Course title: Integrated Watershed Management			
Course code: NRE 167	**No. of credits:** 3	**L-T-P:** 33-12-0	**Learning hours:** 45
Pre-requisite course code and title (if any): NRE 162 Hydrology (preferable)			
Department: Energy and Environment			
Course coordinator:		**Course instructor:** Dr C.K. Singh	
Contact details: chander.singh@terisas.ac.in			
Course type: Elective		**Course offered in:** Semester 3	

Course Description

The course is conceptualized to provide competency in understanding the impact of landuse changes on various hydrological cycle parameters and soil erosion and choosing suitable soil and water conservation techniques to control it. It tries to touch upon divergent disciplines relevant to this complex topic. The course is designed as an elective to help capacity building of the candidates to undertake research work or professional assignment in the sub-fields of watershed management, which plays a key role in sustainable development.

Course objectives

1. To understand different watershed behaviour
2. To be able to interpret runoff data and quantify erosion by using various modelling methods
3. To understand land use classification and impact of land use changes on hydrological cycle parameters

Course content

Module	Topic	L	T	P
1.	Introduction, watershed behaviour, understanding hydrological cycle, water budget, effects of land use and its change on hydrological cycle components, land and water management practices, Land capability and suitability classification	6	2	
2.	Measurement of meteorological (temperature, wind speed, sunshine hours, atmospheric pressure, relative humidity) and hydrological (suspended sediment and bed load) parameters Factors impacting runoff, soil moisture conditions for runoff, Modelling Runoff with SCS methodology, modifications suggested for Indian conditions, case study	5	4	
3.	Erosion process–Factors affecting erosion, Types of erosion Assessment of erosion, Modelling Erosion using USLE, RUSLE, introduction to few other models, Indian studies, case study	6	2	
4.	Control measures for soil erosion – vegetative and mechanical (including design), for agricultural and non-agricultural lands Wind erosion and its modelling, control measures	6	2	
5.	Crop water management and crop planning with special reference to different agro-ecological zones in India Water conservation practices for deserts	4	2	
6.	Watershed development in India, Common Guidelines, Allocation of funds Wetland management- types, hydrologic conditions and water budget, hydrological and ecological functions, the Ramsar convention	4	0	
7.	Drought and its management-causes and impacts, definition,	2	0	

	management objectives and strategy-short term and long term measures			
	Total	**33**	**12**	

Evaluation criteria

- **Test 1: Written Test** [at the end of module 1 and 2] 20%
- **Test 2: Written Test** [at the end of module 3,4 and 5] 20%
- **Assignment/tutorial** [after developing holistic understanding of Module, 1-5] 20%
- **Test 3: Written Test** [completion of the syllabus] 40%

Learning outcomes

- Suggest technical measures for soil erosion control both due to water and wind
- Assess the current status of the watershed at field, by taking up accurate investigation measures and conduct survey
- Suggest drought control measures, water conservation structures, including design

Pedagogical approach

Materials

Required text

1. Sharda V.N., Sikka A.K. and Juyal G.P. (2006) *Participatory Integrated Watershed Management: A Field Manual*, Central Soil and Water Conservation Research and Training Institute, 218, Kaulagarh Road, Dehradun.
2. Tideman E.M. (1999) *Watershed Management–Guidelines for Indian Conditions*, Omega Scientific Publishers, New Delhi.

Suggested readings

1. *Common Guidelines for Watershed Development Projects* (2008) Government of India.
2. Dhruva N.V.V. (2002) *Soil and Water Conservation Research in India*, Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi- 110012.
3. Dhruva N.V.V., Sastry G. and Patnaik U.S. (1990) *Watershed Management*, Indian Council of Agricultural Research, New Delhi.
4. Frevert R.K., Schwab G.O., Edminster T.W. and Barnes K.K. (2009) *Soil and Water Conservation Engineering*, 4th Ed, John Wiley and Sons, New York.
5. Jain S.K. and Singh V.P. (2006) Water Resources Systems Planning and Management, Reed Elsevier India Pvt. Ltd., New Delhi.
6. James L.D. and Lee R.R. (1971) *Economics of Water Resources Planning*, McGraw Hill Book Company.
7. Jeffery R. and Vira B. (eds.) (2001) *Conflict and Cooperation in Participatory Natural Resources Management*, Palgrave, Hampshire.
8. Jones C., Palmer R.M., Motkaluk S. and Walters M. (2002) *Watershed Health Monitoring: Emerging Technologies*, Lewis Publishers, Boca Raton, Florida.
9. *Monitoring & Evaluation for Results* (2009) World Bank Institute Training Program: South Asia Regional Course, New Delhi, February, World Bank Institute Evaluation Group, World Bank Institute.
10. *More Water for Arid Lands: Promising Technologies and Research Opportunities* (2001) U.S.NationalAcademy of Sciences, Honolulu, Hawaii.
11. Mukherjee A. (2004a) *Participatory Learning and Action: Monitoring and Evaluation and Participatory Monitoring and Evaluation*, Concept Publishing Company, New Delhi.
12. Mukherjee A. (2004b) *Participatory Rural Appraisal: Methods and Applications in Rural*

Planning, Concept Publishing Company, New Delhi.
13. Rajora R. (1998) *Integrated Watershed Management–Field Manual for Equitable, Productive and Sustainable Development*, Rawat Publications, Jaipur.
14. Rao K.V.S. (2003) *Watersheds: Comprehensive Development*, B.S. Publications, Hyderabad.
15. Samra J.S., Sharda V.N. and Sikka A.K. (2002) *Water Harvesting and Recycling: Indian Experiences*, Central Soil and Water Conservation Research and Training Institute, Dehradun.
16. Sharda V.N., Juyal G.P., Prakash C. and Joshi B.P. (2007) *Training Manual, Soil Conservation and Watershed Management Volume I-III*, Central Soil and Water Conservation Research and Training Institute, Dehradun.
17. Singh G., Venkataraman C., Sastry G. and Joshi B.P. (1990) *Manual of Soil and Water Conservation Practices*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
18. Singh G.D. and Poonia T.C. (2003) *Fundamentals of Watershed Management Technology*, Yash Publishing House, Bikaner.
19. Singh R.V. (2003) *Watershed Planning and Management*, Yash Publishing House, Bikaner.
20. Suresh R. (2002) *Soil and Water Conservation Engineering*, Standard Publishers Distributors, New Delhi.
21. Suresh R. (2005) *Watershed Hydrology*, Standard Publishers Distributors, New Delhi.

Journals
1. Hydrology Journal, Indian Association of Hydrologists, Roorkee
2. Journal of Soil and Water Conservation, Central Soil and Water Conservation, Research and Training Institute, Dehradun
3. Photonirvachak, Journal of Indian Society of Remote Sensing, Dehradun

Additional information (if any)

Student responsibilities

Attendance, feedback, discipline, guest faculty etc