COURSE STRUCTURE AND SYLLABUS FOR M.TECH (LAND AND WATER RESOURCES ENGINEERING) PROGRAMME

DEPARTMENT OF AGRICULTURAL ENGINEERING AND TECHNOLOGY,
SCHOOL OF ENGINEERING AND TECHNOLOGY
NAGALAND UNIVERSITY, KOHIMA CAMPUS

SEMESTER 1						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELT501	On-farm water management	3	1	0	4
2	AELT502	Climate change and water resources	3	1	0	4
3	AELT503	Integrated Watershed Management and Modelling	3	1	0	4
4	AELT504	Stochastic Hydrology	3	1	0	4
5	AELE5**	Elective 1	3	1	0	4
6	AELE5**	Elective II	3	1	0	4
					Total	24
SEMESTER 2						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELT505	Groundwater Hydrology	3	0	2	4
2	AELT506	Open Channel Hydraulics	3	1	0	4
3	AELT507	Water Resources System Analysis	3	1	0	4
4	AELT508	Geoinformatics for Land and Water Management	3	1	0	4
5	AELT509	Geoinformatics for Land and Water Management Lab	0	0	4	2
6	AELE5**	Elective III	3	1	0	4
					Total	22
SEMESTER 3						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELT601	Research Methodology & Proposal Writing	**3**	1	0	4
2	AELE6**	Elective IV	3	1	0	4
3	AELE6**	Skill Enhancement Elective V	3	1	0	4
4	AELT602	Seminar	0	3	0	3
5	AELT603	M.Tech. Thesis (Part I)	0	0	20	10
					Total	25
SEMESTER 4						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELT604	M.Tech. Thesis (Part II)	0	0	20	10
2	AELT605	Comprehensive Viva-Voce	0	0	16	8
					Total	18
					Grand total credit	**89**
Elective courses I & II						
S.N.	**Course**	**Course title**	**L**	**T**	**P**	**Credits**
	code					

1	AELE501	Hydrological Modelling of Small Watersheds	3	1	0	4
2	AELE502	Surface Water Hydrology	3	1	0	4
3	AELE503	Human Resource Management	3	1	0	4
4	AELE504	Flow Through Porous Media	3	1	0	4
Elective courses III						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELE505	Statistical Methods in Agriculture	3	1	0	4
2	AELE506	Water Resources Planning and Management	3	1	0	4
Elective courses IV						
S.N.	**Course code**	**Course title**	**L**	**T**	**P**	**Credits**
1	AELE601	Pumping Systems	3	1	0	4
2	AELE602	River Basin planning and management	3	1	0	4
Skill Enhancement Elective V						
1	AELE603	Disaster Management	3	1	0	4
2	AELE604	Project Management	3	1	0	4
3	AELE605	Application of Computer Programming in Land and Water Resources Engineering	3	1	0	4

AELT501 On-Farm Water Management

- Irrigation Systems and Water Management in India: Annual utilizable water resources of India, annual water demand for irrigation and other purposes, water balance, significance of irrigation in India, classification of irrigation systems, irrigation potential and expansion, prevalent water allocation and distribution practices, irrigation management organizations, overview of water management in India, national water policy, concept of sustainable development and its criteria, sustainable water use.
- Canal Irrigation Management: Layout of irrigation systems, need for canal irrigation management, causes of poor performance of irrigation systems, strategies for improving canal irrigation management, modern concepts of irrigation management, irrigation efficiencies, canal outlets and their suitability, criteria for analyzing the behavior of outlets, canal regulation, performance evaluation of irrigation systems.
- Farm Water Delivery System and Control: Design of field channels and underground pipelines, water regulating and diversion structures.
- Irrigation Requirements and Scheduling: Evapotranspiration, direct measurement and estimation of evapotranspiration, effective rainfall, irrigation scheduling, scheduling strategies, crop production functions.
- Waterlogging, Salinisation and Lining of Distribution System: Effects and causes of waterlogging, salinisation process and damage, average root zone salinity, use of marginal and poor quality water, salt balance calculations, regional salt balance, remedial measures, conjunctive use of surface water and groundwater, canal losses,

lining of irrigation channels, types of lining, design of lined canal, economics of canal lining.

- Farm Irrigation System Design: Types of farm irrigation systems, application methods and design, performance evaluation of farm irrigation system.
- Micro Irrigation Systems: Micro irrigation systems versus surface irrigation systems, types of sprinklers, principles of sprinkler operation, uniformity coefficient, economic design of a sprinkler system, system design efficiency, trickle irrigation systems, control head, trickle system components, water distribution in the soil profile, trickle system design, fertigation, irrigation automation.
- Drainage of Irrigated Land: Drainage problems, sources of excess water, drainage systems, drainage requirements, planning and design of drainage systems, design of pipe drainage systems, well drainage, mole drainage, cost evaluation of drainage projects.
- Environmental Impact Assessments (EIA): Definition and purpose of EIA, principles of EIA, EIA process and target groups, resources needed for EIA.

Recommended Books:

1. Applied Hydrology, V.T. Chow, D. Maidment and L.W. Mays, McGraw-Hill,1988.
2. Hydrology and Soil Conservation Engineering, G. Das, PHI Learning India Pvt. Ltd., New Delhi, 2000.
3. Watershed Management, E.M. Tideman, Omega Scientific Publication, 1996.
4. Elementary Hydrology, V.P. Singh, Prentice-Hall, 1994.

AELT502 Climate Change and Water Resources:

- Basic concept of climate, climate and weather, climatic classification; drivers of climate change, overview of changing climate, analysis of climate change
- Hydrologic system overview, global and national water budget, rainfall and temperature variability
- An overview of climate change effects on water (runoff, ET, soil moisture, groundwater) and soil (sediment) resources; climate change and droughts and floods; atmospheric circulation
- Climate forecast: GCM and RCM; overview of future climate scenarios; assessment of future water resources (surface/ groundwater/ soil moisture) status and vulnerability
- Application of hydrologic models in present and future resources assessment; climate change adaptation, capacity and methods analysis

Recommended Books:

1. Climatology – An Atmospheric Science, J.E. Oliver and J.J. Hidore, Pearson Education Inc., New Delhi, 2011.
2. IPCC and NIPCC Reports3, Hydrology and Hydro climatology: Principles and Applications, M. Karamouz, S. Nazif and M. Falahi, CRC Press, Florida, 2013.

AELT503 Integrated Watershed Management and Modelling

- Concept of integrated watershed management; consequences of watershed deterioration; watershed management strategies and responses to problems

- Farming system and production technology in watershed; use of agro-forestry in management of hilly watersheds
- Concept of operational watershed, national land use policy, legal and social aspects
- Watershed modelling: scope, classification, technology and analysis, case studies
- Watershed planning processes, watershed and environment, monitoring and evaluation of watershed projects

Recommended Books:

1. Watershed Planning and Management, R.V. Singh, Yash Publishing House, Bikaner, 2000.
2. Hydrology and Soil Conservation Engineering: Including Watershed Management, G. Das, Prentice-Hall of India Learning Pvt. Ltd., New Delhi, 2008.
3. Watershed Management, V.V. Dhruva Narayana, G. Sastry and U.S. Patnaik, ICAR Publication, New Delhi, 1997.
4. Integrated Watershed Management: Principles and Practice, I.W. Heathcote, John Wiley & SonsInc., New Jersey, 2009.
5. Hydrology and the Management of Watersheds, K.N. Brooks, P.F. Folliott, H.M. Gregersen and L.F. DeBano, Wiley-Blackwell,1991.

AELT504 Stochastic Hydrology

- Probabilistic modelling of hydrological process: data requirement, plotting position, continuous probability distribution functions, parameter estimation techniques, goodness of fit test, estimation of return period
- Risk and reliability concept in hydrology: Computation of risk, discrete probability distribution functions
- Time series analysis and forecasting of hydrological processes, sequential generation of hydrological data, stream flow forecasting
- Regional frequency analysis, analysis of low flows
- Range and storage analysis

Recommended Books:

1. Statistical Methods in Hydrology, C.T. Hann, East West Press, 2002.
2. Stochastic Hydrology, P.J. Reddy, Laxmi Publication Pvt. Ltd., New Delhi, 1997.
3. Introduction to Time Series and Forecasting, P.J. Brockwell and R.A. Davis, Springer, New York, 2002.
4. Time Series Analysis, Forecasting and Control, G.E.P. Box, G.M. Jenkins, G.C. Reinsel and G.M. Ljung, John Wiley and Sons Inc., New Jersey, 2015.

AELT505 Groundwater Hydrology

- Ground water development in India; Aquifers: types, properties, determination of specific yield - laboratory and field methods, evaluation of aquifer properties
- Properties affecting groundwater storage and movement; groundwater balance
- Well hydraulics, 2D flow, steady and unsteady state flow in confined and unconfined aquifer, steady flow in semi confined aquifer, steady flow in sloping aquifers and in partial penetrating wells
- Design and construction of tube wells

- Groundwater development and modelling

Recommended Books:

1. Ground Water Hydrology, D.K. Todd, Wiley Eastern, 1997.
2. Ground Water, H.M. Raghunath, Wiley Eastern, 1992.
3. Concept and Models in Groundwater Hydrology, P.A. Domenico, McGraw-Hill, 1972.
4. Numerical Groundwater Hydrology, A.K. Rastogi, Penram International Publishing, Mumbai, 2007.

AELT506 Open Channel Hydraulics

- Open channel and their properties, energy and momentum, critical flow computation and application
- Uniform flow and flow resistance; Sheet flow; Concepts of boundary layer and surface roughness; Theoretical uniform flow equations; Instability of uniform flow
- Gradually varied flow; Flow profile classification and computation methods; Flow profiles in natural channels; Spatially varied flow
- Hydraulic jump and its use as energy dissipator, flow through channel of non-linear alignment and flow through non-prismatic channel sections.
- Unsteady flow, gradually varied unsteady flow and rapidly varied unsteady flow.

Recommended Books:

- Open Channel Flow, M.H. Chaudhry, Prentice Hall,1993.
- Open Channel Hydraulics, V.T. Chow, McGraw-Hill, 1959.
- Open Channel Flow, F.M. Henderson, McMillan,1966.
- Open Channel Hydraulics, T. Sturm, McGraw-Hill, 2009.

AELT507 Water Resources System Analysis

- Concepts and significance of optimization in water resources, objective functions, deterministic and stochastic inputs
- Mathematical programming techniques, linear programming and its extension, simplex method, revised simplex method, simplex method-duality
- Transportation problem, Non-linear programming of simple cases
- Dynamic programming-multi stage decision process, goal programming
- Application of optimization techniques for water resources

Recommended Books:

1. Operations Research: Principles and Practice, A. Ravindran, D.T. Phillips and J.J. Solberg, Wiley Publication, 2007.
2. Operations Research: An Introduction, H.A. Taha, Pearson, 2016.
3. Operations Research, P.K. Gupta and D. S. Hira, S. Chand &Company Ltd.,2005.
4. Water Resources Systems Planning and Management, M.C. Chaturvedi, McGraw-Hill, 1987.
5. Water Resources Systems Modelling Techniques and Analysis, S. Vedula, P. P. Mujumdar, Tata McGraw-Hill Publishing Company Limited, New Delhi,2007.

AELT508 Geo-informatics for Land and Water Management

- Remote sensing: fundamentals, physics of remote sensing, electromagnetic radiation, interaction of ENR with atmosphere, earth surface, soils, water and vegetation.
- Data acquisition; photographic system and imaging systems; visible, NIR, SWIR, and TIR imagery; photogrammetry: vertical photographs, photo interpretation, visual analysis, stereoscopic analysis.
- Digital image processing: image rectification, enhancement, classification and its accuracy.
- Geographic Information System (GIS) approach to integration of spatial and attribute data for capturing, analysis, manipulation and portrayal of natural resources; data types/formats; integration of GIS with remote sensing and Global Positioning System
- Application of RS and GIS technologies in water resources and watershed management; case studies

Recommended Books:

1. Remote Sensing and Image Interpretation, T.M. Lillesand and R.W. Keifer, John Wiley and Sons Inc., New York, 2000.
2. Concept and Techniques of Geographic Information System, C.P. Lo and A.K.W. Yeung, PHI Learning Pvt. Ltd., 2002.
3. Remote Sensing in Water Resources, S.M. Ramasamy, Rawat Publication, 2005.
4. Fundamentals of Geographic Information System, M.N. Demers, John Willey & Sons, 2005.
5. Remote Sensing and its Applications, L.R.A. Narayan, Universities Press, 1999.

AELT509 Geo-informatics for Land and Water Management Lab

AELE501 Research Methodology and Proposal Writing:

- Introduction to Research Methodology: Importance of Research in Decision Making, Defining Research Problem and Formulation of Hypothesis, Experimental Design.
- Data Collection and Measurement; Methods and Techniques of Data Collection, Sampling and sampling Designs, Data Presentation and Analysis; Data Processing.
- Attitude Measurement and Scales; Statistical Analysis and Interpretation of Data, Non-Parametric Tests, Multivariate analysis of Data.
- Measures of Central Tendency, Dispersion, Variation, Correlation, Regression, Model building and Decision Making.
- Report Writing and Presentation: Substance of Reports, formats of Reports, Presentation of Report.

Recommended Books:

1. Research Methodology, C.R. Kothari, New Age Publications, New Delhi,
2. Research Methodology, B. Taylor, G. Sinha and T. Ghoshal, Prentice Hall of India, New Delhi,
3. Research Methodology, R. Panneersalvam, Prentice Hall of India, New Delhi, 2007.
4. Management Research Methodology, K.N. Krishnaswamy, A.I. Sivakumar and M. Mathirajan, Pearson Education, New Delhi, 2008.

AELE502 Hydrological Modeling of Small Watershed

- Hydrological modeling of small watershed: introduction, physical characteristics of watersheds, instrumentation and data collection, generation of hydrologic information
- Hydrologic simulation overview: types of mathematical models, hydrologic simulation models: classification, components, steps; Optimization models in hydrology
- Erosion and sediment yield: sediment yield process and modelling
- Event Based Streamflow Simulation (EBSS): data needs, structure, building of EBSS models, calibration parameters, example EBSS models
- Continuous Streamflow Simulation (CSS): data needs, parameter estimation, building of CSS models, example CSS models

Recommended Books:

1. Introduction to Physical Hydrology, M.R. Hendricks, Oxford University Press, New York,2010.
2. Hydrology of Small Watersheds, P.V. Seethapathi, D. Dutta and R.S. Kumar, TERI Press, Darbari Seth Block, New Delhi,2008.
3. Elementary Hydrology, V.P. Singh, Prentice-Hall of India Pvt. Ltd., New Delhi,1994.
4. Introduction to Hydrology, W. Viessman and G.L. Lewis, Prentice-Hall of India Pvt. Ltd., New Delhi,2008.
5. Remote Sensing and its Applications, L.R.A. Narayan, University Press (India) Ltd., Hyderabad, 1999.
6. Remote Sensing in Water Resources, S.M. Ramasamy, Rawat Publications, Jaipur, 2005.

AELE503 Surface Water Hydrology

- Review of basic hydrology; Hydrometeorology; Evapotranspiration; Infiltration Runoff and hydrograph analysis;
- Flood routing - lumped, distributed and dynamic approaches;
- Hydrologic statistics; Frequency analysis and probability;
- Introduction to environmental hydrology; Urban hydrology; Design issues in hydrology

Recommended Books:

1. Applied Hydrology, V.T. Chow, D. Maidment and L.W. Mays, McGraw-Hill,1988.
2. Hydrology and Soil Conservation Engineering, G. Das, PHI Learning India Pvt. Ltd., New Delhi, 2000.
3. Watershed Management, E.M. Tideman, Omega Scientific Publication, 1996.
4. Elementary Hydrology, V.P. Singh, Prentice-Hall, 1994.

AELE504 Human Resources Management:

- Theoretical foundations of HRM, HRD- an overview, Macro level manpower planning and Labour Market analysis, Organizational human resource planning (HRP).
- Market, Business, Competition and Strategy, HRD strategies, design and experience, Manpower inventory, Models and techniques of manpower Demand and Supply forecasting.

- Design of HR Systems for Competitive Advantage, HRD culture and climate, Behavioural factors in human resource planning-Wastage analysis, Retention, Redeployment, Exit strategies
- Career development, HRD climate and culture, QWL, Management of change. Managing Growth: People Agenda, Managing Change: People Agenda.
- HRM for Corporate Globalization, HR for Mergers, Acquisitions and Joint Ventures, Emerging trends and experiences, TQM and HRD strategies, Human resource information system (HRIS), Human resource valuation and Accounting (HRA).

Recommended Books:

1. Strategic Human Resource Development, T. Agarwala, FMS, Delhi University, New Delhi,
2. Strategic Human Resource Development - A Guide to Action, M. Armstrong, Kogan Page Publications, New Delhi,
3. HR: Development, Planning and Deployment, A.K. Sen, Asian Books Pvt. Ltd., New Delhi.

AELE505 Flow Through Porous Media

- Aquifer and fluid properties, forces holding water in soils, hydrodynamics in porous media and limitations of governing laws.
- Differential equations of saturated flow, initial and boundary conditions
- Dupuit and Boussinesq approximations and linearization techniques.
- Stream functions and potential functions, solutions of confined and unconfined flow problems.
- Unsaturated flow theory and simulation of soil moisture dynamics; Infiltration and capillary rise flux dynamics, analysis of seepage from canals and ditches.

Recommended Books:

1. Dynamics of Fluid Flow in Porous Media, J. Beer, Dover Publications Inc., New York,1972.
2. Groundwater and Seepage, M.E. Harr, Dover Publications Inc., New York,1962.
3. The Flow of Homogeneous Fluids through Porous Media, M. Muskat and R.D. Wyckoff, J.W. Edwards,1946.
4. Physical and Chemical Hydrogeology, P.A. Domenico and F.W. Schwartz, John Wiley and Sons Inc., New Jersey, 1998.
5. Numerical Methods in Subsurface Hydrology, I. Remson, G.M. Hornberger and F.J. Moiz, Wiley Interscience,1971.

AELE506 Statistical Methods in Agriculture:

- Probability, random variable, discrete and continuous random variables and their probability distribution, distribution functions and their properties
- Conditional probability, independence of events, Bayes theorem, mathematical expectation, moments and moments generating function
- Tests of hypothesis for small and large sample sizes
- Methods of east squares, simple linear regression and correlation, multiple linear Regression
- Design and analysis of experiments: analysis of variance for one and two-way classified data, CRD, RBD and LSD

Recommended Books:

1. Fundamentals of Statistic, Vol. I and II, A.M. Groom, M.K. Gupta and B. Dasgupta, The Works Press Pvt. Ltd., Kolkata.
2. Introduction to Probability and Mathematical Statistics, V.K. Rohatgi, Wiley Eastern, New Delhi, 1976.
3. Experimental Design, W.G. Cochran and G.M. Cox, John Wiley and Sons, 1966. Design and Analysis of Experiments, M.N. Das and J. Giri, Springer Verlag.

AELE507 Water Resources Planning and Management

- Water resources system: concept, characteristics and system analysis techniques; challenges in water sector
- Reservoir capacity and yield, flow duration curve, reservoir planning and losses
- Reservoir operation: concept, critical issues, operation, reservoir sedimentation – problems, factors influencing, and life of reservoir
- Cost-Benefit analysis, conjunctive water use planning, project economic s and evaluation
- Integrated river basin development, inter-basin transfer, case studies of river water disputes, environmental impact assessment of water resources projects.

Recommended Books:

1. Water Resources Systems Planning and Management, S.K. Jain and V.P. Singh, Elsevier, Amsterdam, 2003.
2. Water Resources Systems: Modelling Techniques and Analysis, S. Vedula and P.P. Mujumdar, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005

AELE601 Pumping System

- Water lifts: indigenous and modern devices
- Basic design of centrifugal pumps; its operation, installation and efficiency
- Principle and performance characteristics of turbine pumps, submersible pumps and axial flow pumps and their selection and design criteria
- Non-conventional energy sources for pumping, wind mills, solar pumps, hydraulic ram - their selection and design criteria
- Criteria for pump selection and matching of prime movers, design of pumping station, techno-economic evaluation

Recommended Books:

1. Water Well and Pump Engineering, A.M. Michael and S.D. Khepar, Tata McGraw-Hill Co. Ltd., New Delhi, 2003.
2. Centrifugal Pumps and Blowers, A.H. Church and Jagdish Lal, Metropolitan Book Co., 1973.
3. Hydraulic and Fluid Mechanics, P.N. Modi and S.M. Seth, Standard Book House, 2000.

AELE602 River Basin Planning and Management

- Introduction to Integrated River Basin Management; Water scarcity issues: present and future status; Inter and Intra-basin water transfer issues; Concepts of water footprint (blue, green, grey and virtual water), water use efficiency and their assessment.

- River Basin Fundamentals: River characteristics, flow classification, river morphology, river bends and meandering, bifurcation and confluences. Use of flood routing models in sectoral water allocation policy issues.
- Principles of River Basin Planning Processes; Water Allocation Principles and Policies; Computer models for Integrated River Basin management. Regional Water Demands for Domestic, Agricultural and Industrial uses.
- Environment flow: Definition and assessment Surface water and groundwater resources assessment techniques Fundamentals of solute transport dynamics in rivers; Concept of surface water and groundwater interactions.
- River infiltration. Sources of water pollution at basin scale and their management (soil erosion, river bank erosion, point and non-point sources).
- Reservoir operation policies; Optimization techniques for multi-purpose reservoir systems operation; Modeling and analysis approaches. Flood forecasting and warning system.

Recommended Books:

1. Integrated River Basin Management through Decentralization, K.E. Kemper, A. Dinar, and W. Blomquist, The world Bank, Springer, 2007
2. River Basin Planning: Principles, Procedures and Approaches for Strategic Basin Planning, G. Pegram, L. Yuanyuan, T.L. Quesne, R. Speed, L. Jianqiang and S. Fuxin, Asian Development Bank, GIWP, UNESCO, and WWF-UK, 2013.

AELE503 Disaster Management

- Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
- Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.
- Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.
- Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India.

Recommended Books:

1. An Introduction to Disaster Management Natural Disasters and Man made Hazards, S Vaidyanathan, CBS, New Delhi, 1905.
2. Natural hazards and Disaster Management: Vulnerability and Mitigation, R B Singh, Rawat Publications, Jaipur Rajasthan, 2006.

AELE604 Project Management:

- Definition of Project, Need of Project Management, Project Development Cycle, Project Planning, Project Environment analysis, Project Report Preparation; Preliminary Screening, and Feasibility Report preparation and analysis
- Project Evaluation; Market and Demand analysis, Demand Forecasting, Technical, Financial, Socio-economic, Environmental and Entrepreneurial analyses of project, Project Selection Criteria, Project Implementation.
- Resource Planning and Allocation, Estimation of Project Cost, Cost of Capital, Means of Finance, Working Capital requirement, Profitability projection, Cash Flow Analysis, Breakeven analysis.
- Financial Analysis, Financial Statements, Balance Sheet, Ratio Analysis, Depreciation of Fixed Assets, Social Benefit-Cost Analysis
- Project Review Techniques, Network Technique, Programme Evaluation Review Technique (PERT), Network scheduling, CPM, Activity scheduling, Time-cost trade-offs

Recommended Books:

1. Project Management, R. Panneerselvam and P. Senthilkumar, PHI, New Delhi, 2009.
2. Project Management for Business and Technology, J.M. Nicholas, Pearson Education, New Delhi, 2009.
3. Project Formulation, Implementation and Appraisal, P. Chandra, Tata McGraw-Hill, New Delhi, 2006.
4. Financial Management, P. Chandra, Tata McGraw-Hills Publishing Co. Ltd., New Delhi,
5. Project Management, H. Kerzner, CBS Publisher and Distributor, New Delhi, 2004.

AELE605 Application of Computer Programming in Land and Water Resources Engineering

- Introduction to programming and problem solving; programming basics: loops and decisions; structures; functions; objects and classes; arrays and strings; pointers
- Overview of different programming platform and languages: Microsoft Excel Macro, Matlab, C, C++, Python, VBA, Visual Studio, GUI design
- Estimation of hydrologic elements by programming
- Writing programs for simple rainfall-runoff models
- Writing programs for soil conservation structure designing

Recommended Books:

1. Programming Microsoft Visual Basic 6.0, F. Balena, Microsoft Press, 1999.
2. Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, R. Pratap, Oxford University Press, 2016.
3. Matlab Programming, Y.K. Singh and B.B. Choudhuri, Prentice Hall, 2007.
4. Object-Oriented Programming in C++, R. Lafore, Sams Publishing, 2001.
5. Learn Python the Hard Way, Z.A. Shaw, Addition Wesley, Massachusetts, 2014.