Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

in

M.Sc. (Ag.) in Soil Science

2 Year Degree Program

Revised as on 01 August 2023 Applicable w.e.f. Academic Session 2023-24

AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Agriculture Science and Technology

Department of Soil Science

AKS University
Faculty of Agriculture Sciences and Technology
Department of Soil Science
Curriculum & Syllabus of M.Sc.(Ag.) program
(Revised as on 01 August 2023)

CONTENTS

Head of the Department

HEAD
Department of Soil Science
AKS University
Satna (M.P.)

Dean of Faculty

Dean
Faculty of Agriculture Science and Technology
AKS University
Satna (M.P.) 485001

Vice Chancellor

Professor B.A. Chopade
Vice - Chancellor
AKS University
Satna, 485001 (M.P.)

A K S University
Faculty of Agriculture Science and Technology
Department of Soil Science
Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program
(Revised as on 01 August 2023)

Forwarding

I am thrilled to observe the updated curriculum of the Soil Science Department for M. Sc. (Ag) in Soil Science Program, which seamlessly integrates the most recent genetically plant advancements and adheres to the guidelines set forth by National Core Group and BSMA Committees appointed by ICAR. The revised curriculum also thoughtfully incorporates the directives of NEP-2020 and the Sustainable Development Goals.

The alignment of course outcomes (COs), Programme Outcome (POs) and Programme specific outcomes (PSOs) has been intricately executed, aligning perfectly with the requisites of NEP-2020 and NAAC standards. I hold the belief that this revised syllabus will significantly enhance the skills and employability of our students.

With immense satisfaction, I hereby present the revised curriculum for the M. Sc. (Ag) in Soil Science program for implementation in the upcoming session.

Er. Anant Soni
Pro Chancellor & Chairman
AKS University, Satna

01 August 2023

A K S University
Faculty of Agriculture Science and Technology
Department of Soil Science
Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program
(Revised as on 01 August 2023)

From the Desk of the Vice-Chancellor

AKS University is currently undergoing a process to revamp its curriculum into an outcome-based approach, with the aim of enhancing the teaching and learning process. The foundation of quality of quality education lies in the implementation of a curriculum that aligns with both societal and industrial needs, focusing on relevant outcomes. This entails dedicated and inspired faculty members, as well as impactful industry internships.

Hence, it is of utmost importance to begin this endeavor by crafting an outcome-based curriculum in collaboration with academia and industry experts. This curriculum design should be informed by the latest technological advancements, market demands, the guidelines outlined in the National Education Policy (NEP) of 2020, for sustainable development goals.

I'm delighted to learn that the revised curriculum has been meticulously crafted by the Genetics and Plant Breeding Department, in consultation with an array of experts from the Seed industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines, National Core Group and BSMA Committees appointed by ICAR, as well as sustainable goals. It also adeptly incorporates the latest advancements in development of new varieties and seed production technology.

To enhance students' skills, the curriculum integrates hands on training, industrial visits, and Training experiences, research and progress. This well-rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the seed industry.

I am confident that the updated curriculum for Soil Science will not only enhance students' technical skills but also contribute significantly to their employability. During the process of revising the curriculum, I am pleased to observe that the Soil Science department has diligently adhered to the guidelines provided by the National Core Group and BSMA Committees appointed by ICAR. Additionally, they have maintained a total credit requirement of 75 for M. Sc. (Ag) in Soil Science program. It's worth noting that curriculum revision is an ongoing and dynamic process, designed to address the continuous evolution of technological advancements and both local and global concerns. This ensures that the curriculum remains responsive and attuned to the changing landscape of education and industry.

AKS University warmly invites input and suggestions from government agriculture departments farmers, entrepreneurs, industry experts and technocrats and Alumni students to enhance the curriculum and make it more student-centered. Your valuable insights will greatly contribute to shaping an education that best serves the needs and aspirations of our students.

Professor B. A. Chopade
Vice Chancellor
AKS University, Satna

01 August 2023

A K S University
Faculty of Agriculture Science and Technology
Department of Soil Science
Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program
(Revised as on 01 August 2023)

Preface

As part of our commitment to ongoing enhancement, the Department of **Soil Science** consistently reviews and updates its **M. Sc. (Ag) in Soil Science** program curriculum as per recommendation and need of ICAR. Through this process, we ensure that the curriculum remains aligned with the latest technological advancements, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the **M. Sc. (Ag) in Soil Science** Program undergoes evaluation by a panel of technocrats, industry specialists, and academics. Following meticulous scrutiny, the revised curriculum has been formulated and is set to be implemented starting from August 01, 2023. This implementation is contingent upon the endorsement of the curriculum by the University's Board of Studies and Governing Body.

This curriculum closely adheres to the National Core Group and BSMA Committees appointed by ICAR, syllabus distributed in August 2021. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP2020, as well as the principles of Sustainable Development Goals. In order to foster the holistic skill development of students, a range of practical activities, including Hands-On Training, Industrial Visits, Project planning and execution, Report Writing, Seminars, and Industrial Training, have been incorporated.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Programme Specific Outcomes has been undertaken. As the course syllabus is being meticulously developed, various elements such as session outcomes, laboratory instruction, classroom instruction, self-learning activities, assignments, and mini projects are meticulously outlined.
We hold the belief that this dynamic curriculum will undoubtedly enhance independent thinking, skills, and overall employability of the students.

Dr. S. S. Tomar
DEAN (FAST)
AKS University Satna

01 August 2023

Introduction :

AKS University is running multidisciplinary courses out of which Soil Science is one of the core branch of Faculty of Agriculture Sciences continuing from 2012 in the university campus. AKS University is the 1st private organization in Satna region has a systematized Soil Science Laboratory facilities with all the basic and advanced technologies used during nutrient analysis in both plant and soil. The department facilitates the training and demonstration programme for both students, farmers and stake holders as a part of course curriculum in both field and advanced classes in college premises.

Vision :

The AKS university is fully focused in crating the ecofriendly environment by reducing the use of synthetic fertilizers with more emphasis on production and use of organic compost, Manures.
University put more emphasis on increasing the soil health and quality, there by soil nutrient status and creating abundance the beneficial microbes population in soil their by reduces the soil born diseases and increasing the nutrient status in long run.
University promotes, motivate and create awareness among the local farming communities / farmers towards the recent schemes run by the government its use and its importance.

Mission :

M 01 : Achieve academic excellence in Soil Science through an innovative teaching- learning process.

M 02 : Evaluate the basic necessary soil physical, chemical and biological properties in both field and in laboratory

.

M 03 : To identify the deficiency symptoms of essential nutrients in both agricultural and horticultural crops .

M 04 : To understand the process involved in formation of soil and interpret the soils as per their generic classification.

M 05 : To organize the research in leading areas of soil analysis techniques, Organic farming practices and nutrient analysis procedure in both surface and subsurface.

M 06 : To innovate, share and apply the knowledge of integrated nutrient management practices for students and local farming society.

Program Educational Objectives (PEO)

PEO 01: To develop technical and managerial skills among the students with practical knowledge in collecting the soil samples and deal the problems occurred during collection.

PEO 02 : To diagnose the soil profile on the basis of their genesis classification, various process involved in formation of particular soil profile and parent material.

POE03: To formulate the organic manure its use in soil and classification there by reduces the soil born diseases.

Program Outcomes (POs)

Graduate and post graduate students of department of Soil science will able to perform:

PO-1: Basic Knowledge of Agriculture: General information of Agricultural practices used in growing crop in field and basic management tactics used.

PO-2: Classification of Soils: Distribution of soil on basis of agro climatic zones in India and world and its basic properties.

PO-3: Nutrient analysis: Analysis the available macro, secondary and micronutrient status in soil, plant and seed for various crops.

PO-4: Identification and amelioration of problem soil: Formation, reclamation and precaution measure should be taken during amelioration of acidic/Alkaline / salt effected.

PO-5: Preparation and recommendation of Compost / Manure: Manufacturing of various Organic compost, its classification and application method.

PO-6: Composition and manufacture of various fertilizers: Formation of various synthetic Fertilizers, its composition of application method in various crops and different soil types.

PO-7 : Modern concept of Soil Science : Various Soil techniques used in increasing the fertility, productivity and sustainability of soils of India and World.

PO 8: Environment and sustainability: The various tactics used in maintaining the soil/ land environment and its sustainability for better production and promote the growth of useful microbes in soil.

PO-9 : Use of Engineering tools/ software's : Handling and application of various software's for data analysis and GIS system software's to know and locate the various properties of soil(agricultural area , buildings, lake/ river) in map

PO-10 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the agricultural practices.

PO-11 : Life long learning : Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological changes

PO- 12: Project management: Application method used by the farmers for better productivity of crop of various organic or biological microbes in soil.

Program Specific Outcomes (PSOs)

PSO-1: Ability to prepare Nano fertilizer and their application: Preparation and composition of various nutrients (Macro, secondary or micro) nutrients in fertilizers

PSO-2: Ability to understand the soil microbial classification: Identify the process in calculating the microbial population and their contribution in Agricultural crop production.

PSO-3: Ability to prepare the various bio fertilizers and their application in field: Preparation and application of Bio fertilizers in various crop.

PSO-4: The ability to apply technical & engineering knowledge for increased soil fertility and productivity : Use of various software's in running the agricultural equipment's and analysis of field with drown systems preparation of maps with the help of GPS in GIS software and handling of remote sensing .

Consistency/Mapping of PEOs with Mission of the Department

PEO	M 1	M 2	M 3	M 4	M5	M6
PEO 1	3	2	2	2	2	1
PEO 2	2	3	1	3	3	1
PEO 3	3	2	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) "-": No correlation

General Course Structure & Theme

1. Definition of Credit

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

2. Range of Credits:

In the light of the fact that a typical Model Two-year Post Graduate degree program in Masters in Soil Science has minimum credits of about 70credits, the total number of credits proposed for the Two-year M. Sc.(Ag.) is kept minimum of 70 by PG Restructuring Committee.

3. Structure of PG Program in Soil Science:

The structure of PG program in Soil Science shall have essentially the following categories of courses with the breakup of credits as given:

Components of Curriculum
M.Sc.(Ag.) Soil Science

S.No.	Nature of Papers	Credit hours	Percentage of total credits in the Program
1	Major Courses	22	30.14
2	Minor Courses	08	10.95
3	Supporting Courses	07	9.60
4	Non Credit	05	6.85
5	Master's Seminar	01	1.36
6	Research	30	41.10
	Total Credits	**73**	**100**

- **Not consider in total credit**

General Course Structure & Credit Distribution

Semester -I		Semester - II	
Course Title	**Credit**	**Course Title**	**Credit**
1. Soil Biology and Biochemistry	2:0:1 = 3	1. Soil Chemistry	2:0:1 = 3
2. Soil, Water and Air Pollution	2:0:1 = 3	2. Soil Physics	2:0:1 = 3
3. Soil Fertility and Fertilizer Use	3:0:1 = 4	3. Soil Mineralogy, Genesis and Classification	2:0:1 = 3
4. Soil Erosion and Conservation	2:0:1 = 3	4. Remote Sensing and GIS Technique for Soil, Water and crop Studies	2:0:1 = 3
5. Statistical Method for Applied Science	3:0:1 = 4	5. Experimental Designs	2:0:1 = 3
6. Technical Writing and Communications Skill	0:0:1 = 1	6. Intellectual Property and its management in Agriculture	1:0:0 = 1
7. Library and Information Services	0:0:1 =1	Basic concept sin laboratory techniques	0:0:1=1
Total Credit	**19**	**Total Credit**	**17**
Semester -III		**Semester - IV**	
Course Title	**Credit**	**Course Title**	**Credit**
1. Management of Problem soils and water	2:0:1 = 3	1. Master Research	0:0:20 = 20
2. Soil Survey and Land Use Planning	2:0:0= 2		
3. Agricultural research, Research ethics and Rural development programmes	1:0:0=1		
4. Master Seminar	0:1:0 = 1		
5. Master Research	0:0:10 = 10		
Total Credit	**17**	**Total Credit**	**20**

a. Major courses: From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken may be given *mark

b. Minor courses: From the subjects closely related to a student's major subject

c. Supporting courses: The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

d. Common Courses: The following courses (one credit each) will be offered to all students undergoing

Master's Degree Programme :

1. Library and Information Services
2. Technical Writing and Communications Skills
3. Intellectual Property and its management in Agriculture
4. Basic Concepts in Laboratory Techniques
5. Agricultural Research, Research Ethics and Rural Development Programmes

Some of these courses are already in the form of e-courses/ MOOCs. The students may be allowed to register these courses/ similar courses on these aspects, if available online on SWAYAM or any other platform. If a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/Board of Studies (BoS).

Total Credit : 73

Course code and definition:

S.No.	=	Serial Number
L	=	Lecture
T	=	Tutorial
PC	=	Practical Credit
CL	=	Classroom Instruction
LI	=	Laboratory Instruction
SL	=	Self Learning
CT	=	Class Test
CA	=	Class/ Home Assignment
SA	=	Seminar One
AT	=	Class Attendance
CAT	=	Class Activity any one
C	=	Total Credits
SW	=	Sessional Work
PRA	=	Progressive Assessment
ESA	=	End Semester Assessment
PO	=	Programme Outcome
PSO	=	Programme Specific Outcome
SOs	=	Session Outcome
PCC	=	Professional core courses
OEC	=	Open Elective courses
LC	=	Laboratory course
SOIL	=	Soil Science Courses
STAT	=	Statistic Courses
PGS	=	Non Credit Courses

Course level coding scheme:

Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course. Digit at hundred's place signifies the year in which course is offered.

e.g. 101, 102 … etc. for first year. 201, 202 …. Etc. for second year. 301, 302 … for third year. 401. 402--- for Fourth year

Category-wise Courses

Sl.	Code No.	Subject	Semester	Credits
Major Course				L: T: P
1	Soil-501	Soil Physics	2	2:0:1 =3
2	Soil-502	Soil Fertility And Fertilizer Use	1	3:0:1 =4
3	Soil-503	Soil Chemistry	2	2:0:1 =3
4	Soil-504	Soil Mineralogy, Genesis And Classification	2	2:0:1 =3
5	Soil-506	Soil Biology And Biochemistry	1	2:0:1 =3
6	Soil-508	Soil, Water And Air Pollution	1	2:0:1 =3
7	Soil-511	Management of Problematic Soils And Water	3	2:0:1 =3
Minor Course				
8	Soil-509	Remote Sensing And GIS Technique For Soil And Crop Studies	2	2:0:1 =3
9	Soil-505	Soil Erosion And Conservation	1	2:0:1 =3
10	Soil-513	Soil Survey And Land Use Planning	3	2:0:0 =2
Supporting Course				
11	STAT-502	Statistical Methods For Applied Science	1	3:0:1 =4
12	STAT-511	Experimental Designs	2	2:0:1 =3
Non Credits				
13	PGS-503	Intellectual Property And Its Management In Agriculture	2	1:0:0 =1
14	PGS-502	Technical Writing And Communication Skills	1	0:0:1 =1
15	PGS-501	Library And Information Services	1	0:0:1 =1
16	PGS-505	Agricultural Research, Research Ethics and Rural Development programmes	3	1:0:0=1
17	PGS 504	Basic concept sin laboratory techniques	2	0:0:1=1
18	Soil 591	Master Seminar	3	0:1:0=1
19	Soil 599	Master Research	30	0:0:30=30
Total Credits:				**73**

Induction Program

Induction program for students to be offered right at the start of the first year. It is mandatory. AKS University has design an induction program for 1st year student, details are below:

Physical activity

i. Creative Arts
ii. Universal Human Values
iii. Literary
iv. Proficiency Modules
v. Lectures by Eminent People
vi. Visits to local Areas
vii. Familiarization to Dept./Branch & Innovations

Evaluation Scheme:

For Theory Courses:

i. The weightage of Internal assessment is 50% and
ii. End Semester Exam is 50%

The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

For Practical Courses:

i. The weightage of Internal assessment is 50% and
ii. End Semester Exam is 50%

The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

Semester wise Course Structure
Semester wise Brief of total Cerits and Teaching Hours

Semester	L (Lecture)	T (Tutorial)	P (Practical)	Total Hour Per week	Total Credit
Semester -I	12	0	7	27	19
Semester -II	11	0	6	23	17
Semester -III	5	1	11	28	17
Semester - IV	0	0	20	40	20
Total	28	01	44	118	73

Details of SemesterWiseCourseStructure Program: M.Sc.(Ag.) Soil Science
2 years Curriculum Structure
Total Credit (2 year Course)
Semester wise Structure Curriculum
(L= Lecture , T= Tutorial, P= Practical & H = Hours per week)

SEMESTER-1

S.No.	Category	Code	Course Title	L	T	P	Total Hours	Credits
1.	M.Sc.(Ag.)	Soil 502	Soil Fertility and Fertilizer Use	3	-	1	5	4
2.	M.Sc.(Ag.)	Soil 506	Soil Biology and Biochemistry	2	-	1	4	3
3.	M.Sc.(Ag.)	Soil 508	Soil, Water and Air Pollution	2	-	1	4	3
4.	M.Sc.(Ag.)	Soil 505	Soil Erosion and Conservation	2	-	1	4	3
5.	M.Sc.(Ag.)	STAT 502	Statistical methods for Applied Sciences	3	-	1	5	4
6	M.Sc.(Ag.)	PGS 502	Technical Writing and Communication Skills	0	-	1	1	1
7.	M.Sc.(Ag.)	PGS 501	Library and Information Services	0	-	1	1	1
Total				**12**	**0**	**7**	**24**	**19**

SEMESTER-II

S.No.	Category	Code	Course Title	L	T	P	Total H	Credits
1.	M.Sc.(Ag.)	Soil 501	Soil Physics	2	-	1	4	3
2.	M.Sc.(Ag.)	Soil 503	Soil Chemistry	2	-	1	4	3
3.	M.Sc.(Ag.)	Soil 504	Soil mineralogy, Genesis and Classification	2	-	1	4	3
4.	M.Sc.(Ag.)	Soil 509	Remote sensing and GIS Technique for soil, water and crop studies	2	-	1	4	3
5.	M.Sc.(Ag.)	STAT 511	Experimental Designs	2	-	1	4	3
6	M.Sc.(Ag.)	PGS 503	Intellectual property and its management in Agriculture	1	-	-	1	1
7	M.Sc.(Ag.)	PGS 504	Basic Concepts in Laboratory Techniques	0	-	1	1	1
Total				**11**	**0**	**6**	**22**	**17**

SEMESTER-III

S.No.	Category	Code	Course Title	L	T	P	Total Hour	Credits
1.	M.Sc.(Ag.)	Soil 513	Soil survey and Land use planning	2	-	-	2	2
2.	M.Sc.(Ag.)	Soil 511	Management of problem soils and water	2	-	1	4	3
3.	M.Sc.(Ag.)	PGS 505	Agricultural Research, Research Ethics and Rural Development programmes	1	-	-	1	1
4.	M.Sc.(Ag.)	Soil 591	Research Seminar	-	1	-	2	1
5	M.Sc.(Ag.)	Soil 599	Master Research	-	-	10	20	10
Total				**5**	**1**	**10**	**29**	**17**

SEMESTER-IV

S.No.	Category	Code	Course Title	L	T	P	Total Hours	Credits
1.	M.Sc.(Ag.)	Soil 599	Master Research	-	-	20	**1000**	20
Total				-	-	**20**	**1000**	**20**

Total credit : 73

Semester-I

Course Code: SOIL 506

Course Title : **Soil Biology and Biochemistry**

Pre- requisite: Student should have basic knowledge of bio fertilizers and useful microorganisms available in soil help in transforming the fixed forms of nutrients . They know about the various organic waste (plant /animal/rural and urban wastes).

Rationale: The Student learn about available soil microorganisms help in dissolving the fixed form of plant essential nutrients absorbed by the crop. Transformation and lifecycle of all essential plant nutrients. The manufacturing of various bio fertilizers available in market, their composition, combination, properties and use. Importance, principle and role organic farming with the use of consortium for maintaining fertility and sustainability in soil.

Course Outcomes:

Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms

Soil 506.2: To learn the various Interactions of Soil microbes with plants

Soil 506.3: To understand transformation of nutrients with various interaction of soil organism and formation of humus

Soil 506.4: Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture

Soil 506.5: Role, importance, preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 506	Soil Biology and Biochemistry	2	2	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)		
Major Course	**Soil 506**	**Soil Biology and Biochemistry**	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms

Approximate Hours

Item	AppX Hrs
Cl	6
LI	4
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: It gives General introduction on bio fertilizers, its use and importance. **SO1.2:** To recall the diversity in soil microbes, there ecosystem and life cycle **SO1.3** To learn the different interactions occurs between soil and soil organisms	1. Determination of soil microbial population 2. Determination of Soil microbial biomass	**Unit-1 General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms** 1.1 Classification of soil biota and its ecosystem 1.2 Classification of soil microbes 1.3 Importance of soil biota in ecosystem 1.4 Role of soil organisms 1.5 Interaction process occurs with soil organisms 1.6 factors affecting the growth of soil organisms	1. To know about various types of soil organisms

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the classification of soil microbes
- Define soil biota its population and ecosystem

b. Mini Project:

c. Other Activities(Specify): NA

Soil 506.2: To learn the various Interactions of Soil microbes with plants

Approximate Hours

Item	AppX Hrs
Cl	6
LI	4
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To relate the different types of interaction of soil microbes with crop, there growth **SO2.2** To understand the principle and role of soil microbes **SO2.3** To discriminate the various enzymes and chemicals released by the microbes.	1. Determination of Soil enzymes released by soil microbes 2. Study of rhizosphere effect	**Unit : 2: The basic concept , importance and role of soil microbes** **2.1** To learn the classification of soil microbes **2.2** To understand the role of soil microbes in increasing soil fertility **2.3** To know the various enzymes released by the microbes **2.4** To learn the various chemicals reactions affecting the growth of microbes in soil **2.5** To relate the factors affecting the growth of rhizobium **2.6** Classification of different Rhizo-bacteria in soil used in different crops	1. To know about the importance of soil organisms

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- Classification, composition and properties of major nutrient fertilizers.

b. Mini Project:

- Prepare flow chart of integrated nutrient management

c. Other Activities(Specify): NA

Soil 506 .3: To understand transformation of nutrients with various interaction of soil organism and formation of humus

Approximate Hours

Item	AppX Hrs
Cl	6
LI	12
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To learn the various process involved during transformation of different nutrients(macro, secondary and micro nutrients) through microbial activity in soil **SO3.2 To** Understand and learn the nutrient cycle. **SO3.3 To assess the a**bility to understand the Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.	1. Measurement of important soil microbial processes such as ammonification, nitrification, N2 2. To study the determination of fixation of various nutrients in soil 3. To determine the process involved in solubilization of S from a given soil 4. To estimate the Phosphorus solubilization process in soil 5. To estimate the Phosphorus mineralization process in soil 6. Estimation of micro nutrients solubilization and mineralization	**Unit-3 : Transformation solubilization and mineralization of essential plant nutrient** **3.1** Microbial transformation of Major nutrients **3.2** Microbial transformation of secondary nutrients **3.3**Microbial transformation of Micro nutrients **3.4**Role of soil organic matter and crop residue in maintaining soil fertility and productivity **3.5** Formation and components of humus **3.6** To learn the importance of humus in maintaining soil fertility	1. Making chart of available forms to essential plants nutrients

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Humus formation its classification and components
- Transformation of soil nutrients and factor affecting each of them

b. Other Activities (Specify): NA

Soil 506.4: Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture

Approximate Hours

Item	AppX Hrs
Cl	**7**
LI	**6**
SW	**2**
SL	**2**
Total	**17**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To Relate difference between the Biodegradation of pesticides **SO4.2 To** Understand and learn The production and use of organic wastes and manures. **SO4.3 To** Understand and learn the production and use of biogas plant and use of slurry in increasing the sustainability of soil	1. To study the Elemental composition of a given soil 2. To study the functional groups of a given sample 3. To prepare the bio degradable substances	**Unit-4: Production, role and Importance of various bio pesticides, degradable substances and organic waste** **4.1** To learn the Production techniques of biodegradable pesticides **4.2:** To know the application methods of biodegradable pesticides in maintaining soil health and increase the crop yield **4.3:** To learn the Production techniques of biodegradable substances **4.4:**To understand the role of biodegradable substances in maintaining soil health **4.5:** Role of various microbial toxins released in soil **4.6:** Production, importance and use of organic waste **4.7:** Role of various biotic factors involved in soil developments	1. Making chart of useful bio pesticide available in market 2. Identification of different organic manures and nutrient content in it

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Identification of different organic manures and nutrient content in it

b. Mini-Project

- Preparation of various bio pesticides and its application in different crop

c. Other Activities (Specify): NA

Soil 506.5: Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**4**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To know the Effective knowledge on formation and application method of different types of compost, FYM, Vermicomposting. **SO5.2** Understand the procedure , importance, and classification of different Bio fertilizers	1. Decomposition of organic matter in soil 2. To determine the fractionation of organic matter of a given sample	**Unit5: Preparation and Application of organic manure and bio fertilizers in soil** **5.1** To learn the preparation methods of different bulky organic manures **5.2:** To learn the preparation methods of different concentrated organic manures **5.3** Classification and preparation of various bio fertilizers **5.4:** To learn the Application method used during supply of various bio fertilizers in different crops **5.5** Application of different organic manure and bio fertilizer in improving crop production.	1. Enlist the different Methods of organic waste and bio fertilizer available in market

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Preparation Methods of different organic manure in various crops.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instructions (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+ SW+Sl)
Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms	6	4	2	1	13
Soil 506.2: To learn the various interactions of soil microbes with plants	6	4	2	1	13
Soil 506 .3: To understand transformation of nutrients with various interaction of soil organism and formation of humus	6	12	2	1	21
Soil 506..4: Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture	7	6	2	2	17
Soil 506.5: : Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil	5	4	2	1	12
Total Hours	30	30	10	6	76

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms	03	01	01	05
CO-2	The basic concept , importance and role of soil microbes	02	06	02	10
CO-3	Transformation solubilization and mineralization of essential plant nutrient	03	07	05	15
CO-4	Production, role and Importance of various bio pesticides, degradable substances and organic waste	03	07	05	15
CO-5	Preparation and application of organic manure and bio fertilizers	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Biology and Biochemistry** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Principles and Applications of Soil Microbiology	Sylvia DN.	Pearson Edu	2005
3	Fundamental of Soil Science	Indian Society of Soil Science	ISSS, National Societies Block, Pusa, New Delhi	Revised 2012

4	Introduction to Soil Microbiology	Alexander M	John Wiley & Sons	1977
5	Soil Microbial Ecology – Applications in Agricultural and Environmental Management.	Metting FB.	ICAR, New Delhi	1993
6	Soil Biochemistry	Paul EA and Ladd JN.	Marcel Dekker	1981
7	Soil Biochemistry	Stotzky G & Bollag JM	Vol. VIII. Marcel Dekker	1993
8	Soil Microbiology	Subba Rao N.S	Medtech Scientific International	Revised 2017

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh , Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos, POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 506

Course Title: Soil Biology and Biochemistry

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms	2	2	1	1	1	1	2	3	1	2	3	2	1	3	1	2
Soil 506.2: To learn the various interactions of soil microbes with plants	2	2	1	1	1	1	2	3	1	2	3	2	1	3	1	2
Soil 506 .3: To understand transformation of nutrients with various	2	2	2	1	1	1	2	3	1	2	3	2	1	3	2	2

interaction of soil organism and formation of humus																
Soil 506..4: Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**3**	**2**	**1**	**3**	**1**	**2**
Soil 506.5: : Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil	**2**	**1**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**3**	**2**	**1**	**3**	**1**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil 506: **Soil Biology and Biochemistry**

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms**	**SOs: 1.1, SOs:1.2, SOs:1.3**	**LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4**	**Unit-1.0 General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms 1.1,1.2,1.3,1.4,1.5,1.6**	As mentioned in page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 506.2 : To learn the various interactions of soil microbes with plants**	**SOs: 1.1, SOs:1.2, SOs:1.3**	**LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4**	**Unit 2.0 The basic concept , importance and role of soil microbes** 2.1, 2.2, 2.3, 2.4, 2.5,2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 506.3 ::To understand transformation of nutrients with various interaction of soil organism and formation of humus**	**SOs: 1.1, SOs:1.2, SOs:1.3**	**LI: 1.1, LI:1.2, LI:1.3, LI:1.4, LI:1.5, LI:1.6, LI:1.7, LI:1.8, LI:1.9, LI:1.10, LI:1.11, LI:1.12**	**Unit-3.0: Transformation solubilization and mineralization of essential plant nutrient** 3.1, 3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 506.4 :Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture**	**SOs: 1.1, SOs:1.2, SOs:1.3**	**LI: 1.1, LI:1.2, LI:1.3, LI:1.4, LI: 1.5, LI: 1.6**	**Unit-4.0 : Production, role and Importance of various bio pesticides, degradable substances and organic waste** 4.1,4.2,4.3,4.4,4.5,4.6,4.7	

PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 506.5 :Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil**	**SOs: 1.1, SOs:1.2**	**LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4**	**Unit-5.0 : Preparation and Application of organic manure and bio fertilizers in soil 5.1,5.2,5.3,5.4,5.5**	

Semester-I

Course Code: SOIL 508

Course Title : **Soil Water and Air Pollution**

Pre- requisite: Student should have basic knowledge of various forms of pollutants present in soil, water and air.

Rationale: The Student learn about the measurement of soil, water and air pollution , their optimum level. What are the norms to reduce the pollution from soil, air and water used by government in India and world for maintaining ecofriendly nature.

Course Outcomes:

Soil 508.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level

Soil 508.2: To learn the Nature, sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health

Soil 508.3 Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms

Soil 508.4: Classification and behavior of pesticides in soil, and their effect on soil microorganisms

Soil 508.5: To understand the sources and behavior of released toxic substances affect in Soil, water , Air and human health

Soil 508.6: To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air Scheme of Studies

Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water, Air and human health

Course Category	**Course Code**	**Course Title**	**Scheme of studies(Hours/Week)**					**Total Credits (C)**
			Cl	**LI**	**SW**	**SL**	**Total Study Hours (CI+LI+SW+SL)**	
Major Course	Soil 509	Soil Water and Air Pollution	2	2	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Major Course	**Soil 509**	**Soil, Water and Air Pollution**	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 508.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level

Approximate Hours

Item	AppX Hrs
Cl	4
LI	4
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To recall the various types of pollution and there sources **SO1.2:** To discriminate the different types of pollution occur in agricultural field, their source.	1. To determine the nutrient content and sampling process of sewage water and sewage Sludge 2. To determine the nutrient content and sampling process of liquid industrial wastes	**Unit-1 Source of air, water and soil pollution which affect the crop production** 1.1Understand the various types and source of soil pollution 1.2Understand the various types and source of water pollution 1.3 Understand the various types and source of air pollution 1.4 Effect of soil , water and air pollution on growth and development of crop	1. To know about various pollutants and their sources of soil , water and air pollution

SW-1 Suggested Sessional Work (SW):

a) Assignments:

Enlist the various pollutants affecting soil , water and air

b) Mini Project: NA

c) Other Activities(Specify): NA

Soil 508.2: To learn the Nature , sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health

Approximate Hours

Item	AppX Hrs
Cl	**4**
LI	**6**
SW	**2**
SL	**1**
Total	**13**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To assess the nature and sources of pollutants originates from agricultural field (through fertilizers and pesticides) **SO2.2** To assess the nature and sources of pollutants originates from, industrial area, **SO2.3** To assess the nature and sources of pollutants originates from urban wastes lands, acid rains.	1. To determine the BOD of a given water sample 2. To determine the COD of a given water sample 3. To estimate the dissolved and suspended solids from a given sample	**Unit-2.0 To Study the Soil, water and air pollution and there problems** **1.1** To discuss about the Soil pollution **1.2** To discuss about the water pollution **1.3** To discuss about the air pollution **1.4** To Learn the problems associated with agriculture, nature contaminating the soil, water and plant	1.Enlist the various role of fertilizers, pesticides and herbicides in increasing the Soil, water and air pollution

SW-2 Suggested Sessional Work(SW):

a. Assignments:

1. Enlist the nature and sources of pollutants originates from urban wastes lands

2. Factors responsible in cause of acid rains

b. Mini Project: NA

c. Other Activities(Specify): NA

Soil 508 .3: Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms

Approximate Hours

Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Evaluate the effect of sewage water on plant growth and human beings **SO3.2 To** Understand the effect of industrial effluents on growth and development of living beings	To know the Sampling method and precaution measure should be taken during colleting polluted soils and plant	**Unit-3 : To understand the forms and properties of various effluents released from Sewage and industrial** 1.1 To learn about Sewage effluents–their composition 1.2 To learn about industrial effluents–their composition 1.3 To understand the effect of Sewage & industrial effluents on soil properties/ health, and plant growth and human beings 1.4 To understand the soil as sink for waste disposal	1. To know about the various industries running in your surrounding and their discarded material

SW-3 Suggested Sessional Work (SW):

a) Assignments:

- Effect of industrial effluents on growth and development of living beings

Soil 508:4: Classification and behavior of pesticides in soil, and their effect on soil microorganisms

Approximate Hours

Item	AppX Hrs
Cl	4
LI	4
SW	2
SL	2
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
• **SO4.1** Recognize the different type of Pesticides and available nutrients. • **SO4.2** Relate the behavior of pesticides and available nutrients in soil with different crops	1.To understand the management of contaminants in Soil to safe guard food safety 2.To understand the management of contaminants in plants to safe guard food safety	**Unit-4: Study the pesticides–their classification, and soil microorganisms.** 4.1 To study the classification of Pesticides 4.2 To learn the effect of Pesticides in soil properties 4.3 To learn the effect of Pesticides on growth and development of soil microorganisms 4.4 To understand the effect of Pesticides on growth and development of crop	1. Making chart of useful bio pesticide available in market 2. Identification of different banned pesticides but still supplied in market

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Role of pesticides in affecting the population of useful microorganisms

b. Other Activities (Specify): NA

Soil 508.5: To understand the sources and behavior of released toxic substances affect in Soil, water , Air and human health

Approximate Hours

Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To identify the various sources and behavior of released of release of toxic substances in soil **SO5.2** To identify the various sources and behavior of released of toxic substances in plants SO5:3. To identify the various sources and behavior of released of toxic substances in human beings	1. To determine the nitrate and ammonium nitrogen content of a given soil, and water sample 2.To determine the available phosphorus content in a give soil and water sample 3.To determine the available heavy metal content in given soil /water effluents	**Unit-5: Study the Toxic elements and there management** 5.1 To learn about different types of Toxic elements present in soil 5.2 To learn the different sources of Toxic elements present in soil 5.3 To learn the behavior of different Toxic elements present in soil 5.4 Understand the effect on nutrients availability, effect on plant and human health.	1. Enlist the different types of toxic substances affect the soil, water and air

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the various sources and behavior of released of toxic substances in soil and plants
- Enlist the various sources and behavior of released of toxic substances in water
- Enlist the various sources and behavior of released of toxic substances in Air
- Enlist the various sources and behavior of released of toxic substances in human beings

b. Mini Project:

- Llist of toxic substances released from various industries affect the soil, water and air

c. Other Activities (Specify): NA

Soil 508.6: To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air

Approximate Hours

Item	AppX Hrs
Cl	5
LI	6
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO6.1 To review on cause of Pollution of water resources and its reclamation strategies **SO6.2** To understand the cause of release of GH gasses and its reclamation strategies SO6:3. To identify the forms of pesticides affect the soil health	1. To determine of Heavy metals in contaminated plants sample 2.To determine the NO_2, O_2 & sulphate content in a given area air sample 3. To estimation of particulate matter content in a particular area	**Unit .6: Study the pollution of water and green house gasses.** 6.1 To learn about the various ways of water Pollution resources due to leaching of nutrients and pesticides from soil. 6.2 To learn about the various ways of water Pollution resources due to effect of pesticides in soil 6.3 To understand the various sources responsible in emission of green house gases–carbon dioxide, methane and nitrous oxide in atmosphere 6.4 To know the emission of green house gases–carbon dioxide, methane and nitrous oxide 6.5 To study the different practices to manage both water and air pollution through leaching and emission of GHG respectively	1. Enlist the various GH Gases and their contribution in depletion of ozone layer of earth

SW-6 Suggested Sessional Work (SW):

a) Assignments:

- Identify the sources of GH gasses its contribution in affecting the ozone layer depletion

b) **Mini Project: NA**

c) **Other Activities (Specify): NA**

Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water , Air and human health

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**6**
SW	**2**
SL	**1**
Total	**14**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO7.1 To assess the soil pollution **SO7.2**To reclamation the polluted soil, and water **SO7.3** To learn the use of remote sensing in assessing the management of polluted soil and water	1.Visit to various industrial sites to study the impact of pollutants on soil and plants	**Unit-7: Study the polluted contaminated soil and water and there management** **7.1** To learn about the Risk assessment of polluted soil **7.2** Remediation/ amelioration of contaminated soil and water **7.3** Remediation/ amelioration of contaminated water **7.4** To know the remote sensing applications in monitoring **7.5** To know the remote sensing applications in management of soil and water pollution.	1. To learn the use of interment and basic computer knowledge in operating GIS software

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- To use the remote sensing in assessing the management of polluted soil and water and locating techniques in map

b. **Mini Project :NA**

c. Other Activities (Specify): NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+ Sl)
Soil 508.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	**4**	**4**	**2**	**1**	**11**
Soil 508.2: **To learn the Nature , sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health**	**4**	**6**	**2**	**1**	**13**
Soil 508.3: Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms	**4**	**2**	**2**	**1**	**9**
Soil 508.4.: Classification and behavior of pesticides in soil, and their effect on soil microorganisms	**4**	**4**	**2**	**1**	**11**
Soil 508.5: To understand the sources and behavior of released toxic substances affect in Soil, water , Air and human health	**4**	**6**	**2**	**1**	**13**
Soil 508.6: To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air	**5**	**6**	**2**	**1**	**14**
Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water , Air and human health	**5**	**2**	**2**	**1**	**10**
Total Hours	**30**	**30**	**14**	**7**	**81**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Source of air, water and soil pollution which affect the crop production	03	02	02	07
CO-2	To Study the Soil, water and air pollution and there problems	02	03	03	8
CO-3	To understand the forms and properties of various effluents released from Sewage and industrial	03	03	02	8
CO-4	Study the pesticides–their classification, and soil microorganisms.	02	02	03	7
CO-5	Study the Toxic elements and there management	03	02	02	7
CO-6	Study the pollution of water and Green House Gases	02	02	02	6
CO-7	Study the polluted contaminated soil and water and there management	03	02	02	7
Total		18	16	16	50

Legend: R= Remember, U= Understand, A= Apply

The end of semester assessment for **Soil Water and Air Pollution** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Fundamental of Soil Science	Indian Society of Soil Science	ISSS, National Societies Block, Pusa, New Delhi	Revised 2012
2	The Nature and properties of Soils	Nyle B Brady and Ray R Weil	Pearson Education	Revised 2013
3	. Industrial Pollution Control	Middlebrooks EJ.	John Wiley Interscience	1979
4	Toxic Metals in Soil Plant Systems.	Ross SM.	John Wiley & Sons	**1998**
5	Environmental Pollution and Control	Vesilund PA and Pierce	Ann Arbor Science Publication	1983

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh, Professor, Department of Agronomy,, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr.Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos, POs and PSOs Mapping

Course Title: : M.Sc. (Ag.) Course

Course Code : Soil 508

Course Title : Soil Water and Air Pollution

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problemn soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	2	2	3	2	2	2	1	3	1	2	3	2	2	2	2	2
To Study the Soil, water and air pollution and there problems	2	2	2	3	2	2	1	3	1	1	2	3	2	2	1	2

To understand the forms and properties of various effluents released from Sewage and industrial	**1**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**2**
Study the pesticides–their classification, and soil microorganisms.	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**1**	**1**	**3**	**2**	**2**
Study the Toxic elements and there management	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	**3**	**2**	**2**	**3**	**1**	**2**
Study the pollution of water and green house gases	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	**3**	**2**	**2**	**3**	**1**	**2**
Study the polluted contaminated soil and water and there management	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	**3**	**2**	**2**	**3**	**1**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil 508: **Soil Water and Air Pollution**

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	SO1.1 SO1.2	LI. 1.1, LI. 1.2	Unit-1 I Source of air, water and soil pollution which affect the crop production 1.1,1.2,1.3,1.4	As mentioned in page number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.2: To study the soil, water and air pollution and there problems	SO2.1 SO2.2 SO2.3	LI. 2.1, LI. 2.2, LI. 2.3	Unit-2 To Study the Soil, water and air pollution and there problems 2.1,2.2,2.3,2.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.3: To understand the forms and properties of various effluents released from Sewage and industrial	SO3.1 SO3.2 SO3.3 SO3.4	LI. 3.1	Unit-3 Study the pesticides–their classification, and soil microorganisms. 3.1,3.2,3.3,3.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.4: Study the pesticides–their classification, and soil microorganisms.	SO4.1 SO4.2 SO4.3 SO4.4	LI. 4.1 LI. 4.2	Unit-4 Study the pesticides–their classification, and soil microorganisms. 4.1,4.2,4.3,4.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Cos.5: Study the Toxic elements and there management	SO5.1 SO5.2 SO5.3 SO5.4	LI. 5.1, LI. 5.2, LI. 5.3	Unit-5 Study the pesticides–their classification, and soil microorganisms. 5.1, 5.2, 5.3, 5.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Cos.6: Study the pollution of water and green house gases	SO6.1 SO6.2 SO6.3	LI. 6.1, LI. 6.2, LI. 6.3	Unit 6. Study the pollution of water and green house gases 6.1,6.2,6.3,6.4,6.5	

PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Cos.7: Study the polluted contaminated soil and water and there management**	**SO7.1** **SO7.2** **SO7.3**	**LI. 7.1**	**Unit 7: Study the polluted contaminated soil and water and there management** **7.1,7.2,7.3,7.4,7.5**	

Semester-I

Course Code: SOIL 502

Course Title : **Soil Fertility and Fertilizer use**

Pre- requisite: Student should have basic knowledge of different fertilizers and nutrients available in soil for growth and development of crops. They also know about the various organic waste (plant /animal/rural and urban wastes)used in increasing soil fertility.

Rationale: To impart knowledge about soil fertility and its control. To understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency. The manufacturing of various fertilizers available in market, their composition, combination, properties and use for maintaining fertility and sustainability in soil.

Course Outcomes:

Soil 502.1: Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity

Soil 502.2: To understand the mineralization and immobilization of various Nitrogen in soil and plants

Soil 502 .3: To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants

Soil 502 .4: To understand the mineralization and immobilization of various secondary nutrients (Ca, Mg and S) in soil and plant

Soil 502.5: To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants

Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in different crop

Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture

Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil

Soil 502.9: To understand concept of soil health and quality

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 502	Soil Fertility and Fertilizer use	3	1	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial(T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Major Course	**Soil 502**	**Soil Fertility and Fertilizer use**	**15**	**30**	**0**	**0**	**5**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 502.1: Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**4**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: It gives General introduction about Differentiate between soil fertility and productivity. **SO1.2:** To evaluate the optimal dose, deficiency symptoms ,function and sources of nutrients. **SO1.3** To learn the different types of fertilizers and manure	1.To determine the available Macro nutrients (N,P,K) content in plants 2.To determine the available Macro nutrients(N,P,K) content in soil	**Unit-1 Soil fertility and productivity** **1.1** Classification, availability, functions of essential plant nutrients in soil **1.2** To know the deficiency symptoms of essential plant nutrients in soil **1.3** Classification of different types of manure **1.4** Classification of different types of fertilizer **1.5** To learn the interaction of various nutrients in soils and plants	1. To know about various types of nutrients and minerals present in soil

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the classification of essential plant nutrients with its functions and deficiency symptoms
- Classification of fertilizers their formation , nutrient content and application methods in soil
- Classification of Organic manures their formation , nutrient content and application methods in soil

b. Mini Project: NA

c. Other Activities(Specify): NA

Soil 502.2: To understand the mineralization and immobilization of various Nitrogen in soil and plants

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**2**
SW	**2**
SL	**1**
Total	**10**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To Assess the Soil macronutrient status, available forms of Nitrogen **SO2.2** To Evaluate the fixation and transformation of available N in soil **SO2.3** To understand the factors affecting N availability and their fate soil **SO2.4** To evaluate the N management tactics used in maintaining soil fertility in both upland and low land condition	1.To estimate the available nitrogen content through kjeldahl method	**Unit : 2: Immobilization and mineralization of nitrogen** 2.1. To learn the available and unavailable forms of N in soil 2.2 To know the transformation of N in soil 2.3 To understand the factors affecting N availability in soils and plants 2.4 Management of N in upland condition 2.5 Management of N in low land condition	1. To know the role of useful microbes in mineralizatio n of different nutrients in soils

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- Role, function and deficiency symptoms of Nitrogen in plants
- Transformation, mineralization, of N in plants

d. Other Activities(Specify): NA

Soil 502 .3: To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**8**
SW	**2**
SL	**1**
Total	**16**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To Assess the Soil macronutrient status, available forms of Phosphorus and Potassium. **SO3.2** To Evaluate the fixation and transformation of available P and K in soil. **SO3.3** To understand the factors affecting P and K availability and their fate soil SO3.4 To evaluate the P and K management tactics used in maintaining soil fertility in both upland and low land condition	1.Chemical analysis of soil for total and available phosphorus of a given soil through spectrophotometer 2. Estimation of available potassium of given soil sample through flame photometer 3. Estimation of available potassium of given plant sample through flame photometer 4. Estimation of available phosphorus of given plant sample through flame photometer	**Unit : 3: Immobilization and mineralization of** P and K 1. To learn the available and unavailable forms of P and K in soil 2. To know the transformation of P and K in soil 3. To understand the factors affecting P and K availability in soils and plants 4. Management of P and K in both upland land condition 5. Management of P and K in low land condition	1.To know the role of useful microbes in mineralization of different Phosphorus and potassium in soils

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Role, function and deficiency symptoms of P and K in plants
- Transformation, mineralization, of P and K in soil

b. Other Activities (Specify): NA

Soil 502 .4: To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**8**
SW	**2**
SL	**1**
Total	**16**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To Assess the Soil macronutrient status, available forms of secondary nutrients . **SO4.2** To Evaluate the fixation and transformation of available secondary nutrients in soil. **SO4.3** To understand the factors affecting secondary nutrients availability and their fate soil SO2.4 To evaluate the secondary nutrients management tactics used in maintaining soil fertility in both upland and low land condition	1. Estimation of available Ca, Mg in given soil 2. Estimation of available Ca, Mg in plant 3. Estimation of available Sulphur in plant through flame photometer 4. Estimation of available Sulphur in soil through flame photometer	**Unit : 4: Immobilization and mineralization of secondary nutrients** 4.1To learn the available forms of secondary nutrients in soil **4.2** 1To learn the unavailable forms of secondary nutrients in soil **4.3** To know the transformation of secondary nutrients in soil To understand the factors affecting secondary nutrients availability in soils and plants **4.4** Management of secondary nutrients in both upland and low land condition **4.5** Management of secondary nutrients in low land condition	1.To know the role of useful microbes in mineralization of different secondary nutrients in soils

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Role, function and deficiency symptoms of Ca and Mg in plants
- Transformation, mineralization, of Ca and Mg in plants

b. Other Activities (Specify): NA

Soil 502.5: To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**6**
SW	**2**
SL	**1**
Total	**14**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To Assess the Soil macronutrient status, available forms of Micro nutrients (Fe, Mn, Cu, Zn, B, Mo, Ni) . **SO5.2** To Evaluate the fixation and transformation of available Micro nutrients in soil. **SO5.3** To understand the factors affecting Micro nutrients availability and their fate soil SO5.4 To evaluate the Micro nutrients management tactics used in maintaining soil fertility in both upland and low land condition	1.To estimate the micro(Fe, Mn, Cu, Zn) nutrient content in a given soil through AAS 2.To estimate the micro(Fe, Mn, Cu, Zn) nutrient content in a given water through AAS 3.To estimate the available boron content in soil	**Unit : 5: Immobilization and mineralization of** Micro nutrients 5.1: To learn the available and unavailable forms of Micro nutrients in soil 5.2: To know the transformation of Micro nutrients in soil 5.3: To understand the factors affecting Micro nutrients availability in soils and plants 5.4: Management of Micro nutrients in both upland and low land condition 5.5: Management of Micro nutrients in low land condition	1.To know the role of useful microbes in mineralization of different Micro nutrients in soils

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Role, function and deficiency symptoms of Micronutrients in plants
- Transformation, mineralization, of micronutrients in plants

b. Other Activities (Specify): NA

Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in different crop

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**2**
SW	**2**
SL	**1**
Total	**10**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To Apply the various soil testing methods for fertilizer application in different crops **SO6.2** To Evaluate the correlation of soil test crop response	1.To determine the nutrient content through colorimetric method	**Unit : 6: Soil testing methods and there role in soil an** **6.1** To study Common soil test methods for fertilizer 6.2: To study application methods used for fertilizer recommendations in different crop 6.3: To understand the quantity relationships of various nutrients in soil 6.4: To understand the intensity relationships of various nutrients in soil **6.5:** To learn about soil test crop response correlations and response functions in soil and plant.	1.List of Common soil test methods for fertilizer recommendations

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- To enlist the various soil test methods for fertilizer recommendation

b. Other Activities (Specify): NA

Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**0**
SW	**2**
SL	**1**
Total	**08**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO7.1 To Assess the fertilizer use efficiency in soil and plants **SO7.2** To Evaluate the role of INM and assess the principle and concept behind SSNM **SO7.3** To evaluate the use of fertilizers in field		**Unit : 7: To understand the integrated nutrient management and there role in soil and plants** 7.1 To calculate the Fertilizer use efficiency 7.2 To understand the concept of site-specific nutrient management 7.3 To understand plant need based nutrient management techniques 7.4 To understand the basic concept and principle of integrated nutrient management specialty fertilizers concept need and category 7.5 Current status of specialty fertilizers use in soils and crops of India	1. List Current status of specific fertilizers use in soils and crops of India

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept and importance of INM, SSNM techniques

b. Other Activities (Specify): NA

Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**0**
SW	**2**
SL	**1**
Total	**08**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO8.1 To Assess the fertility of Soil through various physical methods **SO8.2** To Assess the fertility of Soil through various physical methods **SO8.3** To Assess the fertility of Soil through various physical methods		**Unit : 8 Soil fertility evaluation and determination of critical limit, DRIS** 8.1 To learn the Soil fertility evaluation techniques come under biological methods, soil, plant and tissue tests 8.2: To learn the Soil fertility evaluation techniques come under physical and Chemical methods of soil 8.3: to learn the visual symptoms occur due to deficiency of nutrients and indicator plants 8.4: To learn and understand the tissue tests methods in plants 8.5: soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS.	1 To know the parameters cones under physical, chemical and biological methods of determinatio n

SW-8 Suggested Sessional Work (SW):

a. Assignments:

- Assessment of soil fertility evaluation through DRIS methods

b. Other Activities (Specify): NA

Soil 502.9: To understand concept of soil health and quality

Approximate Hours

Item	AppX Hrs
Cl	5
LI	0
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO9.1 To Assess the concept and various parameter in measuring Soil quality **SO9.2** To Assess the concept and various parameter in measuring Soil Health		**Unit : 9: Soil quality and health** 9.1: To learn the concept and principle of soil health 9.2: To assess the measure should be taken in maintaining soil health 9.3: Study the long term effects of fertilizers 9.4: To learn the concept and principle of soil quality 9.5: To assess the measure should be taken in maintaining soil quality	1.To know the parameters of soil quality and health

SW-9 Suggested Sessional Work (SW):

a) Assignments:

- Assessment of soil quality parameters
- Assessment of soil Health parameters

b) Other Activities (Specify): NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 502.1: Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity	5	4	2	1	12
Soil 502.2: To understand the mineralization and	5	2	2	1	10

immobilization of various Nitrogen in soil and plants					
Soil 502.3: To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants	5	8	2	1	16
Soil 502.4: To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant	5	8	2	1	16
Soil 502.5: : To understand the mineralization and immobilization of various Micronutrient((Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants	5	6	2	1	14
Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in different crop	5	2	2	1	10
Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture	5	--	2	1	08
Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil	5	--	2	1	08
Soil 502.9: To understand concept of soil health and quality	5	--	2	1	08
Total Hours	**45**	**30**	**18**	**9**	**102**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Soil fertility and productivity	1	2	2	5
CO-2	Immobilization and mineralization of nitrogen	2	3	2	7
CO-3	Immobilization and mineralization of P and K	1	2	2	5
CO-4	Immobilization and mineralization of secondary nutrients	1	2	2	5
CO-5	Immobilization and mineralization of Micro nutrients	2	2	2	6
CO-6	Soil testing methods and there role in soil and plant	2	2	2	6
CO-7	To understand the integrated nutrient management and there role in soil and plants	2	2	2	6
CO-8	Soil fertility evaluation and determination of critical limit, DRIS	2	1	2	5
CO-9	Soil quality and health	2	2	1	5
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Fertility and Fertilizer Use** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Trace Elements in Soils and Plants.	Kabata-Pendias A and Pendias H.	CRC Press.	1992
3	Biofertilizers Technology	Kannaiyan S, Kumar K and Govindarajan K.	Technology. Scientific Publ	2004
4	Nitrogen Fixation at the Millennium	Leigh J G.	Elsevier	2002
5	Principles of Plant Nutrition	Mengel K and Kirkby EA.	International Potash Institute, Switzerland	1982
6	Micronutrients in Agriculture	Mortvedt JJ, Shuman LM, Cox FR and Welch RM.	2nd Ed. SSSA, Madison	1991
7	Soils and Environmental Quality	Pierzinsky GM, Sims TJ and Vance JF.	2nd Ed. CRC Press	2002

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos ,POs and PSOs Mapping

Code : Soil 502

Course Title: Soil Fertility and Fertilizer Use

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
Classification of their uptake and available forms play a important role in maintaining soil fertility and productivity	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To understand the mineralization and immobilization of various Nitrogen in soil and plants	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3

To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To evaluate the soil test methods used for application of various fertilizers in different crop	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To learn the physical, biological and chemical ways to assess the fertility of soil	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**
To understand concept of soil health and quality	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**3**	**3**

Course Curriculum Map: Soil 502; Soil Fertility and Fertilizer use

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.1. Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity	SO1.1 SO1.2 SO1.3	LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4	Unit-1 Soil fertility and productivity 1.1,1.2,1.3,1.4,1.5	As mentioned in page number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.2. To understand the mineralization and immobilization of various Nitrogen in soil and plants	SO2.1 SO2.2 SO2.3 SO2.4	LI. 2.1, LI. 2.2	Unit : 2: Immobilization and mineralization of nitrogen 2.1,2.2,2.3,2.4,2.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.3. To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants	SO3.1 SO3.2 SO3.3 SO3.4	LI. 3.1, LI. 3.2, LI. 3.3, LI. 3.4, LI. 3.5, LI. 3.6, LI. 3.7, LI. 3.8	Unit : 3: Immobilization and mineralization of P and K 3.1,3.2,3.3,3.4,3.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.4. To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant	SO4.1 SO4.2 SO4.3 SO4.4	LI.4.1, LI. 4.2, LI. 4.3, LI. 4.4, LI. 4.5, LI. 4.6, LI. 4.7, LI. 4.8	Unit : 4: Immobilization and mineralization of secondary nutrients 4.1,4.2,4.3,4.4,4.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.5. To understand the mineralization and immobilization of various Micronutrient (Fe, Mn,Cu, Zn,	SO5.1 SO5.2 SO5.3 SO5.4	LI. 5.1, LI. 5.2, LI. 5.3, LI. 5.4,	Unit : 5: Immobilization and mineralization of Micro nutrients 5.1,5.2,5.3,5.4,5.5	

	B, Mo, Ni) content in soil and plants		LI. 5.5, LI. 5.6		
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.6. To evaluate the soil test methods used for application of various fertilizers in different crop	SO6.1 SO6.2	LI. 6.1, LI. 6.2	Unit : 6: Soil testing methods and there role in soil and plant 6.1,6.2,6.3,6.4,6.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.7. To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture	SO7.1 SO7.2 SO7.3	-	Unit : 7: To understand the integrated nutrient management and there role in soil and plants 7.1,7.2,7.3,7.4,7.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.8. To learn the physical, biological and chemical ways to assess the fertility of soil	SO8.1 SO8.2 SO8.3	-	Unit : 8 Soil fertility evaluation and determination of critical limit, DRIS 8.1,8.2,8.3,8.4,8.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.9. To understand concept of soil health and quality	SO9.1 SO9.2	-	Unit : 9: Soil quality and Health 9.1,9.2,9.3,9.4,9.5	

Semester-I

Course Code: Soil 505

Course Title: Soil Erosion and Conservation

Pre- requisite: Students should know about the distribution of eroded land of India and world

Rationale: To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water

Course Outcomes:

Soil 505.1: **To understand the distribution and identification of probes regarding soil erosion in India**

Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion

Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and Factors affecting wind erosion

Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques

Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies Under wet land, waterlogged conditions

Soil 505.6: To measure the watershed management techniques

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Minor Course	Soil 505	Soil Erosion and Conservation	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+ AT)	(ESA)	(PR A+ ESA)
Minor Course	**Soil 505**	Soil Erosion and Conservation	15	30	0	0	5	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India

Approximate Hours

Item	AppXHrs
Cl	**3**
LI	**6**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To identify the soil erosion problem in India SO1.2 To recollect the history and distribution of soil erosion problem in India	1. To understand the agro climatic zones of India 2. To understand the Soil type of India 3. To understand the Soil type of world	**Unit-1.0 Distribution of eroded soil in India** 1.1To recall the history of classification of eroded soil 1.2 To identify the distribution of eroded land 1.3 To identify the major cause of soil erosion 1.4 To understand the geotopography of India 1.5 To understand the geotopography of world	1. To know the various cause of soil erosion

SW-1 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the various types of eroded soils present in India
- Enlist the cause of soil erosion in India

b) Other Activities(Specify): NA

Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion

Approximate Hours

Item	AppXHrs
Cl	7
LI	8
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To understand the types, cause, mechanisms and management of soil erosion SO2.2: To identify the types, cause, mechanisms and management of water erosion SO2.3: Evaluate the measurement and prediction of runoff water SO2.4: To understand the factors affecting soil and water erosion	1. Determination of percolation ratio 2. Estimation of raindrop erodibility index 3. Estimation of suspension percentage 4. Computation of kinetic energy of falling rain drop	**Unit-2 To understand source and factors responsible for soil and water erosion** 1.1 To classify the various forms of soil erosion 1.2 Factors affecting soil erosion 1.3 To understand the sources of water erosion 1.4 To learn the factors affecting water erosion 1.5 To measurement techniques used to manage the eroded land 1.6 To evaluate the empirical and quantitative estimation of water erosion 1.7 To understand the measurement and prediction of runoff water with relation to soil properties and prediction	1.To know the different types of eroded lands present in India and world

SW-2 Suggested Sessional Work (SW):

a. Assignments

i. Classification of eroded lands and their management techniques used
ii. Classification of different cause of soil and water erosion

b. Other Activities(Specify): NA

Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and Factors affecting wind erosion

Approximate Hours

Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To assess the various process involved during wind erosion SO3.2 To assess the factors affecting wind erosion **SO.3.3** To evaluate the extent of wind erosion in state, India and world	1. To determine the Soil texture of particular area 2. To study the topography and Industrial location of a particular area	**Unit-3 : Wind erosion** 3.1 To learn the various sources of wind erosion 3.2 To understand the classification of wind erosion 3.3 To assess the factors affecting wind erosion 3.4 To analyze the extent of wind erosion in state and in India 3.5 To analyses the extent of wind erosion in world	1.To know the area prone to wind erosion

SW-3 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the factors affecting wind erosion
- Distribution of area prone to wind erosion

b) Other Activities(Specify): NA

Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques

Approximate Hours

Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To recollect the knowledge of historical development with modern development of soil classification **SO4.2** To understand the classification, importance and use of various soil maps	1.To determination of erosion ratio 2. Estimation of dispersion ratio 3. Determination of clay ratio/ moisture evaluating ratio	**Unit-4: Erosion controlling measures** 4.1. To learn the concept and principles of erosion controlling measure 4.2 Application of agronomic practices in controlling the erosion 4.3 Utilization of engineering strategies in controlling the erosion 4.4 Preparation of erosion controlling structures	1. To study soil map of India 2. To study soil map of world

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the agronomic practices used in controlling the erosion
- Enlist the engineering techniques in maintaining the eroded lands

b. Other Specific :

- Prepare the models in managing the agronomic measures to preserve the soil from erosion in different topography of India and World

Soil 504.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions

Approximate Hours

Item	AppX Hrs
Cl	5
LI	2
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the soil conservation techniques **SO5.2 To understand the land capability classification**	1. To determine the computation of rainfall erosivity index (EI30) using rain gauge data	**Unit-5: Soil conservation measures** 1.1. To learn the concept of soil conservation planning in arid and semiarid regions 1.2. To learn the concept of soil conservation planning in hilly regions 1.3. To learn the concept of soil conservation planning in waterlogged condition **5.1** To learn the concept of soil conservation planning in wetland 5.5. To understand the concept land capability classification	1. To know the region of waterlogged soil

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Classify the various techniques used for soil conservation planning
- Classify the land capability classification of soil

Soil 505.6: To measure the watershed management techniques

Approximate Hours

Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1. To monitor the watershed management techniques **SO6.2 To understand and evaluate the water harvesting and recycling strategies**	1. To determine the land capability classification of a watershed 2. To visit the watershed area	**Unit-6: Watershed management strategies** 6.1. To learn the concept, objectives and approach of water harvesting 6.2 To learn the concept, objectives and approach of water recycling 6.3 To understand the concept, objectives and approach to control the flood though watershed management 6.4To use the GIS and remote sensing techniques in assessment and planning of water shed, sediment management	1. To know the handling of computer

SW-6 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the watershed management techniques
- Enlist the water harvesting and recycling strategies to be used under recent cenario

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India	5	6	2	1	14
Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	7	8	2	1	18
Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved	5	4	2	2	13

and Factors affecting wind erosion					
Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques	4	6	2	1	13
Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions	5	2	2	1	10
Soil 505.6: To measure the watershed management techniques	4	4	2	1	11
Total Hours	30	30	12	7	79

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Distribution of eroded soil in India**	03	01	01	5
CO-2	**To understand source and factors responsible for soil and water erosion**	05	06	04	10
CO-3	**Wind erosion**	04	03	02	9
CO-4	**Erosion controlling measures**	2	4	2	8
CO-5	**Soil conservation measures**	3	3	3	9
CO-6	**Watershed management strategies**	3	3	3	9
Total		**20**	**20**	**15**	**50**

L: Legend R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Erosion and Conservation** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Soil Management in Relation to Land Degradation and Environment	Biswas TD and Narayanasamy G.	Bull. Indian Society of Soil Science No. 17.	1996
2	Methods of Assessing Soil Quality	Doran JW and Jones AJ.	Society of America, Spl Publ. No. 49, Madison, USA.	1996
3	Manual of Soil and Water Conservation Practices.	Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP.	Oxford & IBH	1990
4	Soil Conservation.	Hudson N. 1995.	University Press	1995
5	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002
6	Soil Physics	Oswal MC.	Oxford & IBH.	1994

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos ,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 505

Course Title: Soil Erosion and Conservation

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India	2	3	1	3	1	2	1	3	1	2	2	2	1	2	2	2
Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	2	3	2	3	2	1	2	3	1	2	3	2	1	2	1	2
Soil 505.3: To understand the cause of wind erosion, its types,	2	3	1	3	2	1	2	3	1	2	2	2	1	2	1	2

mechanisms involved and Factors affecting wind erosion																
Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques	**2**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**3**	**3**	**1**	**2**	**1**	**2**
Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions	**2**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**3**	**3**	**1**	**2**	**1**	**2**
Soil 505.6: To measure the watershed management techniques	**2**	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**3**	**3**	**1**	**2**	**1**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil Erosion and Conservation

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India**	**SOs: 1.1, SOs:1.2**	**LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4**	**Unit-1.0 Distribution of eroded soil in India** **1.1,1.2,1.3,1.4,1.5,1.6**	As mentionedin page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	**SOs: 2.1, SOs:2.2, SOs:2.3 SOs:2.4**	**LI: 2.1, LI: 2.2, LI: 2.3, LI:2.4**	**Unit.2: To understand source and factors responsible for soil and water erosion** 2.1, 2.2, 2.3, 2.4, 2.5,2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and Factors affecting wind erosion**	**SOs: 3.1, SOs:3.2, SOs:3.3**	**LI: 3.1, LI:3.2**	**Unit-3 : Wind erosion** 3.1, 3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques**	**SOs: 4.1, SOs:4.2,**	**LI: 4.1, LI:4.2, LI:4.3**	**Unit-4: Erosion controlling measures** 4.1,4.2,4.3,4.4,4.5,4.6,4.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions**	**SOs: 5.1, SOs:5.2**	**LI: 5.1, LI: 5.2, LI: 5.3, LI:5.4**	**Unit-5: Soil conservation measures** **5.1,5.2,5.3,5.4,5.5**	

PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 505.6: To measure the watershed management techniques**	**SOs: 6.1, SOs:6.2**	**LI:6.1 LI:6.2**	**Unit-6: Watershed management strategies**	

Semester I

Course Code: STAT-502

Course Title: Statistical Methods for Applied Science

Pre-requisite: Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

Rationale: Statistical methods involved in carrying out a study include planning, designing, collecting data, analysing, drawing meaningful interpretation and reporting of the research findings. The statistical analysis gives meaning to the meaningless numbers, thereby breathing life into a lifeless data.

Course Outcomes:

CO1 This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study

CO2 It can be used to find the best solution to any problem be it simple or complex

CO3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient

CO4 To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data

CO5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL	
Supporting Course	STAT-502	Statistical Methods for Applied Science	2	01	02	01	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Home Class/ Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Total Marks (CA+CT+SA+CAT +AT)		
Supporting Course	STAT-502	Statistical Methods for Applied Science	5	30	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field

Approximate Hours

Item	Appx. Hrs.
CI	**6**
LI	**2**
SW	**1**
SL	**2**
Total	**11**

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Apply laws of probability to concrete problems. **SO1.2** Perform statistical inference in several circumstances and interpret the results in an applied context. **SO1.3** Communicate concepts in probability and statistics using both technical and non-technical language**.** **SO1.4** Use a statistical software package for computations with data,	1) To impart knowledge on Statistical concepts like Exploratory data analysis.	**Unit-1.** Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation. **1.1.** Box-plot **1.2** Descriptive statistics **1.3** Exploratory data analysis 1.2 Theory of probability. **1.5** Random variable **1.6** Mathematical expectation	1. Prepare the assignment on Random variable and mathematical expectation.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Random variable and mathematical expectation.
b. Mini Project: - NA
c. Other Activities (Specify):- NA

STAT-502.2 Find the best solution to any problem be it simple or complex

Approximate Hours

Item	Appx. Hrs.
CI	**6**
LI	**8**
SW	**1**
SL	**2**
Total	**17**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Recognize the binomial probability distribution and apply it appropriately.	1- Fitting of Binomial distributions. 2- Fitting of Poisson	**Unit-2 Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions**	Prepare the assignment on Binomial, Poisson, Negative

SO2.2 Recognize the Poisson probability distribution and apply it appropriately. **SO2.3** Recognize and understand discrete probability distribution functions, in general. **SO2.4** Recognize the standard normal probability distribution and apply it appropriately. **SO2.5** Compare normal probabilities by converting to the standard normal distribution.	distributions. 3- Fitting of Negative Binomial distributions. 4- Fitting of Normal distributions.	**and their applications. Concept of sampling distribution: chi-square, *t* and *F* distributions. Tests of significance based on Normal, chi-square, *t* and *F* distributions** **1.1** Discrete and continuous probability distributions **1.2** Binomial, Poisson, Negative Binomial **1.3**. Normal distribution, Beta and Gamma distributions and their applications **1.4** Concept of sampling distribution: chi-square, *t* and *F* distributions. **1.5** Tests of significance based on Normal, chi-square. **1.6** Tests of significance based on *t* and *F* distributions.	Binomial, Normal distribution, Beta and Gamma distributions and their applications.

SW-2 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Probability. Binomial & Poisson Distributions.

a. Other Activities (Specify): NA

STAT-502.3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	6
SW	2
SL	1
Total	15

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Create and analyze scatter plots. **SO3.2** Discuss basic ideas of linear regression and correlation. **SO3.3** Create and interpret a line of best fit. **SO3.4** Calculate and interpret the correlation coefficient.	1- Large sample tests, testing of hypothesis based on eXact sampling distributions ~ chi square, t and F. 2- Large sample tests, testing of hypothesis based on eXact sampling distributions ~t-test. 3- Large sample tests, testing of hypothesis based on eXact sampling distributions ~F- test.	**Unit-3** Definition of Correlation, Scatter Diagram. Karl Pearson's Coefficient of Correlation. Linear Regression Equations. **1.1**. Definition of Correlation **1.2** Types of Correlation **1.3**. Scatter Diagram **1.4**. Karl Pearson's Coefficient of Correlation **1.5** Definition of Regression. **1.6**. Linear Regression Equations	1. Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.

SW-3 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.

b. Other Activities (Specify): NA

STAT-502.4 To understand the process of hypothesis testing and its significance Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use the judiciously for the testing of given data.

Approximate Hours

Item	Appx Hrs.
CI	**6**
LI	**8**
SW	**2**
SL	**1**
Total	**17**

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Conduct and interpret hypothesis tests for a single population mean, population standard deviation known. **SO4.2** Conduct and interpret hypothesis tests for a single	1- Confidence interval estimation and 2- Correlation analysis 3- Regression analysis 4- Fitting of Linear and Quadratic Model.	**Unit-4** Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. **1.1** Introduction to Test of Significance **1.2** One sample **1.3** Two sample test t for	1. Prepare the assignment on Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table.

population mean, population standard deviation unknown. **SO4.3** Describe hypothesis testing in general and in practice **SO4.4** Interpret the chi-square probability distribution as the sample size changes. **SO4.5** Conduct and interpret chi-square goodness-of-fit hypothesis tests.		Means **1.4** Definition of Chi-Square **1.5** Application of Chi-square test **1.6** Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table	

SW-4 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table

b. Other Activities (Specify): NA

STAT-502.5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Approximate Hours

Item	Appx Hrs.
CI	6
LI	6
SW	2
SL	1
Total	15

Session Out Comes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Recognize and differentiate between key terms. **SO5.2** Apply various types of sampling methods to data collection. **SO5.3** Create and interpret frequency	1- Non-parametric tests. 2- ANOVA: One way 3- ANOVA: Two Way	**Unit-5** Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.	Prepare the assignment on Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods,

tables.		**1.1** Introduction to Analysis of Variance **1.2**. Analysis of One Way Classification **1.3**. Introduction to Sampling Methods **1.4** Sampling versus Complete Enumeration **1.5** Simple Random Sampling with and without replacement **1.6** Use of Random Number Tables for selection of Simple Random Sample.	Sampling versus Complete Enumeration.

SW-5 Suggested Sessional Work (SW):

a. Assignments: NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture (C l)**	**Laboratory Lecture (L I)**	**Sessional Work (SW)**	**Self Learning (S l)**	**Total hour (C l + LI+ SW +S l)**
01: This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	06	02	01	02	15
02: It can be used to find the best solution to any problem be it simple or complex.	06	08	01	02	15
03: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	06	06	01	02	15
04: To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	06	08	01	02	15
05: Apply the different sampling methods for designing and	06	06	01	02	15

selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.					
Total Hours	**30**	**30**	**05**	**10**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	02	02	02	06
CO-2	It can be used to find the best solution to any problem be it simple or complex.	02	03	03	08
CO-3	Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	02	04	04	10
CO-4	To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	03	04	05	12
CO-5	Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	04	05	05	14
	Total	13	18	19	50

L: Legend R: Remember, U: Understand, A: Apply

The end of semester assessment for **Statistical Methods for Applied Science** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method

4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
01	An Outline of Statistical Theory	Goon AM, Gupta MK &Dasgupta B.	The World Press	1977 1st adition
02	Fundamentals of Statistics	Goon AM, Gupta MK &Dasgupta B	The World Press	1983. First edition
03	Introduction to Mathematical Statistics	Hoel PG	John Wiley	05th Edition 1971
04	An Introduction to Multivariate Statistical Analysis	T.W. Anderson	John Wiley.	3rd Edition 2009
05	Introduction to Mathematical Statistics	Robert V. Hogg, Joseph W. McKean, Allen T. Craig	Hogg	7th Edition 2012

Curriculum Development Team:

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Professor B.B. Beohar, Director Planning, & Director Extension, A.K.S. University
4. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
5. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
6. Dr. V.K. Vishwakarma , Head Department of Agricultural Economics, FAST
7. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
8. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
9. Mr. Navneet Raj Rathore, Teaching Associate, Department of Agricultural Economics,
10. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : STAT -502

Course Title: Statistical Method For Applied Science

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field	1	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3
STAT-502 CO-2 Find the best solution to any problem be it simple or complex.	1	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3
STAT-502.3: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation	1	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3

coefficient, partial correlation coefficient and Multiple correlation coefficient.																
STAT-502.4: To understand the process of hypothesis testing and its significance. Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**3**
STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**1**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: STAT 502: Statistical Method For Applied Science

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field**	**SO1.1** **SO1.2** **SO1.3** **SO1.4**	**LI. 1.1,**	**Unit-1** This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study. **1.1,1.2,1.3,1.4,1.5,1.6**	**As mentioned in page numbe r _ to _**
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**STAT-502 CO-2 Find the best solution to any problem be it simple or complex.**	**SO2.1** **SO2.2** **SO2.3** **SO2.4**	**LI. 2.1,** **LI. 2.2,** **LI. 2.3,** **LI. 2.4**	**Unit-2** It can be used to find the best solution to any problem be it simple or complex. **2.1,2.2,2.3,2.4,2.5,2.6**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**STAT-502.3: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.**	**SO3.1** **SO3.2** **SO3.3** **SO3.4**	**LI. 3.1** **LI. 3.2** **LI. 3.3** **LI. 3.4**	**Unit-3** Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient. **3.1,3.2,3.3,3.4,3.5,3.6**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**STAT-502.4: To understand the process of hypothesis testing and its significance. Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.**	**SO4.1** **SO4.2** **SO4.3** **SO4.4** **SO4.5**	**LI. 4.1** **LI. 4.2** **LI. 4.3** **LI. 4.4**	**Unit-4** To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data. **4.1,4.2,4.3,4.4,4.5,4.6**	

PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.**	**SO5.1** **SO5.2** **SO5.3**	**LI. 5.1,** **LI. 5.2,** **LI. 5.3**	**Unit-5** Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA. **5.1, 5.2, 5.3, 5.4,5.5,5.6**	

Semester-I

Course Code: PGS 501

Course Title : Library and Information Services

Pre-requisite: Student should have basic knowledge of library because course aims to familiarize the learners with the basic concept of use of library services.

Rationale: To impart to the students an understanding of knowledge classification and the theories of library classification, to develop skills in document classification and content analysis. The course provides the opportunity, ensuring freedom and equal access to information for all members of the community, to educate and enlighten them. To maintain and preserve books, materials and resources with historical, cultural, social, economic and archival value, and other related materials in an organized collection to provide members of the community these materials and enriched their personal and professional lives.

Course Outcomes:

PGS 501.1. Able to understand about various concepts of Library, its functions, objective and connect Foundational concepts, theories, and principles of information organization and access to professional contexts.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total StudyHours (CI+LI+SW+SL)	
Non Credit Course	PGS 501	Library and Information Services	0	1	1	1	3	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies.Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performance sin laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT + SA+CAT +AT)		
Non Credit Course	PGS 501	Library and Information Services	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion

PGS 501.1: Able to understand about various concepts of Library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.

Approximate Hours

Item	Appx Hrs.
Cl	0
LI	30
SW	6
SL	3
Total	39

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	(SL)
SO1.1 Understand the Concept, Definition & Characteristics of Library **SO1.2**Understand the Importance &Functions of Library **SO1.3** Understand the Role of Library and Information Service	1.1 Introduction to library, 1.2 Types of library, 1.3 Role of library in society 1.4 Role of Education sector, 1.5 Classification scheme, 1.6 Types of Information sources 1.7 Abstracting and indexing services, 1.8 Use of Databases, OPAC 1.9 Computerized library services 1.10 Library Services 1.11 Online Public Access Catalogue 1.12 Types of Information Centers 1.13 Library Automation 1.14 Create a Digital Library 1.15 Use of e resources		1. How to Accessioning of Books on software 2 How to Books search in Library through the OPAC 3. Difference Between Library and Information Services

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Introduction to library and its services;
2. Role of libraries in education, research and technology transfer,
3. Classification systems and organization of library;
4. Sources of information-, Primary Sources, Secondary Sources and Tertiary Sources;
5. Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
6. Tracing information from reference sources;

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CL+SW+ SL)
Able to understand about various concepts of Library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	0	30	6	3	39

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO1	Library and Information Services	0	30	70	100

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Library and Information Services** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

Sl. No.	Title	Author	Publisher	Edition and Year
01				
02				

Curriculum Development Team:

1. Dr. S.S. Tomar, DEAN, Faculty of Agriculture Science and Technology, AKS University.
2. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
3. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
4. Mr. Dashrath Patidar, Library incharge , AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS Universit

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : PGS 501

Course Title: Library and Information Services

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 501. Able to understand about various concepts of library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	1	1	1	1	2	2	3	2	3	3	3	2	1	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: PGS 501: Library and Information Services

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	PGS 501. Able to understand about various concepts of library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	**SO1.1** **SO1.2** **SO1.3**	**LI. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12,1.13,1.14,1.15**		**As mentioned in page number _ to _**

Semester- I

Course Code: **PGS 502**

Course Title: **Technical writing and communication**

Pre- requisite: Understanding the principles of various technical writing including thesis, reviews, abstracts and developing communication skills through the proper use of language.

Rationale: The basic purpose of technical writing is to convey complex information in a simple manner. It explains a topic in detail using proper abstract and citations having communication skills being accessible to a general audience.

Course Outcomes:

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing)

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
Non Credit Course	PGS 502	Technical writing and communication.	0	2	0	0	2	0+1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Progressive Assessment (PRA)							
			Class/Home Assignment number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT	Total Marks (CA+CT+SA+CAT+AT)		
Non Credit	PGS 502	Technical writing and communication	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 502.1: **Learning the various form of scientific writing and implementing skills for Formulation of research based documents.**

Approximate Hours

Item	Approximate Hours
CI	**00**
LI	**08**
SW	**01**
SL	**02**
Total	**11**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1. To understand about various form writing research documents. SO1.2. To understand about various technical writing approaches for scientific strengting of research documents. SO1.3. To understand about editing and press reading method to avoid plagiarism.	**Technical writing** 1. Various form of scientific writing – thesis, technical papers, reviews, manuals etc. 2.Various part of thesis and research communication Title page, Authorship content page, Preface, Introduction, Review of literature Material and methods, Experimental result, Discussion citations etc. 3. Commonly used abbreviations in the thesis and research communication, Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. 4. Writing of numbers and dates in scientific write ups, Editing and press reading and Writing of review articles.		Enlisting and write description of research communication contents.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Various part of thesis and research communications.
ii. Writing of abstract, summaries, précis, citations.
iii. Commonly used abbreviations in the thesis and research communication.
iv. Write down the principal of editing and press reading.

b. Mini Project: NA

c. Other Activities (Specify): NA

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing).

Approximate Hours

Item	Approximate Hours
CI	**0**
LI	**08**
SW	**01**
SL	**01**
Total	**10**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1. To understand the types, forms, tenses clauses and their uses. **SO2.2.** To understand common errors, punctuation in the sentences. **SO2.3.** To understand part of speech or word class and their uses. **SO2.4.** To understand discussion in groups and interviews.	**Communication skill-** 1 Grammar (Tenses, part of speed, clauses, punctuation marks) 2 Error analysis (common error), concord, collocation, phonetic, symbols and transcription. 3 Accentual pattern: weak forms in connected speech. 4 Participation in group discussion, Facing of interview and Presentation of scientific paper		1.Enlisting and write the description of communication using proper language skills.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1 Writing types of clauses.

1 Writing the sentences using correct punctuation.

2 Writing the types and forms of tenses.

b. Mini Project:

c. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.	0	8	2	1	11
PGS 502.2: Acquisition of technical communication skill and	0	8	1	1	10

articulate in English (verbal as writing)					
Total	**0**	**16**	**3**	**2**	**21**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	**Technical writing**	00	05	05	10
	1.1 Various form of scientific writing – thesis, technical papers, reviews, manuals etc.				
	1.2 Various part of thesis and research communication	03	03	04	10
	- **Title page**				
	- **Authorship content page**				
	- **Preface**				
	- **Introduction**				
	- **Review of literature**	00	05	05	10
	- **Material and methods**	03	02	05	10
	- **Experimental result**	00	00	10	10
	- **Discussion**				
	1.3 citations etc.	00	05	05	10
		04	02	04	10
		03	02	05	10
	1.4 Commonly used abbreviations in the thesis and research communication .				
	1.5 Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations.				
	1.6 Writing of numbers and dates in scientific write ups.				
	1.7 Editing and press reading				
	1.8 Writing of review articles.				
CO 2	**Communication skill-**				
	1.1 Grammar (Tenses, part of speed, clauses, punctuation marks)	03	02	05	10
		02	03	05	10
	Error analysis (common error), concord, collocation, phonetic, symbols and transcription.	04	04	00	08
		05	02	00	07
	Accentual pattern: weak forms in connected speech.	00	05	05	10
	Participation in group discussion	00	05	05	10
	Facing of interview.				
	Presentation of scientific paper.				

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Technical writing and communication Skill** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Spoken English	Barnes and Noble. Robert C. (Ed.).	Flourish Your Language	2005
2	Technical communication	Mike markel Stular A. Selber	Bedford/St. Martins, 12th edition	2017
3	The Essentials of Technical communication	Elizabeth tebeaux sam dragga.	Oxford university press,4th edition	2017
4	Technical writing prosess	Kieran morgan and sanja spajic	Better on paper publications, 1th edition	2015
5	Developing quality technical information	Moira Mcfadden lanyi, Deirdrelongo	IBM press 3th edition	2014

Curriculum Development Team:

1. Dr. S.S. Tomar, DEAN, Faculty of Agriculture Science and Technology, AKS University.
2. Dr. Neeraj Verma, PG Coordinator, Faculty of Agriculture Science and Technology, AKS University.
3. Dr. Abhishek Singh, HOD, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
4. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
5. Mr. Ayodhya Prasad Pandey, Assistant Professor, Dept. of G&PB, Faculty of Agriculture Science and Technology AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : PGS 502

Course Title: Technical writing and communication Skills

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 501. **Learning the various form of scientific writing and implementing skills for Formulation of research based documents.**	2	1	1	1	1	1	2	1	2	3	3	1	1	1	1	2
PGS 502. **Acquisition of technical communication skill and articulate in English (verbal as writing).**	1	1	1	1	1	1	1	1	2	3	3	1	1	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: PGS 502: Technical writing and communication

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**PGS 502.1.** Learning the various form of scientific writing and implementing skills for Formulation of research based documents.	**SO1.1** **SO1.2** **SO1.3**	**Technical writing** **LI. 1.1,** **LI. 1.2,** **LI. 1.3,** **LI. 1.4**	**-**	**As mentioned in page number _ to _**
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	PGS 502. 2.**Acquisition of technical communication skill and articulate in English (verbal as writing).**	**SO2.1** **SO2.2** **SO2.3** **SO2.4**	**Communication skill** **LI.2.1** **LI.2.2** **LI.2.3** **LI.2.4**	**-**	

Semester-II

Course Code: SOIL 501

Course Title : **Soil Physics**

Pre- requisite: Student should have basic knowledge of various laws of physics (law of gravity etc.,) and basic mathematical calculation.

Rationale: The Student learn about the measurement the physical parameters come under analysis of soil fertility. To impart basic knowledge about soil physical properties and processes in relation to plant growth.

Course Outcomes:

Soil 501.1: To understand the various physical properties of soil responsible in growth and development of crop in field

Soil 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it

Soil 501.3: To understand the consistency and plasticity of soil

Soil 501.4: To understand the classification soil structure and factors responsible in affecting it

Soil 501.5: To learn the classification of soil water and its measuring techniques

Soil 501.6: To understand the application of the various laws applied during measurement of moving water in soil

Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum

Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants

Soil 501.9: To understand the concept , role and measurement of soil temperature

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 501	Soil physics	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Classroom Assignment 5 number 3 marks each	Class Test 2 (2 best out of 3) 10 marks	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)	(ESA)	(PRA+ ESA)
Major Course	Soil 501	Soil Physics	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 501.1: To understand the various physical properties of soil responsible in growth and development of crop in field

Approximate Hours

Item	AppX Hrs
Cl	3
LI	4
SW	2
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: Relate the various branches of soil physics and classify the various physical properties of soil **SO1.2:** To discriminate the various soil physical properties(Air, color, structure..etc) in growth and development of crop **SO1.3** To understand the soil water relationship	1. To determine the bulk density, particle density and porosity of a soil 2. To calculate the mass volume relationship	**Unit-1** General introduction about **physical properties of soil** 1.1 To understand the basic knowledge of physical properties of soil 1.2 Learning the parameter involved under soil physics 1.3 Estimation and calculation of soil bulk density ,particle density and porosity of soil	1. To know about basic calculation of force, density 2. To learn the formulas for calculating volume of different shapes

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Classification of soil and formation of soil
- Enlist the various physical properties come under estimation of soil physical properties

Soil 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it

Approximate Hours

Item	AppX Hrs
Cl	3
LI	2
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To recollect the knowledge on soil texture and its various classes **SO2.2** To learn the various mechanical techniques used to analyses the soil texture	1.To measure the soil texture through international pipette method and hydrometer method	**Unit-2.0 Soil texture** 1.1 To learn about the textural classes of soil 1.2 Estimation and calculation of soil bulk density , particle	1.To know about the calculation of density

		density and porosity of soil of soil 1.3 To learn the color variation of coil and factors affecting it	

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- Enlist the various textural classes and percentage of sand silt and clay in it
- Classification of soil of India on basis of soil texture in map

b. Other Activities(Specify): NA

Soil 501 .3: To understand the consistency and plasticity of soil

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Evaluate the consistency and plasticity of soil on growth of crop **SO3.2 To know** the factors responsible in soil erosion	1. To measure the Atterbergs limit of a soil	**Unit-3 : To understand the soil consistence erosion and edibility** 3.1To learn about the soil consistence dispersion and workability of soils. 3.2 Study the soil compaction, Consolidation and soil strength; swelling and shrinkage 3.3 Learn the basic concepts of Alleviation and soil physical constraints for crop production. 3.4 Knowledge the Soil erosion and edibility.	1. To know about the basic factors responsible in soil erosion

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Write the concept, principle of soil consistency and plastic limits

b. Other Activities (Specify): NA

Soil 501:4: To understand the classification soil structure and factors responsible in affecting it

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Recognize the Indian soil on basis of its structure **SO4.2** Classification soil structure and factors responsible in affecting it **SO4.3** Relate the soil tilth, crusting and aggregation on nutrients availability in different crops	1. To estimate the soil, aggregates in both dry and wet condition	**Unit-4: To Understand the Soil structure of physical properties in soils** **4.1** Understand the soil structure and Learning the genesis, types, characterization and management of Soil Structure **4.2** Study the aggregation, aggregate stability, soil tilth, and characteristics of good soil tilth 4.3 Study the soil crusting mechanism, factors affecting and evaluation. 4.4 Understand the soil conditioners; puddling, its effect on soil physical properties and formation of clods in soil	1. To learn the various types of structure

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Role and classification of soil structure in increasing productivity

b. Other Activities (Specify): NA

Soil 501.5: To learn the classification of soil water and its measuring techniques

Approximate Hours

Item	AppX Hrs
Cl	3
LI	6
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 To classify the soil water and plant available water **SO5.2** To evaluate the soil moisture content and use of soil water characteristics curve SO5:3. To analyze the soil moisture potential and retentions SO5.4 To understand the hysteresis curve of soil	1. To Measure the soil-water content by different methods 2. To Measure the soil-water potential by using tensiometer 3. To Measure the soil-water potential by using gypsum blocks	**Unit-5: Behaviors of Soil water in soil and their characters** **5.2** To learn about content and potential and retention of soil water. **5.3** Study the water constants, measurement of water content, energy state of water in soil. **5.4** Understand the soil water potential, soil moisture there character and Learn the curve hysteresis and measurement of soil moisture potential	1. To learn about nature , source and properties of water used during irrigation

SW-5 Suggested Sessional Work (SW):

a. Assignments:
   - Classification of soil water
   - Soil water retention

b. Other Activities (Specify): NA

Soil 501.6: To understand the application of the various laws applied during measurement of moving water in soil

Approximate Hours

Item	AppX Hrs
Cl	**3**
LI	**4**
SW	**2**
SL	**1**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To identification and classification of saturated and unsaturated soil water **SO6.2** To understand the different law come under soil water measurement and their application and function **SO6:3.** To measure the hydraulic conductivity of saturated and unsaturated water	1. Determination of hydraulic conductivity under saturated and unsaturated conditions 2. Determination of soil-moisture characteristics curve and computation of pore-size distribution	**Unit .6: Study the law applied in analyzing the running soil water** **6.1** Understand the water flow in saturated and unsaturated soils **6.2** Understand the Poiseuille's law and Darcy's law **6.3** To learning the hydraulic conductivity, permeability, fluidity and hydraulic diffusivity and their measurement	1. Making flow chart of soil water flow and there laws.

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the saturated and unsaturated flow of water in soil
- Measurement of hydraulic conductivity in saturated and unsaturated soil

b. Other Activities (Specify): NA

Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum

Approximate Hours

Item	AppX Hrs
Cl	3
LI	4
SW	2
SL	1
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO7.1 To assess the role and process involved in internal drainage and redistribution of soil water **SO7.2** To understand the hydrologic cycle in soil for establish the balance of water in field SO7:3. To understand and learn about the soil plant atmosphere condition	1. Determination of infiltration rate of soil 2. Estimation of water balance components in bare and cropped fields	**Unit-7: Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere.** 7.1 Study the infiltration, internal drainage and redistribution in soil. 7.2 To know about evaporation, hydrologic cycle and field water balance in soil. 7.3 Study the soil-plant-atmosphere continuum in soil water	1. To know the basic difference between infiltration and percolation of water

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the role and process involved in internal drainage and redistribution of soil water

b. Other Activities (Specify): NA

Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants

Approximate Hours

Item	AppX Hrs
Cl	3
LI	4
SW	2
SL	1
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO8.1 To understand the components, principle and importance of air in soil **SO8.2** To understand the its role in growth and development of crop SO8:3. To assess the management and measurement of soil air	1. To determine the aeration porosity in soil 2. To estimate the oxygen diffusion rate in soil	**Unit8: Soil air, composition and there management** 8.1 Understand the importance and components and composition and renewal of soil air 8.2 Learning the convective flow and diffusion of soil air 8.3 Study the measurement of soil aeration and Understand the requirements of aeration for plant growth	1. To know the contribution of various gasses in atmosphere and in soil

SW-8 Suggested Sessional Work (SW):

a. Assignments:
   - Enlist the components, role and importance of soil air
   - Measuring techniques used to measure the content of air in soil

b. Other Activities (Specify): NA

Soil 501.9: To understand the concept , role and measurement of soil temperature

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	2
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO9.1 To assess the role and process involved in transfer of energy in soil with its properties **SO9.2** To measure the soil temperature **SO9:3**. To learn about the basic concept, importance of thermodynamics law in soil **SO9.4**. To assess the effect of soil temperature on growth of plants	1. To measure the Soil temperature measurements by different methods	**Unit-9: Soil temperature** 9.1 Understanding the infiltration in soil. 9.2 Study the infiltration internal drainage and redistribution in soil. 9.3 To know about evaporation, hydrologic cycle and field water balance in soil. 9.4 Study the soil-plant-atmosphere continuum in soil water.	1. To know about the mode of transfer of heat in solid , liquid and gas 2. To learn about the law of thermodynamics

SW-9 Suggested Sessional Work (SW):

a. Assignments:
- Enlist the law of thermodynamics and its role in maintaining soil temperature
- Strategies involved in maintaining soil temperature in soil
- Enlist the factors affecting soil temperature

b. Other Activities (Specify): NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 501.1: To understand the various physical properties of soil responsible in growth and development of crop in field	3	4	2	2	11
Soil 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it	3	2	2	1	8
Soil 501.3: To understand the consistency and plasticity of soil	4	2	2	1	9
Soil 501.4: Classification soil structure and factors responsible in affecting it	4	2	2	1	9
Soil 501.5: To learn the classification of soil water and its measuring techniques	3	6	2	1	12
Soil 501.6: To understand the application of the various laws applied during measurement of moving water in soil	3	4	2	1	10
Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere relationship	3	4	2	1	10
Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants	3	4	2	1	10
Soil 501.9: To understand the concept , role and measurement of soil temperature	4	2	2	2	10
Total Hours	30	30	18	11	89

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO -1	General introduction about physical properties of soil	02	01	01	04
CO -2	Soil texture	02	02	02	06
CO -3	To understand the consistency and plasticity of soil	02	02	01	05
CO -4	To Understand the Soil structure of physical properties in soils	03	02	02	07
CO -5	Behaviors of Soil water in soil and their characters	03	02	02	07
CO-6	Study the law applied in analyzing the running soil water	02	02	02	06
CO-7	Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere	03	01	01	05
CO-8	Soil air, composition and there management	02	02	01	05
CO-9	Soil temperature	02	02	01	05
Total		21	16		50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil physics** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Soil Physics	Baver LD, Gardner WH and Gardner WR.	John Wiley & Sons.	1972.
2	Soil Physics	Ghildyal BP and Tripathi RP.	New Age International	2001
3	Applied Soil Physics.	Hanks JR and Ashcroft GL.	Springer Verlag	1980.
4	Optimizing the Soil Physical Environment toward Greater Crop Yields	Hillel D.	Academic Press	1972
5	Principles of Soil Physics	Lal R and Shukla MK.	Marcel Dekker	2004
6	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002
7	Environmental Soil Physics	Hillel D.	Academic Press	1998

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: : M.Sc. (Ag.) Course

Code : Soil 501

Course Title: Soil Physics

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
SOIL 501.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	2	2	2	1	1	2	2	3	1	2	3	2	2	1	2	2
SOIL 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it	2	2	1	1	2	2	2	2	1	2	2	2	1	2	2	3

SOIL 501.3: To understand the consistency and plasticity of soil	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**
SOIL 504.4: To understand the classification soil structure and factors responsible in affecting it	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**
SOIL 501.5: **To learn the classification of soil water and its measuring techniques**	**1**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**3**
SOIL 501.6: To understand the application of the various laws applied during measurement of moving water in soil	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**3**
SOIL 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**3**
SOIL 501.8: To understand the components, importance and measurement of air **In soil for growth and development of plants**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**3**

SOIL 501.9: To understand the concept , role and measurement of soil temperature	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil 501; Soil Physics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**CO.1; To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level**	**SO1.1, SO1.2, SO1.3**	**LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4**	**Unit-1** General introduction about **physical properties of soil** **1.1,1.2,1.3**	**As mentioned in page numbe r _ to _**
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**CO.2; To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it**	**SO2.1, SO2.2**	**LI. 2.1, LI. 2.2**	**Unit-2.0 Soil texture** **2.1,2.2**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**CO.3; To understand the consistency and plasticity of soil**	**SO3.1, SO3.2**	**LI. 3.1, LI. 3.2**	**Unit-3 : To understand the soil consistence erosion and edibility** **3.1,3.2,3.3,3.4**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**CO.4; To understand the classification soil structure and factors responsible in affecting it**	**SO4.1, SO4.2, SO4.3**	**LI. 4.1 LI. 4.2**	**Unit-4: To Understand the Soil structure of physical properties in soils**	

				4.1,4.2,4.3,4.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.5; To learn the classification of soil water and its measuring techniques	SO5.1 SO5.2 SO5.3 SO5.4	LI. 5.1, LI. 5.2, LI. 5.3, LI. 5.4, LI. 5.5, LI. 5.6	Unit-5: Behaviors of Soil water in soil and their characters 5.1, 5.2, 5.3	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.6; To understand the application of the various laws applied during measurement of moving water in soil	SO6.1, SO6.2, SO6.3	LI. 6.1, LI. 6.2, LI. 6.3, LI. 6.4	Unit .6: Study the law applied in analyzing the running soil water 6.1,6.2,6.3	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.7; To understand the different process in managing the field water balance and soil plant atmosphere continuum	SO7.1, SO7.2, SO7.3	LI. 7.1, LI. 7.2, LI. 7.3, LI. 7.4	Unit-7: Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere. 7.1,7.2,7.3	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.8; To understand the components, importance and measurement of air in soil for growth and development of plants	SO8.1, SO8.2, SO8.3	LI. 8.1, LI. 8.2, LI. 8.3	Unit8: Soil air, composition and there management 8.1,8.2,8.3	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.9 ; To understand the concept , role and measurement of soil temperature	SO9.1, SO9.2, SO9.3, SO9.4	LI. 9.1, LI. 9.2	Unit-9: Soil temperature 9.1, 9.2, 9.3, 9.4	

Semester-II

Course Code: SOIL 503

Course Title : **Soil Chemistry**

Pre- requisite: Student should have basic knowledge of chemical formula of different chemicals, balancing the chemical reaction, atomic number, valence of elements. They also know about the various essential plant nutrients present in soil for maintaining soil fertility.

Rationale: To introduce the basic concepts of soil chemistry and chemical reaction occur in soil with essential plant nutrients. The various forms of ions and charges present in soil their adsorption and absorption process occur in soil.

Course Outcomes:

Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals

Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibrium of elements in soil

Soil 503 .3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil

Soil 503 .4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands

Soil 503.5: To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil

Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil

Soil 503.7: To understand the formation, classification, properties and management of salt affected soil

Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 503	Soil Chemistry	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in Laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+ AT)		
Major Course	**Soil 503**	**Soil chemistry**	15	30	0	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals

Approximate Hours

Item	AppX Hrs
Cl	3
LI	2
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To understand the chemical composition of soil, earth crust **SO1.2** To learn the process of formation of soil, rocks and minerals and factors affecting it	1.Determination of pH, EC, Eh of a given soil sample by Eh-pH meter and conductivity meter	**Unit-1** Components **of earth, soil and rocks and minerals** 1.1 Classification of rocks and minerals with nutrient content in it 1.2 Composition of earth crust 1.3 Formation and composition of nutrients in Soil	1. To know about various types of nutrients and minerals present in soil

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Classification of soils of India on basis of nutrient availability

b. Other Activities(Specify): NA

Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibrium of elements in soil

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	1
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 To Assess the Soil chemical equilibrium **SO2.2** To learn the importance and derivation of thermodynamic law **SO2.3** To understand the electrochemistry of soil	1.Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method from a given soil sample	**Unit : 2: To learn the thermodynamics and chemical kinetics of soil** 2.1 To learn the application of 1^{st}, 2^{nd} and 3^{rd} law of thermodynamics in soil 2.2 To learn the derivation of 1^{st}	1.To know the valences and available forms of elements

		,2nd and 3rd law thermodynamics in soil 2.3 To understand the soil electrochemistry 2.4 To know the chemical kinetics of soil	

SW-2 Suggested Sessional Work(SW):

b. Assignments:

- State the application of thermodynamics in soil with its derivation

c. Other Activities(Specify): NA

Soil 503 .3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil

Approximate Hours

Item	AppX Hrs
Cl	4
LI	8
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 To Assess the properties and classification of soil colloids **SO3.2** To Evaluate various charges and potential of colloids with the concept of diffused double layer **SO3.3** To understand components and characterization of organic matter present in soil SO3.4 To evaluate	1. Extraction of humic substances from given organic matter 2. Determination of humic and fulvic acids through Potentiometric titration from a given soil 3. Determination of humic and fulvic acids through conductivity metric titration from a given soil 4.Determination of (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the D (E4/E6) values at two pH values	**Unit : 3: To learn about colloids and organic matter of soil** 3.1: To learn about the Classification of organic and inorganic colloids with its properties, origin of charges and characterization of charges in soil 3.2 To know the components of pH dependent and independent charges and their importance in soil	1.To know the importance of organic matter in increasing the fertility of soil

the interaction of soil organic matter with clay		3.3 To understand the concept of diffused double layer theories 3.4 To know the fractionation, characterization of SOM and its interaction with clay	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the components and characterization of organic matter present in soil
- Classify the interaction of soil organic matter with clay

b. Other Activities (Specify): NA

Soil 503 .4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands

Approximate Hours

Item	AppX Hrs
Cl	**4**
LI	**6**
SW	**2**
SL	**1**
Total	**13**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To understand the ion exchange theories in soil **SO4.2** To assess the donnan membrane equilibrium concept and its limitations **SO4.3** To understand the factors affecting ion exchange	2. Determination of adsorbed and ligand exchanged phosphate from a given soil sample 3. Determination of adsorbed and ligand exchanged fluoride an sulphate from a given soil sample	**Unit : 4: Ion exchange process in soil** 4.1: To learn the theories of cation exchange based on law of mass action 4.2: To understand the concept of donnan membrane equilibrium 4.3 To understand the concept of adsorption isotherm process 4.4: to know the concept	1. To know the role of useful microbes in mineralization of different secondary nutrients in soils

theories SO2.4 To evaluate sorption desorption of anions and ligands in soil and study the ion exchange phenomena		and principles of anion and ligand exchange theory 4.5 Implementation techniques of ion exchange phenomena and practical implications in plant nutrition.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the therioes of cation exchange based on law of mass action (Gapon equation, hysterises , Jennt's and kerr-vanselow concept
- Concept and importance of Donnan-membrane equilibrium
- Explain the concept, procedure and limitations of diffused double layer

Soil 503.5: To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil

Approximate Hour

Item	AppX Hrs
Cl	**4**
LI	**4**
SW	**2**
SL	**1**
Total	**11**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To understand and evaluate the phosphorus and potassium fixation, precipitation-dissolution equlibria in soil **SO5.2** To understand and evaluate the ammonium fixation in soil covering specific and non specific sorption SO5.3 To understand and evaluate the concept and management of Q/I relationship of nutrients	1.Determination of Q/I relationship of potassium and Phosphate in a given soil	**Unit : 5: To understand the N,P and K adsorption desorption and Q/I relationship of each nutrients in soil** 5.1: To learn the available Potassium , phosphorus and nitrogen sorption in soil 5.2: To understand the ammonium fixation in soil covering specific and non specific sorption 5.3: To understand the Q/I relationship , step and constant rate K 5.4: To evaluate the management of Q/I relationship with N,P and K	1.To know the role difference between the process of adsorption, absorption, desorption and sorption of nutrients in soil

SW-5 Suggested Sessional Work (SW):

a. Assignments:
- Adsorption, desorption and Q/I relationship of phosphorus in soil
- Ammonium fixation, precipitation and dissolution in specific and non specific soil

Soil 503**.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil**

Approximate Hour

Item	AppX Hrs
Cl	4
LI	8
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To understand the formation, classification and chemical reaction occurs in acidic soil **SO6.2** To Evaluate liming potential of different liming materials used during amelioration of acidic soil	1.Determination of measurement of pH, EC of a given acidic soil 2.Determination of HCO, Ca, Mg, K and Na from a given soil 3.Determination of titratable acidity of an acid soil by BaCl2-TEA method 4.Determination of lime requirement of an acid soil by buffer method	**Unit : 6: Chemistry of acidity of soil** **6.1** To understand the classification and formation of acidic soil **6.2** To assess and understand the chemistry of acidic soil in surface soil 6.3 To assess and understand the chemistry of acidic soil in subsurface soil 6.4 To learn the reclamation of acidic soil through liming potential	1.List of liming material, their formation and properties 2.Distribution of acidic soil in India

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the liming potential of limning materials produced from your surrounding industries/ industrial waste used as amelioration of acidic soil

b. Other Activities (Specify): NA

Soil 503.7: To understand the formation, classification, properties and management of salt affected soil

Approximate Hour

Item	AppX Hrs
Cl	**3**
LI	**2**
SW	**2**
SL	**1**
Total	**08**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO7.1 To Assess the chemistry of salt affected soil **SO7.2** To Evaluate the management of salt affected soil	1. Determination of gypsum requirement in alkali soil	**Unit : 7: Chemistry and management of salt affected soil** 7.1 To know the formation of salt affected soil 7.2 To understand the chemical properties and nutrient availability in salt affected soil 7.3 To assess the management of salt affected soil	1. Distribution of salt affected soil in India and their source of formation

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- Formation, classification, properties and management of salt affected soil
- Nutrient availability in salt affected soil

b. Other Activities (Specify): NA

Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil

Approximate Hour

Item	AppX Hrs
Cl	3
LI	2
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO8.1 To Assess the chemical reaction and nutrient availability in submerged soil **SO8.2** To understand the geochemistry of micronutrient and environmental soil chemistry of submerged soil	1. Determination of CEC and AEC of submerged soils	**Unit : 8 Chemistry of submerged soil** 8.1 To understand the formation, classification and properties of submerged soil 8.2 To assess the geochemistry of micronutrients in submerged soil	1 To know the factors responsible for formation of submerged soil

		8.3 To learn the factors affecting submergence and chemical reactions occur in submerged soil	

SW-8 Suggested Sessional Work (SW):

a. Assignments:

- Distribution and formation of submerged soils of India

b. Other Activities (Specify): NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals	3	2	2	1	8
Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibria of elements in soil	4	2	2	1	9
Soil 503.3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil	4	8	2	1	15
Soil 503.4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands	5	4	2	1	12
Soil 503.5: To understand the adsorption desorption of N, P and K in soil	4	2	2	1	9

with basic concept of quantity-intensity relationship of each of them in soil					
Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil	4	8	2	2	16
Soil 503.7: To understand the formation, classification, properties and management of salt affected soil	3	2	2	1	8
Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil	3	2	2	1	8
Total Hours	**30**	**30**	**16**	**9**	**85**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	**Components of earth, soil and rocks and minerals**	**1**	**2**	**2**	**5**
CO-2	**To learn the thermodynamics and chemical kinetics of soil**	**2**	**2**	**2**	**6**
CO-3	**To learn about colloids and organic matter of soil**	**1**	**4**	**2**	**7**
CO-4	**Ion exchange process in soil**	**2**	**3**	**2**	**7**
CO-5	**To understand the N,P and K adsorption desorption and Q/I relationship of each nutrients in soil**	**2**	**3**	**2**	**7**
CO-6	**Chemistry of acidity of soil**	**2**	**2**	**2**	**6**

CO-7	**Chemistry and management of salt affected soil**	**2**	**2**	**2**	**6**
CO-8	**Chemistry of submerged soil**	**2**	**2**	**2**	**6**
Total		**14**	**20**	**16**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Chemistry** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks.

Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Fundamental of Soil Science	Indian Society of Soil Science	ISSS, National Societies Block, Pusa, New Delhi	Revised 2012
3	Principles of Soil Chemistry	Kim H Tan	Routledge Bo CRC Press	4th Edition 2024
4	Chemistry of the Soil	Bear RE.	Oxford and IBH	1964
5	Soil Chemistry	Bolt GH and Bruggenwert MGM.	Elsevier	1978
6	Chemistry of Soil Processes	Greenland DJ and Hayes MHB.	John Wiley & Sons	1981
7	Chemistry of Soil Constituents.	Greenland DJ and Hayes MHB.	John Wiley & Sons.	1981
8	Environmental Chemistry of Soils	McBride MB.	Oxford University Press.	1994

9	The Thermodynamics of Soil Solutions	Sposito G.	Oxford University Press	1981
10	The Surface Chemistry of Soils	Sposito G.	Oxford University Press	1984

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: : M.Sc. (Ag.)

Course Code : Soil 503

Course Title : Soil Chemistry

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 503.1: **To know the chemical composition in earth crust, soil and in different rocks and minerals**	2	2	1	1	1	1	1	2	2	2	3	1	1	1	1	2
Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibria of elements in soil	2	2	2	1	1	2	2	2	1	2	2	1	1	1	1	3

Soil 503.3: **To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil**	**2**	**1**	**3**	**1**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**3**	**3**	**3**
Soil 503.4: **To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**2**	**2**	**3**
Soil 503.5: **To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**2**	**2**	**3**
Soil 503.6: **To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**2**	**2**	**3**
Soil 503.7: **To understand the formation, classification, properties and management of salt affected soil**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**2**	**2**

Soil 503.8: **To assess the electrochemistry and chemical reaction occur in submerged soil**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: SOIL 503: Soil Chemistry

POs & PSOs No.	**COs No.& Titles**	**SOs No.**	**Laboratory Instruction (LI)**	**Classroom Instruction(CI)**	**Self Learning(SL)**
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.1: **To know the chemical composition in earth crust, soil and in different rocks and minerals**	**SOs: 1.1, SOs:1.2,**	**LI: 1.1, LI: 1.2,**	**Unit-1** Components **of earth, soil and rocks and minerals** **1.1,1.2,1.3,1.4,1.5,1.6**	As mentioned in page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibria of elements in soil**	**SOs: 2.1, SOs:2.2, SOs:2.3**	**LI: 2.1, LI: 2.2,**	**Unit : 2: To learn the thermodynamics and chemical kinetics of soil** 2.1, 2.2, 2.3, 2.4, 2.5,2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.3: **To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil**	**SOs: 3.1, SOs:3.2, SOs:3.3 SOs:3.4**	**LI: 3.1, LI:3.2, LI:3.3, LI:3.4, LI:3.5, LI:3.6, LI:3.7, LI:3.8,**	**Unit : 3: To learn about colloids and organic matter of soil** 3.1, 3.2,3.3,3.4,3.5,3.6	

PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.4: **To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands**	**SOs:41.1, SOs:4.2, SOs:4.3 SOs:4.4**	**LI: 4.1, LI:4.2, LI:4.3, LI:4.4,**	**Unit : 4: Ion exchange process in soil** 4.1,4.2,4.3,4.4,4.5,4.6,4.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.5: **To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil**	**SOs: 5.1, SOs:5.2 SOs:51.3**	**LI: 5.1, LI: 5.2,**	**Unit : 5: To understand the N,P and K adsorption desorption and Q/I relationship of each nutrients in soil** **5.1,5.2,5.3,5.4,5.5**	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.6: **To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil**	**SOs:61.1, SOs:61.2**	**LI:6.1, LI:6.2, LI:6.3, LI:6.4, LI:6.5, LI:6.6, LI:6.7, LI:6.8**	**Unit : 6: Chemistry of acidity of soil**	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.7: **To understand the formation, classification, properties and management of salt affected soil**	**SOs:71.1, SOs:71.2**	**LI:7.1, LI:7.2**	**Unit : 7: Chemistry and management of salt affected soil**	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	Soil 503.8: **To assess the electrochemistry and chemical reaction occur in submerged soil**	**SOs:81.1, SOs:81.2**	**LI:8.1, LI:8.2**	**Unit : 8 Chemistry of submerged soil**	

Semester-II

Course Code: Soil 504

Course Title : Soil Mineralogy , Genesis and Classification

Pre- requisite: Students should know about the distribution of soils of India and world

Rationale: To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning

Course Outcomes:

Soil 504.1: To understand the fundamental of crystallography , space lattice, coordination theory isomorphism and polymorphisms in soil

Soil 504.2: To understand the classification , structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals

Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile

Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map

Scheme of Studies:

Course category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 504	Soil Mineralogy, Genesis and Classification	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each	Class Test 2 (2 best out of 3)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (CAT)	Total Marks (CA+CT+SA+CAT+AT)		
Major Course	**Soil 504**	Soil Mineralogy, Genesis and classification	**15**	**30**	**0**	**5**	**0**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil

Approximate Hours

Item	AppXHrs
Cl	**4**
LI	**8**
SW	**2**
SL	**1**
Total	**15**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: They discriminate about the Isomorphs substitution, polymorphisms SO1.2 To understand the concept and importance of crystallography and space lattice	1. To separate the sand silt and clay fractions of soil 2. To determine the soil structure of a given area 3. To estimate the pH of a given soil 4. To study the colour variation of a soil profile	**Unit-1.0 Concept of space lattice, crystallography and isomorphism** 1.1To understand concept of crystallography 4.2 To assess the importance and principle of isomorphism's 4.3 To learn the polymorphisms its importance 4.4 To understand these of space lattice and radius ration of nutrients	1. To know about the principles and concept of basic properties of chemistry

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Concept and principle of isomorphs substitution
- Classify the space lattice and radius ratio of various nutrients

b. Other Activities(Specify):

- Prepare a chart of radius ratio and space lattice structure of all the nutrients

Soil 504.2: To understand the classification, structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals

Approximate Hours

Item	AppX Hrs
Cl	9
LI	10
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To recall the soil primary clay structures, its classification and nutrient content **SO2.2: To i**dentify and relate the various Silicate clay structure and its classification **SO2.3:** Evaluate the role and importance of clay mineral in plant nutrition SO2.4: To assess the interaction of different clay with humus, pesticides and heavy metals	2. To determination of specific surface area of clay 3. To estimate the cation exchange capacity of given soil sample 4. Identification and quantification of minerals in soil fractions 5. Classification of soils of India using soil taxonomy 6. Classification of soils of world using soil taxonomy	**Unit-2 Classification of clay minerals and its interaction with humus, pesticides and heavy metals** 2.1 Classification, structure, chemical composition and properties of clay minerals 2.2 Genesis of clay minerals 2.3 Transformation of crystals line and non crystal line of clay minerals 2.4 Identification of different types of silicate clay minerals through amorphous soil constituents 2.5 Identification of different types of silicate clay minerals through non crystalline silicate minerals 2.6 Role and distribution of various clay minerals of India 2.7 Interaction of silicate clay with humus 2.8 Interaction of silicate clay with pesticides 2.9 Interaction of silicate clay with heavy metals	1. To know the different types of soil of India and world

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Classification of silicate clay structure with diagram and example
- Taxonomical classification and distribution of soil of India and world

b. Other Activities(Specify): Preparation of presentation of different silicate clay structure

Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile

Approximate Hours

Item	AppX Hrs
Cl	09
LI	10
SW	2
SL	1
Total	16

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO3.1 To assess the various process involved in soil and soil profile formation and factors affecting them **SO3.2** To understand the weathering of rocks and minerals and factors affecting them **SO.3.3** To evaluate the modern system of soil classification, importance and its representation in map	1. To study the morphological properties of soil profile in upland 2. To study the morphological properties of soil profile in lowland 3. To study the morphological properties of soil profile in coastal area 4. To study the morphological properties of soil profile in Hilly area 5. Calculation and application of weathering indices during soil formation	**Unit-3 : Soil profile its formation through weathering** 3.1 To learn the process involved in soil and soil profile formation with its components 3.2 Identification of different horizons in soil profile with its properties 3.3 To learn the Specific process involved in soil formation 3.4 Factors affection soil and soil profile formation 3.5 Classify the various types of weathering 3.6 importance of weathering in soil formation 3.7 Factors affecting weathering of rocks 3.8 Transformation of minerals in soil 3.9 To learn the weathering sequences of minerals with special reference to Indian soils	1. To know the climatic condition of India and abiotic factors responsible for weathering

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the factors affecting soil formation and weathering of rocks
- Enlist the process of soil formation
- Classification, nutrient content and structure of silicate clay structure

b. Other Activities(Specify): NA

Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map

Approximate Hours

Item	AppX Hrs
Cl	8
LI	2
SW	2
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To recollect the knowledge of historical development with modern development of soil classification **SO4.2** To understand the classification, importance and use of various soil maps	1.To study the grouping of soil survey available data base in terms of soil quality	**Unit-4: Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutrition.** 4.1. To learn the concept and importance of soil classification system 4.2: To study the history of classification soil taxonomy 4.3: Modern concept and classification of soil taxonomy 4.4: To know about the nutrient content and chemical properties of soil of different taxonomy of India 4.5: To know the distribution of soils of India 4.6: To classify the Soil maps and its importance 4.7: To importance of different Soil maps 4.8: To learn the application of different soil maps	1. To study soil map of India 2. 1. To study soil map of world

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Classification and use of soil map
- Enlist the historical classification of soil taxonomy

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil	4	8	2	1	7
Soil 504.2: To understand the classification , structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals	9	10	2	1	12
Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile	9	10	2	1	12
Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map	8	2	2	2	12
Total Hours	**30**	**30**	**8**	**5**	**43**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Concept of space lattice, crystallography and isomorphism**	03	01	01	5
CO-2	**Classification of clay minerals and its interaction with humus, pesticides and heavy metals**	05	06	04	15
CO-3	**Soil profile its formation through weathering**	05	04	06	15
CO-4	**Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutritions**	4	6	05	15
Total		17	17	16	50

L: Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Mineralogy, Genesis and Classification** will be

held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002
3	Soil Genesis and Classification	Buol EW, Hole ED, MacCracken RJ and Southard RJ.	4th Ed. Panima Publication	1997
4	Minerals in Soil Environments.	Dixon JB and Weed SB.	2nd Ed. Soil Science Society of America, Madison	1989
5	Clay Mineralogy.	Grim RE.	McGraw Hill	1968.
6	Elements of Crystallography and Mineralogy	Wade FA and Mattox RB.	Oxford & IBH.	1960
7	Introductory Pedology: Concepts and Applications	Sehgal J.	New Delhi	2002.

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh , Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science, FAST, AKS University

CO, POs and PSOs Mapping

Course Title: M.Sc. Soil Science and Agricultural Chemistry

Course Code : Soil 504

Course Title: Soil Mineralogy, Genesis and Classification

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil.504:1.Concept of space lattice, crystallography and isomorphism	2	2	1	1	1	1	3	2	2	2	3	2	2	2	2	3
Soil.504:2.Classification of clay minerals and its interaction with humus, pesticides and heavy metals	1	2	3	1	1	1	3	2	2	1	2	3	1	1	1	2
Soil.504:3.Soil profile its formation through weathering	3	3	1	2	1	1	2	1	1	2	3	2	1	1	1	2
Soil.504:4.Learning the Ion exchange processes in soil and ion exchange phenomena and practical	2	2	1	1	1	1	3	2	2	2	3	2	2	2	2	3

implications in plant nutritions																

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: SOIL 504: Soil Mineralogy Genesis and Classification

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil	SO1.1 SO1.2	LI. 1.1, LI. 1.2 LI. 1.3 LI. 1.4 LI. 1.5 LI. 1.6 LI. 1.7 LI. 1.8	Unit-1 Concept of space lattice, crystallography and isomorphism 1.1,1.2,1.3,1.4	As mentioned in page number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 504.2: To understand the classification , structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals	SO2.1 SO2.2 SO2.3 SO2.4	LI. 2.1, LI. 2.2, LI. 2.3 LI. 2.4 LI. 2.5 LI. 2.6 LI. 2.7 LI. 2.8 LI. 2.9 LI. 2.10	Unit-2 Classification of clay minerals and its interaction with humus, pesticides and heavy metals 2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9	

PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile**	**SO3.1** **SO3.2** **SO3.3**	**LI. 3.1, LI. 3.2** **LI. 3.3, LI. 3.4** **LI. 3.5, LI. 3.6** **LI. 3.7, LI. 3.8** **LI. 3.9, LI. 3.10**	**Unit-3 : Soil profile its formation through weathering** **3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map**	**SO4.1** **SO4.2**	**LI. 4.1** **LI. 4.2**	**Unit-4: Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutrition.** **4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8**	

Semester-II

Course Code: **Soil 509**

Course Title : **Remote Sensing and GIS Techniques for Soil, Water and Crop studies**

Pre- requisite: Students should know about the computer handling , use of internet and knowledge of study of map

Rationale: To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; application of remote sensing in general and with special reference to soil, plants and yield forecasting; to impart knowledge about geo-statistical techniques with special reference to krigging, and GIS and applications in agriculture

Course Outcomes:

Soil 509.1: History, concept , principle and application of Remote sensing and GIS system

Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation

Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey

Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability

Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming, disaster management, e governance and ARIS

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Minor Course	Soil 509	Remote sensing and GIS Technique for soil, water and crop studies	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
Minor Course	Soil 509	Remote sensing and GIS Technique for soil, water and crop studies	5	30	15	0	0	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 509.1: History, concept , principle and application of Remote sensing and GIS system

Approximate Hours

Item	AppX Hrs
Cl	7
LI	8
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To identify the required hardware and software use in application of GIS and Remote sensing software's SO1.2 To understand the terminologies used in understanding the basic concept, principle and application of Remote sensing and GIS software	1.To familiarized with the different remote sensing equipment's 2. To familiarized with the different GIS equipment's 3. To familiarized with the different GPS Software 4. understand the working of Computer Microsoft office	**Unit-1.0 Introduction and terminologies used in application of GIS and Remote sensing system** 1.1To learn the Introduction, basic concept, principle and application of remote sensing software 1.2 To learn the Introduction, basic concept, principle and application of GIS software 1.3 Source , Propagation of radiations in atmosphere , interaction with matter 1.4 To understand the requirement of hardware used in Remote sensing 1.5 To understand the requirement of software used in Remote sensing 1.6 To understand the requirement of hardware and software used in GIS system 1.7 To understand the requirement of software used in GIS system	1. Basic knowledge of Remote sensing and GIS software

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept , application of Remote sensing software and locate the different location with the help in Indian Map
- Principle, concept , application of GIS software and locate the different location with the help in Indian Map

b. Other Activities(Specify): NA

Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation

Approximate Hours

Item	AppX Hrs
Cl	**7**
LI	**8**
SW	**2**
SL	**1**
Total	**18**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To understand the concept, principle and importance of different types of sensors, camera and images used in GIS system **SO2.2:** To assess the processing and interpretation of sensors , images and waves in GIS system	1.Interpretation of aerial photographs for mapping of land resources 2. Interpretation of satellite data for mapping of land resources 3.To understand the representation of various boundaries of city , state, country and world 4.To understand the Image over lapping for better understand of the area	**Unit-2 Sensor system- camera, microwave radio meters and scanners** 2.1: To study the classification of different types of sensors and sensor system 2.2: To study the application of different types of camera in different sensors 2.3: To learn the use of microwaves, radio meter 2.4To understand fundamental principle, concept, and use of aerial photographs and multi spectral imagines 2.5 to understand the use of hyper spectral imaging and thermal imagines 2.5To understand the application of processing and interpretations of images 2.7. To understand the interpretations of images	1.To know different types of satellite

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Classification of different types of sensors and images used in locating the locations in Map
- Enlist the different types of satellites

b. Other Activities(Specify): NA

Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey

Approximate Hours

Item	AppXHrs
Cl	6
LI	4
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO3.1 To assess the various application of remote sensing techniques and land use soil survey SO3.2 To understand and evaluate the management techniques used in drought and waste land identification	1. To enable the students to conduct soil survey and interept soil survey reports in terms of land use planning in upland 2. To enable the students to conduct soil survey and interept soil survey reports in terms of land use planning in lowland	**Unit-3 : Management and identification of wasteland, drought area , and prioritization of water shed area** 3.1: To management and identification of the drought area 3.2: To manage and identification of waste land 3.2 Prioritization of watershed 3.3 Application of remote sensing in land use soil survey 3.5. Application of remote sensing techniques on crop stress management 3.6. Application of remote sensing techniques on yield forecasting	1.To know about use of remote sensing in agriculture

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Enlist the techniques used in Prioritization of watershed area through remote sensing

b. Other Activities (Specify): NA

Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**6**
SW	**2**
SL	**0**
Total	**13**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To understand the significance and sources of spatial and temporal variability in soil **SO4.2 To identify geo statistical techniques of evolution of soil variability**	1. To learn the operating process of GPS software 2.Analysis of variability of different soil properties with classical 3. Analysis of variability of different soil properties with geo-statistical techniques	**Unit-4: To evaluate and learn the significance and sources of the spatial and temporal variability in soil** 4.1 To understand the variability in relation to size of sampling **4.2** To evaluate the classical statistical techniques of evolution of soil variability **4.3** To learn the significance of spatial and temporal variability in soil **4.4** To learn the sources of spatial and temporal variability in soil **4.5** To Evaluate the geo statistical techniques of evolution of soil variability	

SW-4 Suggested Sessional Work (SW):

a.Assignments:

- Enlist the application of **geo statistical techniques of evolution of soil variability**

Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming, Disaster management, e governance and ARIS

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**4**
SW	**2**
SL	**1**
Total	**10**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class Room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the application of GIS in Agriculture soil/ water management **SO5.2** To understand the ARIS system	1. To creation of data files in a data base programme 2. To understand the working of GPS system on field	**Unit-5: To understand the application of GIS for water resources, agriculture and ARIS** 5.1 To learn the concept behind the use of GIS in water resource management 5.2 . To understand the use of GIS in precision farming 5.3 .To understand the use of GIS in disaster management 5.4 To understand the use of GIS in managing the e governance 5.5. To understand the use of GIS in Agricultural Research Information System(ARIS)	1. To learn about the e governance management

SW-5 Suggested Sessional Work (SW):

a. Assignments: NA

b. **Other specific:** Preparation of PowerPoint presentation of use of GIS in managing agricultural practices

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+Sl)
Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	7	8	2	1	18
Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	7	8	2	1	18
Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	6	4	2	1	13
Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability	5	6	2	0	13
Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming , disaster management, e governance and ARIS	5	4	2	1	12
Total Hours	**30**	**30**	**10**	**4**	**74**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction and terminologies used in application of GIS and Remote sensing system	03	04	03	10
CO-2	Sensor system- camera, microwave radio meters and scanners	03	04	03	10
CO-3	Management and identification of wasteland, drought area , and prioritization of water shed area	03	04	03	10
CO-4	To evaluate and learn the significance and sources of the spatial and temporal variability in soil	03	04	03	10
CO-5	To understand the application of GIS for water resources, agriculture and ARIS	03	04	03	10
Total		15	20	15	50

L: Legend R: Remember, U: Understand, A: Apply

The end of semester assessment for **Remote sensing and GIS Technique for soil , water and crop studies** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013

2	GIS Fundamentals, Applications and Implementations	Elangovan K.	New India Publ. Agency.	2006
3	Remote Sensing and Image Interpretation	Lillesand TM and Kiefer RW.	3rd Ed. Wiley	1994
4	Spatial and Temporal Statistics	Nielsen DR and Wendroth O.	Catena Verloggmbh	2003
5	Geographic Information System: An Introduction	Star J and Esles J.	Prentice Hall	1990

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr. S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Course Code: Soil 509

Course Title: **Remote Sensing and GIS Technique for soil, water and crop studies**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	1	1	1	1	1	1	2	2	3	2	3	3	1	1	1	3
Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	1	1	1	1	1	1	3	2	3	2	3	3	1	1	1	3

Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**3**	**1**	**1**	**1**	**3**
Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**1**	**1**	**3**
Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming , disaster management, e governance and ARIS	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Remote Sensing and GIS Technique for soil, water and crop studies

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	SOs: 1.1, SOs:1.2,	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit-1.0 Introduction and terminologies used in application of GIS and Remote sensing system 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentionedin page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	SOs: 2.1, SOs:2.2,	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit 2.0 Sensor system- camera, microwave radio meters and scanners 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	SOs: 3.1, SOs:3.2,	LI: 1.1, LI:1.2,	Unit-3.0: Management and identification of wasteland, drought area , and prioritization of water shed area 3.1, 3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12	Soil 509.4: To understand the	SOs: 4.1,	LI: 1.1, LI:1.2,	Unit-4.0 : To evaluate and learn the	

PSO 1,2, 3, 4	**significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability**	**SOs:4.2,**	**LI:1.3,**	**significance and sources of the spatial and temporal variability in soil** **4.1,4.2,4.3,4.4,4.5**	
PO 1,2,3,4,5,6 7,8,9,10,11,12 **PSO 1,2, 3, 4**	**Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming , disaster management, e governance and ARIS**	**SOs: 5.1, SOs:5.2**	**LI: 1.1, LI: 1.2,**	**Unit-5.0 : To understand the application of GIS for water resources, agriculture and ARIS** **5.1,5.2,5.3,5.4,5.5**	

Semester II

Course Code: STAT 512

Course Title: EXPERIMENTAL DESIGNS

Pre-requisite: Experimental design is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Generally, the purpose is to establish the effect that a factor or independent variable has on a dependent variable.

Rationale: Experimental design is used to establish the effect an independent variable has on a dependent variable. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.

Course Outcomes:

STAT 512: 1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

STAT 512:2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

STAT 512:3 Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

STAT 512:4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Minor Course	STAT 512	EXPERIMENTAL DESIGNS	2	01	02	01	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment	Total Marks
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Total Marks (CA+CT+PA +AT)	(ESA)	(PRA+ ESA)
Minor Course	STAT 512	Experimental Design	5	30	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

STAT 512. 1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

Approximate Hours

Item	Appx. Hrs.
CI	3
LI	4
SW	2
SL	1
Total	10

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Design of Experiment is a tool to develop an experimentation strategy that maximizes learning using a minimum of resources.	1-Uniformity trial data analysis. 2- formation of plots and blocks,	**Unit-1.** Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control.	1. Prepare the assignment on Basic principles of designs-randomization,

SO1.2 Extensively used by engineers and scientists involved in the improvement of manufacturing processes to maximize yield and decrease variability. **SO1.3** It is widely used in many fields with broad application across all the natural and social sciences, to name a few: Biostatistics, Agriculture, Marketing, Software engineering, Industry etc.	Fairfield Smith Law	**1.1**. Need for designing of experiments **1.2** characteristics of a good design **1.3** Basic principles of designs- randomization, replication and local control	replication and local control.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Basic principles of designs- randomization, replication and local control.

b. Mini Project: - NA

c. Other Activities (Specify):- NA

STAT 512:2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

Approximate Hours

Item	Appx. Hrs.
CI	**5**
LI	**6**
SW	**2**
SL	**1**
Total	**14**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Good experimental design is important in all research, it helps to ensure the data collection, data analysis and conclusions from a study, are valid (true). **SO2.2** Experiments are designed to test hypotheses, or specific statements about the relationship between variables.	1- Analysis of data obtained from CRD 2- - Analysis of data obtained from RBD 3- - Analysis of data obtained from LSD	**Unit-2** Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. **1.1** Uniformity trials **1.2** size and shape of plots and blocks **1.3**. Analysis of variance; Completely randomized design **1.4** Analysis of variance; randomized block design **1.5** Analysis of variance; Latin square design.	1.Prepare the assignment on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

SW-2 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Simple Problems Based on Analysis of variance; Completely randomized design, randomized block design and Latin square design.

b. Other Activities (Specify): NA

STAT 512.3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

Approximate Hours

Item	Appx. Hrs.
CI	6
LI	14
SW	2
SL	1
Total	23

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Experimental methods introduce exogeneity, allowing researchers to draw conclusions about the effects of an event or a program. **SO3.2. An** experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.	1- Analysis of factorial experiments without confounding. 2- Analysis of factorial experiments with confounding. 3- Analysis with missing data in CRD. 4- Analysis with missing data in RBD. 5- Analysis with missing data in LSD. 6- Split plot designs. 7- Strip plot designs	**Unit-3** Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. **1.1**. Factorial experiments, (symmetrical) **1.2** Factorial experiments, (asymmetrical) **1.3** orthogonality **1.4** partitioning of degrees of freedom **1.5**. Confounding in symmetrical factorial experiments **1.6**. Factorial experiments with control	1. Prepare the assignment on Factorial experiments with control treatment.

SW-3 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Factorial experiments with control treatment.

STAT 512: 4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment

Approximate Hours

Item	Appx Hrs.
CI	**16**
LI	**6**
SW	**1**
SL	**2**
Total	**25**

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1.Ensure your experiment is unbiased **SO4.2** Make sure your experiment is adequately powered **SO4.3** Consider the range of applicability of your experiment.	1.Transformation of data 2. Analysis of resolvable designs 3. Fitting of response surfaces.	**Unit-4** Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. **1.1** Split plot **1.2** strip plot designs **1.3** Analysis of covariance **1.4** Missing plot techniques in randomized block. **1.5** Missing plot techniques in Latin square designs. **1.6** Transformations **1.7** crossover designs **1.8** balanced incomplete block design **1.9** resolvable designs **1.10** Applications of resolvable designs Lattice design **1.11** Lattice design **1.12** Applications of Lattice design **1.13** Alpha design-concepts. **1.14** Randomization procedure. **1.15** Interpretation of results. **1.16** Response surfaces. Experiments with mixtures	1. Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

SW-4 Suggested Sessional Work (SW):

a. **Assignments:** Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (L I)	Sessional Work (SW)	Self Learning (S l)	Total hour (C l + LI+ SW +S l)
STAT 512: 1: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	03	04	01	02	10
STAT 512: 2: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	05	06	01	02	14
STAT 512: 3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	06	14	01	02	25
STAT 512: 4: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	16	06	01	02	25
Total Hours	**30**	**30**	**04**	**08**	**74**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title	Marks Distribution			Total Marks
		R	U	A	
CO-1	Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.	04	04	04	12
CO-2	Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.	04	04	04	12
CO-3	Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.	04	04	04	12
CO-4	Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block	05	04	05	14

	design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.				
	Total	**17**	**16**	**17**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Experimental Designs** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	**Title**	**Author**	**Publisher**	**Edition &** Year
01	Basic Concepts and Application of Experimental Designs and Analysis	Felix Kusanedzie Sylverster Achio Edmund Ameko	Science PG	First Edition 2015
02	Theory and Analysis of Experimental Designs	B.L. Agrawal	CBS	First Edition 2011
03	Design and Analysis of Experiments	Angela Dean Daniel Voss	Springer	Second Edition 2017

Curriculum Development Team:

1. Dr. S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
2. Professor B.B. Beohar, Director Planning, & Director Extension, A.K.S. University
3. Dr. V.K. Vishwakarma , Head Department of Agricultural Economics, FAST
4. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Code : STAT -512

Course Title: Experimental Design

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
STAT 512: 1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
STAT 512.2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	1	2	2	2	3	2	3	2	2	1	2	3	2	2	2	1

STAT-512.3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**2**
STAT-502.4: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	**1**	**2**	**-**	**-**	**1**	**-**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: STAT 512: Experimental Design

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources	**SO1.1** **SO1.2** **SO1.3**	**LI. 1.1, 1.2**	**Unit-1** Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control. **1.1,1.2,1.3**	**As mentioned in page number _ to _**

PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	**SO2.1** **SO2.2**	**LI. 2.1,** **LI. 2.2,** **LI. 2.3,**	**Unit-2** Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. **2.1,2.2,2.3,2.4,2.5**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	**SO3.1** **SO3.2**	**LI. 3.1** **LI. 3.2** **LI. 3.3** **LI. 3.4** **LI.3.5** **LI.3.5** **LI.3.6**	**Unit-3** Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. **3.1,3.2,3.3,3.4,3.5,3.6**	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	**SO4.1** **SO4.2** **SO4.3**	**LI. 4.1** **LI. 4.2** **LI. 4.3**	**Unit-4** Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. **4.1,4.2,4.3,4.4,4.5,4.6,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13,4.14,4.15,4.16**	

Semester II

Course Code: PGS504

Course Title: PGS504

Pre requisite: No specific requirements

Rationale: Studying basic laboratory techniques are fundamental for scientific research, ensuring accurate experimentation and data analysis. Mastery of these skills cultivates precision, reproducibility, and safety, forming the cornerstone of scientific inquiry across disciplines and facilitating advancements in knowledge and technology.

Course Outcomes:

CO1: PGS: 504 Student will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.

Scheme of Studies

Couse Categoey	Course Code	Course Title	Scheme of Studies (Hours/Week)					Total Credit (C)
			CI	LI	SW	SL	Total Study Hours	
Non credit	**PGS-504**	**Basic Concepts in Laboratory Techniques**	00	2	00	00	2	01

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						**End Semester Assessment** (ESA)	**Total Marks** (PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	**Class Test 2 (2 best out of 3) 10 marks each (CT)**	**Seminar one (SA)**	**Class Activity any one (CAT)**	**Class Attendance (AT)**	Total Marks (CA+CT +SA+ CAT+AT)		
Non Credit	PGS-504	Basic Concepts in Laboratory Techniques	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:
Laboratory techniques are important for any person conducting an experiment. Every procedure needs to be complete with accuracy and precision with proper safety measures. Student will understand the safety and details of working in scientific laboratory. Student will familiarize with various instruments and their principles. Student will practice and visualize common experimental procedures.

PGS-504: **Basic Concept of Laboratory Techniques**

Approximate Hours

Item	Appx Hrs
CI	**0**
LI	**30**
SW	**0**
SL	**0**
Total	**30**

Session Outcomes (SOs)	Laboratory Instructions (LI)	Classroom Instructions (CI)	Self-Learning (SL)
SO.L1 Identify safety measures while in Lab SO.L2 Recognize use of glassware's. SO.L3 Discover handling of glassware's.	L1. Safety measures while in Lab; L2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; L3. Washing, drying and		

SO.L4 Recognize Drying of solvents/ chemicals; SO.L5 Describe working with chemicals. SO.L6 Describe working with solutions. SO.L7 Articulate the technique of formulating doses of agrochemicals SO.L8 Discover handling techniques of solutions SO.L9 Identify the handling of acid and bases SO.L10 Discover the formulation of buffer and solutions of specific pH. SO.L11 Identify the use of lab instruments SO.L12 Recognize and categorize the media requirements and its types SO.L13 Discover the methods and application of viability of germplasm SO.L14 Illustrate procedure for plant tissue culture SO.L15 Recognize flowering plant by its taxonomical description	sterilization of glassware; L4. Drying of solvents/ chemicals; L5. Handling of chemical substances; Weighing and preparation of solutions of different strengths and their dilution; L6. Handling techniques of solutions; L7. Preparation of different agro-chemical doses in field and pot applications; L8. Preparation of solutions of acids; L9. Neutralization of acid and bases; L10. Preparation of buffers of different strengths and pH values; L11. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing; L12. Preparation of media and methods of sterilization; L13. Seed viability testing, testing of pollen viability; L14. Tissue culture of crop plants; L15. Description of flowering plants in botanical terms in relation to taxonomy		

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CL+SW+SL)
Basic Concept of Laboratory Techniques	0	30	0	0	30

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO1	**Basic Concept of Laboratory Techniques**		**30**	**70**	**100**

Suggested Learning Resources:

Sl. No.	Title	Author	Publisher	Edition and Year
01	Laboratory Techniques in Organic Chemistry	Jerry R. Mohrig, David G. Alberg, and Gretchen M. Adams	W. H. Freeman and Company.	2014
02	Biotechnology: Expanding Horizons	B D Singh	Kalyani Publishers	2005

Curriculum Development Team

1. Professor. G. C. Mishra, Director Cement Technology, AKS University
2. Dr. S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
5. Mr. Santosh Shrivastava, Assistant Professort, Dept. Biochemistry and Crop Physiology, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Code : PGS 504

Course Title: Basic Concept of Laboratory Techniques

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Agricultural knowledge	Soil analysis	Design /Development of solutions	Management of problematic soils	Modern Tool/ concept usage	The engineer and society	Environment and sustain ability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity	Ability to understand the day to day soil	Ability to understand the latest manure & fertilizer manufacturing technology	Ability to use the research based innovative knowledge for SDGs
Basic Concept of Laboratory Techniques	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: PGS 504 : Basic Concepts of Laboratory Techniques

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Basic Concepts of Laboratory Techniques	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7 SO1.8 SO1.9, SO1.10, SO1.11 SO1.12, SO1.13 SO1.14, SO1.15	LI. 1.1, LI.1.2, LI.1.3, LI.1.4, LI.1.5, LI.1.6, LI.1.7, LI.1.8, LI.1.9, LI.1.10, LI.1.11, LI.1.12, LI.1.13, LI.1.14, LI.1.15		As mentioned in page number _ to _

Semester- II

Course Code: **PGS 503**

Course Title: **Intellectual Property and Its Management in Agriculture**

Pre- requisite: To teach the physiology of Intellectual Property and Its Management in Agriculture

Rationale: The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

Course outcomes:

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits(C)
			Cl	LI	SW	SL	Total Study Hours(CI+LI+SW+SL)	
Non Credit Course	PGS 503	Intellectual Property and Its Management in Agriculture	1	0	1	1	3	1

Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T)and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW&SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment(PRA)					End Semester Assessment	Total Marks
			Class/HomeAssignment1number 5 marks each (CA)	Class Test2 (2 best out) 20 marks each (CT)	Seminar one (SA)	Class Attendance (AT)	Total Marks (CA+CT+PA+AT)	(ESA)	(PRA+ESA)
Non Credit Course	PGS 503	Intellectual Property and Its Management in Agriculture	5	40	0	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes(SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

Approximate Hours

Item	AppXHrs
Cl	04
LI	0
SW	01
SL	02
Total	07

Session Outcomes(SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self-Learning (SL)
SO1.1 Student will understand the Historical perspectives and need for the introduction of Intellectual Property Right. **SO1.2** Student will recognize the TRIPs and various provisions in TRIPS Agreement. **SO1.3** Student will understand different Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs		**Unit-1.0** Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs. **1.1** Historical perspectives and need for the introduction of Intellectual Property Right regime. **1.2** TRIPs and various provisions in TRIPS Agreement. **1.3** Intellectual Property and Intellectual Property Rights (IPR) **1.4** Benefits of securing IPRs.	1. Role of IPR and its benefits. 2. Role of TRIPS and its benefits

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Preparation of file and write the role of IPR and TRIPS and their purpose.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	02
SL	03
Total	11

Session Outcomes(SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self-Learning (SL)
SO2.1 Students will understand the Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout **SO2.2**Students will understand the trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection. **SO2.3** Students will identify the role of Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.		**Unit-2** Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. **2.1** Indian Legislations for the protection of various types of Intellectual Properties. **2.2** Fundamentals of patents, copyrights, geographical indications, designs and layout. **2.3** trade secrets and traditional knowledge and trademarks. **2.4** protection of plant varieties and farmers' rights and biodiversity protection. **2.5** Protectable subject matters, protection in biotechnology. **2.6** protection of other biological materials, ownership and period of protection.	1. Basic Indian Legislature. 2. Plant varieties and farmers' rights act (2001). 3. Biodiversity act (2002).

SW-2 Suggested Seasonal Work (SW):

a. Assignments:

- Note on Plant varieties and farmers' rights act (2001).
- Note on Biodiversity act (2002).

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Approximate Hours

Item	AppX Hrs
Cl	**05**
LI	**0**
SW	**02**
SL	**01**
Total	**08**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Students will identify the National Biodiversity protection initiatives and Convention on Biological Diversity. **SO3.2** Students will understand the International Treaty on Plant Genetic Resources for Food and Agriculture and Licensing of technologies. **SO3.3** Students will understand the Material transfer agreements, Research collaboration Agreement and License Agreement.		**Unit-3:** National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement. **3.1** National Biodiversity protection initiatives. **3.2** Conventions on Biological Diversity. **3.3** International Treaty on Plant Genetic Resources for Food and Agriculture. **3.4** Licensing of technologies and Material transfer agreements. **3.5** Research collaboration Agreement and License Agreement.	1. Plant Genetic Resources.

SW-3 Suggested Sessional Work (SW):

a. **Assignments**:
   - Note on Plant Genetic Resources.
   - Note on National Biodiversity protection initiatives

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property	**04**	**01**	**02**	**07**

	Right.				
PGS 503.2:	Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	**06**	**02**	**03**	**11**
PGS 503.3:	Students will be able to understand Research collaboration Agreement, License agreement.	**05**	**02**	**01**	**08**
Total		**15**	**05**	**06**	**26**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	**Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs.**	05	03	02	**10**
CO 2	**Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.**	05	02	03	**10**
CO 3	**National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.**	05	03	02	**10**
	Total	15	8	7	**30**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Intellectual Property and Its Management in Agriculture** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method

4. Group Discussion
5. Role Play
6. Visit to organic fields
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Intellectual Property Rights in Agricultural Biotechnology	Erbisch FH and Maredia K	CABI.	1998
2	Intellectual Property Rights: Unleashing Knowledge Economy	Ganguli P	McGraw-Hill.	2001
3	Intellectual Property Rights: Key to New Wealth Generation		NRDC and Aesthetic Technologies.	2001
4	State of Indian Farmer. Vol. V. Technology Generation and IPR Issues	Ministry of Agriculture, Government of India	Academic Foundation	2004
5	Intellectual Property Rights in Animal Breeding and Genetics	Rothschild M and Scott N	CABI	2003

Curriculum Development Team:

1. Dr. S.S. Tomar, DEAN, Faculty of Agriculture Science and Technology, AKS University.
2. Dr. Neeraj Verma, PG Coordinator, Faculty of Agriculture Science and Technology, AKS University.
3. Dr. Abhishek Singh, HOD, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
4. Dr. T. Singh, Professor, Department of Agronomy, FAST, AKS University.
5. Dr. Bharti Sao, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
6. Dr. B. V. Singh, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
7. Dr. Mohni Parmar, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
8. Dr. S. K. Chandel, Assistant Professor, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.
9. Mr. Ansul Asre, Teaching Associate, Dept. of Horticulture, Faculty of Agriculture Science and Technology AKS University.

****

Cos, POs and PSOs Mapping

Course Code:- PGS 505
Course Title: - Intellectual Property and Its Management in Agriculture

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property	3	1	1	2	1	1	1	2	3	2	1	3	3	1	2	1

Right.																
PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	3	2	1	2	2	2	1	3	2	1	2	3	3	2	2	3
PGS 503.3: Students will be able to understand Research collaboration Agreement, License agreement.	3	2	1	2	2	2	3	2	1	2	3	3	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Intellectual Property Right

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PGS 503.1:** Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.	**SO1.1** **SO1.2** **SO1.3**		**Unit-1.0** Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs. **1.1, 1.2, 1.3, 1.4**	As mentioned in page number ……..
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PGS 503.2:** Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	**SO1.1** **SO1.2** **SO1.3**		**Unit-2.0 –** Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. **2.1, 2.2, 2.3, 2.4, 2.5, 2.6**	As mentioned in page number ……..
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 503.3: Students will be able to understand Research collaboration Agreement, License agreement.	**SO1.1** **SO1.2** **SO1.3**		**Unit-3.0** National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement. **3.1, 3.2, 3.3, 3.4, 3.5**	As mentioned in page number ……..

Semester-III

Course Code: Soil 511

Course Title : Management of Problem soils and water

Pre- requisite: Students should know about the classification and distribution of problematic soils and water

Rationale: To educate students about basic concept of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production

Course Outcomes:

Soil 505:1. Distribution of problematic soils in India
Soil 505.2: To understand the morphological, chemical and biological features of salt affected soils
Soil 505.3: To understand the Management of salt affected soil
Soil 505.4: To understand the origin, nutrient content and management of acidic soil
Soil 505: To understand and analysis the quality of irrigation water
Soil 505.6: Application of agronomic practices in maintaining the quality of ground water

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Major Course	Soil 511	Management of problematic soils and water	2	1	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks
			Class/ Assignment number 5 Home 3 marks	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)	(ESA)	(PRA+ESA)
Major Course	Soil 511	Management of problematic soils and water	**15**	**30**	**0**	**0**	**5**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 511.1: Distribution of problematic soils in India

Approximate Hours

Item	AppX Hrs
Cl	**4**
LI	**8**
SW	**2**
SL	**1**
Total	**15**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To identify the problematic soil in India, their origin and extend of problem SO1.2 Reasons for problematic soils	1. To determine the characters of acidic soils 2. To determine the characters of salt affected soils 3. To determine the characters of acid sulphate soils 4. To determine the characters of calcareous soils	**Unit-1.0 Distribution of problematic soils in India** 1.1To learn the origin and basic concept of problematic soils 1.3 Classification of problematic soil on basis of pH 1.4 classification and reason for degraded land 1.4 Reason for conversion of development of problematic soils/ area.	1. To know the classification of problematic lands in India

SW-1 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the properties of acidic, acid sulphate, salt affected and calcareous soil
- Enlist the cause of soil erosion in India

b) Other Activities(Specify): NA

Soil 511.2: To understand the morphological, chemical and biological features of salt affected soils

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To understand the important characterization morphological features of salt affected soil **SO2.2:** To assess the chemical and microbiological properties of salt affected soil	1. Determination of gypsum required by the given salt affected soil	**Unit-2 Morphological features of salt affected soil** 2.1: To study the Morphological features of saline 2.2 , To study the Morphological features of sodic and saline-sodic soils. 2.3: To know characterization of salt-affected soils-soluble salts 2.4 To understand the physical, chemical and microbiological properties	1.To know the physical , chemical and biological parameters come under estimation

SW-2 Suggested Sessional Work (SW):

b) Assignments:

a. Classification of salt affected soil with its chemical properties
b. Distribution of salt affected soil in India and world

b) Other Activities(Specify): NA

Soil 511.3: To understand the Management of salt affected soil

Approximate Hours

Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 To assess the various management techniques used in maintaining salt content in soil SO3.2 To understand the cultivation of suitable crop ti be grown in salt affected area	1. Determination of Cations in soil (Na+,K+, Ca2+,and Mg2+) in given soil 2. Determination of Cations in soil (Na+,K+, Ca2+,and Mg2+) in given water sample	**Unit-3 : Management salt affected soil** 3.1: To manage the salinity in saline soil 3.2: To manage the salt content in salt affected area/soil 3.3 Cultivation of salt tolerant or sensitive crop 3.4 To understand the management principles for sandy and clayey soils 3.5. to understand the management principles for red lateritic and dry land soils 3.6 To understand the management principles for dry land soils	1.To know the salt affected area and the climatic situation

SW-3 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the area come under salt affected soil
- Formation, properties and management of salt affected soils

b) Other Activities(Specify): NA

Soil 511.4: To understand the origin, nutrient content and management of acidic soil

Approximate Hours

Item	AppX Hrs
Cl	**5**
LI	**6**
SW	**2**
SL	**1**
Total	**14**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To understand the origin, chemical properties of acidic soil **SO4.2** To identify the management of acidic soil	1.To determination ion content in a given soil sample 2. To determination ion content in a given water sample 3. To estimate the lime requirement in a acidic soil	**Unit-4: Acidic soil formation and their management** 4.1. To understand the origin and source for development of acidic soil 4.2 To evaluate the management strategies in reducing the acidity from soil 5.3 To learn the effect of soil acidity on growth and development of crop 5.4 To identify the use of different types of lime as ameliorating substances 4.5 To understand to biological sickness of soils and its management	1. To study cause of acidity in soil 2. To study distribution of acidic soils in India

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the factors affecting soil acidity

Soil 511.5: To understand and analysis the quality of irrigation water

Approximate Hours

Item	AppX Hrs
Cl	5
LI	6
SW	2
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the quality of irrigation water **SO5.2** To understand the management of brackish, water and salt balance in irrigation water	1. Determination of carbonate and bicarbonate in water 2. To estimate the B content in a given water sample 3. to estimate the Na, Ca, Mg and Cl content in a given water sample	**Unit-5: Quality of irrigated water** 5.1. To learn the concept behind the management of irrigation water 5.2 To understand the parameter behind analyzing the quality of irrigation water 5.3 To learn the characteristics of brackish water 5.4 To learn the management of brackish water for irrigation / drinking purpose 5.5 Learn to balance the salt content in irrigated water 5.6 To understand the relationship in water use and quality	1. To learn the parameter to be understand to measure the quality of irrigation water 2. To know the effect of harmful / bad quality of irrigation water on growth and development of crop

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Classify the brackish water and its management
- Enlist the parameters to classify the quality of irrigation water

Soil 511.6: Application of agronomic practices in maintaining the quality of ground Water

Approximate Hours

Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1. To understand and utilize the agronomic practices in maintaining the quality and level of ground water **SO6.2** To understand use of various cropping patterns in maintaining the quality of ground water	1. To determine the land capability classification of a watershed 2.To visit the watershed area	**Unit-6: Agronomic practices in relation to problematic soils** 6.1. To learn and apply the agronomic practices used in managing the ground water level 6.2 To learn and apply the cropping pattern used in managing the quality of ground water 6.3 To learn the agronomic practices used in managing the acidic, saline soil 6.4 To learn the cropping system used in managing the degraded land 6.5 To learn the cropping system in managing the ground water level	1. To know agronomic practices in managing the problematic soil

SW-6 Suggested Sessional Work (SW):

b. Assignments:

- Enlist the agronomic practices used in maintaining the ground water level

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 511.1: Distribution of problematic soils in India	4	8	2	1	15
Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	4	2	2	1	9

Soil 511.3: To understand the Management of salt affected soil	6	4	2	2	14
Soil 511.4:To understand the origin, nutrient content and management of acidic soil	5	6	2	1	14
Soil 511.5: To understand and analysis the quality of irrigation water	6	6	2	1	15
Soil 511.6: Application of agronomic practices in maintaining the quality of ground water	5	4	2	1	12
Total Hours	30	30	12	7	79

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Unit-1.0 Distribution of problematic soils in India**	3	1	1	5
CO-2	**Unit-2.0 Morphological features of salt affected soil**	5	6	4	10
CO-3	**Unit-3.0 Management salt affected soil**	4	3	2	9
CO-4	**Unit-4.0 Acidic soil formation and their management**	2	4	2	8
CO-5	**Unit-5.0 Quality of irrigated water**	3	3	3	9
CO-6	**Unit-6.0 Agronomic practices in relation to problematic soils**	3	3	3	9
Total		20	20	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Management of problem soils and water** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Onlinesources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils	Brady NC and Weil RR	13th Ed. Pearson Edu.	2013
2	Chemistry of the Soil	Bear FE.	Oxford & IBH	1964
3	Salt-affected Soils. Department of Soil Science & Biometeorology	Jurinak JJ.	Utah State University	1978
4	Diagnosis and improvement of Saline and Alkali Soils.	USDA Handbook No. 60.	Oxford & IBH	1954

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T Singh, Professor, Department of Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos, POs and PSOs Mapping

Course Code:- Soil 511

Course Title: - Management of Problem Soil

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 511.1: Distribution of problematic soils in India	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	1	2	2	2	3	2	3	2	2	1	2	3	2	2	2	1
Soil 511.3: To understand the Management of salt affected soil	1	2	1	1	1	2	3	2	2	2	1	3	1	1	2	2
Soil 511.4: To understand the origin, nutrient	1	2	1	3	1	2	2	2	1	1	1	3	3	3	3	2

content and management of acidic soil																
Soil 511.5: To understand and analysis the quality of irrigation water	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**1**	**3**
Soil 511.6: Application of agronomic practices in maintaining the quality of ground water	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil 511: Management of Problem Soil

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.1: Distribution of problematic soils in India	SO1.1 SO1.2	LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4,	Unit-1.0 Distribution of problematic soils in India 1.1,1.2,1.3,1.4	As mentioned in page number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	SO2.1 SO2.2	LI. 2.1	Unit-2 Morphological features of salt affected soil 2.1,2.2,2.3,2.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511. 3: To understand the Management of salt affected soil	SO3.1SO3.2	LI. 3.1, LI. 3.2,	Unit-3 Unit-3 : Management salt affected soil 3.1,3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.4:To understand the origin, nutrient content and management of acidic soil	SO4.1 SO4.2	LI. 4.1 LI. 4.2 LI. 4.3	Unit-4: Acidic soil formation and their management 4.1,4.2,4.3,4.4,4.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.5: To understand and analysis the quality of irrigation water	SO5.1 SO5.2	LI. 5.1, LI. 5.2, LI. 5.3,	Unit-5: Quality of irrigated water 51,5.2,5.3,5.4,5.5,5.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.6: Application of agronomic practices in maintaining the quality of ground water	SO6.1 SO6.2	LI. 6.1, LI. 6.2,	Unit-6: Agronomic practices in relation to problematic soils 6.1,6.2,6.3,6.4,6.5	

Semester III

Course Code: - PGS 505

Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Pre requisite: -Student should have basic knowledge of agricultural research, research ethics, and agricultural history along with fellowship program, rural development programme.

Rationale: - The students studying agricultural research and research ethics should possess understanding about method of research application, research ethics and fellowship for research and other scholars in construction agricultural development. This encompasses familiarity with the invention and evolution of agricultural research and development of agricultural programme, students ought to acquire fundamental insights into various agricultural technologies, their applications, as well as the Indian needs in agricultural developments.

Course Outcomes:

PGS 505.1: Identify the history, levels of research, economic and social welfare through research programme.
PGS 505.2: Apply the functioning, role and significant of regional, national and international research.
PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.
PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development
PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Scheme of studies

Categories of Course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			C l	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Non Credit Course	**PGS 505**	Agricultural Research, Research Ethics and Rural Development Programmes	01	00	02	01	04	01

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA +CAT+AT)		
Non Credit Course	**PGS 505**	**Agricultural Research, Research Ethics and Rural Development Programmes**	**15**	**30**	**00**	**00**	**5**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme

Approximate Hours

Item	AppX Hrs
C l	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1- Introduce about the history of agriculture in brief **SO1.2 -** Brief the basic concept global agricultural research system. **SO1.3 - Discuss** about the need, scope, opportunities; Role in promoting food security of global agricultural research system. **SO1.4-** Describes the reducing poverty and protecting the environment through global agricultural research system **SO1.5** Asses the functions and use of national Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions.		**Unit-I** **History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions;** **1.1-** History of agriculture in brief **1.2-** Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment **1.3-** National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions	**1.1-** Prepare the assignment on Global agricultural research system

SW-1 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Global agricultural research system

b. Mini Project: - NA

c. Other Activities (Specify):- NA

PGS 505.2: Apply the functioning, role and significant of regional, national and International research.

Approximate Hours

Item	AppX Hrs
CL	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 – introduce to the Consultative Group on International Agricultural Research (CGIAR) **SO2.2** – learned about the International Agricultural Research Centers (IARC), **SO2.3-** Briefing the partnership with NARS, role as a partner in the global agricultural research system **SO2.4-** Briefing the strengthening capacities at national levels; International fellowships for scientific mobility **SO2.5–**Discuss to the strengthening capacities at regional levels; International fellowships for scientific mobility		**Unit-II** **Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility** **2.1 -** Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC) **2.2-** Partnership with NARS, role as a partner in the global agricultural research system. **2.3-,** Strengthening capacities at national and regional levels; International fellowships for scientific mobility.	**2.1 –** Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system

SW-2 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system.

b. Mini Project: NA

c. Other Activities (Specify): NA

PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.

Approximate Hours

Item	AppX Hrs
C l	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 – Identify to the Research ethics **SO3.2 –** Discuss to the research integrity, research safety in laboratories **SO3.3-** Apply the welfare of animals used in research **SO3.4-** Discuss to computer ethics and standards **SO3.5**– Describe the problems in research ethics		**Unit-3** **Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics** **3.1-**Research ethic and research integrity **3.2-** Research safety in laboratories, welfare of animals used in research. **3.3-** Computer ethics, standards and problems in research ethics.	**3.1** Prepare the assignment on Research ethic and research integrity.

SW-3 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Research ethic and research integrity
b. Mini Project: NA
c. Other Activities (Specify): NA

PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development

Approximate Hours

Item	App X Hrs
Cl	**3**
LI	**0**
SW	**2**
SL	**1**
Total	**06**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 –Identify the Concept and connotations of rural development. **SO4.2 -** Apply the rural development policies and strategies **SO4.3-** Asses the Rural development programmes: Community Development	**LE1.1 -**	**Unit-4.0 - I** **Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development**	**1.1-** Prepare the assignment on Community Development Programme.

Programme, Intensive Agricultural District Programme. **SO4.4-** Describes the Special group – Area Specific Programme. **SO4.5**– Brief the Integrated Rural Development Programme (IRDP)		**Programme (IRDP)** **4.1-** Concept and connotations of rural development, rural development policies and strategies **4.2-** Rural development programmes: Community Development Programme, Intensive Agricultural District Programme **4.3-** Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP)	

SW-4 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Community Development Programme
b. Mini Project: Prepare a project report of leadership styles and influence process; leadership theories, leadership styles and effective leader
c. Other Activities (Specify):

PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Approximate Hours

Item	App X Hrs
Cl	06
LI	00
SW	02
SL	1
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 –Indentify Panchayati Raj Institutions and Co-operatives. **SO5.2-** Identify the Voluntary Agencies **SO5.3-** Identify the Non-Governmental Organisations **SO5.4-** Discuss the , Critical evaluation of rural development		**Unit-5.0** **Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes** **5.1-** Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations	**1.1 -** Prepare the assignment on Panchayati Raj Institutions,

policies **SO5.5-** Briefs the programmes. Constraints in implementation of rural policies and programmes		**5.2-** Critical evaluation of rural development policies and programmes **5.3-** Constraints in implementation of rural policies and programmes	

SW-5 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Panchayati Raj Institutions,
b.Other Activities (Specify): NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture (C l)**	**Sessional Work (SW)**	**Self Learning (S l)**	**Total hour (C l + LI+ SW +S l)**
PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme	3	2	1	06
PGS 505.2: Apply the functioning, role and significant of regional, national and international research.	3	2	1	06
PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.	3	2	1	06
PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development	3	2	1	06
PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	3	2	1	06
Total Hours	**15**	**10**	**05**	**30**

Suggested Specification Table (For ESA)

CO	**Unit title**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Identify the history, levels of research, economic and social welfare through research programme.	02	03	00	05

CO-2	Apply the functioning, role and significant of regional, national and international research.	02	05	03	10
CO-3	Asses the agricultural research, research ethics with operating and safety of laboratory.	00	08	07	15
CO-4	Analyze the various development programmes and their functioning with its impact on agricultural development.	02	05	08	15
CO-5	Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program	00	03	02	05
	Total	06	24	20	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Agricultural Research, Research Ethics and Rural Development Programmes will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to Industry
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Face book, Twitter, Whatsapp, Mobile, Online sources) Brainstorming

Suggested Learning Resources:

S.No.	Title	Author	Publisher	Edition & Year
01	Indian Agriculture - Four Decades of Development	Bhalla GS & Singh G.	Sage Publ	2001
02	Manual on International Research and Research Ethics	Punia MS	CCS, Haryana Agricultural University, Hisar.	
03	Rural Development Strategies and Role of Institutions Issues, Innovations and Initiatives.	Rao BSV.	Mittal Publ	2007
	Rural Development - Principles, Policies and Management	Singh K..	Sage Publ	1998.

Curriculum Development Team:

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Professor B.B. Beohar, Director Planning, & Director Extension, A.K.S. University
4. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
5. Dr. T. Singh, Professor, Department of Agronomy, FAST, AKS University
6. Dr. V.K. Vishwakarma , Head Department of Agricultural Economics, FAST
7. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
8. Dr. Ashutosh Kumar Singh, Associate professor Department of Agricultural Economics,
   FAST
9. Dr. Yogesh Tiwari , Assistant Professor , Department of Agricultural Economics, FAST
10. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
11. Shri Deep Narayan Mishra , Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
12. Ku. Tulika Panigrahi, Teaching Associate, Department of Agricultural Economics, FAST, AKS University

****

Cos, POs and PSOs Mapping

Course Code:- PGS 505

Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Course Outcomes	**Program Outcomes**												**Program Specific Outcome**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
	Basic Knowledge of Agriculture	**Classification of Soils**	**Nutrient analysis**	**Identification and amelioration of problem soil**	**Preparation and recommendation of Compost / Manure**	**Composition and manufacture of various fertilizers**	**Modern concept of Soil Science**	**Environment and sustainability**	**Use of Engineering tools/ software's**	**Ethics**	**Life long learning**	**Project management**	**Ability to prepare and use the doses of various Nano fertilizers**	**Ability to understand the soil microbial classification**	**Ability to Prepare the various bio fertilizers and their applications in field**	**The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity**
PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme	3	1	1	2	1	1	1	2	3	2	1	3	3	1	2	1
PGS.505.2: Apply the functioning, role and significant of regional, national and international research.	3	2	1	2	2	2	1	3	2	1	2	3	3	2	2	3

PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.	3	2	1	2	2	2	3	2	1	2	3	3	2	3	3	3
PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development	2	2	3	1	2	2	3	2	1	2	1	1	3	3	2	2
PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	2	3	3	1	3	2	2	2	2	1	1	2	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Agricultural Research, Research Ethics and Rural Development Programmes

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO-1 Identify the history, levels of research, economic and social welfare through research programme	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**		**Unit-1.0** History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions 1.1, 1.2, 1.3.	As mentioned in page number ……..
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 2: Apply the functioning, role and significant of regional, national and international research.	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**		**Unit-2.0 –** Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility 2.1, 2.2, 2.3.	As mentioned in page number ……..
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.	**SO1.1** **SO1.2** **SO1.3** **SO1.4**		**Unit-3.0** Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics 3.1, 3.2, 3.3.	As mentioned in page number ……..

		SO1.5			
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**		**Unit-4.0** Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) 4.1, 4.2, 4.3.	As mentioned in page number ……..
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	**SO1.1** **SO1.2** **SO1.3** **SO1.4** **SO1.5**		**Unit-5.0** Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes 5.1, 5.2, 5.3.	As mentioned in page number ……..

Semester-III

Course Code: Soil 513

Course Title : Soil Survey and Land use planning

Pre- requisite: Students should know about the computer handling , use of internet and knowledge of study of map

Rationale: To teach the better utilization of land for agricultural purposes, and better management of runoff or surplus/excessive rain-water in the catchment area for agricultural purposes in a watershed

Course Outcomes:

Soil 513:1. To understand the soil survey, its techniques, types and interpretation in map with the application of remote sensing and geographic information system(GIS)
Soil 513.2: To assess the classification of land capability and irritability classification its Management approaches under ago-ecosystem
Soil 513.3: To understand the concept, management techniques and factor governing present land use cultivation of suitable crops
Soil 513.4: To evaluate and understand the Agro-ecological regions/sub-regions in India its status of LUP and characteristics in relation to crop production

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Minor Course	Soil 513	Soil Survey and Land Use Planning	2	0	1	1	4	2

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C:Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			(Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class ctivity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
Minor Course	**Soil 513**	**Soil Survey and Land Use Planning**	**10**	**40**	**0**	**0**	**0**	**50**	**50**	**100**

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Soil 513.1: To understand the soil survey, its techniques, types and interpretation in map with the application of remote sensing and geographic information system(GIS)

Approximate Hours

Item	AppXHrs
Cl	**8**
LI	**0**
SW	**2**
SL	**1**
Total	**11**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To understand the types and techniques used in soil survey,its interpretation in Soil map SO1.2 To evaluate the recent techniques used in application of Remote sensing and GIS software in soil survey and mapping of Indian soil		**Unit-1.0 To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India** 1.1To learn the Introduction, concept and types soil survey 1.2 To understand the importance and use of both conventional and modern soil survey techniques 1.3 To learn the Soil series its characterization and procedure for establish soil series 1.4 identification of benchmarks for sol series 1.5 To understand the interpretation of soil survey with thematic and cartographic mapping 1.6 To learn the recent techniques for generation of soil maps of India 1.7 Application of GIS in soil survey and mapping of major groups of Indian soil 1.8 Application of Remote sensing in soil survey and mapping of major groups of Indian soil	1. Basic knowledge of Remote sensing and GIS software

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept , application of Remote sensing software and locate the different location with the help in Indian Map
- Enlist the soil survey techniques and its interpretation in soil maps of Indian soil

b. Other Activities(Specify): NA

Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches as per agro ecosystem

Approximate Hours

Item	AppX Hr
Cl	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: *To understand the concept, types, irritability and capability classification of land use types* **SO2.2:** *To assess the recent approaches in managing soil and land scopes in framework of agro ecosystem*		**Unit-2 Land use types, its relationship with soil evaluation and management with the help of remote sensing and GIS system** 2.1: To understand the state wise distribution of major soil groups of India 2.2: To understand the representation of state wise distribution of major soil groups of India in map 2.3: To study the land capability classification 2.4: To learn the land irritability classification 2.5 To understand the land evaluation techniques 2.6 To understand the concept and application approaches for managing soil in the framework of agro-ecosystem 2.7 To understand the concept and application approaches for managing landscape in the framework of agro-ecosystem 2.8. To understand distribution and concept of LUT	1.To know different types of satellite

SW-2 Suggested Sessional Work (SW):

a.Assignments:

- Classification of different soil groups of India Map

Soil 513.3: To understand the concept, management techniques and factor governing present land use cultivation of suitable crops

Approximate Hours

Item	AppX Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 To assess the various application of remote sensing techniques and land use soil survey SO3.2 To understand and evaluate the management techniques used in drought and waste land identification		**Unit-3 : To understand the basic concept of land use planning , techniques used and factors governing current land use** 3.1: To understand the concept and importance of land use planning 3.2: To understand recent techniques used under land use planning 3.3 Assess the factors governing land use planning 3.4 To learn the land evaluation methods 3.5. application of land evaluation method sand soil-site suitability evaluation for different crops 3.6. To classify the land capability classification 3.7. To understand the contains under land capability classification 3.8 To understand the factors affecting land capability classification 3.9. To understand the factors affecting land irritability classification	1.To know about classificati on of lands of India

SW-3 Suggested Sessional Work (SW):

a.Assignments:

- Enlist the techniques used in land use planning for suitable evaluation of different crops

b.Other Activities(Specify): NA

Soil 513.4: To evaluate and understand the Agro-ecological regions/sub-regions in India its status of LUP and characteristics in relation to crop production

Approximate hours

Item	AppX Hrs
Cl	**5**
LI	**0**
SW	**2**
SL	**1**
Total	**08**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To evaluate Land use planning as per agro-ecological regions of India **SO4.2 To understand the concept , distribution of land as per agro-ecological regions of India in relation to crop production**		**Unit-4: To evaluate Land use planning as per agro-ecological regions of India** 4.1. To learn the distribution of Agro ecological regions of India 4.2 To learn the distribution of Sub-regions of India 4.3 To understand the characteristic of agro ecological regions in relation to crop production 4.4 To understand the status of LUP in agro ecological regions 4.5 To understand the use of GIS system in representation of land as per agro ecological regions	1. To know about the agro ecological distribution of soils of India

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the **evaluate Land use planning as per agro-ecological regions of India**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil	8	0	2	1	11
Soil 513.2: To understand the land forms , types concept , capability and irritability classification with	8	0	2	1	11

managing approaches as per agro ecosystem					
Soil 513.3: To understand the concept and techniques of land use planning	9	0	2	1	12
Soil 513.4: To understand the management and distribution of LUP under Agro-ecological regions/ sub regions in relation to crop production	5	0	2	1	8
Total Hours	30	0	8	4	42

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India**	03	04	06	13
CO-2	**Land use types, its relationship with soil evaluation and management with the help of remote sensing and GIS system**	03	04	06	13
CO-3	**To understand the basic concept of land use planning , techniques used and factors governing current land use**	03	04	05	12
CO-4	**To evaluate Land use planning as per agro-ecological regions of India**	03	04	05	12
Total		15	20	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Soil Survey and Land Use Planning** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2002
2.	Soil Genesis and Classification	Boul SW, Hole ED, MacCraken RJ and Southard RJ.	4th Ed. Panima Publication	1997
3.	Spatial and Temporal Statistics	Nielsen DR and Wendroth O.	Catena Verloggmbh	2003
4.	Fabric and Mineral Analysis of Soils	Brewer R.	John Wiley & Sons	1976

Curriculum Development Team

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
4. Dr. T. Singh (Head) Dept. Agronomy, FAST, AKS University
5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
6. Mr. Atul Kumar Singh, Assistant Professor , Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 513

Course Title: Soil Survey and land use Planning

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches	1	2	2	2	3	2	3	2	2	1	2	3	2	2	2	1

as per agro ecosystem																
Soil 513.3: To understand the concept and techniques of land use planning	**1**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**1**	**2**	**2**
Soil 513.4: To understand the management and distribution of LUP under Agro-ecological regions/ sub regions in relation to crop production	**1**	**2**	**-**	**-**	**1**	**-**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil Survey and Land Use Planning

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil**	**SO1.1** **SO1.2**		**Unit-1** To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India **1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8**	**As mentioned in page number _ to _**
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches as per agro**	**SO2.1** **SO2.2**		**Unit-2** Land use types, its relationship with soil evaluation and management with the help of remote sensing and GIS system **2.1,2.2,2.3,2.4,2.5.2.6,2.7,2.8**	

	ecosystem				
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 513.3: To understand the concept and techniques of land use planning**	**SO3.1** **SO3.2**		**Unit-3** To understand the basic concept of land use planning , techniques used and factors governing current land use 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 513.4: To understand the management and distribution of LUP under Agro-ecological regions/ sub regions in relation to crop production**	**SO4.1** **SO4.2**		**Unit-4 To evaluate Land use planning as per agro-ecological regions of India** **4.1,4.2,4.3,4.4,4.5**	

Semester- III

Course Code: Soil 591

Course Title: Master Seminar

Pre- requisite: Students should have knowledge about basic and futuristic technologies subjected to ICT technology and Soil Science and Agricultural Chemistry.

Rationale: Student will become familiar with fundamental application of ICT technologies related with Soil Science and Agricultural Chemistry that will support students in their career skills and leadership development in order to shape tomorrow's social and educational development in Soil science sector.

Course Outcomes:

SOIL 591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
No Credit Course	**SOIL 591**	**Master Seminar**	0	1	1	1	3	(0+1)= 1

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.),**SL:** Self Learning, **C:**Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks(PRA + ESA)
			Class/Home Assignment 5 number3 marks each (CA)	Class Test 2(2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class Activity one (CAT)	Class Attendance(AT)	Total Marks(CA+ CT+SA+ CAT+AT)		
No Credit Course	**SOIL 591**	**Master Seminar**	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should show case their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

SOIL 591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.

Approximate Hours

Item	Approximate Hours
CI	**0**
LI	**2**
SW	**0**
SL	**2**
Total	**4**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 The research seminar allows students to work with ICT technologies, refine their skills and knowledge of the subject **SO1.2.** Research seminars develop vocational qualities in students.	1. Selection of topic and collection of presentation materials by using the ICT tools related to the Soil Science on selected topic 2. Presentation of acquired material in PPT form.		**1.** Finding the topic related material. **2.** Preparation of PPT related to concerned topic.

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Preparation of PPT slides on the given topics as per the advisor

b. **Other Activities (Specify): NA**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.	**30**	**0**	**2**	**32**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO 1	Unit 1. Seminar Presentation regarding Soil Science	20	40	40	100

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Master Seminar** will be 100 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pub made			
5	Academia			
6	Google scholar			
7	Soil Science journals			
8	Multi authored books			
9	Book chapters			
10	As per directions of course instructor.			

Curriculum Development Team:

1. Professor G. C. Mishra, Director Cement Technology, AKS University
2. Dr. S S Tomar(Dean) Dept. of Agriculture Science and Technology
3. Dr. T Singh (Head) Dept. of Agriculture Science and Technology
4. Dr. Sugyata Shivhare, (Head) Assistant Professor , Dept. of Agriculture Science and Technology
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. of Agriculture Science and Technology
6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 591

Course Title: Master Seminar

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 513.1: Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.	3	2	3	1	3	2	3	2	3	2	1	3	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Master Seminar

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**Soil 513.1:** Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.	**SO1.1** **SO1.2**	**LI 1.1,** **LI 1.2**		**As mentioned in page number** **_ to _**

Semester- III

Course Code: SOIL 599

Course Title: Master Research

Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Soil Science and Agricultural Chemistry.

Rationale: The basic purpose of master's research is to understand the application of research methodology tools to do research on particular topic related to Soil science and Agricultural Chemistry and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
Non Credit Course	**SOIL 599**	**Master Research**	0	10	0	0	10	(0+10)= 10

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.),**SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA + ESA)
			Class/Home Assignment 5 number 1 marks each (CA)	Class Test 2 2 best out of 3) 10 marks e ach (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks(CA+CT +SA+ CAT+AT)		
Non Credit Course	**SOIL 599**	**Master Research**	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Approximate Hours

Item	Approximate Hours
CI	**0**
LI	**10**
SW	**0**
SL	**2**
Total	**12**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1. Plan the proposal of research related to the topic taken with the help of guide SO1.2. Design the layout according to topic SO1.3. Describe the terminology related to the topic SO1.4. Plan the methodology to conduct the research on the topic SO1.5. Select the data to be taken during research	**Unit .1. Master Research :** **1.** Submission of research proposal consisting concern programme **2**. Explain definition of the problems reference to topic **3**. Collection of Review of literature as per the Thesis Title **4**. Arrange the references of past work of 20 years **5**. Collection of data by focusing their objectives to be taken mentioned in their synopsis **6** Collection of data by focusing their observations to be taken mentioned in their synopsis and Nutrient analysis of Soil samples before sowing 8 Nutrient analysis of Soil samples after harvest of crop Nutrient analysis of gains/seed of crop		**1.**Finding of reviews related with the topic of research. **2.**Preparation of manuscripts related to concerned topic.

SW-1 Suggested Sessional Work (SW):

a. Assignments: Preparation of PPT slides on the related topic of dissertation by the advisor

b. Other Activities (Specify): Presentation of the observation taken during the research trial in Kharif session

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.		**10**	**2**	**12**
Total		**10**	**2**	**12**

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			

Curriculum Development Team:

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar(Dean) Dept. of Agriculture Science and Technology
3. Dr. T Singh , Professor, Department of Agriculture Science and Technology
4. Dr.Sugyata Shivhare, (Head) Assistant Professor , Dept. of Agriculture Science and Technology
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. of Agriculture Science and Technology
6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 599

Course Title: Master Research

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic	3	3	3	2	3	3	3	2	3	2	3	3	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Master Research

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**SOIL 599.1.** Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	**SO1.1** **SO1.2**		**Unit-1** Master Research **1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8,1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15**	**As mentioned in page number _ to _**

Semester- IV

Course Code: SOIL 599

Course Title: Master Research

Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Soil Science and Agricultural Chemistry.

Rationale: The basic purpose of master's research is to understand the application of research methodology tools to do research on particular topic related to Soil science and Agricultural Chemistry and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study HoursCI+LI+SW+SL	
Non Credit Course	**SOIL 599**	**Master Research**	0	20	0	0	20	(0+20)= 20

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),**LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)**SW:** Sessional Work (includes assignment, seminar, mini project etc.),**SL:** Self Learning,**C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks(PRA + ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks(CA+ CT+SA+ CAT+AT)		
Non Credit Course	**SOIL 599**	**Master Research**	0	0	0	0	0	0	100	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Approximate Hours

Item	Approximate Hours
CI	**0**
LI	**20**
SW	**0**
SL	**2**
Total	**22**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1. Plan the proposal of research related to the topic taken with the help of guide SO1.2. Design the layout according to topic SO1.3. Describe the terminology related to the topic SO1.4. Plan the methodology to conduct the research on the topic SO1.5. Select the data to be taken during research	**Unit .1. Master Research :** **1.** Submission of research proposal consisting concern programme **2**. Explain definition of the problems reference to topic **3**. Collection of Review of literature as per the Thesis Title **4**. Arrange the references of past work of 20 years **5**. Collection of data by focusing their objectives to be taken mentioned in their synopsis **6** Collection of data by focusing their observations to be taken mentioned in their synopsis 7 Nutrient analysis of Soil samples before sowing & after harvest of crop 8 Nutrient analysis of crop 9 Calculation of nutrients uptake by the crop 10 Statistical calculation of the collected data, Collection of Agro metrological data during field preparation till harvest of crop and Compilation of all the chapters of the thesis and preparation of research paper from the thesis		**Soil survey1.**Finding of reviews related with the topic of research. **2.**Preparation of manuscripts related to concerned topic.

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Preparation of PPT slides on the related topic of dissertation by the advisor
b. **Other Activities (Specify):** Presentation of the observation taken during the research

trial in Rabi session

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 599.1. Prepare various research activities related to field analysis of Soil Science and Agricultural Chemistry and compose manuscript i.e., synopsis related to particular topic.		**20**	**2**	**22**
Total		**20**	**2**	**22**

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.
Suggested Instructional/Implementation Strategies:
1.Improved Lecture
2. Tutorial
3.CaseMethod
4.Group Discussion
5. Role Play
6. Demonstration,
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT Blog, Facebook, Twitter, Whats-app, Mobile, Online Sources)
8. Brainstorming

Suggested Learning Resources:
(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			

Curriculum Development Team:

1. Professor G C Mishra, Director Cement Technology, AKS University
2. Dr.S S Tomar(Dean) Dept. of Agriculture Science and Technology
3. Dr. T Singh, Professor, Dept. of Agronomy, FAST, AKS University.
4. Dr.Sugyata Shivhare, (Head) Assistant Professor , Dept. of Agriculture Science and Technology
5. Mr. Atul Kumar Singh, Assistant Professor , Dept. of Agriculture Science and Technology
6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

****

Cos,POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 599

Course Title: Master Research

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	3	3	3	2	3	3	3	2	3	2	3	3	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: SOIL 599: Master Research

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 **PSO 1,2, 3, 4, 5**	**SOIL 599.1.** Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	**SO1.1** **SO1.2**	**Master Research** **1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8,1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15**		**As mentioned in page number _ to _**