DEPARTMENT OF AGRONOMY
Faculty of Agricultural Sciences
University of the Punjab, Lahore

Course Outline

rogramme	B.Sc. (Hons.) Agriculture (Agronomy)	**Course Code**	**AGR-312**	**Credit Hours**	3 (2-1)
Course Title	**INTRODUCTION TO CROP MODELLING**				

Course Introduction

To acquaint students with the modern tools of crop models for better management of field crops

Learning Outcomes

On successful completion of this course, students will have;

1. Get introduced to the discipline of crop modeling
2. Basic concept of crop model and its applications
3. Hands on training on DSSAT and other models
4. To develop presentational skills through class participation and improve learning abilities of students with home assignments.

	Course Content	**Assignments/Readings**
Week 1	**Unit-I** 1.1 Introduction, significance historical development & role in agriculture 1.1.1 Introduction of crop modeling	Ch.1.Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press.
	Unit-I 1.1.2 History & Significance and importance 1.1.3.Role of crop modeling in agriculture	
	Practical Measurement of Different Environmental Variable • Temperature variable • Sun radiation • Precipitation • Humidity • Wind Evaporation	
Week 2	**Unit-II**	

	1.2 Fundamental concepts of crop modeling, their importance and uses 1.2.1 Systems Models, System approach 1.2.2 System Environment and Boundary	Ch.1.Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press.
	Unit-II 1.2.3 System Model and Simulation	
	Practical Visit to Weather stations for instruments observation and working	
Week 3	**Unit-III** 1.3 Fundamental concepts of crop modeling, their importance and uses 1.3.1 System Models, State Variables U (t), Explanatory Variables	Ch.1.Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press.
	Unit-III 1.3.2 Parameters 1.3.3. Importance and uses of Modeling	
	Practical • Introduction to the CQESTR model and Tutorial • Introduction to metadata and CQESTR inputs • Introduction to RUSLE files	CQESTR Model software
Week 4	**Unit-IV** 1.4. Developing Dynamics System Models 1.4.1 Methods, Example development of a system model	Ch.1.Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press.
	Unit-IV 1.4.2 Random Element in Dynamic equations 1.4.3. A Dynamic System Model as a Response Model	
	Practical • Preparation of RUSLE Files	CQESTR Model software
Week 5	**Unit-V** 1.5 Dynamic Agricultural System Models 1.5.1 Simple Maize Crop Model	1. Ch.1. Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd
	Unit-V 1.5.2 Dynamic Soil Water Model & Drought Index	

	1.5.3. Population Dynamics Models	Edition. Academic Press 2. Internet Source
	Practical • Run simulation with prepared • Prepare metadata for field sites • Run simulation and produce output • Interpret CQESTR simulation results	CQESTR Model software
Week 6	**Unit-VI** 1.6 Introduction to CQESTR Model (Soil model) 1.6.1 General description of the CQESTR model ,Soil organic C budget and algorithms, Organic residue decomposition phases **Unit-VI** 1.6.2 Soil texture and drainage algorithms 1.6.3 Belowground biomass algorithms 1.6.4 Surface residue algorithms	1. Research Article: Liang, Y., H.T. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, et al. 2008. CQESTR simulation of management practice effects on longterm soil organic carbon. Soil Sci. Soc. Am. J. 72:1486–1492. doi:10.2136/ sssaj2007.0154 2. Internet Source
	Practical Calibration and Validation of CQESTR	CQESTR Model software
Week 7	**Unit-VII** 1.7 Preparation of RUSLE Files for CQESTR 1.7.1 Weather Input file 1.7.2 Vegetation Input File , **Unit-VII** 1.7.2 Operation Input File 1.7.3. Construction of RUSLE	1. Research Article: Liang, Y., H.T. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, et al. 2008. CQESTR simulation of management practice effects on longterm soil organic carbon. Soil

		Sci. Soc. Am. J. 72:1486–1492. doi:10.2136/ sssaj2007.0154 2. Internet Source
	Practical DSSAT software 4.5 • Introduction • Main Programs • Modular Formats • Modes of Operation	CQESTR Model software
Week 8	**Unit-VIII** 1.8 Simulation in CQESTR Model 1.8.1 Simulation, Development of Graphs **Unit-VIII** 1.8.2 Calibration and Validation of data	1. Research Article: Liang, Y., H.T. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, et al. 2008. CQESTR simulation of management practice effects on longterm soil organic carbon. Soil Sci. Soc. Am. J. 72:1486–1492. doi:10.2136/ sssaj2007.0154 2. Internet Source
	Practical Crop System Models Components • Main Program • Land Unit Module • Input Module • Plant Module	
Week 9	**MID TERM EXAM**	
Week 9	**Unit-IX** 1.10 Introduction to DSSAT 1.9.1 Birth of DSSAT 1.9.2 Basic concept 1.9.3 Minimum Data requirement	1. A manual, System Model documentation.DSSAT 4.5. (2010). University

	Unit-IX 1.9.4 DSSAT Model Application 1.9.5 DSSAT Limitation	of Florida, Griensvile, U.S.A. 2. Internet Source
Week 10	**Practical** • Crop System Models Components • Soil Module • Soil plant Atmosphere interface module • Weather Module • Operations Management Module	DSSAT software 4.5
Week 11	**Unit-X** 1.10 Input data sets for DSSAT Model 1.10.1 Model inputs and Outputs	Ch.2.A manual, System Model documentation.DSSAT 4.5. (2010). University of Florida, Griensvile, U.S.A. Internet Source
	Unit-X 1.10.2 Linkage b/w experimental data and simulations 1.10.3 Levels of Data sets	
	Practical Preparation of X file	DSSAT software 4.5
Week 12	**Unit-XI** 1.11 Input data sets for DSSAT Model 1.11.1 Model inputs 1.11.2 Model outputs	Ch.3. Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press Internet Source
	Unit-XI 1.11.4 Linkage b/w experimental data and simulations 1.11.5. Levels of Data sets	
	Practical • Preparation of weather file	DSSAT model software 4.5
Week 13	**Unit-XII** 1.12 Crop Model Operation 1.12.1 Weather Data 1.12.2. Soil Characteristics Data 1.12.3. Crop Management Data	Ch.9: Understanding options for Agricultural Production. Internet Source
	Unit-XII 1.12.4 Enhanced Understanding of Model	
	Practical	DSSAT model software 4.5

	Preparation of Soil file	
Week 14	**Unit-XIII** 1.13 Simulation and evaluation of Dynamic models 1.13.4 Introduction 1.13.2 Simulating Continuous Time Models 1.13.3.Simulation of System Models in Difference equation forms 1.13.3	Ch.3. Working with Dynamic Crop Models: Methods, Tools and Examples for Agriculture and Environment.3rd Edition. Academic Press Internet Source
	Unit-XIII 1.13.4 Evaluation 1.13.5 Introduction 1.13.6.A model as scientific Hypothesis Comparing Simulation & Observed Values	
	Practical Preparation of A/T file	DSSAT model software 4.5
Week 15	**Unit-XIV** 1.14 Modeling and Crop Improvement 1.14.2 Crop parameters 1.14.2 Risk factors	Power Point Presentation
	Unit-XIV 1.14.3. Improvment 1.14.4 Climate Change 1.14.5 Utilization of Models	
	Practical Calibration & Validation of DSSAT model	DSSAT model software 4.5
Week 16	**Unit-XV** 1.16 Modelling a tool for future predictions 1.16.1 Cultivation of Crops under changing climate	Ch.9: Understanding options for Agricultural Production. Internet Source
	Unit-XV 1.15.2. Crop Zoning 1.15.3. Crop Zoning With Respect to Pakistani Conditions	
	Practical Software based Quiz	DSSAT model software 4.5
Week 17	**Unit-XVI** 1.16 Course review	Group Discussion

	1.16.1 Review of whole course through class discussion	
	Unit-XVI 1.16.2 Review of whole course through class discussion	
	Practical Revision of Lab work	
Week 18	**FINAL EXAM**	

Textbooks and Reading Material

1. Textbooks.
   In the detail course outline, one may mention chapters of the textbook with the content topics
2. Suggested Readings
   2.1. Cao, W., J.W. White and E. Wang. 2009. Crop Modeling and Decision Support. Springer, Heidelberg, Germany.
   2.2. Singh, P. 2008. Modeling Crop Production Systems: Principles and applications. Science publishers. Enfield, New Hampshire 03784.USA
   2.3. Sivakumar, M. V. K. and R. P. Motha. 2007. Managing Weather and Climate: Risks in Agriculture. Springer, Berlin, Heidelberg, New York.
   2.4. Sivakumar, M. V. K. and J. Hansen. 2007. Climate Predictions and Agriculture. Springer, Berlin, Heidelberg, New YorkJournal Articles/ Reports

Research Article:

Research Article: Liang, Y., H.T. Gollany, R.W. Rickman, S.L. Albrecht, R.F. Follett, W.W. Wilhelm, et al. 2008. CQESTR simulation of management practice effects on longterm soil organic carbon. Soil Sci. Soc. Am. J. 72:1486–1492. doi:10.2136/ sssaj2007.0154

Note:

1. It is preferable to use latest available editions of books. Mention the publisher & year of publication.
2. The References/ bibliography may be in accordance with the typing manual of the concerned faculty/subject. Preferably follow APA 7th Edition publication manual.

Teaching Learning Strategies

1. Lectures
2. Reports
3. Class discussion

Assignments: Types and Number with Calendar

1. Modeling as a tool for future prediction
2. Impact of Climate Change On Wheat Phenology
3. Global warming and food crisis

4. Impact of Climate Warming and management on Rice Phenology
5. Agriculture contribution in Green House emission in Pakistan

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.