האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Application of radar to meteorology - 82825

Last update 25-02-2014

HU Credits: *2*

Degree/Cycle: *2nd degree (Master)*

Responsible Department: *Atmospheric Sciences*

Academic year: *2*

Semester: *2nd Semester*

Teaching Languages: *Hebrew*

Campus: *E. Safra*

Course/Module Coordinator: *Prof. Daniel Rosenfeld*

Coordinator Email: *daniel.rosenfeld@huji.ac.il*

Coordinator Office Hours: *By appointment*

Teaching Staff:

Prof Daniel Rosenfeld
Goren Tom

Course/Module description:
Understanding the operating principles of weather radar and the ways by which they are applied to rainfall measurements and monitoring rain cloud systems

Course/Module aims:
Learning the principles of weather radar and its applications to meteorological applications.

Learning outcomes - On successful completion of this module, students should be able to:
Knowledge of using meteorological radar for meteorological observations and weather prediction.

Attendance requirements(%):
100%

Teaching arrangement and method of instruction: Lecture and exercise

Course/Module Content:
1. The principles of electromagnetic radiation: Electric and magnetic fields; the principle of dipole antenna; the propagation of EM radiation; polarization of the radiation.
2. Radar radiation: Location within the EM spectrum; the principles of selecting a suitable wavelength for a meteorological radar; the operating principles of a pulse radar.
3. Propagation of EM radiation in the atmosphere: index of refraction in dry air; impact of water vapor on the index of refraction; change of index of refraction with height and impact on curvature of the radiation. Anomaplous propagation and waveguides in the atmosphere; clear air radar applications.
4. The radar equation: calculating the antenna gain; the radar equation for a single reflector; the radar constant; the radar equation for an ensemble of reflectors; definition of radar reflectivity; the interaction between reflected radiation from many particles; Kessler correction; limitations imposed by the finite speed of light.
5. Quantitative rainfall measurement with radar: the relation between rainrate and reflectivity. The lack of unique relationship; raindrop terminal fall speed; power law

between reflectivity and rain rate; vertical reflectivity profiles and range effects.
6. Assumptions in rain rate measurements and the results of their invalidity:
7. Doppler radar: the Doppler principle; measuring Doppler shift with pulse radar; measurement limitations.
8. Applications of Doppler radar: the velocity spectrum width; removal of ground clutter; detection of wind shear; building vertical wind profile.
9. Polarimetric radar: the parameters that are derived from differences between the horizontal and vertical polarizations and their applications: differential polarization; linear depolarization; cross correlation; applications for identifying hydrometeor types.
The parameters derived from phase differences between the polarizations and their applications: phase shift and its integral; application to rainfall measurement.
10. Radar detection of severe weather phenomena: aviation hazards; downburst; hail; tornado; squall lines.
11. Radar identification of rain systems: the lifecycle of a convective cell; stratiform rain; rain cloud systems that are associated with cyclones.
13. Weather radar in space: operating principles; advantages and disadvantages; radar satellites: TRMM, GPM, CLOUDSAT, EARTHCARE.

Required Reading:
None

Additional Reading Material:
1.R. Doviak and D. Zrnic: Doppler Radar and Weather Observations

2. R. Reinhart: Radar For Meteorologists

3. D. Atlas: Radar in Meteorology

Course/Module evaluation:
End of year written/oral examination 80 %
Presentation 0 %
Participation in Tutorials 0 %
Project work 0 %
Assignments 20 %
Reports 0 %
Research project 0 %
Quizzes 0 %
Other 0 %

Additional information:

None