Wave Optics

1. **Course number and name:** 020OPTCI3 Wave Optics

2. **Credits and contact hours:** 2 ECTS credits, 1x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Pascale Abboud

4. **Instructional materials:** PowerPoint slides, in-class problems.

5. **Specific course information**
   a. **Catalog description:**
      This course covers the key concepts of the wave theory of light. It begins with the definition of spherical and plane waves, accompanied by a comprehensive exploration of key principles associated with them, such as optical path length, wave intensity, wavefront, wave trains, and coherence length. Special attention is given to light interference through wavefront division (Young's double-slit experiment) and through amplitude division (Michelson interferometer). The impact of extended and narrow-spectrum light sources is also examined. Furthermore, an analysis of the Fraunhofer diffraction phenomenon is presented, followed by a study of interference generated by multiple coherent waves and the use of diffraction grating.

   b. **Prerequisites:** 020SPHCI1 Physical Signals

   c. **Required/Selected Elective/Open Elective**: Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand the fundamental principles of the wave nature of light.
      - Analyze the interference patterns produced by coherent sources.
      - Apply the principles of Michelson interferometry in practical applications such as length measurements and characterization of the refractive index of a material.
      - Understand the phenomenon of Fraunhofer diffraction and its theoretical foundations in the context of wave theory of light.
      - Utilize the gratings equation in practical applications such as wavelength measurements and color separation.

   b. **PI addressed by the course:**

PI	1.2	1.3	7.1
Covered	x	x	x
Assessed	x	x	x

7. **Brief list of topics to be covered**
   - Scalar theory of light: Monochromatic light, Optical path length, Wavefront, Spherical and plane wave (2 lectures)
   - Interference of two light waves: Coherence conditions, coherence length, Interference pattern, Young's double-slit experiment, Fraunhofer diffraction setup, Utilization of an extended source, Influence of spectral width (4 lectures)
   - Michelson interferometer: Presentation of the device, Configuration of the air gap illuminated by an extended source, Configuration of the air wedge illuminated by a distant extended source (4 lectures)
   - Diffraction: Huygens-Fresnel theory, Fraunhofer diffraction (2 lectures)
   - Interference of multiple coherent waves: Fresnel representation, Diffraction grating (3 lectures)