The University of Jordan

الجامعة الاردنية

Form: Course Syllabus	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
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	Number of Pages	07

1.	Course Title	**Seismology and Geodynamics**
2.	Course Number	**0305972**
3.	Credit Hours (Theory, Practical)	3 theoretical
	Contact Hours (Theory, Practical)	3 hr theory
4.	Prerequisites/ Corequisites	
5.	Program Title	Environmental and applied Geology
6.	Program Code	
7.	School/ Center	School of science
8.	Department	Geology
9.	Course Level	PhD in Geology
10.	Year of Study and Semester (s)	Fall 2025/2026
11.	Other Department(s) Involved in Teaching the Course	none
12.	Main Learning Language	English
13.	Learning Types	■Face to face learning ☐Blended ☐Fully online
14.	Online Platforms(s)	☐Moodle ☐Microsoft Teams
15.	Issuing Date	10/10/2025
16.	Revision Date	10//10/2025

17. Course Coordinator:

Name: Dr.Wadah F. Mahmoud Contact hours: Sunday 13:30-17:30

Office number: 203 Phone number: 23972 mob.: 0798515490

Email: w.mahmoud@ju.edu.jo

18. Other Instructors: (None)

Office numbers, office hours, phone numbers, and email addresses should be listed.

Name:

Office number:

Phone number:

Email:

Contact hours:

19. Course Description:

As stated in the approved study plan.

Introduction, plate tectonics and earthquakes, mathematical introduction, the inverse problems theory concepts, the physical theory of earthquakes, barriers and asperities, seismic sources and mechanisms, seismotectonic applications, induced seismicity, and seismicity of the Arabian plate and the Jordan Dead Sea Transform, feasibility and environmental impact of earthquake studies, seismic risk hazard, and earthquake prediction.

20. Course aims and outcomes:

A. Aims:

Having completed this course, students should be able to:

1. Explain Key Concepts in Seismology
2. Analyze Earth Structure Using Seismic Data
3. Understand Geodynamic Processes
4. Apply Quantitative and Computational Methods
5. Evaluate Seismic Hazards and Earthquake Behavior
6. Integrate Seismology and Geodynamics
7. Demonstrate Scientific and Research Skills

B- Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to

1. Explain Key Concepts in Seismology
- Describe the physical principles governing seismic wave generation, propagation, and attenuation.
- Distinguish between different seismic wave types and interpret what they reveal about Earth's interior.

2. Analyze Earth Structure Using Seismic Data
- Interpret seismograms to determine earthquake location, depth, magnitude, and focal mechanisms.
- Use seismic observations to infer the composition and physical properties of the crust, mantle, and core.

3. Understand Geodynamic Processes
- Explain the mechanisms driving plate tectonics, mantle convection, lithospheric deformation, and magmatism.
- Relate geodynamic processes to observable geological features such as rifts, subduction zones, and mountain belts.

4. Apply Quantitative and Computational Methods
- Process and analyze seismic datasets using appropriate analytical and computational tools.
- Apply basic inversion and modeling techniques to solve geophysical problems.

5. Evaluate Seismic Hazards and Earthquake Behavior
- Assess seismic hazard parameters and understand their implications for risk and infrastructure.
- Interpret patterns of seismicity in the context of tectonic processes.

6. Integrate Seismology and Geodynamics
- Combine seismic observations with geodynamic models to explain Earth processes across different scales.
- Critically evaluate how deep Earth dynamics influence surface tectonics and long-term planetary evolution.

7. Demonstrate Scientific and Research Skills
- Critically analyze scientific literature in seismology and geodynamics.
- Communicate geophysical findings effectively through written reports, presentations, or data visualizations.

21.Topic Outline and Schedule:

Topic	Wee k	Achieved ILOs	Reference
Introduction to Earth Structure & Geophysical Methods • Overview of Earth's interior • Introduction to seismology and geodynamics • Types of geophysical data and their uses	**1**	**1 & 2**	Textbooks, Lecture Notes
Fundamentals of Seismic Waves • Wave types (P, S, surface waves) • Wave propagation, velocity, and attenuation • Basic seismogram interpretation	**2**	**1 & 2**	Textbooks, Lecture Notes
Seismic Sources & Earthquake Physics • Earthquake generation and fault mechanics • Moment magnitude, energy release • Focal mechanisms and stress fields	**3**	**1 & 2**	Textbooks, Lecture Notes
Seismometers & Data Acquisition • Seismic networks and instrumentation • Digital seismology basics • Noise, filtering, and data quality	**4**	**1, 2, 3**	Textbooks, Lecture Notes
Earthquake Location & Magnitude Determination • Travel-time curves • Hypocenter determination • Magnitude scales and their applications	**5**	**1, 2, 3**	Textbooks, Lecture Notes
Seismic Tomography & Earth Imaging • Body-wave and surface-wave tomography • Inversion concepts • Global and regional Earth models	**6**	**1, 2, 3**	Textbooks, Lecture Notes
Structure of the Crust & Lithosphere • Crustal thickness, composition, and seismic properties • Lithospheric structure and strength • Seismic anisotropy	**7**	**4, 5**	Textbooks, Lecture Notes
Review & Practical Data Workshop • Hands-on seismogram analysis • Earthquake catalog interpretation • Midterm exam or project checkpoint	**8**	**4, 5**	Textbooks, Lecture Notes
Plate Tectonics & Geodynamic Framework • Plate boundaries and kinematics • Driving forces of plate motion • Heat flow and energy balance	**9**	**2, 3, 6**	Textbooks, Lecture Notes
Mantle Convection & Deep Earth Dynamics • Convection theory and modeling • Mantle plumes and subduction dynamics • Thermal and chemical structure of the mantle	**10**	**2, 3, 6**	Textbooks, Lecture Notes
Lithospheric Deformation & Rheology • Elastic, brittle, and ductile behavior • Mountain building, rifting, and orogenesis • Stress and strain in geodynamic systems	**11**	**2, 3, 6**	Textbooks, Lecture Notes
Earthquake Hazards & Risk Assessment • Seismic hazard analysis • Ground motion prediction • Societal impacts and mitigation strategies	**12**	**5**	Textbooks, Lecture Notes
Integrating Seismology & Geodynamics • Using seismic data to constrain geodynamic models • Case studies: subduction zones, continental collision, hotspots • Interdisciplinary approaches	**13**	**6**	Textbooks, Lecture Notes
Student Presentations & Final Project • Presentation of research or modeling projects • Course synthesis and future directions in geophysics	**14**	**6, 7**	Textbooks, Lecture Notes

22.Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

Detailed lectures are presented on each subject. PowerPoint is utilized when needed. Weekly exercises are given on the interpretation of geophysical data. Geophysical field surveys are conducted at some selected environmental sites. Students are trained on the processing and interpretation of the collected data.

23.Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

First Exam 20%; second Exam 20%, Practical Exam 10%; Final Exam 50%; Total = 100%

24.Course Policies:

A- Attendance policies: **university regulations**
B- Absences from exams and submitting assignments on time: **university regulations**
C- Health and safety procedures:
For field application, the following safety must be taken in consideration:

1. Suitable cloths depending on weather conditions
2. Every student must take general safety precautions while working, not disturb others and the local community, adhere to lecture etiquette and university regulations, and wear comfortable walking shoes.

D- Honesty policy regarding cheating, plagiarism, misbehavior: **university regulations**
E- Grading policy: May subjected to changes (depends on the overall results)

60- 64 C
65- 69 C+
70- 74 B-
75- 79 B
80- 84 B+
85- 89 A-
90-100 A

F- Available university services that support achievement in the course:
internet connection, geophysical instruments, field trips, self-equipment (compasses, hummers, GPS, etc…….).

24. Course Requirements:

(e.g.: students should have a computer, internet connection, webcam, account on a specific software/platform…etc.):
This course needs the following geophysical instruments:
1. **Seismology Instruments**: Seismometers / Broadband Seismic Stations/ Accelerometers/
2. **Geodynamics & Tectonics Instruments**: GPS/GNSS Receivers/ Gravimeters / Magnetometers
Students need a computer (or smartphone) and internet access to watch important videos and applications.

25.References:

Required book (s), assigned reading and audio-visuals:
Seismology Textbooks

- Seth Stein & Michael Wysession, 2009, **An Introduction to Seismology, Earthquakes, and Earth Structure,** Blackwell Publishing
- Thorne Lay & Terry C. Wallace, 1995, **Modern Global Seismology,** Academic Press
- Keiiti Aki & Paul G. Richards, 2002, **Quantitative Seismology,** University Science Books

Geodynamics Textbooks

- Donald L. Turcotte & Gerald Schubert, 2002, **Geodynamics,** Cambridge University Press
- M. R. Fowler, 2005, **The Solid Earth: An Introduction to Global Geophysics,** Cambridge University Press
- Gerald Schubert, Donald L. Turcotte & Peter Olson, 2001, **Mantle Convection in the Earth and Planets,** Cambridge University Press

26.Additional information:

Introduce different geophysical/geological software/s and mobile applications.

Name of the Instructor or the Course Coordinator:	Signature:	Date:
…**Dr. Wadah F. Mahmoud**……	……..……	……..……
Name of the Head of Quality Assurance Committee/ Department	Signature:	Date:
Dr Najel Yaseen…….	……..……	……..……
Name of the Head of Department	Signature:	Date:
……**Abdalla M. Abu Hamad** ……	……..……	……..……
Name of the Head of Quality Assurance Committee/ School of Science	Signature:	Date:
Prof. Emad A. Abuosba	……..……	……..……
Name of the Dean or the Director	Signature:	Date:
Prof. Mahmoud I. Jaghoub	……..……	……..……