

UNIVERSITY OF SARGODHA
DEPARTMENT OF SOIL & ENVIRONMENTAL SCIENCES, UNIVERSITY COLLEGE OF AGRICULTURE

COURSE OUTLINE

Spring 2020

Course Title: **Trace Elements in Agriculture**
Course Code: **SES-406**
Credit Hours: **3(2-1)**
Instructor: **Muhammad Zeeshan Manzoor**
Email: **zeeshansial106@gmail.com**

DESCRIPTION AND OBJECTIVES

The objective of this course is to equip the students with the knowledge about nutritional importance and environmental hazards of trace elements in agriculture

INTENDED LEARNING OUTCOMES

Sources and bio-geo-chemistry of trace elements, bioavailability and toxicity and environmental contamination issues are discussed. This course will equip the students with expertise about nutritional importance and environmental hazards of trace elements in agriculture.

COURSE CONTENTS

1. Introduction
2. Use of trace elements as commercial fertilizers. Trace elements status of Pakistan soils and their response to various crops.
3. Micronutrients: Forms in soils and factors affecting their availability
4. Trace elements in agriculture (B, Cl, Co, Cu, Fe, Mn, Mo and Zn): Nutritional aspects, availability, deficiency, toxicity and interaction.
5. Critical limits and functions in plants and their mobility.
6. Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V) in terrestrial and atmospheric eco-systems and their effects on plants, animal and human health.
7. Study of National Environmental Quality Standards (NEQS) in soil and water.

Practical

1. Analytical test of trace elements in soil and plant.
2. Deficiency and toxicity symptoms

READINGS

1. Adriano, D.C. 2001. Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Springer –Verlag New York, Inc. USA.
2. Bell, R.W. and B. Dell. 2008. Micronutrients for Sustainable Food, Feed, Fiber and Bio-energy Production. International Fertilizer Industry Association (IFA), Paris, France.
3. Kabata – Pendias, A. and H. Pendias. 2001. Trace Elements in Soils and Plants. 3rd Ed. CRC Press, Inc. Boca Raton, FL, USA.
4. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. Micronutrients in Agriculture. 2nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA.
5. Westermann, R. L. 1990. Soil Testing and Plant Analysis. 3rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
6. Carter, M.R. and E.G. Gregorid (eds.). 2008. Soil Sampling and Methods of Analysis. 2nd Ed. Taylor &Fancis Groups, Boca Raton, FL, USA.

7. Alfred R. C. 2014. Introduction to Soil Chemistry: Analysis and Instrumentation, 2nd Edition. John Wiley & Sons, Inc., Hoboken, New Jersey.
8. Hooda, P. S. 2010. Trace elements in soils. John Wiley & Sons, Inc.

COURSE SCHEDULE			
Week	Lecture / Practical	Topics and Readings	Books with Page No.
1	Lecture # 1	Introduction: Analytical tests	Introduction to Soil Chemistry: Analysis and Instrumentation, Alfred R. C. 2014. 2nd Edition. John Wiley & Sons, Inc., Hoboken, New Jersey.
	Lecture # 2	General Introduction	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA. pp. 1-27.
	Practical # 1	Introduction: trace elements in agriculture	Trace Elements in Soils and Plants. 3 rd Ed. Kabata–Pendias, A. and H. Pendias. 2001. CRC Press, Inc. Boca Raton, FL, USA. Chapter 5. Trace elements in plants.
2	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Use of trace elements as commercial fertilizers	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 523-46.
	Practical # 2	Use of trace elements as commercial fertilizers	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 523-546.
3	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Trace elements status of Pakistan soils	Lecture notes
	Practical # 3	Response of TE to various crops	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 549-583.
4	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Micronutrients	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 114-137.
	Practical # 4	Micronutrients	Micronutrients for Sustainable Food, Feed, Fiber and Bio-energy Production. Bell, R.W. and B. Dell. 2008. International Fertilizer Industry

			Association (IFA), Paris, France. pp. 22-24 & 29-40.
5	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Micronutrients: Forms in soils and factors affecting their availability	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 114-137.
	Practical # 5	Micronutrients: Forms in soils and factors affecting their availability	Micronutrients for Sustainable Food, Feed, Fiber and Bio-energy Production. Bell, R.W. and B. Dell. 2008. International Fertilizer Industry Association (IFA), Paris, France. pp. 9-27.
6	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Trace elements in agriculture (B, Cl, Co, Cu, Fe, Mn, Mo and Zn)	Micronutrients for Sustainable Food, Feed, Fiber and Bio-energy Production. Bell, R.W. and B. Dell. 2008. International Fertilizer Industry Association (IFA), Paris, France. pp. 29-41.
	Practical # 6	Trace elements in agriculture (B, Cl, Co, Cu, Fe, Mn, Mo and Zn)	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 90-111.
7	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Nutritional aspects, availability, deficiency, toxicity and interaction	Trace elements in soils. Hooda, P. S. 2010. John Wiley & Sons, Inc. pp. 175-181
	Practical # 7	Nutritional aspects, availability, deficiency, toxicity and interaction	Trace elements in soils. Hooda, P. S. 2010. John Wiley & Sons, Inc. pp. 181-192.
8	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Analytical test of trace elements in soil and plant continue	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Practical # 8	Analytical test of trace elements in soil and plant continue	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
9	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Critical limits of TE	Lecture notes
	Practical # 9	Critical limits of TE	Trace elements in soils. Hooda, P. S. 2010. John Wiley & Sons, Inc. pp. 293-304.

10	Lecture # 1	Analytical test of trace elements in soil and plant	Soil Testing and Plant Analysis. Westermann, R. L. 1990. 3 rd Ed. Soil Science Society of America, Inc. Madison, Wisconsin, USA.
	Lecture # 2	Functions in plants and their mobility	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 297-310.
	Practical # 10	Functions in plants and their mobility	Micronutrients in Agriculture. Mortvedt, J.J. F.R. Cox, L.M. Shuman and R.M. Welch. 1991. 2 nd Ed. Soil Sci. Soc. Am. Inc., Madison, WI, USA. pp. 310-324.
11	Lecture # 1	Deficiency and toxicity symptoms	Lecture notes
	Lecture # 2	Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V)	Trace Elements in Soils and Plants. 3 rd Ed. Kabata-Pendias, A. and H. Pendias. 2001. CRC Press, Inc. Boca Raton, FL, USA. Chapter 5. Trace elements in plants.
	Practical # 11	Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V)	Trace Elements in Soils and Plants. 3 rd Ed. Kabata-Pendias, A. and H. Pendias. 2001. CRC Press, Inc. Boca Raton, FL, USA. Chapter 5. Trace elements in plants.
12	Lecture # 1	Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V)	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Lecture # 2	Trace elements pollutants (Ag, As, Cd, Co, Cr, Hg, Ni, Pb, Se and V)	Lecture notes
	Practical # 12	Presentations 09-04-18	-
13	Lecture # 1	Deficiency and toxicity symptoms	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Lecture # 2	TE in terrestrial and atmospheric eco-systems and their effects on plants, animal and human health	Lecture notes
	Practical # 13	TE in terrestrial and atmospheric eco-systems and their effects on plants, animal and human health	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
14	Lecture # 1	Deficiency and toxicity symptoms	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Lecture # 2	TE in terrestrial and atmospheric eco-systems	Lecture notes

		and their effects on plants, animal and human health	
	Practical # 14	TE in terrestrial and atmospheric eco-systems and their effects on plants, animal and human health	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
15	Lecture # 1	Deficiency and toxicity symptoms	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Lecture # 2	Study of National Environmental Quality Standards (NEQS) in soil	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Practical # 15	Study of National Environmental Quality Standards (NEQS) in soil	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
16	Lecture # 1	Deficiency and toxicity symptoms	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Lecture # 2	Study of National Environmental Quality Standards (NEQS) in water	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.
	Practical # 16	Overall discussion	Trace elements in the Terrestrial Environment: Biogeochemistry, Bioavailability and Risks of Metals. Adriano, D.C. 2001. Springer –Verlag New York, Inc. USA.

RESEARCH PROJECT/PRACTICAL/LABS/ASSIGNMENTS

State here the prerequisites of assigned research project, including term paper or lab assignment etc.

ASSESSMENT CRITERIA

Sessional:	20 % of the total theory marks (Project, Presentation, Participation and Assignment)
Project:	-
Presentation:	-
Participation:	-
Mid Exam:	30 % of the total theory marks
Final Exam:	50 % of the total theory marks
Practical Exam:	100 % of the total practical marks

