MEEN 5800 SYLLABUS FALL 2020

Course: Optics & Thermal Radiation
Instructor: Dr. Richard Zhang
Lecture times: MW 7:00-8:20pm
Classroom: Zoom web conference
Office hours: MW 4:30-5:30pm, or by appointment
E-mail: zihao.zhang@unt.edu

This course will cover the fundamentals of light propagation in vacuum and other optical media. Engineering applications of optical systems will be discussed and studied. Advanced concepts of thermal radiation will be covered later in the course.

Required Textbook: "Optics", 5th Edition, by Eugene Hecht
Supplementary Textbook: "Introduction to Heat Transfer", 5th Edn., by T.L. Bergman, et al.
Supplementary Textbook: "Nano/Microscale Heat Transfer", 1st Edition, by Zhuomin Zhang

Grading system:

(1) Attendance is mandatory – webcam must be on	
(2) Homework	10%
(3) Post-lecture quizzes	20%
(4) Two midterms	20% each
(5) Final exam	30%

Homework:

Additional derivation of proof of key concepts will be assigned.
Due day will appear on assignments
Late homework: deduct 20% for each unexcused late day

Tentative outline:

1. Introduction (Ch 1)
   Wave frequency, wavelength, wave number, photon energy, photon momentum, blackbody radiation, electromagnetic wave spectrum
2. Mathematics of waves (Ch 2)
   Wave equation, relation between wave and oscillation, propagating wave, phase, phase velocity, phasor, plane wave, spherical wave
3. Electromagnetic waves (Ch 3)
   Electromagnetic theory, Maxwell equation, wave equation for EM wave, properties of EM waves, speed of EM wave in vacuum and in dielectric medium, energy flux, momentum flux, dispersion relation and model for index of refraction.
4. Light propagation (Ch 4)
   Scattering, Snell's law of reflection and refraction, Huygens's principle, Fermat's principle, Fresnel's equation for amplitude and phase of reflected/transmitted EM waves, Stokes relation, total internal reflection, EM wave propagation in metal.

Mid-term exam 1 (Early October)

5. Geometric optics (Ch 5, 6)
   Imaging principle, imaging by Cartesian surface, single spherical sphere, thin lens, lens system, thick lens, ray matrix, focal point, principle points, nodal points, ray diagram, aperture and stop, application of optical systems.
6. Polarization (Ch. 8)
   Electric field vector in EM wave, definition of polarization, Jones vector for polarization state, Jones matrix for polarization operation, linear polarizer, birefringence, polarization by reflection, phase retarder, optical activity.

Mid-term exam 2 (Early November)

7. Interference of light (Ch 7, 9)
   Superposition of waves, Fourier transform, interference of two waves, Yong's experiment of its alternatives, light interference on thin film, interference of multiple waves, Fabry-Perot, Interferometers, multilayer films
8. Diffraction (Ch 10)
   Kirchhoff diffraction formula, Fraunhofer diffraction, single slit, double slit, circular aperture, rectangular aperture, many slits, grating, resolution of image, foundation of Fourier optics, Fresnel diffraction, zone plate, Fresnel diffraction of rectangular aperture.
9. Radiation intensity and view factors (Ch 12, 13 of IHT)
   Intensity, angular dependency, view factor integral, view factor case studies
10. Nanoscale thermal radiation engineering (Ch 9,10 of NMHT)
    Bragg reflector, Fabry-Perot cavity, RCWA, view factor, plasmonics, metamaterials, near-field photon tunneling

Final exam: **7:00-9:00pm Monday, Dec. 7, 2020**