

**DEPARTMENT OF SOIL CONSERVATION  
NAGALAND UNIVERSITY  
SASARD, MEDZIPHEMA**

**COURSE CURRICULLUM FOR M.Sc. (Ag) DEGREE PROGRAMME IN SOIL CONSERVATION:**

MINIMUM CREDIT REQUIREMENT:

<b>i. Course work:</b>	<b>Credits hours</b>
Major subject courses	20
Minor subject courses	09
Supporting subject courses	05
Non- credit compulsory courses	Non-Credit
Seminar	01
<b>Total</b>	<b>35</b>
<b>ii. Comprehensive Examination</b>	Non-Credit
<b>iii. Thesis</b>	<b>20</b>
<b>Grand Total</b>	<b>55</b>

COURSES FOR M.Sc. (Ag) IN SOIL CONSERVATION:

**I. Major subjects Courses:**

S. No	Course No	Course Title	Credit hours
1	SCN 501*	Soil Degradation, Conservation, and Restoration	2 (2+0)
2	SCN 502*	Hydrology and Watershed Management	2 (2+0)
3	SCN 503*	Soil Erosion and Sedimentation	3 (2+1)
4	SCN 504*	Soil Conservation Engineering	3 (2+1)
5	SCN 505*	Soil Conserving Ecosystems	3 (2+1)
5	SCN 506*	Soil Conservation Agronomy	2 (1+1)
7	SCN 507*	Soil Fertility and Water management	3 (2+1)
8	SCN 508*	Soil and Water Conservation Methodology	3 (2+1)
9	SCN 509	Irrigation and Drainage	3 (2+1)
10	SCN 510	Ecosystem Management	3 (2+1)
11	SCN 511	Special Topics in Soil and Water Conservation	1 (1+0)
12	SCN 591*	Masters' Seminar	1 (0+1)
13	SCN 599*	Masters' Research	20 (0+20)
*compulsory courses			

**Course structure:**

**1. SCN 501 Soil Degradation, Conservation, and Restoration 2 (2+0)**

**Objectives:** To impart advance knowledge about soil degradation, soil conservation and related issues.

**Theory:**

UNIT I

Modern concept of soil, Importance of soil– main uses of soil. Soil formation rates and ecosystem stability.

UNIT II

Soil degradation– causes and processes, magnitude of soil degradation in India and North Eastern hill (NEH) region. Effect of erosion on agro-ecosystem with emphasis on soil properties. Soil degradation and crop productivity & food security. Soil and water pollution and waste disposal.

UNIT III

Soil conservation. The need to save soil. Man: the key to conservation. Basic aspects of soil and water conservation. Soil resilience and conservation. Characterization of soils and climates in relation to erosion hazards. Impact of global warming on soil and water conservation.

UNIT IV

Soil quality. Management sensitive soil properties and their relationship with soil quality determinants-soil fertility and plant growth conditions and environment quality. Soil quality and sustainability.

UNIT V

Soil restoration. Restoration of agriculturally marginal soils. Saline and alkali soil reclamation. Restoration of mined and oil damaged soils.

UNIT VI

Constraints in soil conservation. Legal aspects of soil conservation. Agencies and organizations involve in soil conservation works.

**Suggested Readings:**

Agassi, M. 1996. Soil erosion, Conservation, and Rehabilitation. Marcell Dekker, Inc. New York.

Barrow, C.J. 1994. Land Degradation-Development and breakdown of terrestrial environments. Cambridge University Press, New York.

Bennet, H.H. 2001. Soil Conservation for sustainable Agriculture. Agrobios (India), Jodhpur.

Datta, S. K. 2006. Soil Conservation and Land Management. International Book Distributors, Dehradun, U.P.

Kovaks, M. (ed.) 1985. Pollution Control and Conservation. Ellis Horwood Limited Publisher, Chichester.

Lawrance, B., R. Stinner and J. H. Garfield (eds). 1984. Agricultural Ecosystems. John Wiley & Sons, New York.

Morgan, R.P.C. 2005. Soil Erosion and Conservation. Blackwell Publishing, Malden, USA.

Singh, K.K., J. Asha, A.K. Singh and A. Tomar (eds.). 2007. Air, Water and soil pollution. Kalyani Publishers, Ludhiana.

**2. SCN 502                      Hydrology and Watershed Management                      2(2+0)**

**Objectives:** To teach principles of hydrology and concept of watershed management and their applicability in natural resource management.

**Theory:**

UNIT I

Hydrologic processes—precipitation, runoff, interception, infiltration, groundwater, evapo-transpiration, unit hydrograph, rainfall- runoff relationship.

UNIT II

Watershed—definition, concept—how a watershed functions, characteristics of a forested watershed. Delineation of small watershed from contours.

UNIT III

Different conservation practices— biological, engineering measures. Effect of various conservation practices on watershed behavior— surface storage, basin recharge and agriculture & forest development. Stream gauging.

UNIT IV

Agricultural equipment for soil conservation— farm animals and tractor drawn implements. Education program in watershed management.

UNIT V

Watershed restoration plans— protective and productive measures. Special agronomic practices for hill agriculture, water harvesting. Future trends in watershed management and land development research.

**Suggested Readings:**

Chow, V.T., M. David and L.W. Mays. 1988. Applied Hydrology. McGraw Hill, New Delhi.

Ghanshyam Das. 2000. Hydrology and Soil conservation. Prentice Hall, Pvt, Ltd. New Delhi.

FAO Conservation Guide 1, 1977. Guidelines for Watershed Management.

Khan, I, 1987. Wasteland afforestation. Oxford & IBH Publishing Co., Pvt., New Delhi.

Lal, R and E. W. Russell (eds). 1981. Tropical Agricultural Hydrology. John Wiley & Sons, New York.

Tideman, E.M. 1996. Watershed Management. Omega Scientific Publication, New Delhi.

**3.        SCN 503                      Soil Erosion and Sedimentation                      3 (2+1)**

**Objectives:** To teach the concepts, factors, methods of prediction and measurement of erosion and sedimentation & control measures.

## **Theory:**

### UNIT I

Soil erosion—man and soil erosion, geographical distribution of erosion, geological and accelerated erosion, forms and amount of erosion, magnitude of soil erosion damage in India, acceptable limits of erosion.

### UNIT II

Rainfall characteristics related to soil erosion-erosivity of rainfall. Land factors affecting erosion—erodibility of soil. Surface runoff and its estimation, rainfall—runoff—soil interactions.

### UNIT III

Erosion prediction— universal soil loss equation. Wind erosion. Gully erosion. Loss of soil and plant nutrients in erosion. Off-site and on-site effects of erosion.

### UNIT IV

Principle of erosion control. Control of erosion on arable and non-arable land. Sedimentation—causes, movement of sediments, sediment characteristics, sediment deposit, method of measurement— stream gauging and reservoir siltation, sediment delivery ratio, silting of reservoirs in India and control measures.

### UNIT V

Soil erosion problem in India with special reference to NEH region, shifting cultivation—problem and alternative strategies.

## **Practical**

Measurement of peak rate of runoff, volume and velocity of runoff. Estimation of soil and nutrient loss in erosion. Planning and conducting an experiment to evaluate impact of erosion on crop production. Acquaintance with equipment and installation for rainfall, runoff and sediment measurements. Visit to soil conservation centers and projects.

## **Suggested Readings:**

Ahmad, E. 1973. Soil erosion in India. Asia Publishing House, New Delhi.

Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.

Chauhan, B.S. (2001) Shifting Cultivation in perspective. Nagaland University, Kohima, India.

Follet, R.F. and B.A. Stewart (eds.). 1985. American society of Agronomy., Crop Science Society of America., Soil Science Society of America, Inc., Publishers, Madison, Wisconsin, USA.

Garde, R.J. and K.G. Ranga Raju. 1977. Mechanics of sediment transport and alluvial stream problems. Wiley Eastern Ltd., New Delhi.

Harold, G. 1985. Erosion – its causes and cure. International Books and Periodical supply services, New Delhi.

Hudson, N. 1989. Soil Conservation. B.T. Botsford, London.

Lal, R.1981. Management of soils for continuous production: Controlling erosion and maintaining physical conditions. In characterization of Soils. D. J. Greenland Clarendon Press, Oxford.

Morgan, R.P.C. 2005. Soil Erosion and Conservation. Blackwell Publishing, Malden, USA.

Tripathi, R.P. and H.P. Singh. 1993. Soil Erosion and Conservation. Wiley Eastern Ltd. New Delhi.

#### **4. SCN 504**

#### **Soil Conservation Engineering**

**3 (2+1)**

**Objectives:** To teach applicability of Engineering techniques in soil and water conservation and land development.

#### **Theory:**

##### UNIT I

Principle of mechanical protection. Planning, design and construction of mechanical protection works –contour trenches, contour bunds, and contour terraces, maintenance of terraces.

##### UNIT II

Delineation of watersheds. Design of temporary and permanent gully control structures. Design of small dams for head water flood control.

##### UNIT III

Design criteria of waterways and diversion ditches, farm ponds, storage reservoirs. Land leveling and design– Land clearing, land leveling and economic land development, earthwork estimation, land development machinery.

##### UNIT IV

Water harvesting ponds and structures with emphasis on rainwater. Flood control and stream bank protection measures. Flood frequency analysis. Remote sensing and geographic information system in soil and water management.

#### **Practical:**

Measurement of slope of land, reading contour maps of different scales and identification of various land features on map including delineation of watershed. Design and layout of terraces, contour bunds and waterways etc. Estimation of volume of earth work and its cost. Survey of longitudinal and cross section of gully and planning gully control structures. Computation of capacity farm ponds from farm contour maps.

#### **Suggested Readings:**

Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.

Mal, B.C. 1995. Soil and Water Conservation Engineering. Kalyani Publishers, New Delhi.

Morgan, R.P.C. 2005. Soil Erosion and Conservation. Blackwell Publishing, Malden, USA.

Murthy, V. V. N. 1985. Land and Water Management Engineering. Kalyani Publishers, New Delhi.

Schwab, G. O, R. K. Frevert, T. W. Edminster and K. K. Barnes. 1981. Soil and Water Conservation Engineering. John Wiley & Sons, New York.

Schwab, G. O, D.D. Fengmeier, W.J.Elliot and R.K. Frevert. 1993. Soil and Water Conservation Engineering. John Wiley & Sons, New York.

## 5. SCN 505

## Soil Conserving Ecosystems

3(2+1)

**Objectives:** To teach the students about the importance of forests, grasslands and pasture ecosystems in soil and water conservation together with their establishment and management in varied conditions.

### Theory:

#### UNIT I

Importance of forests, grasslands and pastures in soil and water conservation. Forest need of the country. National Forest Policy. Deforestation and its consequences. Economics of ecosystem degradation.

#### UNIT II

Wasteland afforestation with special reference to soil management practices to support afforestation of ravines and gullied areas, waterlogged areas, saline and alkaline soils, steep hill slopes, boulder and ravine areas. Choice of species for each problem site with emphasis on the local forest species and techniques of propagation.

#### UNIT III

Forest management. Forest regeneration. Silviculture of some forest plants. Forest destruction– effect of fire on soil and site. Farm forestry, social forestry and agro-forestry systems. Conservation of forests in India.

#### UNIT IV

Cultivated grasses and grassland legumes for tropics and temperate areas. Grassland management. Grass legume association and natural succession. Establishment of pastures and grassland on wastelands, eroded areas. Selection of grasses and legumes for special problem sites.

#### UNIT V

Management of grassland pastures- overgrazing and desertification. The use of shelter belts and wind breaks and other plantation crops in soil conservation.

### **Practical**

Silvicultural characteristics of tree species. Measurement of height, canopy, dbh and density of plants. Preparation of soil conservation and farm forestry plan. Planning vegetative measures for gully plugging, vegetative check dams, landslide and slips. Identification of important grasses and trees in nearby locality. Development of fuel, fodder plantation plan in the field. Observation of compatibility of trees and grasses with agricultural crops. Visit of institutes related to forestry and soil conservation.

**Suggested Readings:**

- Birla Institute of Scientific Research, 1986. Social Forestry in India. Radiant Publisher.
- Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.
- Das Gupta, M., A. K. Gangopadhyay, T. Bhattacharya and M. Chakraborty (eds). 1986. Forestry Development in North East India. Omsons Publications, Guwahati.
- Pritchett, W. L. 1979. Properties and management of forest soils. John Wiley & Sons, New York.
- Ramade, F. 1984. Ecology of Natural Resources. John Wiley & Sons, New York.
- Rao Sita Ram, 1979. Introduction to Social Forestry. Mohan Pramlani for Oxford and IBH Publishing Co., New Delhi.
- Shankarnarayan, K. A. and V. Shankar. 1984. Grasses and Legumes for Forage and soil conservation, ICAR, New Delhi.

**6. SCN 506****Soil Conservation Agronomy****2(1+1)****Objectives:** To teach the principles of agronomy applicable in soil and water conservation.**Theory:**

## UNIT I

Agronomic practices and soil conservation. Strip cropping– functions and types, methods of laying out strips, selecting crops for strip and interculture, procedure to fix strip width and strip ratios of erosion permitting and erosion resistant crops for different climatic belts.

## UNIT II

Tillage and tillth– objectives, tillage for water and wind erosion control. Conservation tillage- concept and advantages. Special farming practices: terrace farming, contour farming and contour tillage. Role of basin listing. Mulch–types and advantages of mulching.

## UNIT III

Cropping systems– mixed cropping, cover cropping, soil depleting and soil building systems. Sustainable agriculture.

**Practical**

Staking for laying out for strip cropping. Practices in contour farming. Judging tillth and moisture in the field. Evaluating soil conserving agronomic practices in the field. Planning and Laying out of field experiments, analysis of data and interpretation of results. Canopy measurement of different field crops. Planning soil conservation cropping systems and fertilizer programmes for small farms. Visit of institutes related to soil and water conservation.

**Suggested Readings:**

- Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.

Chatterjee, B. N. and S. Maiti. 1984. Cropping Systems—Theory and Practices. Oxford and IBH Publishing Co., New Delhi.

FAO. 1978. Soil Erosion by water—Some measures for its control on cultivated lands.

Morachan, Y. B. 1978. Crop Production and Management. Oxford and IBH Publishing Co., New Delhi.

Ruthenburg, H. 1980. Farming systems in the Tropics. Clarendon Press, London.

Reddy, T.Y. and C. H. S. Reddi. 1992. Principles of Agronomy. Kalyani Publishers, Ludhiana.

## **7. SCN507**

## **Soil Fertility and Water Management**

**3 (2+1)**

**Objectives:** To impart knowledge of plant nutrient dynamics in soil and relevant aspects soil fertility & soil water management.

### **Theory:**

#### UNIT I

Fundamentals of soil fertility and soil productivity. Dynamics and availability of major nutrients in soil. Soil properties in relation to nutrient availability.

#### UNIT II

Major aspects of soil fertility management— soil loss, soil drainage, soil structures, soil organic matter, tillage, soil fertility and fertilizer and amendments. Immediate and long-term fertility management of terraced land.

#### UNIT III

Cropping systems and land management. Soil management for optimum production with special reference to rainfed conditions of NEH regions.

#### UNIT IV

Major aspects of soil water management— Soil as a store for water and crop growth, consumptive use of water, water requirement of crops, evapotranspiration, scheduling of irrigation for different crops, optimum allocation of water under different constraints, irrigation water and water use efficiency, moisture stress and plant growth, water and soil properties concerned in tillage, optimizing use of water through soil and crop management and soil water loss.

### **Practical**

Determination of various forms of N, P and K in soils. Estimation of nutrient uptake by crop plants. Planning and layout of experiments related to soil fertility and water management practices, analysis of data and interpretation of results.

### **Suggested Readings:**

Alexander, M. 1978. Introduction to Soil Microbiology. Wiley Eastern (P) Ltd., New Delhi.

Baver, L.D., W. H. Gardner and W. R. Gardner. 1978. Soil Physics, Wiley Eastern (P) Ltd., New Delhi.

Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.

Brady, N.C., 1995. The nature and properties of soils. Prentice Hall India Pvt. Ltd. New Delhi.

Foth, H. D. (1990) Fundamentals of Soil Science, 8<sup>th</sup> ed. John Wiley and Sons, Singapore.

Harrison, A.F. 1987. Soil Organic Phosphorus. C.A.B. International, Wallingford.

I.A.R.I., 1977. Water Requirement and Irrigation Management of Crops in India. IARI, New Delhi.

I.S.S.S, 1976. Potassium in Soils, Crops and Fertilizers. ISSS, New Delhi.

Monteith, J. and C. Webb. 1981. Soil, Water and Nitrogen; Martinus Nijhoot, Dr. W. Junk Publishers, The Hague.

Tisdale, S.L, Nelson, W.L., J.D. Beaton, and J.L. Halvin. 2002. Soil fertility and fertilizers. 5<sup>th</sup> edition, Prentice-Hall of India, Pvt., Ltd., New Delhi.

## **8. SCN 508 Soil and Water Conservation Methodology 3 (2+1)**

**Objectives:** To impart knowledge about erosion research methods and strategies for soil conservation and management of acid and waterlogged soils.

### **Theory:**

#### UNIT I

Erosion research methods—erosion and land degradation assessment, quantitative measurement of impact of erosion, measurement of causes and processes of erosion, experimentation on erosion control and soil conservation practices.

#### UNIT II

Important centrally sponsored soil conservation schemes and projects. Planning ahead. The need for action and research.

#### UNIT III

Strategies for soil and water conservation with special reference to NEH region. Soil conservation techniques for resource poor small land holders, Role of Agroforestry in soil and water conservation with special reference to NEH region.

#### UNIT IV

Acidic soils—their origin, characteristics and management. Crop response to liming. Waterlogged soils— effect of waterlogging on soil properties and plant growth. Availability of important plant nutrients in waterlogged soils with emphasis on N. Management of waterlogged soils for rice production.

#### UNIT V

Fertility problems in eroded soils and their management. Management of dry sands, nutrient depleted sites, landslide areas, oil damaged soils.

### **Practical**

Use of run-off plots in soil erosion studies. Estimation of erosivity from rainfall data. Solving soil conservation problems on a given watershed. Determination of lime and gypsum requirement of soils. Preparation of saturation extract of soil and its analysis for cations and anions and electrical conductivity.

**Suggested Readings:**

- Blanco, H. and R. Lal. 2008. Principles of Soil Conservation and Management, Springer.
- Brester, E., B. L. McNeal and D. L. Carter. 1982. Saline and Sodic Soils. Springer-Verlag, Berlin Heidelberg, New York.
- Lal, R. (ed.). 1988. Soil Erosion Research Methods. Soil and Water Conservation Society, Ankeny, Iowa.
- Maliwal, G.L. and L.L. Somani. 2010. Nature, properties and management of saline and alkali soils. Agrotech Publishing academy, Udaipur, India.
- Mandal, S. C., M. K. Sinha and H. Sinha. 1982. Acid Soils of India and Liming. ICAR, New Delhi Technical Bulletin, 51.
- Morgan, R.P.C. 2005. Soil Erosion and Conservation. Blackwell Publishing, Malden, USA.
- Russell, E. W. 1973. Soil Conditions and Plant growth. Longman Group Ltd., London.

**9. SCN 509****Irrigation and Drainage****3 (2+1)**

**Objectives:** To teach important aspects of irrigation and drainage and their application in soil and water conservation.

**Theory:**

## UNIT I

Water resources and irrigation development in India. Water conveyance and control. Hydraulics of open channels. Design of farm channels. Lining of water courses. Command area management.

## UNIT II

Hydraulic principle of water management. Measurement of irrigation water– velocity-area method, water meter, weir, Parshall flume, orifices etc,

## UNIT III

Water application methods. Irrigation systems and their design. Pumps and tube wells. Comparative efficiency and economics of different methods of irrigation. Time of irrigation, irrigation water measurement.

## UNIT IV

Principle and importance of field drainage. Methods and design of surface and sub-surface drains. Drainage of irrigated lands. Interceptor relief drains and tile drains and their design. Drainage requirement of crops. Drainage in relation to irrigation and salinity control.

**Practical**

Measurement of irrigation water from pumps and tube wells. Design and layout of irrigation drainage systems. Computation of quantity of water to be applied. Measurement of water velocity and water quantity. Preparation of drainage and irrigation plan for a small farm.

**Suggested Readings:**

- Finkel, H.J. 1983. Hand Book of irrigation Technology. Vol. I& II, CRC Press, Inc. New York
- Karmeli, D., G. Pen and M.Todes. 1985. Irrigation Systems: Design and Operation. Oxford University Press. New Delhi.
- Rydzewski. 1987. Irrigation Development planning. John Wiley and sons, New York.
- Sivanappan, R.K., O. Padamkumari and V. Kumar. 1987. Drip Irrigation. Keerthi Publication House, Coimbatore.
- Sivanappan, R.K. 1987. Sprinkler Irrigation. Oxford & IBH, New Delhi.
- Bhattacharaya, A.K and A.M. Micheal. 2003. Land Drainage. Vikas Publishing house Pvt. Ltd. New Delhi..
- Luthin, J.N. 1978. Drainage Engineering. Wiley Eastern Ltd., New Delhi.

**10. SCN 510****Ecosystem Management****3 (2+1)**

**Objectives:** To impart knowledge of different ecosystems and their management.

**Theory:**

## UNIT I

Ecosystem: Agricultural ecosystem– properties and interactions. Nutrient cycling in natural and agro-ecosystems. Effect of erosion on natural and agro-ecosystems. Soil formation rates and ecosystem stability.

## UNIT II

Mountain ecosystem– stability and instability of mountain ecosystem. Principles of management. Management of mountain ecosystem. Hill slope stability and land use.

## UNIT III

Destruction of forest, woodland and natural range lands and their protection and management for long term productivity. Degraded ecosystems and their management.

## UNIT IV

wildlife and biosphere reserves. Environment degradation. Economics of ecosystem degradation.

**Practical**

Measurement of decomposition of organic residues added to the soils. Measurement of various forms of plant nutrients and their movement in agro-ecosystem. Measurement of soil erosion in agro-ecosystem and natural ecosystem. Development of a plan for the management of forest of nearby locality.

**Suggested Readings:**

- Alexander, M. 1978. Introduction to Soil Microbiology. Wiley Eastern (P) Ltd., New Delhi.
- Harrison, A.F. 1987. Soil Organic Phosphorus. C.A.B. International, Wallingford.
- I.S.S.S, 1976. Potassium in Soils, Crops and Fertilizers. ISSS, New Delhi.
- Lawrance, B. R. Stinner and J. H. Garfield (eds). 1984. Agricultural Ecosystems. John Wiley & Sons, New York.



### III. Supporting subject courses:

Supporting courses of minimum 5 credit hours will be offered by the students. Statistics course of 4 credit hours will however, be compulsory.

### IV. Non credit compulsory courses:

S. No	Course No	Course Title	Credit hours
1	PGS 501	Library and information services	1(0+1)
2	PGS 502	Technical writing and communication skills	1(0+1)
3	PGS 503 (e-course)	Intellectual property and its management in agriculture	1(1+0)
4	PGS 504	Basic Concepts in laboratory techniques	1(0+1)
5	PGS 505 (e-course)	Agricultural research, research ethics and rural development programmes	1(1+0)
6	PGS 506 (e-course)	Disaster management	1(1+0)