האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

ELECTROMAGNETIC WAVES AND ANTENNAS - 83888

Last update 20-05-2015

HU Credits: 4

Degree/Cycle: 1st degree (Bachelor)

Responsible Department: Applied Phyisics

Academic year: 1

Semester: 2nd Semester

Teaching Languages: English

Campus: E. Safra

Course/Module Coordinator: Prof Yuri Feldman

Coordinator Email: yurif@vms.huji.ac.il

Coordinator Office Hours: coordinate in advance

Teaching Staff:

Prof Yuri Feldman
Daniel Agranovich

Course/Module description:
Maxwell's equations, plane waves, Transmission and reflection waveguide transmission lines, coupled lines, sretemarap-S fields, radiation, antennas broadcast reception antennas, linear and tie. Antennas improved. Array antennas. Applications

Course/Module aims:
NA

Learning outcomes - On successful completion of this module, students should be able to:
NA'

Attendance requirements(%):
0

Teaching arrangement and method of instruction: Frontal lecture

Course/Module Content:
Lecture 1

Maxwell's Equations; Maxwell's Equations, Lorentz Force, Constitutive Relations, Boundary

Conditions, Currents, Fluxes, and Conservation Laws, Charge Conservation, Energy Flux and

Energy Conservation, Harmonic Time Dependence, Simple Models of Dielectrics, Conductors,

and Plasmas, Dielectrics, Conductors, Charge Relaxation in Conductors, Power Losses, Energy

Density in Lossless Dispersive Dielectrics, , Group Velocity.

Lecture 2

Uniform Plane Waves; Uniform Plane Waves in Lossless Media, Monochromatic Waves,

Energy Density and Flux, Wave Impedance, Uniform Plane Waves in Lossy Media,

Propagation in Weakly Lossy Dielectrics, Propagation in Good Conductors, Propagation in

Oblique Directions, Complex or Inhomogeneous Waves, Polarization,

Lecture 3

Reflection and Transmission; Propagation Matrices, Matching Matrices, Reflected and

Transmitted Power, Single Dielectric Slab, Reflectionless Slab, Time-Domain Reflection

Response, Multilayer Structures ; Multiple Dielectric Slabs, Antireflection Coatings, Equal

Travel-Time Multilayer Structures, Applications of Layered Structures, Chebyshev Design of

Reflectionless Multilayers

Lecture 4

Waveguides; Longitudinal-Transverse Decompositions, Power Transfer and Attenuation,

TEM, TE, and TM modes, Rectangular Waveguides, Higher TE and TM modes, Operating

Bandwidth, Power Transfer, Energy Density, and Group Velocity, Power Attenuation,

Reflection Model of Waveguide Propagation, Resonant Cavities, Dielectric Slab Waveguides

Lecture 5

Transmission Lines; General Properties of TEM Transmission Lines, Parallel Plate

Lines, Micro strip Lines, Coaxial Lines, Two-Wire Lines, Distributed Circuit Model of

a Transmission Line, Wave Impedance and Reflection Response, Two-Port Equivalent

Circuit, Terminated Transmission Lines, Power Transfer from Generator to Load, Open- and

Short-Circuited Transmission Lines, Standing Wave Ratio, Determining an Unknown Load

Impedance, Smith Chart, Time-Domain Response of Transmission Lines

Lecture 6

S-Parameters; Scattering Parameters, Power Flow, Parameter Conversions, Input and Output

Reflection Coefficients, Stability Circles, Power Gains, Generalized S-Parameters and Power

Waves, Simultaneous Conjugate Matching, Power Gain Circles, Unilateral Gain Circles,

Operating and Available Power Gain Circles Noise Figure Circules

Lecture 7

Radiation Fields; Currents and Charges as Sources of Fields, Retarded Potentials, Harmonic

Time Dependence, Fields of a Linear Wire Antenna, Fields of Electric and Magnetic Dipoles,

Ewald-Oseen Extinction Theorem, Radiation Fields, Radial Coordinates, Radiation Field

Approximation, Computing the Radiation Fields.

Lecture 8

Transmitting and Receiving Antennas; Energy Flux and Radiation Intensity, Directivity,

Gain, and Beamwidth, Effective Area, Antenna Equivalent Circuits, Effective Length,

Communicating Antennas, Antenna Noise Temperature, System Noise Temperature, Data Rate

Limits, Satellite Links, Radar Equation.

Lecture 9

Linear and Loop Antennas; Linear Antennas, Hertzian Dipole, Standing-Wave Antennas,

Half-Wave Dipole, Monopole Antennas, Traveling-Wave Antennas, Vee and Rhombic

Antennas, Loop Antennas, Circular Loops, Square Loops, Dipole and Quadrupole Radiation,.

Lecture 10.

Radiation from Apertures ; Field Equivalence Principle, Magnetic Currents and Duality,

Radiation Fields from Magnetic Currents, Radiation Fields from Apertures, Huygens Source,

Directivity and Effective Area of Apertures, Uniform Apertures, Rectangular Apertures,

Circular Apertures, Vector Diffraction Theory, Extinction Theorem,

Lecture 11

Aperture Antennas; Open-Ended Waveguides, Horn Antennas, Horn Radiation Fields, Horn

Directivity, Horn Design, Microstrip Antennas, Parabolic Reflector Antennas, Gain and

Beamwidth of Reflector Antennas, Aperture-Field and Current-Distribution Methods, Radiation

Patterns of Reflector Antennas, Dual-Reflector Antennas, Lens Antennas,

Lecture 12.

Antenna Arrays; Antenna Arrays, Translational Phase Shift, Array Pattern Multiplication, One-
Dimensional Arrays, Visible Region, Grating Lobes, Uniform Arrays, Array Directivity, Array

Steering, Array Beam width.

Lecture 13

Applications; Radars, ground penetration radars, space communications, Radio astronomy,

Microwave heating, wireless communication etc

Required Reading:
NA

Additional Reading Material:
1. Sophocles J. Orfanidis, “Electromagnetic Waves and Antennas” ECE Department

Rutgers University , 94 Brett Road Piscataway, NJ 08854-8058 www.ece.rutgers.edu/

~orfanidi/ewa/

2. David R. Jackson PLANE WAVE PROPAGATION AND REFLECTION Department

of Electrical and Computer Engineering, University of Houston Houston, TX

77204-479 http://www.egr.uh.edu/courses/ece/ECE6340/SectionJackson/Handouts/

plane%20waves.pdf

3. J. D. Kraus, Antennas, McGraw-Hill, 1988,

4. R. E. Collin, Field Theory of Guided Waves, 2nd Ed., IEEE Press, 1991

Course/Module evaluation:
End of year written/oral examination 90 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 10 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:

NA