אורט בראודה
המכללה האקדמית להנדסה
ORT Braude College

Physics department and Optical Engineering

Spring 2019

Course name: Light Sources and Lasers
Course number: 391310
Prerequisites: 391150 Modern Physics and Introduction to Quantum Mechanics, 391410 Physical Optics
Credit: 3.5 points (lecture 3hrs/week, exercise 1hr/week x 13weeks=52hrs)

Course objectives

1. Introduction to natural radiation sources and properties
2. Lasers engineering and applications

Course website

http://moodle.braude.ac.il

Subjects

1. Emission and radiation – brief overview (4 hrs)

1.1 Description of radiation energy using classical electromagnetic theory
1.2 Radiant intensity and flux
1.3 Luminosity function and intensity
1.4 Radiance
1.5 Lambertian surface properties
1.6 Examples of different sources of radiation

2. Blackbody radiation and Einstein coefficients (12 hrs)

2.1 Energy levels description of atomic system - general
2.2 Boltzmann distribution
2.3 Wien law
2.4 Rayleigh-Jeans model
2.5 Planck model and quantum description of radiation

2.6 Interaction of light with two level system
2.7 Absorption and spontaneous emission
2.8 Stimulated emission
2.9 Derivation of Einstein coefficients.

3. Coherence theory and Introduction to Lasers (20 hrs)

3.1 Temporal and spatial coherence with monochromatic and polychromatic light
3.2 Description of light matter interaction of two-level system and its limitations
3.3 Life time and broadening mechanisms
3.4 Lasing, description of main parts of lasing system
3.5 Properties of lasing system: lasing, loss, and gain
3.6 Laser of three and four level system
3.7 Rate equations
3.8 laser oscillator
3.9 Examples on gas and solid state lasers
3.10 Applications in industry and medicine

4. Optical cavities (8 hrs)

4.1 Fabry-Perot cavity properties: optical modes, free spectral range (FSR), Q factor, radiative and nonradiative broadening
4.2 Transmission, reflectivity, and absorption of cavities
4.3 Optical resonators and different configurations
4.4 Stability of optical resonators and design considerations
4.5 Confocal resonator
4.5 Propagation of Gaussian beam inside optical cavity

5. Continuous and short pulse lasers (8 hrs)

5.1 Gas (He:Ne, N_2, CO_2),
5.2 Solid state (Ruby, YAG, Ti:Sa) and semiconductor lasers,
5.3 Q-switching
5.4 Mode locking

Books:

1. Mark Csele, *Fundamentals of Light Sources and Lasers*, 3rd edition, John Wiley & Sons Inc., 2004.

2. Anthony E. Siegman, *Lasers*, University Science Books (1986).
3. W. Koechner, Solid-State Lasers Engineering, 4th edition, Springer-Verlag Berlin Heidelberg New York, 1999.
4. K. K. Sharma, *Optics: principles and applications*, Academic press, 2006.
5. Amnon Yariv and Pochi Yeh, *Photonics: Optical Electronics in Modern Communications (Oxford Series in Electrical and Computer Engineering)*, 6th edition, 2006.

Library website:
/http://www.braude.ac.il/library/readers_services/learning_materials

Grades:

Home works- 5 %. At least 80% of the exercises have to be completed in order to pass the course.
Homework-based exams- 15%
Final exam- 80%