



# ENGINEERING CHEMISTRY

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Department of Science and Humanities

# ENGINEERING CHEMISTRY

## Module 1- Molecular spectroscopy

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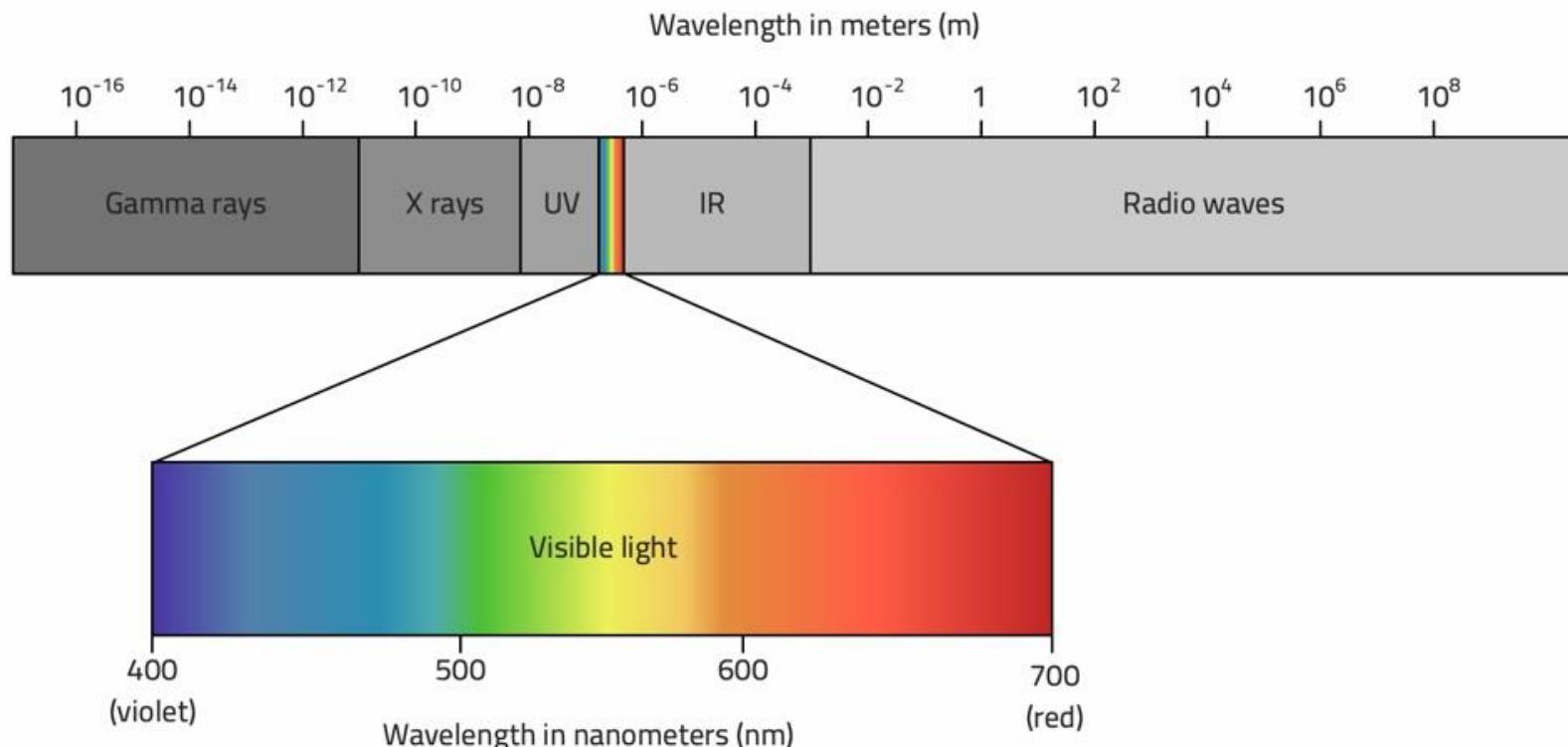
### *Class Content :*

- *Electromagnetic spectrum*
- *Information obtained from each region of the spectrum*

# ENGINEERING CHEMISTRY

## Module I- Molecular Spectroscopy

### Electromagnetic spectrum



Source: <https://www.radio2space.com/components-of-electromagnetic-spectrum/>

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## Module I- Molecular Spectroscopy

**Information obtained from different regions of electromagnetic spectrum**

<b>Radiofrequency region</b>	<b>Wavelength (10m-1cm)</b> <b>NMR, ESR</b> <b>Nuclear and electron spin reversal</b>
<b>Microwave region</b>	<b>Wavelength (1cm-100μm)</b> <b>Rotational spectroscopy</b> <b>Rotational transitions</b>
<b>Infra Red region</b>	<b>Wavelength (100μm-1μm)</b> <b>Vibrational spectroscopy</b> <b>Vibrational transitions</b>

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## Module I- Molecular Spectroscopy

### Information obtained from different regions of electromagnetic spectrum

<b>Visible and Ultra-Violet region</b>	<b>Wavelength (1μm-10nm)</b> <b>UV-Visible spectroscopy</b> <b>Electronic states</b> <b>Change in electronic distribution of valence electrons</b>
<b>X-ray region</b>	<b>Wavelength (10nm-100pm)</b> <b>X-ray spectroscopy</b> <b>Change in electronic distribution of inner electrons</b>
<b>γ- ray region</b>	<b>Wavelength (100pm-1pm)</b> <b>γ- ray spectroscopy</b> <b>Rearrangement of nuclear particles</b>

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## Module I- Molecular Spectroscopy

### Raman Spectroscopy: scattering of light

When monochromatic radiation is passed through a transparent medium:

Most of the scattered radiation consists of radiation of incident wavelength –

**Rayleigh scattering**

Some of the scattered radiation consists of radiation with different wavelength

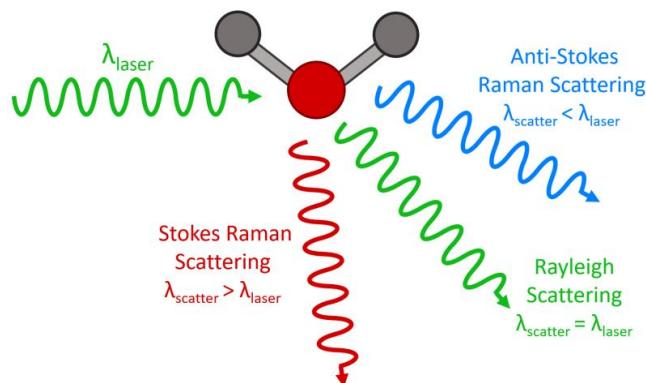
from incident wavelength – **Raman scattering**

When the wavelength of scattered radiation is more than that of incident radiation

– **Stokes lines**

When the wavelength of scattered radiation is less than that of incident radiation –

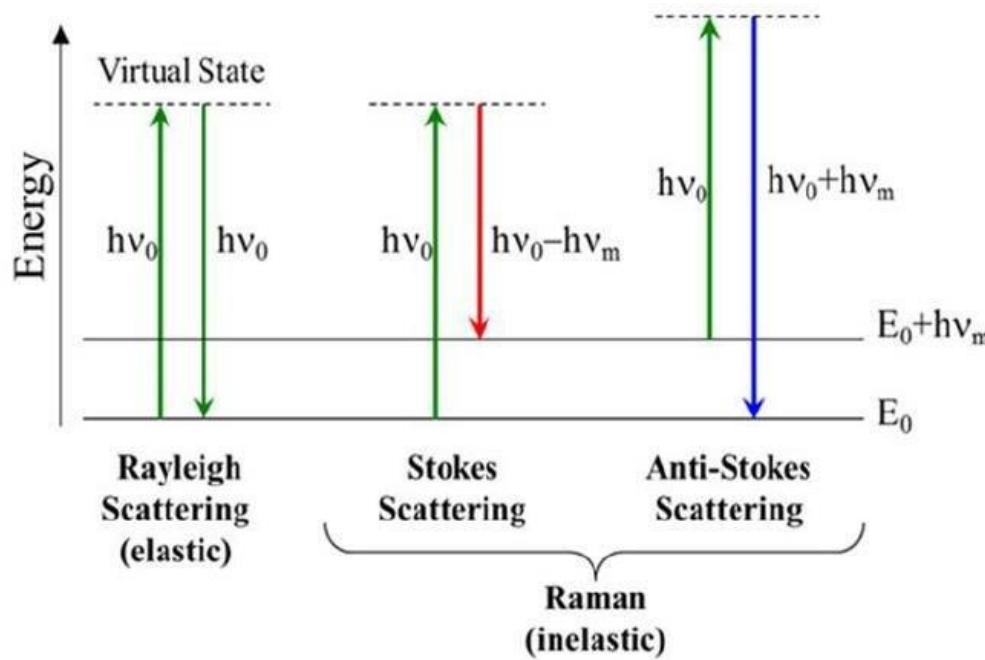
**anti -Stokes lines**



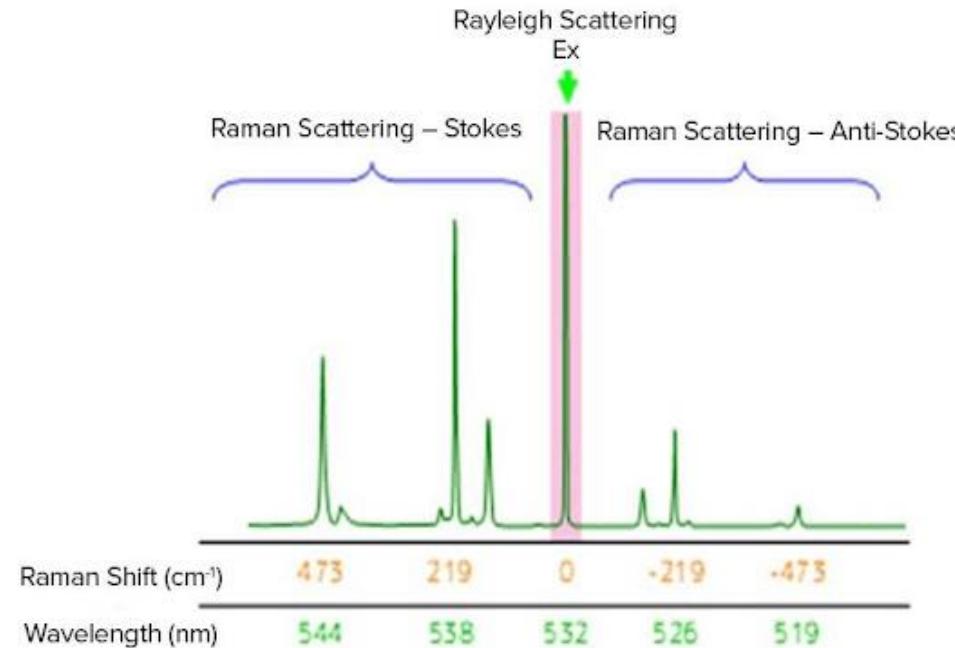
<https://www.edinst.com/blog/what-is-raman-spectroscopy/>

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## Module I- Molecular Spectroscopy



Source:[https://www.researchgate.net/figure/A-simplified-diagram-of-energy-transitions-for-Rayleigh-and-Raman-scattering\\_fig7\\_327321311](https://www.researchgate.net/figure/A-simplified-diagram-of-energy-transitions-for-Rayleigh-and-Raman-scattering_fig7_327321311)



Source: <https://www.jasco-global.com>

**Exchange of energy** between the molecules and radiation

**Homonuclear diatomic molecules** which are microwave and Infra-red inactive are Raman active

# ENGINEERING CHEMISTRY

## Module I- Molecular Spectroscopy

Information obtained from different regions of electromagnetic spectrum

Spectral region	VHF	UHF	Microwave	Infrared	Visible	Ultraviolet	X-rays	γ-rays
Common usage	NMR	EPR	rotational transitions	vibrational transitions	electronic transitions	ionisation	nuclear effects	
Frequency (Hz)	$5 \times 10^8$	$3 \times 10^{10}$	$3 \times 10^{11}$	$3 \times 10^{13}$	$6 \times 10^{14}$	$1.2 \times 10^{15}$	$3.0 \times 10^{17}$	$1.5 \times 10^{19}$
Wavelength	0.6 m	1 cm	1 mm	$10 \mu\text{m}$	500 nm	250 nm	1 nm	20 pm
Wavenumber ( $\text{cm}^{-1}$ )	0.017	1.0	10.0	1000	20,000	40,000	$1.0 \times 10^7$	$5.0 \times 10^8$

Source: <http://photobiology.info/Visser-Rolinski.html>



**THANK YOU**

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