विघ्न विचारत भीरु जन, नहीं आरम्भे काम,
विपति देख छोड़े तुरंत मध्यम मन कर श्याम।
पुरुष सिंह संकल्प कर, सहते विपति अनेक,
'बना' न छोड़े ध्येय को, रघुबर राखे टेक।।

रचितः मानव धर्म प्रणेता
सद्गुरु श्री रणछोड़दासजी महाराज

ALTERNATING CURRENT

Some questions (Assertion–Reason type) are given below. Each question contains STATEMENT – 1 (Assertion) and STATEMENT – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. So select the correct choice :

Choices are :

(A) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is** a correct explanation for Statement – 1.
(B) Statement – 1 is True, Statement – 2 is True; Statement – 2 **is NOT** a correct explanation for Statement – 1.
(C) Statement – 1 is True, Statement – 2 is False.
(D) Statement – 1 is False, Statement – 2 is True.

535. **STATEMENT – 1**
The alternating current cannot be used to conduct electrolysis.

STATEMENT – 2
The ions due to their inertia, cannot follow the changing $\vec{E}$.

536. **STATEMENT – 1**
In a series LCR circuit at resonance, the voltage across the capacitor or inductor may be more than the applied voltage.

STATEMENT – 2
At resonance in a series LCR circuit, the voltages across inductor and capacitor are out of phase.

537. **STATEMENT – 1**
By only knowing the power factor for a given LCR circuit it is not possible to tell whether the applied alternating emf leads or lags the current.

STATEMENT – 2
$\cos\theta = \cos(-\theta)$

538. **STATEMENT – 1**
In the purely resistive element of a series LCR, AC circuit the maximum value of rms current increases with increase in the angular frequency of the applied emf.

STATEMENT – 2
$I_{max} = \frac{\varepsilon_{max}}{z}$, $z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$, where I_{max} is the peak current in a cycle.

539. **STATEMENT – 1**
AC source is connected across a circuit. Power dissipated in circuit is P. The power is dissipated only across resistance.

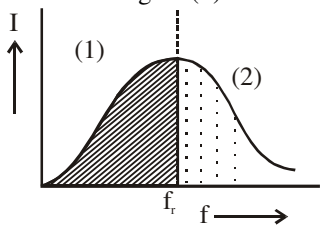
STATEMENT – 2
Inductor and capacitor will not consume any power in AC circuit.

540. **STATEMENT – 1 :** In series RLC circuit potential drop across inductive reactance will be same as capacitive reactance at resonance.

STATEMENT – 2 : At frequency less than resonance frequency for series RLC nature of circuit will be capacitive, frequency more than resonance nature of overall circuit will be inductive.

541. **STATEMENT – 1 :** For series RLC network, power factor of circuit in region (1) is positive and in region (2) is negative.

STATEMENT – 2 : Overall nature of circuit in region (1) is inductive while in region (2) is capacitive.



542. **STATEMENT – 1 :** In a series LCR circuit, at resonance condition power consumed by circuit is maximum.

STATEMENT – 2 : At resonance condition effective resistance of circuit is maximum.

543. **STATEMENT – 1 :** In series L–R circuit voltage leads the current.

STATEMENT – 2 : In series L–C circuit current leads the voltage.

544. **STATEMENT – 1 :** Average value of a.c. over a complete cycle is always zero.

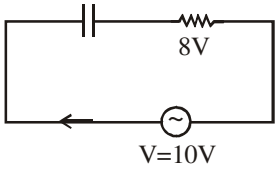
STATEMENT – 2 : Average value of a.c. is always defined over half cycle.

545. **STATEMENT – 1 :** In series LCR circuit resonance can take place.

STATEMENT – 2 : Resonance takes if inductance and capacitive reactance are equal.

546. **STATEMENT – 1 :** KVL rule is also being applied in AC circuit shown below.

STATEMENT – 2 :



V_C in the circuit = 2V.

547. **STATEMENT – 1 :** AC generators are based upon EMI principle.

STATEMENT – 2 : Resistance offered by capacitor for alternating current is zero.

548. **STATEMENT – 1 :** For sinusoidal a.c. ($I = I_0 \sin \omega t$) $I_{rms} = \frac{I_0}{\sqrt{2}}$.

STATEMENT – 2 : The r.m.s. value of alternating current is defined as the square root of the average of I^2 during a complete cycle.

549. **STATEMENT – 1**
Rate of heat generated when resistance is connected with AC source depends on time.

STATEMENT – 2
RMS voltage may be greater than maximum AC voltage.

550. An inductor, capacitor and resistance connected in series. The combination is connected across AC source.
STATEMENT – 1 : Peak current through each remains same.

STATEMENT – 2 : Average power delivered by source is equal to average power developed across resistance.

551. **STATEMENT – 1 :** In alternating current direction of motion of free electrons changes periodically.

STATEMENT – 2 : Alternating current changes its direction after a certain time interval.

552. **STATEMENT – 1 :** When frequency is greater than resonance frequency in a series LCR circuit, it will be an inductive circuit.

STATEMENT – 2 : Resultant voltage will lead the current.

553. **STATEMENT – 1 :** When capacitive reactance is smaller than the inductive reactance in LCR circuit, e.m.f. leads the current.

STATEMENT – 2 : The phase angle is the angle between the alternating e.m.f. and alternating current of the circuit.

554. **STATEMENT – 1 :** An alternating current shows magnetic effect.

STATEMENT – 2 : Alternating current varies with time.

Hint & Solution

535.	(A)	536.	(B)				
537.	(A)	538.	(D)	539.	(A)	540.	(B)
541.	(C)	542.	(C)	543.	(B)	544.	(B)
545.	(A)	546.	(C)	547.	(C)	548.	(A)
549.	(C)	550.	(B)	551.	(B)	552.	(A)
553.	(C)	554.	(B)				

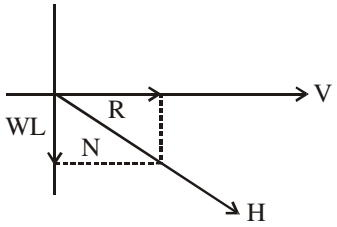
537. For a certain values of cos θ (power factor) two values of θ are possible. One is positive the other is much negative. Accordingly the applied emf may lead or lag.

538. The maximum value of rms current $= \frac{\varepsilon_{rms}}{z} = \frac{\varepsilon_{rms}}{R}$. It does not depend upon ω.

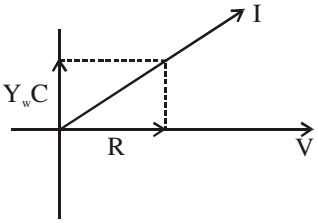
542. $$P_{av} = \frac{VI\cos\phi}{2}$$

At resonance condition cos ϕ = 1
But Z = R
Which is minimum.

543. L–R circuit



C–R circuit.



544. For half cycle $I_{mean} = 0.636 I_0$
or $E_{mean} = 0.636\ E_0$

Average value is always defined over a half cycle cause in next half cycle it will be opposite in direction. Hence for one complete cycle, average value will be zero.

545. At resonant frequency
$X_L = X_C \therefore Z = R$ (minimum)
Therefore current in the circuit is maximum.

546. Voltage will be added vectorially.

547. $$X_C = \frac{1}{\omega C}$$
$\omega \neq O$ area for AC.

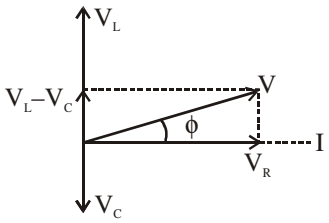
$$I_{rms}\left[\frac{\int_0^T I^2 dt}{\int_0^T dt}\right]^{1/2} = \left[\frac{\int_0^{2\pi/\omega} I_0^2 \sin^2 \omega t\, dt}{\int_0^{2\pi/\omega} dt}\right]^{1/2} = \frac{I_0}{\sqrt{2}}.$$

549. Rate of heat generated depends on time.

550. Average power consumed by capacitor or inductor is zero.

551. Motion of electron is random with drift velocity opposite to the direction of current.

552.



553. $$\tan\phi = \frac{X_L - X_C}{R} = \frac{\omega L - \frac{1}{\omega C}}{R}$$
When $X_L > X_C$ then $\tan\phi$ is positive i.e. ϕ is positive (between 0 and $\pi/2$). Hence e.m.f. leads the current.

554. Like direct current, alternating current also produces magnetic field. But the magnitude and direction of the field goes on changing continuously with time.