Revised course

School Engineering

Department Energy (Open Elective/CBCT course)

Course Code EN552

Course Name **Climate change mitigation and energy management for crop based livelihood**

L T P CH Credit **3 0 0 3 3**

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Abstract

Crop production has been prime livelihood for a major portion of global population. Potential adverse impact of climate change (cc) on crop production and hence on livelihood has been a serious concern. This course is designed through a multi-disciplinary approach to impart interconnected knowledge on climate change and approaches to mitigate it. Know-how on climate smart crop production with advanced mitigation approaches such as selection of smart varieties, crop-energy management, and application of various modeling tools are expected to benefit the learners. The course is designed to as an open elective course at PG level.

Objectives

(a) To provide understanding on climate change phenomena and its potential impact on crop based livelihood

(b) To provide understanding on climatic change mitigation approaches (viz., climate smart crop development, energy management) including advanced techniques of climate smart crop production

(c) To create an understanding about assessment of climate change forecasting tools for crop based livelihood

Prerequisites of the course: Graduation in any discipline with science subjects at 12^{th} standard. Preliminary knowledge and proficiency on computer is desirable.

Lecture Plan (42 lectures)

Unit 1 (*Introductory Unit***):** Introduction to climate change, crop production based livelihood, introduction to smart crop development, advanced techniques of climate smart crop production including IT application and crop-water management

Contents	No of classes
Introduction of the course: Concept of earth-atmosphere-climate, spatial diversity and temporal variations. Climate change – crop production – mitigation – technologies – livelihood nexus.	01
Climate change - potential impact on nature and human development: Global warming – understanding greenhouse phenomena, sources and sinks of GHGs and historical trend, different phases of human development and reflection in greenhouse gas emission	01
Crop production based livelihood - relevance to human survival vis-à-vis economy, factors of crop production, inputs requirement of crop production, yield-energy-emission relationship	01
Historical examples of crop failure, reasons and its social consequences, need and strategy of development of climate smart crop, successful examples of climate smart crops	01
Crop-water relationship and needs of advance technique of crop-water management, importance of water management for crop based livelihood	01
Controlled environment and application of IT for climate smart crop – need and strategy of growing of climate smart crops, successful examples of climate smart crops	01

Unit 2: Understanding climate change and its possible impacts on crop productions

Crop and climate: growing seasons and botanical features of major crops (rice; wheat; maize; sugarcane; rapeseed & mustard, pulses, tea, cotton and rubber)	02
Understanding of crop physiology: Crop growth and development in relation to environmental stress -water and temperature stress, nutrient stress and resistance mechanism	02
Climate impact on crop: Effect of climate change including impact of elevated CO_2 and air pollutants on ecosystem growth and productivity: with special reference to agroecosystem (including horticultural and plantation crops)	02

Unit 3: Climate smart crop development

Concept of crop domestication: Importance of genetic diversity, introduction to crop genetics and examples of development of some major crops	02
Threats of climate change on crop production: Biotic and abiotic stress with examples. Challenges arising out of climate change and case studies. Threats of climate change on crop production: Biotic and abiotic stress with examples, Challenges arising out of climate change examples (e.g., cultivating Durum wheat in Ethiopia and its mitigation)	02
Concept and strategies of climate smart/resilient crops: How can plants adapt to changing climatic conditions; Overview on Breeding and Biotechnological toolboxes.	02

Unit 4: Crop yield variations and possible impact on livelihood by climate change

Introduction of simulation tools for predicting extreme climate events: global and regional examples	02
Understanding of crop yield data and climate change data and introduction to the computational tools of crop yields and climate predictors to predict crop yield	02
Sensitivity crop production to climate conditions, temperature-related indicators on crop yields, examples	02

Unit 5: Climate change mitigation approaches for crop production

Biotechnological approaches of climate change mitigation for crop based livelihood.	02
Cultivation approaches for climate change mitigation: With reference to input management and cropping system for lower GHG emission and better carbon sequestration	02
Climate change mitigation through control environment: advance techniques, applications of sensors, control system, IT	03
Advances of crop water management for climate smart crop production, examples of case studies	03
Renewable energy (solar, biomass) and energy management (conservation agriculture, precision farming) aiming to reduce carbon footprint	03

Unit 6: Climate smart crop based livelihood

Crop-based livelihoods: History: Subsistence agriculture, Traditional farming for barter and cash, Modern agriculture for trade – extensive and intensive. Economic aspects of crops – direct and associated. Crop-based industries. Demand-supply influences on crop-based livelihoods.	02
Climate-change impacts on crop-based livelihoods: Effects of climate on crops and vice versa, case study examples.	02
Effects of climate change on small to large farmers, crop-based industries and overall economy, case study examples.	01

Teaching-learning methods to be used

- Lecture and Discussion
- Case studies
- Assignments and Presentations
- Problem Solving using AdaptNET E lab
- Blended learning

Learning outcomes

- Ability to analyze climate change-crop production-livelihood nexus
- Ability to understand climate change mitigation approaches
- Ability to understand the need for climate smart agriculture and the genetic approaches available for climate change mitigation
- Ability to understand global, national and regional concern of climate change-crop production-livelihood nexus

Suggested Reading Materials

[1] Benkeblia Noureddine (Ed) (2020) Climate Change and Crop Production: Foundations for Agroecosystem Resilience; CRC Press

[2] Reynolds Matthew (Ed) (2017) Climate Change and Crop Production; CABI Climate Change Series; CIMMYT, Mexico

[3] Saxena A. B. (2011); A Textbook of Energy, Environment, Ecology and Society, New Age International

[4] Climate Smart Agriculture: Building Resilience to Climate Change. Edited by Leslie Lipper, Nancy McCarthy, David Zilberman, Solomon Asfaw, GiacomoBranca, Springer, FAO, 2018

[5] Hebbar, KB, Naresh Kumar, S. and Chowdappa, P. (2017). Impact of Climate Change on Plantation Crops (Eds). P 260. Astrel International –Daya Publishing House, New Delhi, India, ISBN: 9789351248330

[6] Nelson, G.C., Rosegrant, M.W., Koo, J., Robertson, R., Sulser, T., Zhu, T., Ringler, C., Msangi, S., Palazzo, A., Batka, M. and Magalhaes, M., 2009. Climate change: Impact on agriculture and costs of adaptation (Vol. 21). Intl Food Policy Res Inst.

[7] Climate Change and Agriculture Worldwide (Editor: Emmanuel Torquebiau) Springer Netherlands, 2015

[8] Research papers and Reports from standard sources such as FAO, UNFCC