SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: 23BMT201 & Circuit Analysis

II Year : III Semester

Unit III –THREE PHASE SYSTEM

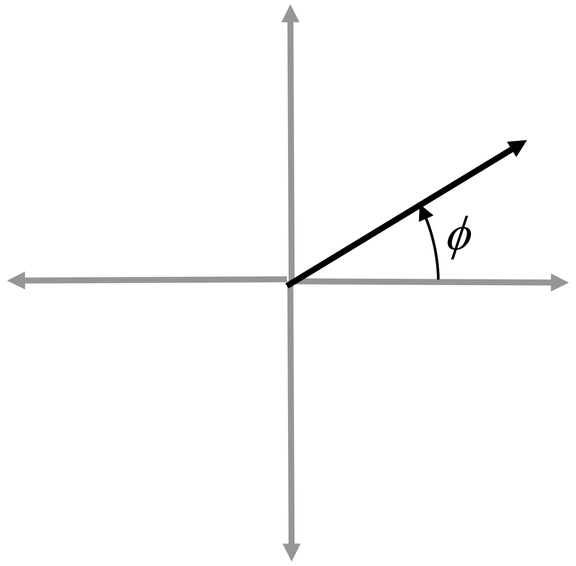
Topic : Phasor relationship for R, L, and C,

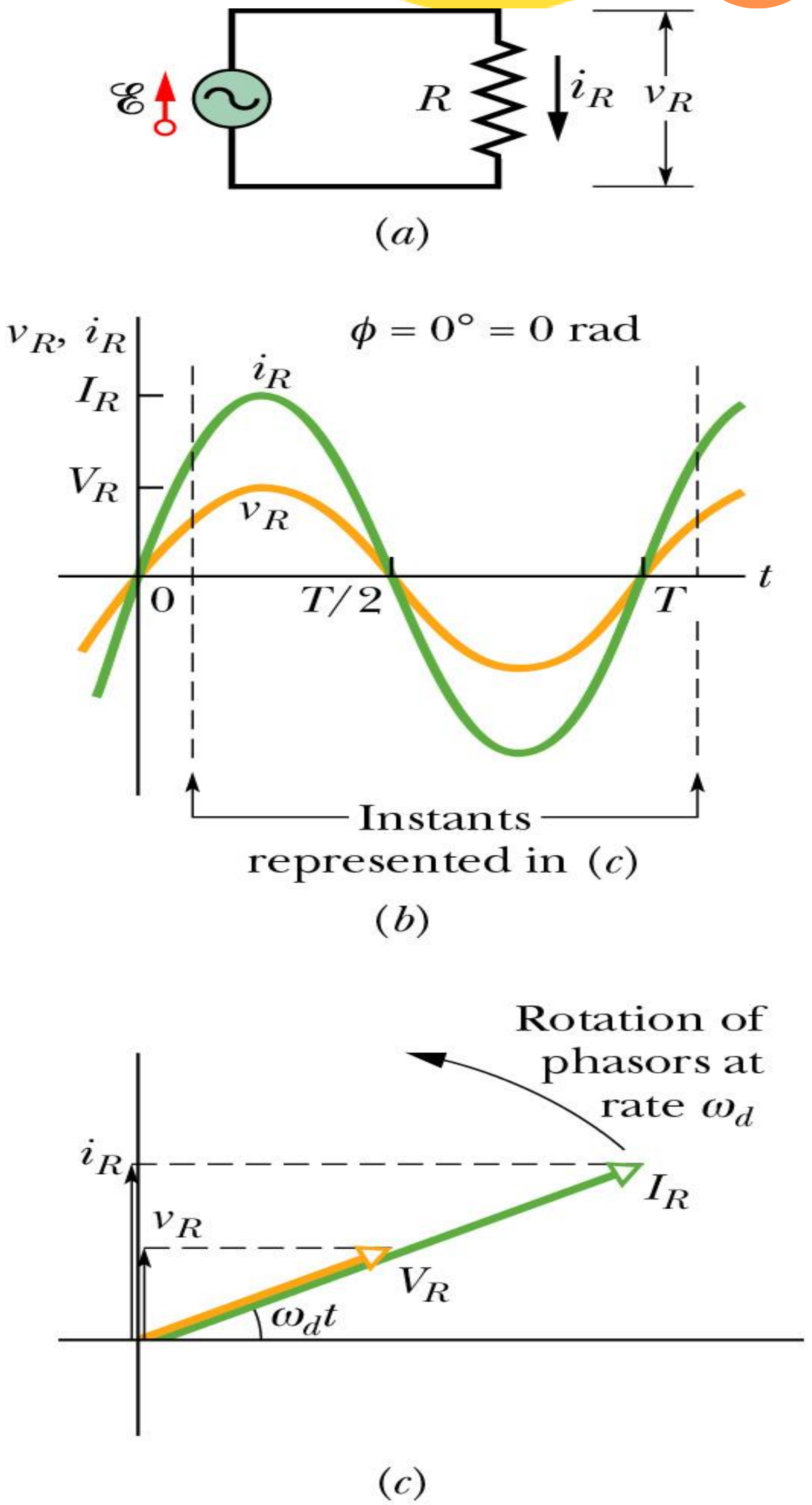
Resistive Load

- Phasor Diagram: shows the instantaneous phase of either voltage or current.
- For a resistor, the current follows the voltage, so the voltage and current are in phase (ϕ= 0).

- If $v_R = V_R \sin \omega_d t$

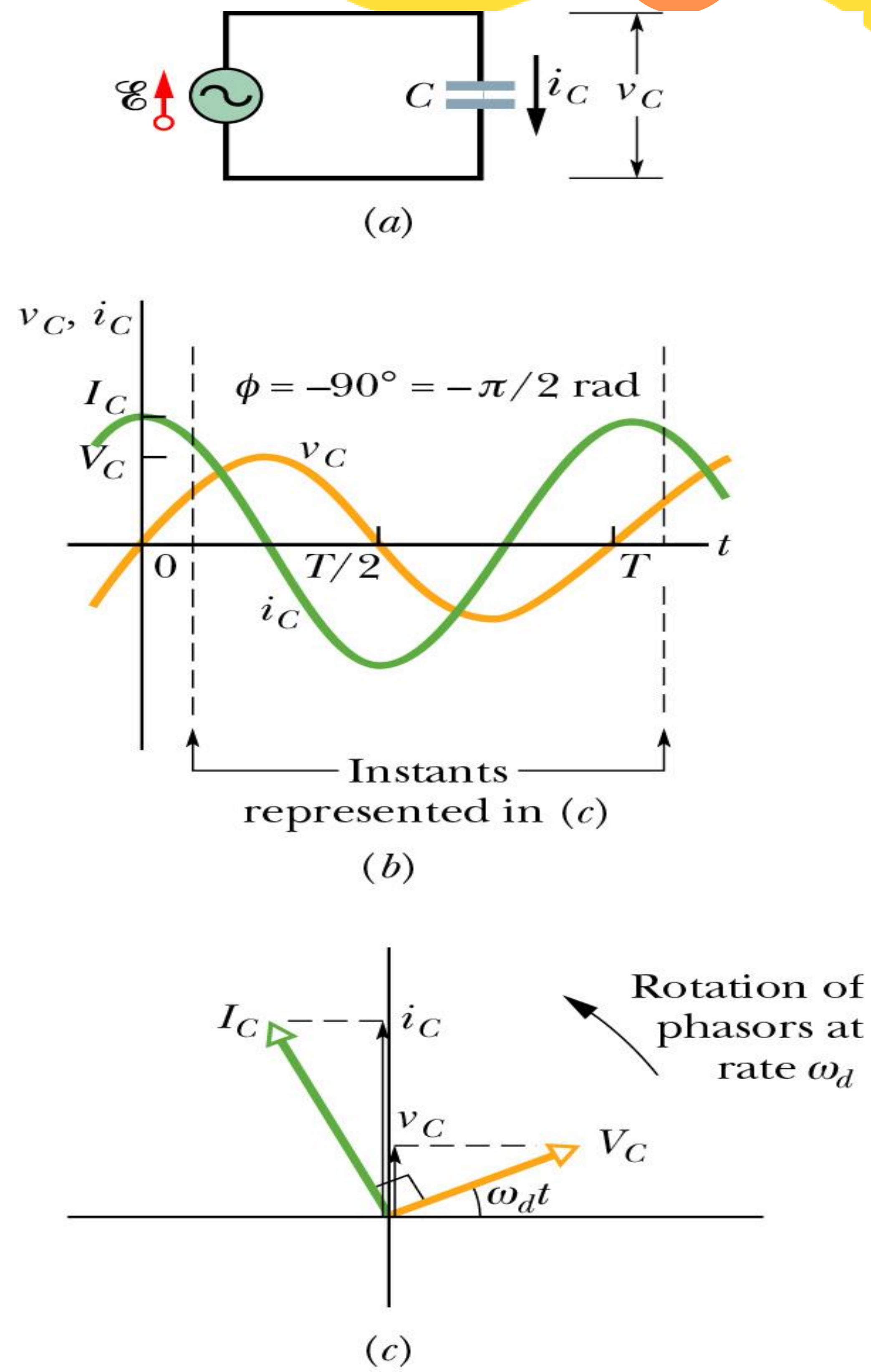
- Then $i_R = I_R \sin \omega_d t = \dfrac{V_R}{R} \sin \omega_d t$





Capacitive Load

- For a capacitive load, the voltage across the capacitor is proportional to the charge $v_C = \frac{q}{C} = \frac{Q}{C}\sin\omega_d t$
- But the current is the time derivative of the charge $i_C = \frac{dq}{dt} = \omega_d C V_C \cos\omega_d t$
- In analogy to the resistance, which is the proportionality constant between current and voltage, we define the "capacitive reactance" as $X_C = \frac{1}{\omega_d C}$
- So, $i_C = \frac{V_C}{X_C}\cos\omega_d t$
- The phase relationship is that $\phi = -90^o$, and current leads voltage.



Inductive Load

- For an inductive load, the voltage across the inductor is proportional to the time derivative of the current

$$v_L = L\frac{di_L}{dt}$$

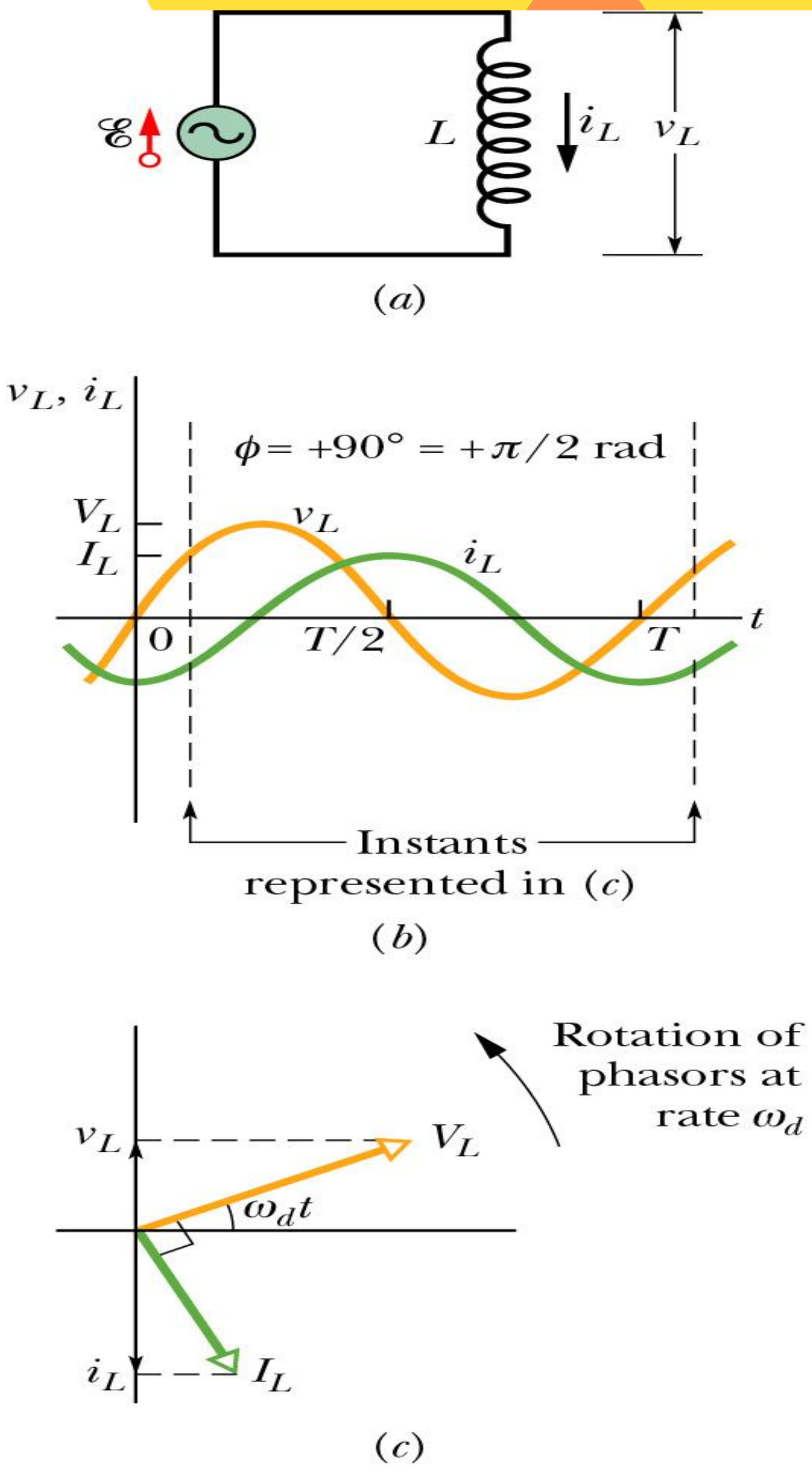
- But the current is the time derivative of the charge

$$i_L = \frac{V_L}{L}\int \sin\omega_d t\, dt = -\left(\frac{V_L}{\omega_d L}\right)\cos\omega_d t$$

- Again in analogy to the resistance, which is the proportionality constant between current and voltage, we define the "inductive reactance" as

$$X_L = \omega_d L$$

- So, $i_L = -\frac{V_L}{X_L}\cos\omega_d t$
- The phase relationship is that $\phi = +90^o$, and current lags voltage.



Inductive Load

Circuit Element	Symbol	Resistance or Reactance	Phase of Current	Phase Constant	Amplitude Relation
Resistor	R	R	In phase with v_R	0º (0 rad)	$V_R=I_R R$
Capacitor	C	$X_C=1/w_d C$	Leads v_R by 90º	-90º (-p/2)	$V_C=I_C X_C$
Inductor	L	$X_L=w_d L$	Lags v_R by 90º	+90º (p/2)	$V_L=I_L X_L$