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| <b>Department</b>              | 06 Applied Sciences and Mechatronics   |
| <b>Course title</b>            | Waves/Acoustics/Wave Optics  |
| <b>Course number</b>           | PSB310   |
| <b>Hours per week (SWS)</b>    | 5 (4V 1U)  |
| <b>Number of ECTS credits</b>  | 5 CP   |
| <b>Course objective</b>        | this module introduces in particular competencies for physics knowledge in mechanical and optical waves as well as   |
| <b>Prerequisites</b>           | Mechanics/Osillations and Heat/Electricity   |
| <b>Recommended reading</b>     | Halliday, Resnick, Walker: Physik; Wiley-VCH<br>Tipler: Physik; Spektrum Verlag<br>Demtröder: Experimentalphysik 1,2; Springer-Verlag<br>Giancoli: Physik, Pearson Studium<br>Hering, Martin, Stohrer: Physik für Ingenieure, VDI-Verlag<br>E. Hecht, Optik, Addison-Wesley-Verlag<br>Pedrotti et.al., Optik für Ingenieure, Springer-Verlag   |
| <b>Teaching methods</b>        | Seminar-style teaching with exerises   |
| <b>Assessment methods</b>      |  |
| <b>Language of instruction</b> | English  |
| <b>Name of lecturer</b>        | Prof. Datong Wu  |
| <b>Email</b>                   | <a href="mailto:datong.wu@hm.edu">datong.wu@hm.edu</a>   |
| <b>Link</b>                    | <a href="https://sci-intern.hm.edu/fk/modulbeschreibungen.php?lang_nr=&amp;id=2164">https://sci-intern.hm.edu/fk/modulbeschreibungen.php?lang_nr=&amp;id=2164</a>  |
| <b>Course content</b>          | <p>Mechanical Waves</p> <p>Wave equations; waves on a string<br/>Superposition of waves; standing waves, eigenvalue and boundary value problems<br/>General wave theory; wavelength, frequency, phase and group velocity, dispersion, longitudinal and t</p> <p>Transmission Lines</p> <p>Lecher line<br/>Impedance, reflection, and transmission at boundaries<br/>Coupled oscillating circuits, beats, frequency and amplitude modulation</p> <p>Acoustics</p> <p>Acoustic wave equation, acoustic field quantities, acoustic impedance, acoustic transmission, reflectic<br/>Propagation of sound waves in media. Sound measurement techniques<br/>Doppler effect, audible range, sound attenuation, ultrasound</p> <p>Electromagnetic Waves</p> <p>Maxwell's theory; transversal waves, speed of light, refractive index<br/>Hertz dipole; near and far fields<br/>Waveguides with transversal modes, phase velocity, group velocity<br/>Dispersion, wave vector, energy transfer, intensity, Poynting vector</p> <p>Wave Optics</p> <p>Polarization; linear, circular, birefringence, wave plates, polarizers</p> <p>Reflection: metals and dielectrics; plasma frequency and Fresnel equations; Brewster angle, total refl</p> |

## Courses in English Course Description

### Interference:

Huygens' principle, coherence, two-beam interference, interference at thin layers,  
Interferences of equal inclination and equal thickness

Michelson, Mach-Zehnder, and Sagnac interferometers; Fourier spectroscopy

Multi-beam interferences; Fabry-Perot interferometer, applications of optical coherence tomography

### Diffraction:

Single slit, Fresnel and Fraunhofer diffraction, double slit, grating, circular aperture, Bragg reflection

Spectrographs and monochromators, atomic spectroscopy and chemical spectral analysis

Resolution of optical instruments, Abbe's imaging theory, Rayleigh criterion

### Remarks

Practice: Exercises on the above-mentioned topics with together developed solutions