Course descriptor B30TC

Course code	**B30TC**
Course title	Fundamentals of Photonics and Micromechanics
Credits	15
School	Engineering and Physical Sciences
SCQF Level	10
Semester	1
Aims	• Develop detailed knowledge and skills to deal with diverse and complex technological systems that exist in microsystems engineering and a critical understanding of the range of tools and techniques available to support this process. • Develop a critical understanding of the relationships and interactions between the various components in a microsystem (Hardware and software) to achieve the overall goal of the systems structure and operation. • Develop and use a significant range of principal and specialist skills, techniques and practices in the domain of fundamental photonics and micromechanics. • Critically review existing practice and develop original and creative solutions to problems within the domain. • Communicate and work effectively with peers and academic staff in a variety of tasks, demonstrating appropriate levels of autonomy and responsibility. • Plan and execute a significant project of research, investigation or development in a specialist area, demonstrating extensive, detailed and critical understanding of that specialism.
Syllabus	• Basics of mechanics, Young's modulus, shear rate, Poisson's ratio, yield strength, fracture, examples; Extrapolation to non isotropic materials, notion of tensor, stiffness matrix, compliance, examples; Plane Statics, bending and elastic forces, Dynamics of vibrating structures and stress and strain of elastic structure, non linear elasticity theory, visco – elasticity, basics of fracture and theory, surface tension effects. • Basic properties of lasers; analogy with electronic amplifiers/oscillators; optical amplifiers and oscillators; Beer's law; laser oscillation threshold; interaction of radiation (photons) with matter; absorption; spontaneous emission; stimulated emission; population inversion; elementary rate equations; optical feedback in lasers; laser resonators; laser beam properties: power/energy; divergence; monochromatic light; brightness; coherence. Introduction to semiconductors; optical properties of semiconductors; the p-n junction; LEDs; diode laser structure; diode laser operation; heterostructure lasers; photodetectors. Fibre structure; principles of waveguiding; the dielectric slab waveguide; modal power distributions; dispersion; guided modes; multimode & single mode fibres;

	novel fibre optics. Laser distance measurements to satellites; Lasers materials processing; Optical storage (CD / DVD); Optical communication systems.

Learning Outcomes	
Subject Mastery	• Fundamental understanding of the principal theories, principles and concepts relating to the use of photonics and mechanics and especially micromechanics in the domain of Microsystems engineering and scientific applications. • Extensive, detailed and critical understanding of some specialist areas within the domain of photonics and micromechanics for microsystems. • Understanding and use of a significant range of the principal skills, techniques and practices in micromechanics and basic photonics, and a range of specialised skills, research and investigation techniques, and practices informed by leading-edge research and development. • A broad knowledge of the main areas of photonics and micromechanics techniques. • Application-based knowledge and skills relating to the broad range of activities within the photonics and micromechanics domains, and specialist knowledge and skills in applications relating to a number of specialist areas within the domain. • Fundamental knowledge and skills to deal with diverse and complex technological systems that exist in engineering and science disciplines and a critical understanding of the range of tools and techniques available to support this process. • A critical understanding of the relationships and interactions between the various components in a system (Hardware and software) to achieve the overall goal of the systems structure and operation.
Personal Abilities	• Develop and apply skills in critical analysis, evaluation and synthesis in consideration of the range of theories, concepts and techniques in use within the domain of photonics and micromechanics, and in the design of projects and experimental models. • Abilities to critically understand and apply relevant theories and technologies to developing analytical and design skills • Develop and utilise advanced problem-solving skills and techniques in the development of original and creative solutions to general and specialist issues within the domain of Microsystems engineering. • Develop and demonstrate skills and techniques in communication with peers and academic/industrial staff, using a range of appropriate methods to suit different levels of knowledge and expertise within the audience. • Develop and demonstrate critical knowledge and skills in the planning and usage of software tools and numerical techniques to develop, present and communicate information on projects and processes. • Demonstrate critical awareness of the current issues within the discipline, and make informed judgements with incomplete or

	inconsistent data, or where there are no professional/ethical codes or practices for guidance. • Work autonomously and within teams, as appropriate, demonstrating a capability for both taking and critically reflecting on roles and responsibilities.

Assessment method	Course work 20% Exam 80%