a sinusoidal wave.

The mean of the squares of the instantaneous values of current over one complete cycle is (even the value over half a cycle will do)

$$= \int_0^{2\pi} \frac{i^2\, d\theta}{(2\pi - 0)}$$

The square root of this value is $= \sqrt{\left(\int_0^{2\pi} \frac{i^2\, d\theta}{2\pi} \right)}$

Hence, the r.m.s. value of the alternating current is

$$I = \sqrt{\left(\int_0^{2\pi} \frac{i^2 d\theta}{2\pi} \right)} = \sqrt{\left(\frac{I_m^2}{2\pi} \int_0^{2\pi} \sin^2 \theta\, d\theta \right)} \qquad (\text{put } i = I_m \sin\theta)$$

Now, $\cos 2\theta = 1 - 2\sin^2\theta \quad \therefore \quad \sin^2\theta = \frac{1 - \cos 2\theta}{2}$

$$\therefore \quad I = \sqrt{\left(\frac{I_m^2}{4\pi} \int_0^{2\pi} (1 - \cos 2\theta)\, d\theta \right)} = \sqrt{\left(\frac{I_m^2}{4\pi} \left| \theta - \frac{\sin 2\theta}{2} \right|_0^{2\pi} \right)}$$

$$= \sqrt{\left(\frac{I_m^2}{4\pi} \times 2\pi \right)} = \sqrt{\left(\frac{I_m^2}{2\pi} \right)} \quad \therefore \quad I = \frac{I_m}{\sqrt{2}} = 0.707\, I_m$$

Q4. Describe the method of measurement of power of R-L-C series circuit in laboratory with neat circuit diagram.

Ans. The power(P) consumed in an AC circuit is given by the product of voltage(V) and that part of current (I) which is in phase with V.

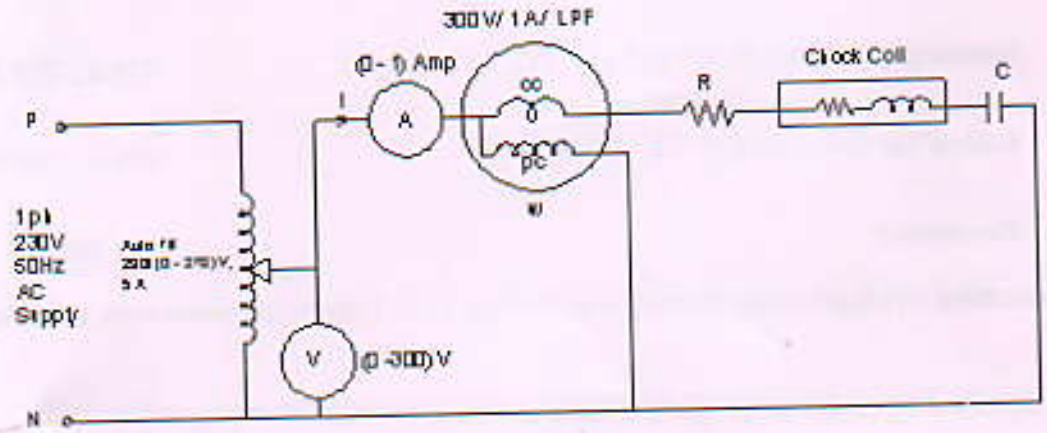
$$P = VI \cos \varphi$$

Where P = Power input to the load circuit V = Voltmeter across the Load.

I = Current through the load cos ϕ Load power factor

The factor, cosϕ is called power factor of the circuit and its value depends upon the angle ϕ by which the current I leads or legs the voltage V. power factor of a circuit depends upon the nature and value of the circuit elements, viz, resistance, inductance and capacitance. The power factor various between O and 1 since ϕ can vary between 0° and 90°.

Power in a single phase ac circuit can be measured either directly by a watt meter or by measuring V, I and cosϕ separately and multiplying their values.



Procedure: Make the connection as shown in circuit diagram of fig.

1. Switch ON the supply and set value of applied voltage equal to 150 V.
2. Take reading of Voltmeter, Ammeter & Watt meter.
3. Increase the apply voltage in step of 20V & take above reading.
4. Repeat step 3 and 4, for different value of resistance.

Prepared by G.S. Rathore