University of Tehran
School of Electrical and Computer Engineering

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<tr><td>Course:</td><td colspan="10">8101491 – Fourier Optics</td></tr>
<tr><td>Course type:</td><td colspan="10"><table>
<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">Credit: 3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td colspan="10">Undergraduate ☐
Graduate ■</td></tr>
<tr><td>Co-requisite(s):</td><td colspan="10">-</td></tr>
<tr><td>Prerequisite(s):</td><td colspan="10">Signals & Systems, Fields & waves</td></tr>
<tr><td>Prerequisite by topic:</td><td colspan="10">Temporal Fourier transform and its properties, Temporal impulse response of linear systems and their transfer functions, Green's theorem, Spherical Waves and their properties.</td></tr>
<tr><td>Textbook(s):</td><td colspan="10">[1] J. W. Goodman, Introduction to Fourier Optics, 3rd Ed., Roberts & Company, 2005.
[2] Selected papers.</td></tr>
<tr><td>Coordinator:</td><td colspan="10">Reza Faraji-Dana, Professor, School of Electrical & Computer Eng.</td></tr>
<tr><td>Goals:</td><td colspan="10">- Making students familiar with the applications of linear systems theory and Fourier transform in the analysis of optical systems which are employed for the storage, processing and transmission of optical information.</td></tr>
<tr><td>Outcome:</td><td colspan="10">Upon successful completion of the course, students will have the following capabilities:
1. Analyzing scalar diffraction problems and calculate the diffraction patterns of objects by using the linear systems and Fourier transform tools.
2. Using the concepts of coherence, incoherence and partial coherence in the analysis of optical systems.
3. Analyzing and designing optical imaging and processing systems and implement object restoration algorithms.
4. Familiarity with holography and its applications.
5. Familiarity with the applications of Fourier optics in modern optical communications.</td></tr>
<tr><td>Topics:</td><td colspan="10">1- Two Dimensional Signals and Systems (Mathematical background: 2D Fourier transform, Impulse response and transfer function of 2D linear systems, 2D sampling theorem) (4 sessions)</td></tr>
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	2- Scalar Diffraction Theory (Kirchhoff diffraction formulation, Rayleigh-Sommerfeld formulation, Angular spectrum of plane waves and its application in analyzing the propagation of a disturbance in free space, Fresnel and Fraunhofer approximations) **(6 sessions)** **3- Wave-Optics Analysis of Coherent Optical Systems** (Application of a thin lens in taking Fourier transform, Imaging properties of lenses) **(3 sessions)** **4- Frequency Analysis of Optical Imaging Systems** (Analysis of coherent and incoherent imaging systems by using frequency domain methods, Transfer function of coherent and incoherent imaging systems, Aberration effects, Comparison of coherent and incoherent imaging systems, Rayleigh resolution limit, Object restoration and super-resolution techniques) **(6 sessions)** **5- Analog Optical Information Processing** (Historical background, VanderLugt filter, Matched filter, Optical Character Recognition (OCR), Imaging with Synthetic Aperture Radar (SAR)) **(5 sessions)** **6- Wavefront reconstruction (Holography)** (Historical background, Different holographic techniques, Application of holography) **(4 sessions)** **7- Applications of Fourier Optics in Optical Communications** (Fiber Bragg Grating (FBG), OCDMA, Array Waveguide Grating (AWG)) **(4 sessions)**
Computer usage:	MATLAB or other programming tools are required in doing the course numerical projects.
Assignments:	7 problems sets, 3-4 quizzes.
Projects:	Some small numerical projects and a final term project.
Grading:	Assignments: 15-20% Quizzes: 5-10% Term Project: 5-10% Final exam: 60-70%
Further readings:	[1] E. G. Steward, *Fourier Optics, An Introduction*, 2nd Ed., Horwood, 1987. [2] F. S. Yu, *Optical Information Processing*, John Wiley and Sons, 1983. [3] M. Born and E. Wolf, *Principle of Optics*, 7th Ed., Cambridge University Press, 1999.
Prepared by:	Reza Faraji-Dana
Date:	June, 2017

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		

Con	Control		
D	Digital System		