



**Sher-e-Kashmir**  
**University of Agricultural Sciences & Technology of Kashmir**  
**Main Campus Shalimar Srinagar**

Subject: Institution of Ph. D Degree Programmes -reg.

University Order No. 36 (Acad.) of 2026  
Dated: 17.04.2026

Pursuant to the decision of the Academic Council taken at its 45<sup>th</sup> meeting, and based on the recommendations of the Standing Committee on Accreditation, and approval of the Hon'ble Vice-Chancellor, the following Ph.D Degree programmes, in the disciplines, as indicated hereunder, are hereby instituted.

S. No.	Degree Programme	Discipline	Division/ Faculty/College	Semester from which Programme Instituted	Scheme & Course Contents
1.	Ph. D	Agro-meteorology	Division of Agro-meteorology, FoH, Shalimar.	Spring Semester 2026	Annexure-A
2.	Ph. D	Irrigation & Drainage Engineering	Division of Irrigation & Drainage Engineering, CoAE&T, FoH, Shalimar.	Spring Semester 2026	Annexure-B
3.	Ph. D	Processing & Food Engineering	Division of Processing & Food Engineering, CoAE&T, FoH, Shalimar.	Spring Semester 2026	Annexure-C
4.	Ph. D	Fisheries Extension	Division of Social Science, Faculty of Fisheries, Rangil, Ganderbal	Autumn Semester 2026	Annexure-D

By order

Sd/-  
(Prof. Azmat Alam Khan)  
Registrar


Encls/; a. a 27 pages

No.AU/Acad./2026/A-10(II)/1161-79

Dated: 17.04.2026

Copy to the:

- Director Education (Chairman, Accreditation Committee), SKUAST-Kashmir, Shalimar. This refers to his No.Au/D.Edu/A-18/39 dated 06.04.2026.
- All concerned Deans/Associate Deans of Subject Matter faculties/Colleges
- All concerned Heads of Divisions
- Professor In-charge ARIS for placing on university website.
- Secretary to Vice-Chancellor, SKUAST-Kashmir.

  
(Mohd Waseem Malik)  
Assistant Registrar (Acad.)

**Course Title with Credit Load for PhD in Agriculture Meteorology  
Course Structure (as per BSMA-ICAR guidelines)**

Course Code	Course Title	Credit Hours
AGM 601*	Climate change and sustainable development	2+1
AGM 602	Meteorology of air pollution	2+2
AGM 603	Livestock and fisheries meteorology	2+2
AGM 604	Hydrometeorology	2+1
AGM 605	Analytical tools and methods for Agro-meteorology	1+1
AGM 606	Research and publication ethics	2+0
AGM 607	Environmental Physics for Agricultural Meteorology	3+0
AGM 608*	Computer Programs and Software for Agrometeorological data Management	1+1
AGM 691	Doctoral seminar	1+0
AGM 692	Doctoral seminar	1+0
AGM 699	Doctoral research	75

\*Indicates core courses for PhD

**Course Contents**

**Course Title:** Climate Change and Sustainable Development

**Course Code:** AGM 601

**Credit Hours:** 2+1

**Aim of the course:**

To impart the theoretical and practical knowledge of climate change and the cause, effect, mitigation of climate change.

**Theory**

**Unit I**

Climate change and global warming: definitions of terms; causes of climate change and global warming; greenhouse gases, ozone depletion; past records, present trends, extreme weather events and future projections; Case studies on various climatic projections and consequences thereof in relation to agriculture.

**Unit II**

Impacts of climate change on various systems: impacts resulting from projected changes on agriculture and food security; hydrology and water resources; terrestrial and freshwater ecosystems; coastal zones and marine ecosystems; human health; human settlements, energy, and industry; insurance and other financial services; climate change and crop diversification, loss of biodiversity, microbes and pest dynamics; climate change and storage, climate change and weed management. Advance methodology of assessing the impact of climate change on crops.

**Unit III**

Sensitivity, adaptation and vulnerability: system's sensitivity, adaptive capacity and vulnerability to climate change and extreme weather events; regional scenarios of climate change and variability.

**Unit IV**

Mitigation strategies for sustainable development: international policies, protocols, treaties for reduction in greenhouse gases and carbon emissions; carbon sequestration; carbon credit; Clean Development Mechanism (CDM) and land use.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

Crop management options for low emission, land use change and forestry mechanism, alternate energy sources, etc.

#### Unit V

Agricultural food security: reduction in carbon and GHG emission; fuel conservation and reduction in energy use, conservation tillage, biofuels for fossil fuels, reduction in machinery use etc; increasing carbon sinks; resource conservation technologies, mixed rotations of cover and green manure crops, minimization of summer fallow and no ground cover periods, etc.

#### Practical

- Case studies on various climatic projections and consequences thereof in relation to agriculture
- Advance methodology of assessing the impact of climate change on crops

#### Teaching methods/ activities

Classroom teaching, showing climatic models (GCMs and RCMs) through PPT, Hands on practical

**Course Title:** Meteorology of Air Pollution

**Course Code:** AGM 602

**Credit Hours:** 2+2

#### Aim of the course:

To impart the theoretical and practical knowledge of air pollutants.

#### Theory

##### Unit I

Introduction to air pollution- history, definition: clean air definition; natural versus polluted atmosphere; atmosphere before the industrial revolution, Real time air quality index and National air quality index

##### Unit II

Sources of air pollution; classification and properties of air pollutants; emission sources, importance of anthropogenic sources; behaviour and fate of air pollutants; photochemical smog; pollutants and trace gases. Acid rain and development of Gas Washing

##### Unit III

Meteorological factors in the dispersion of air pollutants; topographical, geographical and large scale meteorological factors attached air pollution; Planetary Boundary Layer (PBL) and mixing layer; meteorological conditions and typical plume forms; air pollution forecasting - Gaussian diffusion models, Numerical dispersion models.

##### Unit IV

Air quality standards; effect of air pollution on biological organisms; ozone layer depletion; air pollution control technologies; management of air pollution; principles of diffusion of particulate matter in the atmosphere; air pollution laws and standards. Scales of air pollution: local, urban, regional, continental and global.

##### Unit V

Air pollution sampling and measurement: types of pollutant sampling and measurement, ambient air sampling, collection of gaseous air pollutants, collection of particulate pollutants, stack sampling; analysis of air pollutants - sulfur dioxide, nitrogen dioxide, carbon monoxide, oxidants and ozone, hydrocarbons, particulate matter.

#### Practical

- Measurement of different air pollutants
- Measurement of different air pollution gases
- Measurement of visibility

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

- Measurement of ozone and aerosol optical thickness (AOT)
- To study the temperature profile at different heights
- To study the stability of the atmosphere
- To determine height of partial flume through chimani
- To study the effect of temperature on vegetables, orchards and agricultural crops

#### Teaching methods/activities

Classroom teaching and practical

**Course Title:** Livestock and Fisheries Meteorology

**Course Code:** AGM 603

**Credit Hours:** 2+2

#### Aim of the course:

To impart the theoretical and practical knowledge of weather, climate for livestock and fisheries management.

#### Theory

##### Unit I

Thermal balance in animals; energy exchange processes at the skin of the animals and the need for the maintenance of thermal balance in the animals. Animal traits and physiological responses.

##### Unit II

Effects of weather on animal production, loss of water from the body, growth rate and body weight, reproduction, grazing habit, food intake, milk production, sun burns and photosensitive disorders.

##### Unit III

Meteorological conditions prevailing in glass-house, green house, animal shed, poultry house and grain storage barns; heating, cooling and ventilation of these structures as governed by meteorological factors. Environmental modification within the shelters of livestock. Applications of biometeorological information for rational planning, design and management. Weather and animal diseases and parasites; diseases of poultry and its relation with weather and thermal comfort.

##### Unit IV

Livestock production and climate change, Management of livestock to reduce greenhouse gas emission.

##### Unit V

Weather effect on fish behaviour. Water temperature affecting fish activity. Marine weather and fishing. Climate change and fisheries production.

#### Practical

- Measurement of meteorological parameters within the shelters of livestock
- Calculation of animal comfort zone index
- Radiation of animal farm house and body
- Estimation of energy fluxes on body
- Measurements of CO<sub>2</sub> and methane in animal farm house.

#### Teaching methods/activities

Class room teaching for theory part, visit to farm house for practical

**Course Title:** Hydrometeorology

**Course Code:** AGM 604

**Credit Hours:** 2+1

**Aim of the course:**

To impart the theoretical and practical knowledge of different components of hydrologic cycle.

**Theory**

**Unit I**

Hydrologic cycle and its modification; rainfall and its interception by plants and crops. Interpolation and measurement of missing rainfall data; adequacy of rain gauges; average rainfall on an area depth basis; presentation and processing of precipitation data.

**Unit II**

Measurement of runoff, infiltration, moisture retention of soil, percolation, evaporation, evapotranspiration and its importance to agriculturists, irrigation engineers and flood forecasting personnel; water holding capacity of soils, plant available water, cultural practices on soil moisture in relation to different phases of crop growth; evaporation from snow, lakes, reservoirs and crop fields.

**Unit III**

Classifying rainfall data into class interval; ranking of rainfall data; relationship between intensity and duration; methods of predicting runoff rate; factors affecting runoff; rainfall-runoff relation; estimation of evapotranspiration from water balance methods; response of crops to water stresses under different agroclimatic situation on India.

**Unit IV**

Moisture availability indices and their application for Indian condition; wet and dry spell by Markov-chain model; drought and its classification, hydrological drought, drought indices and their applications under Indian conditions.

**Practical**

- Analysis of rainfall data
- Determination of effective rainfall
- To estimate missing rainfall data for a given station
- To find out the optimum number of rain gauges for a given catchment
- To find out the mean rainfall for a given drainage basin by Thiessen polygon method and isohyetal method
- To estimate the volume of runoff by SCS method
- Estimation of evapo-transpiration from field based water balance method.

**Teaching methods/activities**

Theory and practical classes

**Course Title:** Analytical Tools and Methods for Agro-meteorology

**Course Code:** AGM 605

**Credit Hours:** 1+1

**Aim of the course:**

To impart the theoretical and practical knowledge of new tools for analysis of agro climatic features.

**Theory**

**Unit I**

Review of agro-climatic methods; characterization of agroclimatic elements; sampling of atmosphere; temporal and spatial considerations; micro-meso-macro climates.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

04 of 07

## Unit II

Network spacing; spatial and temporal methods; GIS fundamentals and applications; numerical characterization of climatic features; crop response to climate, time lags time and distance constants, hysteresis effects.

## Unit III

Influence of climate on stress-response relations; thermal time approach in agroclimatology- heat and radiation use efficiency in crop plants; applications to insect-pest development and prediction; comfort indices for human and animals; impact of natural and induced variability and change of climate on crop production.

## Unit IV

Instrumentation and sampling problems; design of agro-meteorological experiments.

## Unit V

Basic knowledge of application of computers in agriculture; theories of computer language BASIC, FORTRAN, C, C++ and Visual basic.

## Unit VI

Empirical and statistical crop weather models and their application with examples; incorporating weather, soil, plants and other environment related parameters as subroutine and remote sensing inputs in models; growth and yield prediction models; crop simulation models; forecasting models for insects and diseases.

## Practical

- Calculation of continentality factors.
- Climatic indices and climogram.
- Agrometeorological indices: Degree-days, photothermal units, heliothermal units, phenothermal index.
- Heat and radiation use efficiency and other indices of crops.
- Crop growth rates.
- Analysis of thermogram, hygrogram, hietogram, sunshine cards etc. stream lines and wind roses and statistical analysis of climatic data.
- Working with statistical models: crop yield forecasting, crop weather relationship and insect & disease forecasting models.
- Working with crop simulation models
- Small programme writing in computer languages like BASIC, FORTRAN, C, C++ and Visual basic.
- Geographical Information System.

## Teaching methods/activities

Theory and practical classes, learning of computer language

**Course Title:** Research and Publication Ethics

**Course Code:** AGM 606

**Credit Hours:** 2+0

**Aim of the course:**

## Unit I

Introduction to philosophy: definition, nature and scope, concept, branches

## Unit II

Ethics: definition, moral philosophy, nature of moral judgements and reactions

## Unit III

Scientific conduct: Ethics with respect to science and research, intellectual honesty and research integrity, Scientific misconducts- falsifications, fabrications and plagiarism (FFP): Redundant publications: duplicate and overlapping publications, salami slicing; selective reporting and misrepresentation of data

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar. 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

#### Unit IV

Publication ethics: Definition, introduction and importance. Best practices/standard setting initiatives and guidelines: COPE, WAME etc., conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, type, violation of publication ethics, authorship and contributorship, Identification of publication misconduct, complaints and appeals, predatory publishers and journals

#### Unit V

Open access publishing: open access publication and initiatives: SHERPA, RoMEO online resource to check publisher copy right and self archiving policies; software tool to identify predatory publications developed by SPPU, Journal finder/journal suggestions tools, viz., JANE, Elsevier Journal Finder, Springer Journal Suggester etc.

#### Unit VI

Publication misconduct: Group discussions- subject specific ethical issues, FFP, authorship, conflicts of interest, complaints and appeals examples and fraud from India and abroad. Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools.

#### Unit VII

Database and Research metrics: Indexing data base, citation database, web of science, scopus, etc. Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, G-index, i-10 index altimetric

#### Teaching methods/activities

Classroom teaching and field and laboratory activities

**Course Title:** Weather and Climate Risk Management

**Course Code:** AGM 607

**Credit Hours:** 3+0

#### Aim of the course:

To impart the theoretical knowledge of Physics applied to atmosphere and meteorology

#### Theory

#### Unit I

Thermodynamics of the atmosphere. Physics of radiation: origin and nature of radiation, radiation geometry in Cartesian, spherical cylindrical coordinate systems, conservation principles for radiant energy; fluid motion: laminar and turbulent transfer, fluctuation theory for turbulent transfer of momentum, heat and water vapour.

#### Unit II

Physics of evaporation: aerodynamic approach, energy balance approach and combination approach for evaporation estimates.

#### Unit III

Physics of soil water system: the concept of potential as applied to soil water system, total potential and components, movements of water on soil, fundamental equation, hydraulic conductivity, infiltration, field drainage and water vapour movement in soil.

#### Unit IV

Physics of water use: a physical introduction to plant-water system and relationships, water transport through soil-plant-atmosphere systems, measurement of crop water use in terms of water conservation equation.

#### Teaching methods/activities

Classroom teaching

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

**Course Title:** Computer Programs and Software for Agro-meteorological Data Management

**Course Code:** AGM 608

**Credit Hours:** 1+1

**Aim of the course:**

To impart knowledge on management of agromet data and train the students in commercialization of agrometeorological data through e-services.

**Theory**

**Unit I**

Data and information; types of data; climate, soil and crop data; Importance of database management, Softwares related to database management; data requirements; data collection and recording (Automatic and manual).

**Unit II**

Data structure/format; quality control of data through computer software; techniques of climatic data generation; missing data; introduction to different software for database management.

**Unit III**

Processing and analysis of data and data products; value addition of data and data products; data users, public, commercial, academic or research. Availability, accessibility and security of data; evaluating the cost of data; e-management of data. Meta analysis: Advantages and problems, Steps, Approaches and methods, Applications.

**Unit IV**

Computer Programming: History, Quality requirements, Readability of source code, Algorithmic complexity, Debugging, Programming languages

**Practical**

- Types of instruments and data recording
- AWS data retrieval, storage and transfer
- Exposure to different software for Agromet data analysis; exposure to Statistical software
- Temporal and spatial analysis of data; exposure to GIS
- Value addition to data
- Introduction to internet protocols
- Uploading and downloading data, password and security of data
- E-management of data
- Introduction to computer programming

**Teaching methods/activities**

Hands on practical and theory



07 of 07

## Programme Structure

Name of the programme	Ph.D. Agricultural Engineering
Major Field	Irrigation and Drainage Engineering
Minor Field(s)	Soil and Water Engineering, Civil Engineering, Mechanical Engineering, Renewable Energy Engineering, Processing and Food Engineering, Farm Machinery and Power Engineering
Supporting Fields	Energy in Agriculture, Computer Science Engineering, Electrical Engineering, Mathematics and Statistics.
Core Courses	IDE 601, IDE 602
Optional Courses	IDE 603, IDE 604, IDE 605, IDE 606
Deficiency Courses, if any	Students pursuing Ph.D programme will have to pass deficiency courses, if he/she has not studied courses relevant to core courses in M.Tech (Irrigation and Drainage Engineering)
Research Work	IDE 699
Seminar	IDE 691, IDE 692
<b>Minimum credit requirement</b>	
Major	12
Minor	6
Supporting	5
Seminar	2
Research	75
<b>Total Credit</b>	<b>100</b>

### Major Courses (Requirement: 12 Credits)

Course Code	Course Title	Credits
*IDE 601	Recent Developments in Irrigation Engineering	2+1
*IDE 602	Advances in Drainage Engineering	2+1
IDE 603	Hydro-Mechanics and Ground Water Modeling	3+0
IDE 604	Soil-Water-Plant-Atmospheric Modeling	2+1
IDE 605	Plant Growth Modeling and Simulation	2+0
IDE 606	Multi Criteria Decision Making System	2+0

### Minor Courses (Requirement: 06 Credits)

Course Code	Course Title	Credits
SWCE 502	Applied Watershed Hydrology	2+1
SWCE 603	Reservoir Operation and River Basin Modeling	2+1
SWCE 604	Modeling Soil Erosion Processes and Sedimentation	2+1
CSE 503	Neuro-Fuzzy Application in Engineering	2+1
CSE 506	Digital Image Processing	2+1
FMPE 602	Advances in Machinery for Precision Agriculture	2+1
REE 615	Energy Planning, Management and Economics	3+0

Any other course(s) of other department can be taken as per recommendations of the student's advisory committee.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



### Supporting Courses (Requirement: 05 Credits)

Course Code	Course Title	Credits
CPE-RPE	Research and Publication Ethics	1+1

Courses from subject matter fields (other than Major and Minor) relating to area of special interest and research problem can be taken as per recommendations of the student's advisory committee.

### Syllabus (Major Courses)

**IDE 601 Recent Developments in Irrigation Engineering 2+1**

**Objectives:** To focus the students for the recent designs progressed in surface irrigation systems, surface and subsurface drip irrigation systems and for utilizing good and poor-quality waters for sustaining crop productivity.

**Unit-I:** Geospatial analysis of hydraulic properties of the soil. Surge flow irrigation systems. One dimensional and two-dimensional zero inertia modelling of border irrigation, surge irrigation and furrow irrigation. Integral equation solutions to surface irrigation. Design of irrigation runoff recovery systems. Cablegation: Automated supply for surface irrigation. Analyzing wind distortion in sprinkler irrigation systems uniformity.

**Unit-II:** Design of sub-surface drip irrigation systems. Modeling soil water regimes and solute distribution emanating from surface and sub-surface drip irrigation systems. Recent developments in designs of surface and sub-surface drip irrigation systems. Effects of emitter variability and plant and soil variability on soil moisture distribution uniformity. Irrigation scheduling through partial root zone irrigation. Low energy drip irrigation systems.

**Unit-III:** Drip irrigation for poor quality water. Drip automation for time and volume. Drip irrigation system modification for waste water utilization. Modeling deficit irrigation and crop yield in response to hydraulic variation of the system and distribution uniformity of the soil-crop water fertilizer response function. Crop water salinity response function.

**Unit-IV:** Drip irrigation in command area development. Mulching and its effect on crop productivity. Analyzing moisture and temperature profiles with time and depth. Effect of shading and mulching on crop productivity, vapour phase movement.

**Practical:** Designing border irrigation using zero inertia model, volume balance approaches, evaluating surge flow irrigation systems, operation of segmented border irrigation systems for enhancing water use efficiency, geospatial analysis of soil properties, design and planning of surface drip irrigation systems using various designs, design of subsurface drip irrigation, analyzing three dimensional moisture movement under subsurface drip irrigation using simple empirical models, design and planning of surface and subsurface drainage systems, developing the irrigation schedules using partial root zone irrigation, seasonal and dated production functions for forecasting crop yield.

**IDE 602 Advances in Drainage Engineering 2+1**

**Objectives:** To provide comprehensive knowledge of advances in land drainage, synthetic materials for drainage systems, linear flow laws and environmental issues related to drainage.

**Unit-I:** Physics of land drainage. Forces, surface tension and energy effects water. Energy of soil water. Capillary potential.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190028 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



02 of 04

**Practical:** Estimation of potential evapotranspiration. Measurement of ET parameters under open and protected cultivation and development of stochastic and deterministic models of ET. Use of software for estimation of crop water requirement and ET.

**IDE 605 Plant Growth Modeling and Simulation**

2+0

**Objectives:** To impart the in-depth knowledge of plant growth modeling, type of modeling approach, quantitative analysis of photosynthesis and remote sensing-based modeling.

**Unit-I:** Introduction to plant growth modeling. Simulation and simulation language. Types of models and modeling approaches.

**Unit-II:** Relational diagram of principle process. Structure of a generalized agricultural simulator. Input environment and techniques for monitoring plant environment.

**Unit-III:** Process and aspects of growth and development. Input yield models. Quantitative analysis of photosynthesis, respiration, growth, water and nutrient uptake. Yield functions.

**Unit-IV:** Remote sensing-based modeling and field variability of growth influencing factors.

**IDE 606 Multi Criteria Decision Making Systems**

2+0

**Objectives:** To acquaint students about multi criteria decision making system which include multi-attribute decision making and multi-objective decision making.

**Unit-I:** Introduction: MCDM overview, basic foundations and Pareto optimality elementary decision analysis. Decision trees and influence diagrams.

**Unit-II:** Multi-attribute decision making (MADM): Deterministic utility theory, value decomposition, additive value decomposition, Multi-facility location analysis, expected utility theory, single attribute utility functions, multi-attribute overview, two-attribute utility models, multi-attribute computer programs, multi-attribute assessment.

**Unit-III:** Multi-objective decision making (MODM): Vector optimization theory, weighting methods, weighting example. Linear vector optimization (LVOP), parametric decomposition, LVOP algorithm, LVOP example.

**Unit-IV:** Non interactive and interactive methods: Geoffrion's Bi-criterion method, linear goal programming, nonlinear and integer goal programming.

**Unit-V:** Interactive trade-off methods: Zionts-Wallenius, Surrogate worth, Group decision making methods.



03 of 04

**Unit-II:** Devices to measure capillary potential. Hysteresis, Darcy's law. Synthetic materials for drainage systems. Environmental issues related to drainage. Socio-economic impacts of drainage systems.

**Unit-III:** Laplace equation its derivation and solution in various forms. Boundary value problems, Liner flow laws.

**Unit-IV:** Drainage criteria saturated flow theory, steady flow and non-steady flow. Controlled drainage for reducing agricultural non-point pollution. Application of simulation models for drainage systems.

**Unit-V:** Flow equations in general and the approach. Flow problem and physical boundary conditions.

**Practical:** Steady state and non-steady state flow problems. Measurement of capillary potential. Use of various synthetic materials under the field condition. Use of simulated models for drainage system.

**IDE 603 Hydro-Mechanics and Groundwater Modeling 3+0**

**Objectives:** To acquaint students about the concept of soil aquifer system, unsaturated flow models, numerical modeling of groundwater flow, theory of krigging and movement of groundwater in fractured and swelling porous media.

**Unit-I:** Concept of soil aquifer system, flow of water in partially saturated soils. Partial differential equation of flow, pressure under curved water films, moisture characteristic functions.

**Unit-II:** Physical models, Analog models, Mathematical modelling, Unsaturated flow models, Numerical modelling of groundwater flow, Finite difference equations and solutions. Successive over relaxation. Alternating direction implicit procedure. Crank Nicolson equation. Iterative methods. Direct methods. Inverse problem. Finite element method.

**Unit-III:** Determination of unsaturated hydraulic conductivity and model for its estimation. Diffusivity and its measurement. Infiltration and exfiltration from soils in absence and presence of water table.

**Unit-IV:** Fence diagram and aquifer mapping. Movement of groundwater in fractured and swelling porous media. Spatial variability, theory of krigging.

**Unit-V:** Data requirements. Conceptual model design: Conceptualization of aquifer system. Parameters, Input-output stresses, Initial and Boundary conditions. Model design and execution: Grid design, Setting boundaries, Time discretization and transient simulation. Model calibration: Steady state and unsteady state. Sensitivity analysis. Model validation and prediction. Uncertainty in the model prediction.

**IDE 604 Soil-Water-Plant-Atmospheric Modelling 2+1**

**Objectives:** To impart the knowledge of measurement of radiation within plant cover, thermodynamics of flow through plant cells, heat transfer and radiation exchange under plant cover.

**Unit-I:** Radiation balance of earth's surface. Turbulent transport of heat and momentum. Radiation exchange and heat transfer in a low plant cover.

**Unit-II:** Measurement of radiation, leaf and air temperature, humidity and wind profiles within plant cover. Predicting potential evapotranspiration.

**Unit-III:** Thermodynamics of flow through plant cells. Dynamics of water movement through soil plant atmosphere system. Stomatal aperture, photosynthesis and actual evapotranspiration relationship.

**Unit-IV:** Production functions of evapotranspiration. Evapo-transpiration in mathematical modelling and optimization of design and regulation of irrigation systems and for utilization of limited water resources in agriculture.

**Unit-V:** Crop water requirement under protected cultivation and remote sensing-based modeling.

**Programme Structure**

Name of the programme	Ph.D. Agricultural Engineering
Major Field	Processing and Food Engineering
Minor Field(s)	Farm machinery and Power Engineering, Civil Engineering, and Soil and Water Engineering, Renewable Energy.
Supporting Fields	Energy in Agriculture, Computer Science, Electrical Engineering, Mathematics, and Statistics.
Core Courses	PFE-601, PFE-602
Optional Courses	PEE-603, PFE-604, PFE-605, PFE-606
Deficiency Courses, if any	Students pursuing Ph.D. programme will have to pass deficiency courses, if he/she has not studied courses relevant to core courses in MTech (Processing and Food Engineering)
Research Work	PFE-699
Seminar	PFE-691, PFE-692
<b>Minimum credit requirement</b>	
Major	12
Minor	06
Supporting	05
Seminar	02
Research	75
<b>Total credit</b>	<b>100</b>

**Major Courses:**

Course No.	Course Title	Credits
PFE-601	Advances in Food Process Engineering	(2+1)
PFE-602	Drying and Dehydration of Food Materials	(2+1)
PFE-603	Textural and Rheological Characteristics of Food Materials	(2+1)
PFE-604	Agricultural Waste and By-Products Utilization	(2+1)
PFE-605	Mathematical Modeling in Food Processing	(3+0)
PFE-606	Bioprocess Engineering	(2+1)

**Minor Courses:**

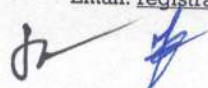
Course No.	Course Title	Credits
CSE-506	Digital Image Processing	(2+1)
CSE-507	Process Control System	(2+1)
REE-616	Renewable Energy for Industrial Application	(2+1)
MEE-501	Mechatronics and Robotics in Agriculture	(2+0)
CE-501	Dimensional Analysis and Similitude	(1+1)

Any other course (s) of other department other than course(s) from major can be taken as per recommendations of the student's advisory committee.

**Supporting courses:**

Course No.	Course Title	Credits
*CPE-RPE	Research and Publication Ethics	(1+1)
STAT-502	Theory of Designs and Analysis of Experiments	(1+1)

Courses from subject matter fields (other than Major and Minor) relating to area of special interest and research problem can be taken as per recommendations of the student's advisory committee.



## Syllabus (Major Courses)

PFE 601      Advances in Food Process Engineering      2+1

**Objectives:** To acquaint and equip the students with the modern and latest techniques of food engineering.

**Unit-I** Preservation of foods: Physical and chemical methods, microbiological aspects, thermo bacteriology, process calculation and selection. Thermal processing of canned foods: Introduction, commercial sterilization systems, thermal inactivation, kinetics of bacterial spores, heat transfer in canned foods, process calculations, numerical computer simulation of heat transfer, aseptic processing.

**Unit-II** Low temperature preservation: Cooling and cold storage. Hurdle technology: Principles and applications. Food irradiation: Advantages and applications, beneficial chemical and biological effects on foods, mechanisms of food irradiation, sources of food irradiation, criteria for judging the efficacy, dosimetry, radiation tolerance of foods, upper irradiation dose for foods, safety of irradiated foods. Microwave processing: Interaction with food materials, microwave equipment. Hydrostatic pressure treatment of food: Equipment, processing and effect on microorganisms. High pressure processing: Introduction, equipment and operation principles. Chemical and thermodynamic principles. Applications of HP to foods. Commercial high pressure equipment and applications. Membrane concentration of liquid foods: Principles, thermodynamics and osmotic pressure, mechanisms of membrane transport, membrane transport models.

**Unit-III** Application of heat energy and ultrasound: Effects of different environmental factors on microbial ultrasonic resistance, effects of treatment parameters on lethal effect of ultrasound, mechanism of action of inactivation of microorganisms and enzymes, cavitation. Electrical resistance heating of food: Heat generation. Ohmic heating and moderate electric field: Introduction, microbial death kinetics, electrolytic effects, applications, ohmic heater, heating models. Pulsed electric field preservation: Principles and application, microbial inactivation mechanism, determinant factors in PFE technology, influence on food ingredients, pulsed electric field treatment unit, modeling PFE microbial inactivation, alternative applications of PFE technology, decontamination of microorganisms by surface treatment.

**Unit-IV** Extrusion cooking: Rheology of extrudates, newtonian models of single-screw extruder performance, non-newtonian models of single-screw extruder performance, single-screw extruder leakage flows, extruder die and its interaction with extruder behaviour, screw power demand, non-isothermal screw operation, feed zone, behavior of more complex single-screw designs, multiple-screw extruders, partially filled screws, analysis of complex screws, heat transfer in extruders, extruder residence-time distributions, recent developments, methods, equipment, design criteria of extruders.

**Practical:** Thermal processing of foods, sterilization, irradiation, membrane concentration, ultrasound, ohmic heating, pulsed electric field preservation, extrusion cooking, product quality determination. Visit of related food industries.

PFE 602      Drying and Dehydration of Food Materials      2+1

**Objectives:** To acquaint and equip the students with the latest technologies of dehydration of food products and the design features of different dryers.

**Unit-I** Importance of drying, principles of drying, moisture determination, equilibrium moisture content, determination of EMC, methods and isotherm models. Psychrometry: Psychrometric terms, construction and use of psychrometric

-----  
Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



02 of 06

charts. **Unit-II** Air flow and resistance, principles and equipment for air movement and heating, drying methods and theory of drying, dryers, classification and other allied equipment, thin layer drying of cereal grains, deep bed and continuous flow drying, drying models.

**Unit-III** Heat requirements and thermal efficiency of drying system, aeration, tempering and dehydration, operation of dryers and their controls, selection of dryers, performance testing of grain dryers, drying characteristics of cereals, pulses and oilseeds, microwave drying, radio frequency drying and tunnel drying, principles and equipment.

**Unit-IV** Drying of liquid foods, spray drying, drum drying, freeze drying, foam mat drying, heat pump drying, refractance window drying, infrared drying osmotic dehydration. Principles, methods, construction and adjustments, selection of dryers, heat utilization factor and thermal efficiency.

**Practical:** Experiments on batch type thin layer dryer, fluidized bed dryer, continuous flow mixing type dryer, continuous flow non mixing type dryer, sand medium dryer (conduction type drying), agricultural waste fired furnace dryer, spray dryer, drum dryer, foam mat drying and osmotic dehydration to evaluate the thermal efficiency and heat utilization factor.

### **PFE 603 Textural and Rheological Characteristics of Food Materials 2+1**

**Objectives:** To acquaint and equip the students with advances in measurement of textural and rheological characteristics affecting the food quality.

**Unit-I** Rheological properties of foods: Food rheology, physical states of materials, classical ideal material, rheological models, elements in the models, electrical equivalence, maxwell model, Kelvin model and four element burger's model, stress-strain behavior. Elastic-plastic behavior, visco-elastic behavior, creep behavior, dynamic visco-elastic behavior, flow behavior of fluids, creep, stress relaxation.

**Unit-II** Viscometry: Capillary viscometry, casson model, flow rate equation, friction losses in pumping, turbulent flow, newtonian fluid, power law fluid, cone and plate viscometry, parallel plate viscometry, mixer viscometry. Flow through a converging die, cogswell's equations, gibson's equations, empirical method. Applications of stress and strain, shear modulus and shear loss modulus, storage compliance and loss compliance, comparison of moduli and compliances.

**Unit-III** Objective and subjective measurements of texture: Texture classification, relation of food texture with structure and rheology, principles and practices of objective or instrumental texture measurements, fundamental rheological tests, physiological aspects, mechanical aspects and viscosity measurements and relationship between fundamental tests and sensory evaluation. Imitative and empirical measurements of texture: Tenderometer, brabender farinograph, firmness meter, texture profile method, dynamic methods for evaluation of food texture, dimensional analysis of food texture, firmness and hardness measurement.

**Unit-IV** Mathematical models and their application along with pipe line design and pump selection for non-newtonian fluids. Recent advances in textural, rheological and viscoelastic characteristics of foods and their associated mathematical models.

**Practical:** Determination of viscosity of liquid foods, gumminess, chewiness, springiness and hardness of various fruits, vegetables and processed foods using texture profile analysis. Determination of force-distance relationship. Sensory evaluation/ subjective measurement and correlation between subjective and objective measurements of foods.

**Objectives:** To acquaint and equip the students with the techniques of utilization of agricultural waste and by-products and also about development of value-added products from wastes.

**Unit-I Conversion processes:** Thermo-chemical conversions, densification, combustion and gasification, extraction, biological conversions, anaerobic digestion, biochemical digestion process, digestion systems, energy from anaerobic digestion, cellulose degradation, fermentation process. Agricultural wastes as paper, boards and fuel.

**Unit-II Briquetting:** Briquetted fuel from husk, hull and other wastes selection, design of briquetting machines. Utilization of shell, stem and stalk: Production of activated carbon. By-products of agro-industries: Rice mill, oil mill, cattle feed mill, valuable constituents and composition. Utilization of rice husk: Production of silica and cement from rice husk. Stabilization and storage of rice bran, extraction of rice bran oil.

**Unit-III By-products of oil refining:** Fatty acids/soap stock, wax and gum, characteristics and utilization. Rice germ and broken rice. Production of starch and infant food, industrial uses of starch. By-products of oil milling: Oil cake and defatted oil cake, cattle feed and industrial uses. Utilization of starch and other industrial wastes: Microcrystalline cellulose, production of ethanol, wastes of tapioca starch industries, thippi-utilization as fuel, extraction of starch by hydrolysis, utilization of starch for food, adhesives and feed purposes.

**Unit-IV By-products of sugar industry:** Sugarcane tops, bagasse, molasses and pressmud, utilization as animal feed. By-products of fruits and vegetables based agro-industries: Mango seed kernel and pineapple waste.

**Practical:** Exercises on stepped grate and fixed grate rice husk furnaces, waste fired furnace, briquette machine, production of alcohol from waste materials, production and testing of paperboards and particleboards from agricultural wastes.

PFE 605 Mathematical Modelling in Food Processing 3+0

**Objectives:** To acquaint and equip the students with the mathematical modeling techniques and their applications in food processing

**Unit-I** An overview of the modeling process. Introduction to mathematical, correlative and explanatory models. Formulation, idealization and simplification of the problems.

**Unit-II** Probability models, series and linear mathematical approximation, dynamic and interacting dynamic processes.

**Unit-III** Applications of mathematical modelling techniques to food processing operations like parboiling, convective drying, pasteurization, dehydration, shelf-life prediction, fermentation, aseptic processing, moisture diffusion, deep fat drying, microwave processing, infrared heating and ohmic heating.

**Unit-IV** Stochastic finite element analysis of thermal food processes. Neural networks approach to modelling food processing operations.

PFE 606 Bioprocess Engineering 2+1

**Objectives:** To acquaint and equip the students with the basic principles of biochemical process engineering.

**Unit-I** Applications of engineering principles: Mass and energy balance, fluid flow principles, Unit operations of process engineering.

**Unit-II** Fundamentals of growth kinetics, maintenance energy and yield concepts, principles of media sterilization, media formulations of industrial fermentation.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



04/07/06

**Unit-III** Aerobic and agitated rheology of fermentative fluids, design and scale-up of bioreactors, enzyme reactors.

**Unit-IV** Principles of recovery of fermented products in bio-processing, instrumentation, transport phenomenon.

**Practical:** Kinetics of one substitute reactions, kinetics of growth in batch cultures, design consideration for bioreactors, media preparation and sterilization, microprocessor-based monitoring of bioprocess parameters.

**CSE 506      Digital Image Processing      2+1**

**Objectives:** To give an overview of digital image processing including visual perception, image formation, spatial transformations, image enhancement, color image representation and processing, edge detection, image segmentation and morphological image processing.

**Unit-I**

Digital image fundamentals, elements of visual perception, light and the electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, basic relationships between pixels, linear and nonlinear operations.

**Unit-II**

Image enhancement in the spatial domain, basic gray level transformations, histogram processing, basics of spatial filtering, smoothing spatial filters, sharpening spatial filters.

**Unit-III**

Color image processing, color fundamentals, color models, pseudo color image processing, basics of full-color image processing, color transformations, smoothing and sharpening, color segmentation.

**Unit-IV**

Image segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, segmentation by morphological watersheds.

**Unit-V**

Morphological image processing, dilation and erosion, opening and closing, extensions to gray-scale images.

**Practical:**

To write program to read and display digital image, image processing program using point processing method, program for image arithmetic operations, program for image logical operations, program for histogram calculation and equalization, program for geometric transformation of image, understand various image noise models and to write programs for image restoration and to remove noise using spatial filters. Brief outline of image processing tools.

**Course Outcome:**

This course introduces digital image processing. It focuses on the theory and algorithms underlying a range of tasks including acquisition, formation, enhancement, segmentation and representation.

**ME 501      Mechatronics and Robotics in Agriculture      2+0**

**Objectives:** To introduce the fundamentals of mechatronics and the concepts behind designing mechatronic systems and their subsystems and its application in automation in agriculture.

**Unit-I**

Introduction to mechatronics: Basic definitions, key elements of mechatronics, historical perspective, the development of the automobile as a mechatronic system. Mechatronic design approach, functions of mechatronic systems, ways of

-----  
Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



05/07/06

integration, information processing systems, concurrent design procedure for mechatronic systems.

#### Unit-II

System interfacing, instrumentation, and control systems. Input/output signals of a mechatronic system, signal conditioning, microprocessor control, microprocessor numerical control, microprocessor input/output control.

#### Unit-III

Microprocessor based controllers and microelectronics: Introduction to microelectronics, digital logic, overview of control computers, microprocessors and microcontrollers, programmable logic controllers, digital communications.

#### Unit-IV

Technologies of robot: Sub systems, transmission system (Mechanics), power generation and storage system, sensors, electronics, algorithms and software. Servo motor drives types and applications. Stepper motor and its concept. Industrial robots: Classification and sub systems. Defining work space area.

#### Unit-V

Application of robots in agriculture: Harvesting and picking, weed control, autonomous mowing, pruning, seeding, spraying and thinning, phenotyping, sorting and packing. Utility platforms. Use of different agrobots in agriculture.

#### Course Outcome:

Ability to understand agricultural machinery that is built on concepts of mechatronics and ability to use robotic machinery in agriculture.

### CE 501 Dimensional Analysis and Similitude 2+0

**Objectives:** To acquaint the students with importance of analysis of dimensions and similitude principles in structuring mathematical/simulation models of various processes under different constraint variables.

#### Unit-I

Introduction, Dimensions, Dimensional homogeneity, Non-dimensional parameter, Methods of dimensional analysis: Rayleigh's method, Buckingham-Pi theorem, Choice of variables, Model analysis, Examples on various applications, Dimensional analysis and Intermediate Asymptotic.

#### Unit-II

Model studies, Model classification, Dimensionless numbers: Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, Scale effects, Distorted models, Model laws.

#### Unit-III

Similitude: Types of similarities (geometric-kinematic and dynamic similarity), force ratios, similarity laws. Model analysis: Physical models. Similarity methods for nonlinear problem types of models, Scale effect. Numerical problems on Reynolds's and Froude's Model.

#### Unit-IV

Use and scope of mathematical modeling, Principles of model formulation, Role and importance of steady-state and dynamic simulation, Classification of models, Model building, Modeling difficulties, Degree-of-freedom analysis, Selection of design variables.

#### Course Outcome:

The students will be able to analyze complex problems using dimensional analysis and to develop rules for experiments with scale models and provide basis for analyses and calculations, including simplifications and assumptions made, when formulating mathematical models.

06/06



method; Inter rater Consistency and Consensus - inter rater reliability and inter rater agreement; Alternative Forms or parallel forms reliability -Reliability of difference-Factors Affecting the Validity and Reliability of Test Scores; Generalizability Theory;

## UNIT II

**Errors in management:** Errors - Meaning and sources; Types - Sampling error, non-sampling or measurement error and Processing error- Meaning, causes; Effects of errors and biases on data quality; Bias in behavioral research - Meaning, causes, Types - Respondent and researcher biases; Methods of reducing errors and biases in surveys, questionnaires, personal interviews, focus groups and online methods.

## UNIT III

**Scales, indices and tests:** Approaches to measurement and scale development - Classical test theory. Formative or index models, The C-OAR-SE approach and Item Response Theory; Item analysis in Classical test theory - item difficulty and item discrimination; Scoring performance in scales and tests - meaning, types and methods; Scale development strategies - deductive and empirical; Stimulus-centered scales - method of equally appearing intervals, paired comparison, Person scaling - Q methodology; Subject-Centre scales - The Likert scale and Semantic Differential; Steps in constructing a multi- dimensional scale using confirmatory factor analysis, Response scales -Guttman's scalogram analysis and The Rasch method;

## UNIT IV

**Indices and tests:** Indexes -Meaning, types, importance; Similarities and differences with scales, Methods of constructing indexes; Common indexes used in extension. Measurement invariance -Meaning, types, methods of assessing measurement in variance. Tests-meaning, types, importance; steps in conducting various tests-knowledge test.

## UNIT V

**Qualitative research methods and emerging approaches:** Qualitative methods - Meaning; Types - Ethnography, Grounded theory, Phenomenology, Ecological psychology, Discourse Analysis; Observational research; Case study research-Sampling and sample size; Data collection methods - In-depth interviews, Focus groups, Direct observation, Record review; Content analysis; Unobtrusive Measures; Projective and semi-projective techniques; Selecting right qualitative method - Strengths and limitations of qualitative research; Analysis and interpretation of qualitative research data; Research synthesis - meaning, importance, methods ; Systematic reviews and meta-analysis - meaning, steps, and applications; Policy research. Mixed methods research - meaning, purpose, types and applications; Participatory research - Meaning, importance, types, methods and tools and applications; Action research - Meaning, importance, Principles, Types, Steps in conducting action research, application in Behavioural sciences. Social Network Analysis-Meaning, importance, types, steps in social network analysis, applications; Advanced methods of measuring perception and beliefs. Multicriteria decision making, analytical hierarchy approach.

## UNIT VI

**Ethics in extension research:** Research reports - Meaning, types, contents; Presentations - Meaning, types, principles of good presentation - Tell 'Em" and KISS 'Em" principles; Research publications - meaning, importance, types; Guidelines for preparing research papers - Peer review process, citation styles; Open access publishing; Publishing in social media. Software's in academic writing. Ethics in conducting behavioural research; Human subject research - Meaning, history, and ethical guidelines; Ethical aspects of collecting and using Indigenous knowledge and farmer's technologies; Ethical practices in publishing; Plagiarism - meaning, sources, Identifying and correcting plagiarism in a research paper using

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



02 of 10

anti-plagiarism software.

### **PRACTICAL**

Practice in developing research instruments; Methods of assessing measurement properties of research instruments - dimensionality, reliability and validity; Hands-on experience in constructing tests, scale and indexes; Practice in summated scale development using confirmatory factor analysis; Hands on experience in assessing measurement invariance; Practicing and collecting data using participatory tools and techniques, analyzing and interpreting qualitative data; Hands-on experience in writing systematic review using meta-analysis; Field practice in conducting action research; Practical experience in writing research paper; Hands on exercises using software for qualitative data analysis; Practice in detecting and correcting plagiarism using software.

## **FEX 602 EDUCATIONAL TECHNOLOGY AND INSTRUCTIONAL DESIGN - 2+1**

### **Theory**

#### **UNIT I**

**The landscape of educational technology and instructional design:** Understanding various terms - educational technology, instructional design, instructional systems design, curriculum design, pedagogy, and ragogy; Brief overview of the origin and evolution of ET and ID as theory and practice; what is the relevance of ET and ID relevant in extension and rural advisory services? Extensional professionals as instructional designers and architects of the learning experience; Types of learning or learning domains- Bloom's taxonomy of the cognitive domain, Krathwohl and Bloom's affective domain and Simpson's psychomotor domain

#### **UNIT II**

**Technology enabled learning:** What is the role of technology in education? Digital media, new tools and technology; Open and distance Learning (ODL); Online Education - Synchronous and Asynchronous learning models; eLearning, Massive Open Online Courses - SWAYAM, Open Education Resources (OERs), Course CERA, Edu Ex, CoL, RLOs; digital education and its applications in higher agricultural education; Smart classrooms and Campuses, Web-based remote laboratory (WBRL); Integrating media and digital tools into ID; types and implications of disruptive technologies for higher education and extension; Augmented learning; Adaptive learning; meaning, features and good practices in using open source Learning Management Systems (Moodle); Quality assurance and certification in e-learning.

#### **UNIT III**

**Theories and models of instruction:** Howard Gardner's Theory of Multiple Intelligences, David Kolb's Experiential Learning Cycle, Albert Bandura's Social Learning Theory, Rand Spiro's Cognitive Flexibility Theory and Its Application In eLearning, Wlodkowski's Motivational Framework for Culturally Responsive Adult Learning; ADDIE Model, Dick and Carey Model, SAM Model, Bloom's Taxonomy; integrating the theories of instruction into the practice of ID in extension and RAS ecosystem.

#### **UNIT IV**

**Creating instruction and instructional strategies:** Overview of planning, designing and implementing the curricula and learning experiences; Needs Analysis - meaning, approaches and steps; Task and content analysis - meaning, approaches, steps and techniques (topic analysis, procedural analysis, and the critical incident method); Learner analysis - meaning, importance and approaches, relevance of Maslow's Hierarchy of Needs and learning styles, Captive Audience vs. Willing Volunteers, Universal vs. user-centered design, Learner Analysis Procedures; Writing learning objectives: Meaning of Learning Goal and Learning Objectives;

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

03 07 10

ABCDs of well-stated objectives; Setting goals, translating goals into objectives; Contextualizing ADDIE process within the Extension learning environment; Organizing content and learning activities-scope and sequence of instruction; Posner's levels of organizing (Macro, Micro, Vertical, and Horizontal) and structures of organizing (content vs. media) instruction, Gagne's events of instruction, Edgar Dale's Cone of Experience; Methods of Delivery- classroom teaching, programmed instruction, synchronous and asynchronous modes of distance education; Changing role of a teacher in classroom and teaching competencies

#### UNIT V

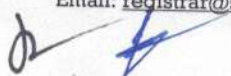
**Organizing content and learning activities:** Scope and sequence of instruction; Posner's levels of organizing (Macro, Micro, Vertical, and Horizontal) and structures of organizing (content vs. media) instruction, Gagne's events of instruction, Edgar Dale's Cone of Experience; Methods of Delivery- classroom teaching, programmed instruction, synchronous and asynchronous modes of distance education; Changing role of a teacher in classroom and teaching competencies.

#### UNIT VI

**Trends in instructional design and evaluating instruction:** Alternatives to ADDIE (Analysis, Design, Development, Implementation and Evaluation) model - Rapid prototyping and constructivist ID, reflections on instructional design as science and as an art; Relating ID models and process in extension learning environment; research in education and instructional design. Meaning of Assessment, Measurement and Evaluation; Developing learner evaluations and their reliability & validity; assessment techniques for measuring change in knowledge, skill and attitude of learners - Objective Test Items, Constructed-Response Tests, Direct Testing, Performance Ratings, Observations and Anecdotal Records, Rubrics, Portfolios, Surveys and Questionnaires, Self-Reporting Inventories, Interviews; Conducting learner evaluation pre-, during and post- instruction; Formative and Summative Evaluation- meaning, approaches and steps; Evaluating Learner Achievement and the Instructional Design Process; Evaluating the success of instruction; Performance appraisal of teachers

#### Practical

Preparation of the analysis Report that includes the task/content analysis and learner analysis and the Design Plan includes learning objectives and corresponding instructional strategies and assessment items; Prepare course outline and lesson plan with an appreciation for diverse learning styles based on temperament, gender, and cultural/ethnic differences and deliver a lecture for UG/PG students; Assessing learning styles through Barsch and Kolb inventories; Development and testing of survey instruments for evaluating learning outcomes/ competencies of students; Development and testing of survey instruments for performance appraisal / competency assessment of teachers; Design an online e-learning module on a topic of interest as a capstone project - integrate and apply the knowledge and skills gained from the course for creating an effective learning experience for a target audience; Designing and developing a theme based knowledge portals; Exercises on designing an online course using open source LMS like Moodle or EdX; Select and evaluate or design for social media; Prepare a short research paper on recent theories and models of instructional design; Interview an instructional designer of your choice and prepare a synthesis report about what job roles he/she perform, What ID processes does he or she use, challenges faced; Develop a prototype for one of the lessons in your design plan using PowerPoint or a website builder such as Weebly to create the screens integrating multimedia content and various functionalities; Field visit to a virtual learning/augmented learning lab, e-learning labs, distance learning centers, etc.; Hands-on practice with video-editing software, web conferencing and video conferencing solutions.



**UNIT I**

**Gender related concepts and divides:** Historical perspective of gender: Feminism and emergence of gender as a concept, Scope of gender studies in agriculture and rural development; Agrarian Importance of Gender: Understanding the importance of gender in national and global agriculture-Key gender issues and challenges in agriculture/fisheries - Gender and value chain- Global actions to address gender-needs and strategies to address gender and women empowerment. Gender related concepts and divides: Understanding of the concepts of gender, gender equality and equity, gender balance, gender blind, gender relations, gender neutrality, gender bias and discrimination, gender rights, gender roles and responsibilities. Gender budgeting, Gender divides and their implications such as gender digital divide, gender access to resources and inputs divide, gender mobility divide, gender wage divide, Gender needs: practical and strategic

**UNIT II**

**Gender analysis:** Gender analysis: Importance, usage, prerequisites, Tools for gender analysis, gender sensitive indicators: HDI, GDI, GEM; Gender and technology: How gender and technology impact each other, Gender neutral technology, Gender sensitive technology, Gender supportive assistance in technology adoption- Gender in fisheries research and extension.

**UNIT III**

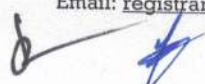
**Gender mainstreaming, women empowerment and policies for women:** Gender mainstreaming: Importance of gender mainstreaming in agriculture, Extension strategies to address gender issues such as gender and health, nutrition, gender in agricultural / fisheries value chains, gender and climate change adaptation, gender and globalization & liberalization for mainstreaming gender concerns into the national Programmes and policies. Women Empowerment: Importance of women empowerment, Current national women empowerment and gender indices. Women empowerment approaches (technological, organizational, political, financial, social, legal and psychological). Global Best Practices, Policies and Frameworks: Global best practices, women empowerment and gender mainstreaming models and frameworks for addressing gender concerns in agriculture/fisheries, approaches of various organizations: gender mainstreaming and special women focused Programmes in agriculture and rural development.

**UNIT IV**

**Livelihoods and its challenges:** Basic concepts of livelihood and development, Types of development-Immanent/inherent and interventionist/ intentional; Why promote livelihood; Livelihood intervention: definition, types-Spatial, segmental, sector-sub-sector; Systemic view of Livelihoods, Understanding Rural Livelihoods-Farm, Non-Farm, and off farm; Linkages with Farm and Off-farm Livelihoods; Economic Models; Livelihood Challenge-Political economy of Livelihoods, Issues of access to farm and non-farm livelihoods; Livelihoods from a Gender Perspective-Feminization of agriculture/poverty, women in the unorganized sector, the issue of unpaid and informal work; Livelihood Coping Mechanism-Climate Change and Livelihoods; Livelihoods and Disasters.

**UNIT V**

**Livelihood frameworks, intervention and promotion approaches:** Sustainable Livelihoods Approaches (SLAs)-Definition and origins of SLA; Assets or capitals and capabilities in SLA and its linkage to the other capitals; Vulnerability Assessment-Shocks, trends, seasonality; Policies, institutional context and processes; Conceptual Frameworks-DFID, CARE, UNDP, OXFAM, BASIX livelihood triad, Nine square Mandala or Rural Livelihood System's Framework, etc; Past, Present and



05 of 10

possibilities for the future of the SLA, critiques of the approach.

#### UNIT VI

**Livelihood promotion approaches:** Approaches and programs in India; Livelihood and a Rights Based Approach-MGNREGA and its critique; Livelihood and a Social Capital based approach: NRLM; Livelihood Augmentation (LA)- Basic concepts; Pathways: a) Entrepreneurial strategies for LA; b) NRM based intervention; c) Market based interventions including Value-chain analysis; d) ICT based interventions; e) Livelihood and allied agriculture based livelihood; f) Forest based Livelihoods vis a vis Livelihood Protection and Promotion: Contribution of NTFP in supporting rural livelihoods.

#### Practical

Visit to a village for understanding gender roles and for capturing shifts in gender roles in fisheries; Conducting gender analysis in a village using gender analysis tool; Exercise for identification and prioritization of issues affecting/needs for men and women in fisheries; Village visit to understand the livelihood pattern of villagers and how the other socio-economic factors affect the livelihood of people; Application of participatory rural appraisal skills for understanding village context; Engagement of working with rural communities and their grass-root institutions, understanding dynamics of working in a group; Visit to different agri-business models as mentioned in the Block 'C'. Group assignments may be given to document the field experience in the form of case study of an enterprise/ entrepreneur/members and other related stakeholders; Visit to agencies supporting women empowerment followed by report presentation. Each student to visit a different organization such as State Rural Livelihood Mission, Women Development Corporation, Department of Agriculture, Important NGOs working for women empowerment; Interaction with a successful women entrepreneur/ SHG; Case studies based on livelihood promotion and rural development. Case studies on Livelihood augmentation and gender related issues in fisheries sector.

### FEX 604 EXTENSION SERVICE SYSTEM MANAGEMENT - 2+1

#### Theory

#### UNIT I

**Extension service system:** Meaning and scope of extension service system and its management; Public administration and bureaucracy - concepts, origin and development; Marxian, Weberian and Gandhian thoughts on bureaucracy; bureaucratic vs developmental organization.

#### UNIT II

**Processes of management:** POSDCORB; Structure, organization, function, working and management of public extension service agencies like DoFs, FFDA, BFDA, MPEDA, NFDB, NABARD, Fisheries Development Corporations, State Fish Seed Development Corporations, KVKs, SAUs, Fisheries Cooperatives, international agencies, corporate sector, private organizations and MNCs.

#### UNIT III

**Organizational conflicts:** Delegation of power, autonomy and organizational communication and conflicts in governmental, UN agencies, non-governmental and private extension service organizations; Conflicting roles and responsibilities of extension agents.

#### UNIT IV

**Organizational communication:** Meaning, methods, types and techniques; functions and importance in motivation and control; formal and informal communication networks in GOs, NGOs and POs; behaviour of individuals in organizations; Organizational change and communication; patterns of communication of organizational communication; managing organizational communication in fisheries sector.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

06 of 10

## UNIT V

**Research, extension and client systems linkages:** Linkages and coordination between Dept. of Fisheries and other line Depts. like Irrigation / Water Resources, Environment, Forestry, Agriculture at grassroots, District, State and Central levels; HRD policy in governmental, non-governmental and private extension service organizations. Strengthening governance-transparency, accountability and people's participation.

## UNIT VI

**Strengthening extension service system:** Strengthening the Human Resources of Extension System - Strengthening the Information and Communications Technology (ICT) Capacity. Decentralize the existing extension system. Developing Participatory Public Extension System: PRA, RRA, etc. Investments needed to strengthen extension systems: Civil Works, Equipment, Vehicles, Technical Assistance and Operational Expenses. Supervising, monitoring, and evaluating extension projects.

### Practical

Case study and analysis of State Departments of Fisheries in selected States; Case studies in structure organization, staffing, career advancement, quality of service delivery at grassroots level in governmental, nongovernmental and private extension service organizations like DoFs, FFDA, NABARD, State Fish Seed Development Corporations, KVKs, Fisheries Co-operatives, NGOs, and private sector organizations; Study of patterns of communication and effectiveness of Fisheries Development Organization; Study visit to DoF, NGOs, NABARD, private sector agencies involved in fisheries extension.

## FEX 605 TECHNOLOGY COMMERCIALISATION AND INTELLECTUAL PROPERTY MANAGEMENT - 2+1

### Theory

#### UNIT I

**Overview of intellectual property rights:** Introduction to IPR; Overview & Importance; Genesis; IPR in India and IPR abroad; Patents, copyrights, trademarks & trade secrets, geographical indication, industrial design; Emergence of IPR Regimes and Governance Frameworks - Trade-Related Aspects of Intellectual Property Rights (TRIPS), Convention on Biological Diversity (CBD), Cartagena Protocol, International Union for Protection of New Plant Varieties(UPOV), and BIMSTEC.

#### UNIT II

**IPR protection laws and systems:** National IPR Policy; and IPR laws; procedures for filing IP protection; Systems of IP protection and management in agricultural universities and research institutions and also by stakeholders; Mechanisms of IPR Management - Institutional arrangement, IP Management processes - invention disclosure; IP portfolio management; Infringement management; National Biodiversity Act (2002); Protection of Plant Varieties and Farmers Rights Act (2001); Guidelines for registration and transfer of biological resources; Farmers rights; Mechanisms of documenting/ collecting, protecting and commercializing farmers varieties and other biological resources; National Biodiversity Authority, PPVFRA and other agencies involved in management of biological resources in India. Access to Genetic Resources and Sharing of Benefits.

#### UNIT III

**Traditional and indigenous knowledge:** Grassroots and Farmers Innovations - Meaning, forms and importance; Systems of documentation, registration, protection and commercialization. Documentation of traditional indigenous knowledge-Traditional Knowledge Digital Library (TKDL), Community Biodiversity Registers (CBRs), People's Biodiversity Registers (PBRs), Plant

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)

07/07/10

Biodiversity Register, and Honeybee Network.; The Global Concerns on Use of Genetically Modified Organisms in Food and Agriculture; The Cartagena Protocol on Biosafety; Regulation of GMO in India.

#### UNIT IV

**Technology commercialization and IP valuation:** Technology - Definition, functions, process of technological advancement - invention, discovery, innovation and technology; Types of innovation- Basic research, Breakthrough innovation, Disruptive Innovation and Sustaining Innovation; Technology transfer and commercialization, Technology transfer Vs Commercialization; Technology commercialization process - elements, models, systems and processes; Technology commercialization strategies - Meaning, approaches for technology commercialization-technology scaling up, technology licensing, handholding, agri-preneur development;

#### UNIT V

**Technology assessment and refinement:** Meaning; Importance; Approaches and methods of assessment and refinement of various technologies-stakeholder oriented approaches including participatory technology assessment and refinement; Returns to investment; IP Valuation-Oxford context, IP Valuation methods - Cost approach; Income approach - Discounted Cash Flow, Risk-Adjusted Net Present Value, Net Present Value with Monte Carlo Simulation and Real Options Theory; Market approach - Industry Standards Method, Rating/Ranking Method, Rules of Thumb Approach and Auction Method; Hybrid approaches; Royalty rate method.

#### UNIT VI

**Technology incubation and promotion:** Technology business incubation - Meaning, functions and types; stakeholder-oriented incubation process - Livelihood incubation, village incubators. System of technology incubation- incubation process; its effectiveness; Managing profit oriented and non-profit incubators; Schemes for promoting incubators in India; Technology Scouting and Innovations in technology incubation. Technology promotion: meaning, types, business meetings, scientist-industry/ entrepreneur meets, technology conclave, business plan competition, farmers fairs, technology shows; Business Etiquette; business networking.

#### Practical

Understanding the technology commercialization process - Visit to Technology Commercialization Unit of ICAR Institute/ Agricultural University ; Understanding the IPR protection practices - Visit to Patent Attorney office; Hands-on experience in drafting IPR application - Patent/Copyright/ Trademark; Documenting Traditional and indigenous knowledge - Field experience in using various protocols of using traditional and indigenous knowledge; Hands on experience in technology licensing process including drafting agreements; Understanding the Technology Business Incubation -Visit to Agri Business Incubator or Technology Business incubator; Hands on experience in planning and organizing technology promotion events; Hands on experience in various techniques in business communication and Business etiquette; Protecting unique local goods through Geographical Indications - Hands on experiences in documenting and registering Geographical indications; Technology assessment/ validation of traditional and indigenous knowledge -Quik and other methods; Hands on experience in technology valuation.

Address: Academic Section, Office of the Registrar, SKUAST-K, Shalimar Srinagar, 190025 (J&K)

Email: [registrar@skuastkashmir.ac.in](mailto:registrar@skuastkashmir.ac.in), [dracad@skuastkashmir.ac.in](mailto:dracad@skuastkashmir.ac.in) Website: [www.skuastkashmir.ac.in](http://www.skuastkashmir.ac.in)



08 of 10

Theory

**UNIT I**

**Understanding policy, policy advocacy and tools:** Why policies are important for extension? Role in providing structure, ensure funding and framework for providing functions-examples; Policy: definitions and types: Is policy a product or a process or both? Policies and institutions-How these influences defining organizational roles and performance in extension organizations-Role of policies in up scaling knowledge.

**UNIT II**

Role of extension in influencing policies to enable innovation; Definition of advocacy, Approaches to policy advocacy-Advising, Media campaigning, Lobbying, Activism, Information education communication (IEC) and Behaviour change communication(BCC); Advocacy for RAS; Policy advocacy strategy.

**UNIT III**

**Policy analysis and development process:** Explain the meaning and use of policy analysis in decision- making; Describe different types of policy analysis-empirical, evaluative or normative policy analysis, retrospective/prospective policy analysis, predictive/prescriptive/descriptive policy analysis; How to do policy analysis? - understand the process of policy analysis, highlight the different methods and techniques used in policy analysis, doing ethical policy analysis; Tools for policy impact- research tools, context assessment tools, communication tools, policy influence tools. Who drives policy change? National Governments, Donors, Civil Society- varied experiences:

**UNIT IV**

**Understanding the environment and key actors in policy space-** problem identification-policy adoption, implementation and evaluation; stakeholder mapping, identifying opportunities and barriers, mobilizing financial resources; Dealing with policy in coherence: identifying contradictions and challenges in policy implementation. Generating evidence:

**UNIT V**

**Policies in fisheries sector:** Policy and regulatory environment in Marine Fisheries Sector, Inland Fisheries Sector, Brackish water Aquaculture Sector, Freshwater Aquaculture Sector, International policy and regulatory scenario in fisheries sector; FAO's CCCRF; UN's Law of the Sea and other conventions; EU's Common Fisheries Policy; Fisheries policy and regulation of select countries in Asian and American region; WTO and Fisheries Subsidies and taxation in fisheries sector, NIFAP, Marine Policy.

**Practical**

Analysis of country/state level fisheries/ extension policy to understand the policy intentions from strengthening EAS; Analysis of fisheries policies of other countries: policy intentions, processes adopted in development of the policy and mechanisms of policy implementation

Interaction with key policy actors in EAS arena at the state/national level (e.g.: Secretary of fisheries, Director of fisheries, etc) to explore policy level challenges in EAS;

Identifying what evidence policymakers look for from extension research (Is the evidence available? If so what form? (Reports, Briefs etc), If not, develop a plan; Explore how different stakeholders influence policies (e.g.:policy advocacy of prominent NGOs, private sector and public sector) -What mechanisms and tools they use; Identifying policy level bottlenecks that constrain effective EAS delivery at the district level- E.g.:Issues around linkages between KVK and ATMA; inter-departmental collaboration; public private partnerships; joint action etc.;

09 of 10

Case studies on sub-sectoral review of fisheries policy and legislative framework in select Indian States; Case studies on shrimpculture policy and development in Thailand & East Coast of India; Case studies on leasing policy in Bihar, Rajasthan, Tamil Nadu, Orissa, Karnataka, Maharashtra and Himachal Pradesh; Case studies on implications of WTO agreements for Indian and world fisheries.

**FEX 607 PARTICIPATORY APPROACHES IN FISHERIES EXTENSION - 1+1**

**Theory**

**UNIT I**

**Participatory approaches for aquatic resources management and development:** need, importance and guiding principles; Community mobilization methods - Farmer-First Approach; Trickle Down System-concept, method and processes; Knowledge Driven Extension System-concept and method.

**UNIT II**

**Community based fisheries management and Fisheries co- management:** Concept, origin, importance, types, method, processes, stakeholder rights, responsibilities and participation, institutional mechanisms, implementation constraints, experiences from other countries; conflict resolution and management; Public- Private- Community Partnership.

**UNIT III**

**Participatory Learning Approach (PLA):** Role-plays, case studies, brainstorming, and ranking of priority issues, discovery-based experiential learning, participatory education methods like FGD;

**UNIT IV**

Participatory appraisal techniques - census mapping, resource mapping, social mapping; selection of participatory methods and their uses; Farmer Field Schools for Aquaculture. Strength and weakness, Constraints in PRA methods

**Practical**

Conducting Participatory Rural Appraisal in select villages and developing action plans; Conducting focused group discussion and developing action plan; Facilitating group formation based on the felt needs and to implement the action plans / plan of work; Reviewing national and international case studies on participatory approach to aquaculture research and development; case studies and simulation exercises on fisheries co-management/community based fisheries management.