YEAR 2022-2023 Second TERM

'An ambitious curriculum that meets the needs of all'

Medium Term Planning - Topic: Waves

Curriculum Intent	In addition to working further on objectives from Year 11 Physics, pupils will be taught, following National Curriculum guidelines, the following this term:

Skills/Assessment Objective Links

3.3.1 Progressive and stationary waves

3.3.1.1 Progressive waves

Content	Opportunities for skills development
Oscillation of the particles of the medium; amplitude, frequency, wavelength, speed, phase, phase difference, $c = f\lambda$ $f = \frac{1}{T}$ Phase difference may be measured as angles (radians and degrees) or as fractions of a cycle.	**PS 2.3 / MS 0.1, 4.7 / AT a, b** Laboratory experiment to determine the speed of sound in free air using direct timing or standing waves with a graphical analysis.

3.3.1.2 Longitudinal and transverse waves

Content	Opportunities for skills development
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 will not be expected.	**PS 2.2, 2.4 / MS 1.2, 3.2, 3.4, 3.5 / AT i** Students can investigate the factors that determine the speed of a water wave.

3.3.1.3 Principle of superposition of waves and formation of stationary waves

Content	Opportunities for skills development
Stationary waves. Nodes and antinodes on strings. $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ for first harmonic. The formation of stationary waves by two waves of the same frequency travelling in opposite directions. A graphical explanation of formation of stationary waves will be expected. Stationary waves formed on a string and those produced with microwaves and sound waves should be considered. Stationary waves on strings will be described in terms of harmonics. The terms fundamental (for first harmonic) and overtone will **not** be used.	**MS 4.7 / PS 1.2, 2.1 / AT i** Students can investigate the factors that determine the frequency of stationary wave patterns of a stretched string.
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.	

3.3.2 Refraction, diffraction and interference

3.3.2.1 Interference

Content	Opportunities for skills development
Path difference. Coherence. Interference and diffraction using a laser as a source of monochromatic light. 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. Fringe spacing, $w = \frac{\lambda D}{s}$ Production of interference pattern using white light. Students are expected to show awareness of safety issues associated with using lasers. Students will not be required to describe how a laser works. 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.	**AT i** Investigation of two-source interference with sound, light and microwave radiation.
Required practical 2: Investigation of interference effects to include the Young's slit experiment and interference by a diffraction grating.	

3.3.2.2 Diffraction

Content	Opportunities for skills development
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 $d\sin\theta = n\lambda$ Use of the spectrometer will not be tested. Applications of diffraction gratings.	

3.3.2.3 Refraction at a plane surface

Content	Opportunities for skills development
Refractive index of a substance, $n = \frac{c}{c_s}$ Students should recall that the refractive index of air is approximately 1. Snell's law of refraction for a boundary $n_1\sin\theta_1 = n_2\sin\theta_2$ Total internal reflection $\sin\theta_c = \frac{n_2}{n_1}$ Simple treatment of fibre optics including the function of the cladding. Optical fibres will be limited to step index only. Material and modal dispersion. Students are expected to understand the principles and consequences of pulse broadening and absorption.	**MS 0.6, 4.1**

Spiritual, moral, social, and cultural development	**SMSC:** Listening to each other and valuing each person's contributions in discussions, working together in lessons to problem solve and achieve a shared goal. Learning about different scientists and learning how their understanding of the world evolved. **PSHE/British Values:** Working together in practical and problem-solving work. The practical work in this section requires two people to work together to take the measurements whilst holding the equipment in place. **Skills Builder:** development of practical skills through the numerous practical activities.
Numeracy	Constant numerical development in every lesson. Measuring skills, graph skills, problem solving. Exam questions build on topics with mechanics components frequently brought in.
Literacy	**Vocabulary Tier 2: wavelength, frequency, transverse, longitudinal, speed, stationary wave** **Vocabulary Tier 3: node, antinode, modal dispersion, optical fibre, phase difference, polarization, pulse broadening, refractive index, Snell's law, Young's Double Slit experiment.** **Reading:** Reading of the booklet and questions. Students need to be able to read the methods for practical lessons and ensure they complete them in the right order, using the right equipment. **Writing:** Students are exposed to a number of questions, both numerical and short and long written answers. Students need to be able to write in a concise way whilst using the key words. **Oracy:** Class discussions are incredibly important in physics where students regularly participate in class discussion to discuss abstract concepts. Students need to be able to express their understanding of concepts and theories.
Becoming future ready	**Careers/Employability:** Waves links in with music as well as light waves. All waves are explored here, from microwaves and their use in astronomy to their use in communications.
Adaptation **QFT/SEND Provision**	Throughout this topic, quality first teaching will provide differentiation: **By product:** different learners are asked different questions, different level of detailed responses are expected and the level of scaffolding for the problem solving questions are varied. **By resource:** All resources are the same, however, extra scaffolding may be provided if necessary. **By Intervention**: by providing different levels of supervision and support **By Progressive Questioning:** exploring pupils' understanding through interactive dialogue. **By Grouping:** according to prior attainment, gender, social preference, preferred learning style. **By Task:** Pupils should be involved in the identification of targets which are meaningful to them and in the selection of an appropriate task from the given range. **By Offering Optional Activities:** In class or as homework, to extend learning. This QFT/SEND provision will be explicit within the lesson-by-lesson schemes of work.
Implementation	• To be able to:

Curriculum Delivery	
Learning Outcomes (Knowledge)	• To know and understand longitudinal and transverse waves, explaining the motic the particles • To be able to describe displacement - displacement graphs and displacement - ti graphs • To be able to explain phase difference in waves using degrees and radians. • To be able to calculate wave speed • To be able to understand and explain polarisation • To be able to explain superposition of waves • To be able to explain how stationary waves form • To know about stationary waves in instruments. • To be able to describe interference. • To be able to explain what a coherent source is • To understand Young's Double Slit Experiment • To be able to apply the theory to the booklet/exam questions • To know and understand diffraction • To be able to draw and explain the intensity pattern for narrow and wide slits • To derive and apply the diffraction grating equation • To be able to apply the theory to the booklet/exam questions • To know that waves can be transmitted, reflected or absorbs. • To understand refraction • To measure refraction of a Perspex block • To know and apply Snell's Law • To know, understand and apply TIR & critical angle. • To complete exam questions on refraction • To know the uses of optical fibres. • To know and explain material dispersion. • To know and explain modal dispersion. • Red denotes interleaving; aspects of knowledge covered previously.
Current learning to be developed in the future within:	The students use this information in the quantum physics with de Broglie waves.
Assessment	Refer to assessment maps for formative and summative assessment opportunities.
Impact	Attainment and Progress – Refer to assessment results / data review documentation.