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Time: 15 Minutes	WORKSHEET – 1	Max. Marks: 15

TOPIC: 7.1 ALTERNATING CURRENT – INTRODUCTION

Answer the following. Q. 1 to 4 carry 1 mark each; Q. 5, 6 and 7 carry 2 marks each.

1. If the *rms* current in a 50 Hz *ac* circuit is 5 A, the value of the current 1/300 second after its value becomes zero is **[1M]**

(a) $5\sqrt{2}$ A (b) $5\sqrt{(3/2)}$ A (c) 5/6 A (d) $5/\sqrt{2}$ A

2. An alternating current generator has an internal resistance R_g and an internal reactance X_g. It is used to supply power to a passive load consisting of a resistance R_g and a reactance X_L. For maximum power to be delivered from the generator to the load, the value of X_L is equal to **[1M]**

(a) zero (b) X_g (c) $-X_g$ (d) R_g

3. In an *ac* circuit, the maximum value of voltage is 423 V. Its effective voltage is **[1M]**

(a) 400 V (b) 300 V (c) 323 V (d) 340 V

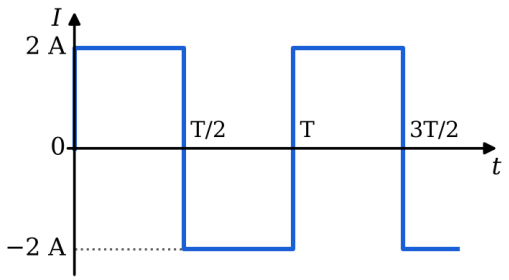
4. The peak voltage of 220 V *ac* mains is **[1M]**

(a) 155.6 V (b) 220.0 V (c) 311 V (d) 440 V

5. A 100 Ω resistor is connected to a 220 V, 50 Hz *ac* supply. **[2M]**
(a) What is the rms value of current in the circuit?
(b) What is the net power consumed over a full cycle?

6. A light bulb is rated 100 W for 220 V *ac* supply of 50 Hz. Calculate **[2M]**
(a) the resistance of the bulb; (b) the rms current through the bulb.

7. What is the rms value of the alternating current shown in the figure? **[2M]**



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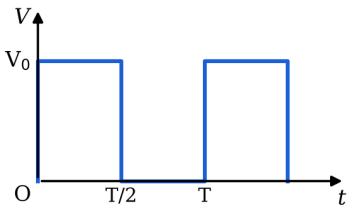
TOPIC: 7.2 AC VOLTAGE APPLIED TO A RESISTOR

Answer the following. Q. 1 to 6 carry 1 mark each; Q. 7 and 8 carry 2 marks each.

1. What is the rms value of an alternating current which, when passed through a resistor, produces heat which is thrice that produced by a direct current of 2 A in the same resistor? **[1M]**

(a) 6 A (b) 2 A (c) 3.46 A (d) 0.66 A

2. The rms value of the potential difference V shown in the figure is **[1M]**



(a) $V_0/\sqrt{3}$ (b) V_0
(c) $V_0/\sqrt{2}$ (d) $V_0/2$

3. In a purely resistive *ac* circuit, the current **[1M]**

(a) is in phase with the emf.
(b) is out of phase with the emf by π radian.
(c) leads the emf by a phase difference of π/2 radian.
(d) lags behind the emf by a phase difference of π/2 radian.

4. 220 V, 50 Hz *ac* is applied to a resistor. The instantaneous value of voltage is **[1M]**

(a) $v = 220\sqrt{2}\sin(100\pi t)$ (b) $v = 220\sin(100\pi t)$
(c) $v = 220\sqrt{2}\sin(50\pi t)$ (d) $v = 220\sin(50\pi t)$

5. In an *ac* series circuit, the instantaneous current is maximum when the instantaneous voltage is maximum. The circuit element connected to the source will be **[1M]**

(a) pure inductor (b) pure capacitor
(c) pure resistor (d) combination of a capacitor and an inductor

6. For a purely resistive circuit, plot the graph of variation of resistance with the frequency of the source. **[1M]**

7. The instantaneous current in an *ac* circuit is $I = 0.5\sin 314t$. What is (i) the rms value and (ii) the frequency of the current? **[2M]**

8. Calculate the resistance required to operate a lamp (60 V, 10 W) from a source of (100 V, 50 Hz). **[2M]**

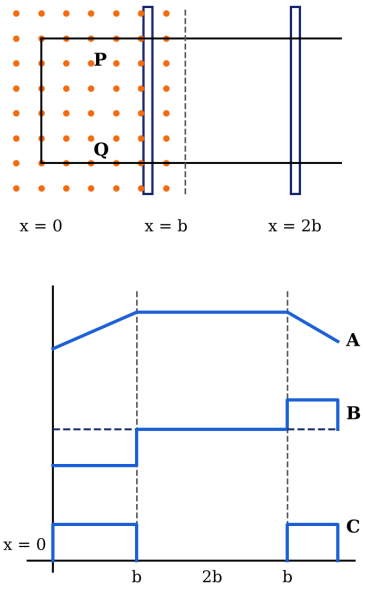
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Time: 15 Minutes	WORKSHEET – 3	Max. Marks: 10

TOPIC: 7.3 REPRESENTATION OF AC CURRENT AND VOLTAGE BY ROTATING VECTORS – PHASORS

Answer the following. Q. 1, 2 and 5 carry 1 mark each; Q. 3 and 4 carry 2 marks each; Q. 6 carries 2 marks.

1. The arm PQ of a rectangular conductor is moved from $x = 0$ to $x = 2b$ outwards and then inwards from $x = 2b$ to $x = 0$, as shown in the figure. A uniform magnetic field perpendicular to the plane acts from $x = 0$ to $x = b$. Identify the graphs showing the variation of different quantities with distance. **[1M]**



(a) A – Flux, B – Power dissipated, C – EMF
(b) A – Power dissipated, B – Flux, C – EMF
(c) A – Flux, B – EMF, C – Power dissipated
(d) A – EMF, B – Power dissipated, C – Flux

2. A 10 Ω resistance is connected across a 220 V – 50 Hz *ac* supply. The time taken by the current to change from its maximum value to the rms value is **[1M]**

(a) 2.5 ms (b) 1.5 ms (c) 3.0 ms (d) 4.5 ms

3. An alternating voltage given by $V = 140 \sin 314t$ is connected across a pure resistor of 50 Ω. Find (i) the frequency of the source and (ii) the rms current through the resistor. **[2M]**

4. The peak value of an alternating voltage applied to a 50 Ω resistance is 10 V. Find the rms current. If the voltage frequency is 100 Hz, write the equation for the instantaneous current. **[2M]**

5. A 100 Ω resistor is connected to a 220 V, 50 Hz *ac* supply. What is the net power consumed over a full cycle? **[1M]**

6. (a) For a given *ac*, $i = i_m \sin \omega t$, show that the average power dissipated in a resistor R over a complete cycle is $\frac{1}{2} i_m^2 R$. **[2M]**
(b) A light bulb is rated at 100 W for a 220 V *ac* supply. Calculate the resistance of the bulb.

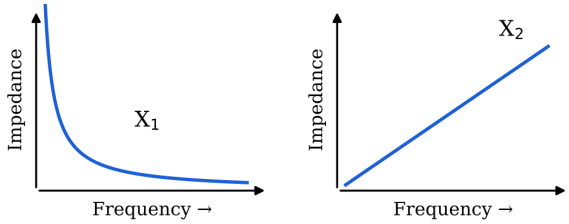
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Time: 15 Minutes	WORKSHEET – 4	Max. Marks: 15

TOPIC: 7.5 AC VOLTAGE APPLIED TO A CAPACITOR

Answer the following. Q. 1 and 2 carry 1 mark each; Q. 3 to 6 carry 2 marks each.

1. The graphs given below depict the dependence of two reactive impedances X_1 and X_2 on the frequency of the alternating emf applied individually to them. We can say that **[1M]**



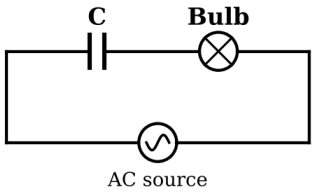
(a) X_1 is an inductor and X_2 is a capacitor (b) X_1 is a resistor and X_2 is a capacitor
(c) X_1 is a capacitor and X_2 is an inductor (d) X_1 is an inductor and X_2 is a resistor

2. A coil of self-inductance L is connected in series with a bulb B and an *ac* source. Brightness of the bulb decreases when **[1M]**

(a) an iron rod is inserted in the coil. (b) frequency of the *ac* source is decreased.

(c) number of turns in the coil is reduced. (d) a capacitance of reactance $X_C = X_L$ is included in the same circuit.

3. A bulb is connected in series with a variable capacitor and an *ac* source as shown. How does the brightness of the bulb change on reducing (a) the capacitance and (b) the frequency? Justify your answer. **[2M]**



4. (a) A 60 μF capacitor is connected to a 110 V, 60 Hz *ac* supply. Determine the rms value of current in the circuit. **[2M]**
(b) What is the net power absorbed by the circuit in a complete cycle?

5. A radio can tune over the frequency range of a portion of the medium wave (MW) broadcast band (800 kHz to 1200 kHz). If its LC circuit has an effective inductance of 200 μH, what must be the range of its variable capacitor? **[2M]**

6. (a) A charged 30 μF capacitor having initial charge 6 mC is connected to a 27 mH inductor. What is the angular frequency of free oscillations of the circuit? **[2M]**
(b) What is the total energy stored in the circuit initially? What is the total energy at a later time?

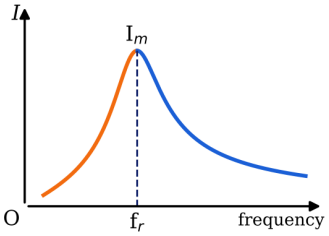
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Time: 15 Minutes	WORKSHEET – 5	Max. Marks: 15

TOPIC: 7.6 AC VOLTAGE APPLIED TO A SERIES LCR CIRCUIT

Answer the following.

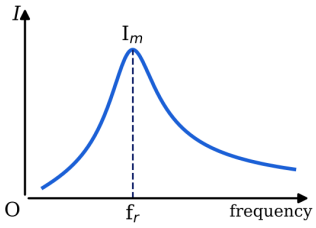
1. The graph shows the variation of current with frequency for a series LCR network. Keeping L and C constant, if R decreases: **[1M]**



(a) maximum current (I_m) increases
(b) sharpness of the graph increases
(c) quality factor increases
(d) bandwidth increases

(1) a, b, c (2) b, c, d (3) c, d, a (4) All

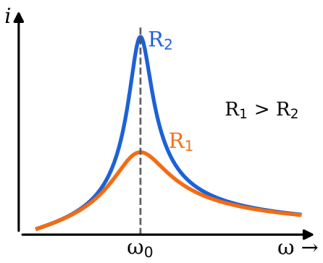
2. The graph shows the variation of I with f for a series LCR network. Keeping L and C constant, if R decreases, what is its effect on (a) maximum current, (b) sharpness of the graph and (c) quality factor? **[2M]**



3. A circuit containing an 80 mH inductor and a 60 μF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible. **[2M]**
(a) Obtain the current amplitude and rms values.
(b) Obtain the rms values of potential drops across each element.
(c) What is the average power transferred to the inductor?
(d) What is the average power transferred to the capacitor? (Average implies average over one cycle.)

4. In a series resonant LCR circuit, if L is increased by 25% and C is decreased by 20%, find the new resonant frequency. **[2M]**

5. In a series circuit connected to an *ac* source of variable frequency and voltage, the graph shows the variation of the amplitude of circuit current with the angular frequency of the applied voltage for two different values of resistance R_1 and R_2 ($R_1 > R_2$). Answer the following using this graph: **[3M]**



(a) In which case is the resonance sharper, and why?
(b) In which case is the power dissipation more, and why?
(c) Which one would be better suited for fine tuning in a receiver set?

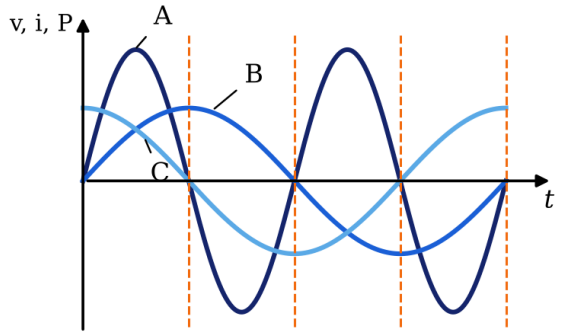
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TOPIC: 7.7 POWER IN AC CIRCUIT: THE POWER FACTOR

Answer the following.

1. A device 'X' is connected to an *ac* source. The variation of voltage, current and power in one complete cycle is shown in the figure. **[3M]**



(a) Which curve shows power consumption over a full cycle?
(b) What is the average power consumption over a cycle?
(c) Identify the device 'X'.

2. In an *ac* circuit, V and I are given by $V = 100 \sin(100t)$ V and $I = 100 \sin(100t + \pi/3)$ mA. Find **[2M]**
(a) the total impedance, reactance and resistance;
(b) the power factor and power.

3. A voltage of 10 V and frequency 10^3 Hz is applied to a $(1/\pi)$ μF capacitor in series with a resistor of 500 Ω. Find the power factor of the circuit and the power dissipated. **[3M]**

4. A circuit consisting of an inductance and a resistance is joined to a 200 V *ac* supply. It draws a current of 10 A. If the power used in the circuit is 1500 W, calculate the wattless current. **[2M]**

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TOPIC: 7.8 TRANSFORMERS

Answer the following.

1. The output of a step-down transformer is measured to be 24 V when connected to a 12 W light bulb. The value of the peak current is **[1M]**

(a) $1/\sqrt{2}$ A (b) $\sqrt{2}$ A (c) 2 A (d) $2\sqrt{2}$ A

2. A power transmission line feeds input power at 2300 V to a step-down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary windings in order to get output power at 230 V?

3. A 60 W load is connected to the secondary of a transformer whose primary draws line voltage. If a current of 0.54 A flows in the load, what is the current in the primary coil? Comment on the type of transformer being used. **[2M]**

4. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two-wire line carrying power is 0.5 Ω per km. The town gets power from the line through a 4000 V – 220 V step-down transformer at a sub-station in the town. Calculate **[3M]**

(i) the line power loss in the form of heat;

(ii) how much power the plant must supply, assuming negligible power loss due to leakage;

(iii) characterise the step-up transformer at the plant.

5. How is the transformer used in large-scale transmission and distribution of electrical energy over long distances? **[2M]**

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