CMP4203 Lasers and Photonics

Period per Week			Contact Hour per Semester	Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WE	WCM	CU
30	30	00	45	100	60	40	3

Rationale

The content is designed to provide the foundations with which the operation of laser devices may be
understood at the mechanistic level. Together with skills acquired in related courses in the Computer Engineering degree program, this provides the student with the skill base to approach the next level of accomplishment, namely where they may be required to design and construct a laser-based device in a professional situation.

Objectives

The design, construction and application of laser systems of various types is of considerable significance in modern technology. This course undertakes the development of a working understanding of the principles and properties of lasers and gives an introduction to photonics which involves the control of light.

Course Content

1. ***Historical Development Of The Laser***
   - Evolution from Masers
   - Gordon Gould and Prokhorov's contributions
2. ***Atomic Theory Pertaining to Laser Development***
   - Review of atomic theory
   - Radiation and Infrared frequencies.
   - Wavelength bands
   - Gases in lasers.
   - Solid state lasers
3. ***Interaction of Light with Matter***
4. ***Optimal Mirror Cavities***
5. ***Three and Four Level Lasers***
6. ***Types of Lasers***
   - Molecular lasers
   - Semiconductor lasers
   - Gas lasers
   - Chemical lasers
   - Excimer lasers
   - Solid-state lasers
   - Fiber-hosted lasers
   - Ruby, Nd:YAG, He-Ne Lasers
7. ***Introduction To Optical Fibres***
   - History
   - Optical fiber communication
   - Fiber optic sensors
   - Principle of operation
   - Mechanisms of attenuation
   - Manufacturing
8. ***Q-Switching And Mode Locking***
   - Population Inversion

- Average power of the laser
- High peak powers
- Modelocked laser
- Non-linearity in optical materials

*9. **Non-Linear Optical Processes***

- Types and Differences
- Hamonic Generation
- Advantage over linear processes

Recommended and Reference Books

[1] Saleh, B. E. A., and M. C. Teich, *Fundamentals of Photonics,* New York, NY: Wiley, 1991. ISBN: 9780471839651.

[2] J. Goodman, *Introduction to Fourier Optics* (2nd edition), McGraw-Hill, 1996

[3] A Ghatak and K Thyagarajan, *An Introduction to Fibre Optics*, Cambridge University Press, 1998

[4] W. J. Smith, *Modern Lens Design*, McGraw-Hill, 1993

[5] K. T. V. Gratten and B T Meggitt, *Optical Fibre Sensor Technology: Applications and Systems*, Kluwer Academic Publishers, 1999

[6] K. Barnham and D. D. Vvedensky, *Low-Dimensional semiconductor structures*, Cambridge University Press, 2001

[7] P. S. Zory, *Quantum Well Lasers (Quantum Electronics: Principles and Applications)* Academic Press, 1993

[8] O. Svelto, *Principles of Lasers* (4th edition), Plenum Press, 1998

[9] L. A. Coldren and S. W. Corzine, *Diode Lasers and Photonic Integrated Circuits,* Wiley – Interscience, 1995

[10] B. G. Streetman and S. Banerjee, *Solid State Electronic Devices* (5th Edition) Prentice-Hall 1999

[11] R. W. Boyd, *Nonlinear Optics*, Academic Press, 1991

[12] M. Born and E. Wolf, *Principles of Optics: Electromagnetic Theory of Propagation, Interference and Diffraction of Light*, Cambridge University Press, 1999

[13] W. T. Welford, *Geometrical Optics*, North-Holland Press, 1962

[14] J. M. Senior, *Optical Fiber Communications, Principles and Practice*, Prentice-Hall International 1985

[15] W. T. Welford, *Aberrations of Optical Systems* (2nd edition), Adam Hilger, 1991

[16] H. A. Macleod, *Thin Film Optical Filters* (2nd edition), Adam Hilger, 1986

[17] P. Hariharan, *Basics of Interferometry*, Academic Press, 1992