Meden School Curriculum Planning							
Subject	Physics	**Year Group**	12	**Sequence No.**	3	**Topic**	3.3 Waves

Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
GCSE P6 EMS and ionising radiation, Wave basics, wave equation, waves on a string.	**3.3.1.1 Progressive Waves** Mechanical waves have oscillations of the particles of the medium; All waves can be describe in terms of their amplitude, frequency, wavelength, speed, phase, phase difference The wave equation is : $c = f\lambda$ The time period of a wave is the time taken for one complete wave cycle to pass a point, the link between frequency and period is: $f = 1/t$ Phase difference may be measured as angles (radians and degrees), wavelength or as fractions of a cycle. **3.3.1.2 Longitudinal and Transvers waves** Nature of longitudinal and transverse waves. Examples to include: sound, electromagnetic waves, and waves on a string.	

	Students will be expected to know the direction of displacement of particles/fields relative to the direction of energy propagation and that all electromagnetic waves travel at the same speed in a vacuum. Polarisation as evidence for the nature of transverse waves. Applications of polarisers to include Polaroid material and the alignment of aerials for transmission and reception. **(Malus's Law in not required)** **3.3.1.3 Principle of superposition of waves and formation of stationary waves** The formation of stationary waves by two waves of the same frequency travelling in opposite directions. To include reflected waves travelling along the normal. Key examples are waves on a vibrating string, reflected microwaves and sound waves. Nodes and antinodes occur at intervals along a string. Nodes have zero displacement and antinodes are points of maximum displacement. The distance between two nodes is equal to *λ/2.* Stationary waves on strings will be described in terms of harmonics. The terms fundamental (for first harmonic) and overtone will **not** be used. **Required practical 1:** Investigation into the variation of the frequency of stationary waves on a string with length, tension and mass per unit length of the string. To include the application of data in the formula of the first harmonic $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ **3.3.2.1 Interference**	Various industries such as plastic industries, chemical industries, metallurgy and smithy factories, etc. make use of polarization of radiations to carry out tests for stress and pressure analysis of objects. One of the most common testing procedures used by such industries includes optical stress analysis. Optical stress analysis makes use of plastic models to determine the regions of potential weaknesses of the material. When the material is put under stress, a stress pattern is formed that contains various bands of light and dark colour. The image of the stress pattern is generally formed with the help of polarizers.

	Two source interfence between monochromatic coherent waves. Coherence occurs between waves with the same wavelength, frequency and a fixed phase difference. Path difference is the amount by which one waves travels a longer path than another. Maxima occur between waves with a path difference = n λ where n is an interger, minima occur between waves with a path difference= (n+1/2) λ **Required practical 2:** Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating. Young's double-slit experiment: the use of two coherent sources or the use of a single source with double slits to produce an interference pattern. Interference pattern, $w = \frac{\lambda D}{s}$ Production of interference pattern using white light. Students are expected to show awareness of safety issues associated with using lasers. Students will be expected to describe and explain interference produced with sound and electromagnetic waves. Appreciation of how knowledge and understanding of nature of electromagnetic radiation has changed over time. **3.3.2.2 Diffraction** Appearance of the diffraction pattern from a single slit using monochromatic and white light. Qualitative treatment of the variation of the width of the central diffraction maximum with wavelength and slit width. The graph of intensity against angular separation is not required. Plane transmission diffraction grating at normal incidence. Derivation of $d \sin\theta = n\lambda$	

	Applications of diffraction gratings. 3.3.2.3 Refraction at a plane surface The refractive index of a substance is $n = \frac{c_v}{c_S}$ The refractive index of air is approximately 1, Snell's law of refraction for a boundary, $n_1 \sin\theta_1 = n_2 \sin\theta_2$ The critical incident angle is reached when the refraction angle is 90°, this only occurs when a ray is passing from a more dense into a less dense medium. Total internal reflection occurs when the incident angle is greater than the critical angle. Critical angle is determined using the equation: $\sin\theta_C = \frac{n_2}{n_1}$ Simple treatment of fibre optics including the function of the cladding. Cladding must be less optically dense than the medium of the fibre to ensure TIR, it also provides a protective layer around the fibre to prevent scratches. Signal degradation is due to absorption and dispersion. Absorption is solved by using repeaters along the fibre to regenerate the signal. Material and modal dispersions occurs in optical fibres leading to pulse broadening. Dispersion is the broadening of a pulse which may lead to one pulse overlapping another. Modal dispersion is caused by light rays entering a fibre at slightly different angles causing paths of different lengths and therefore different transmission times. Solution	**Cable Television**. The high bandwidth and faster speeds of fiber optic cables make them a perfect choice for cable television. **Internet Systems**. The significantly improved bandwidth and higher speeds of fiber have meant they are replacing copper wires and coax cables. **Telephone**. Fiber optic cable has replaced copper undersea cables and is used extensively throughout the telephone network. The growth of 5G networks is greatly increasing the use of fiber in small cell networks and throughout the network. **Automobiles.** signal transmission between sensors and computing devices. Those sensors are often used to activate airbags and must be not only fast but also reliable. **Medical Applications**. Endoscopic surgery is dependent on fiber optics for lighting and viewing the site of the surgery. Dentistry uses fiber optic

	is single mode fibres which are very narrow and so only have a narrow pathway. Material dispersion is caused by the difference in refraction values of light with different wavelengths. Solution is to use monochromatic light.	cables to direct a pinpoint of high-power light in the search for cracks and cavities. **Mechanical Inspections**. It's easy to see how fiber optic cables used in endoscopic surgery could also be used for mechanical inspections. They are small enough to get into the tightest spaces and the length of the cable is not an issue with the low-loss characteristics of fiber optics. **Military Applications**. Fiber's low weight, immunity to electromagnetic interference, and security from interception make it excellent in military applications. **Aerospace Applications**They are even experimenting with manufacturing fiber optic cable in space to achieve improved specifications in a zero-gravity environment.