COURSE CONTENT

Academic Year	AY2018/19	**Semester**	2
Course Coordinator			
Course Code	CV2016		
Course Title	Hydrology		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lecture: 26 hrs; Tutorial: 13 hr; Lab: 0 hr.		
Proposal Date	30 September 2018		

Course Aims

To introduce the basic topics of engineering hydrology. You would be able to estimate the risk and probability of occurrence of certain hydrologic events, and in particular, assess the magnitude of the rainfall, and runoff from a catchment. You will also be able to route the flood/flow through channel and reservoir, and conduct evaluation of the stage and potential of flooding. This course also forms the first course towards water resources engineering.

Intended Learning Outcomes (ILO)

By the end of this course, you would be able to:

1. Describe and apply the basic principle of engineering hydrology;
2. Perform frequency analysis and hydrologic design based on return periods
3. Evaluate water budget in a catchment;
4. Assess performance of a groundwater aquifer;
5. Define a catchment and determine the effects of various factors on runoff hydrograph; generate and synthesise runoff hydrographs
6. Calculate streamflow rate based on measured data;
7. Design and sizing of reservoir capacity;
8. Perform reservoir/channel routing

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1.	Hydrologic cycle and basic meteorology	1	
2	Probability in hydrology: data selection, frequency analysis	2	1
3	Interpretation of precipitation data	4	2
4	Evaporation and transpiration. Infiltration and percolation	2	1
5	Groundwater: aquifers, yield, hydraulics of groundwater flow	3	2
6.	Definition of catchment characteristic	1	
7.	Surface runoff and Streamflow hydrograph	3	2
8	Unit hydrograph: derivation, synthesis and applications	4	2

9.	Reservoir yield and storage	3	1
10.	Flood routing: storage equation, reservoir and channel routing	3	2
	Total:	26	13

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
1. Final Examination	1, 2, 3, 4, 5, 6, 7, 8	CVE SLOs (2018) a, d, e, g, j	60%	Individual	
2. Continuous Assessment 1 (CA1) : Quiz 1	1, 2, 3, 4, 5	CVE SLOs (2018) a, d, e, g, j,	20%	Individual	
2. Continuous Assessment 2 (CA2): Quiz 2	2, 6, 7	CVE SLOs (2018) a, d, e, g, j,	20%	Individual	
Total			100%		

CVE SLOs (2018)

a) **Engineering Knowledge**: Apply the knowledge of mathematics, natural science, engineering fundamentals, and civil engineering specialisation to the solution of complex civil engineering problems.

b) **Problem Analysis**: Identify, formulate, research literature, and analyse complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/development of Solutions**: Design solutions for complex civil engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) **Investigation**: Conduct investigations of complex problems using research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex civil engineering activities with an understanding of the limitations.

f) **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and Sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.

h) **Ethics**: Apply ethical principles and commit to professional and moral responsibilities in the civil engineering practice.

i) **Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) **Communication**: Communicate effectively on complex civil engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation, and make effective presentations.

k) **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

l) **Life-long Learning**: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological evolution.

Formative feedback

The instructor(s) will provide feedback on your performance on the CA; Guidance will also be provided through active interactions during tutorial sessions and consultation meetings,

Learning and Teaching approach

Class meets three times per week in lecture (2 hours) and tutorial (1 hour) format.

Approach	**How does this approach support students in achieving the learning outcomes?**
Lecture	Formal lectures on the topics with in-class discussions
Tutorial	This helps you to achieve one or more of the outcomes as you would need to work on tutorial questions using the concepts and principles

	taught in lectures. (The class is split into groups for tutorials so that the instructor-student interaction can be more effective.)

Reading and References

Textbooks :
1. Warren Viessman, Jr. and Gary L. Lewis (2012) "Introduction to Hydrology", Pearson Singapore (Fifth Edition).

References :
1 Wilson, E.M., "Engineering Hydrology, 4th Edition, Macmillan, 1990

Course Policies and Student Responsibilities

You are advised to go through the class material before lecture. You are also encourage to share and deliberate on the challenges and difficulties of the tutorial exercises during the tutorials.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
A/P Tan Soon Keat	N1-01b-50	6790 5321	ctansk@ntu.edu.sg
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Planned Weekly Schedule

Week	Topics	Course ILO	Activities
1	Hydrologic cycle and basic meteorology Introduction: Distribution of water; the hydrologic cycle; hydrology in engineering design; Heat balance of Earth's surface and atmosphere; Temperature; Lapse rate; Humidity; wind.	1	1 Lecture and 1 tutorial Discussion on hydrologic cycle and identify relevant hydrologic elements
1 and 2,	Probability in hydrology: data selection, frequency analysis Application of probability in hydrologic processes: selection of data; time series; plotting positions; distribution; flood probabilities; precipitation probabilities; design rainfall; intensity duration frequency curve; probable maximum precipitation;	2	2 lectures 1 Tutorial exercise on probability in hydrologic events
2 and 3	Interpretation of precipitation data - 1 Types of precipitation; formation of precipitation; measurement of precipitation; Interpretation of the precipitation data; estimating missing precipitation data, double mass analysis,	2,3	2 lectures 1 tutorial exercise on rainfall time series
3 and 4	Interpretation of precipitation data - 2 average rainfall over area, depth-area-duration analysis; geographic variations	2,3	2 lectures 1 tutorial exercise on computation of average rainfall over time and space
4 and 5	Evaporation and transpiration. Infiltration and percolation water budget; energy budget; Pan evaporation; transpiration; evapotranspiration; Percolation and sub-surface water: percolation rate; water budge method; existence of sub-surface water	2,3	2 lectures 1 tutorial exercise on rainfall losses and use of water budget method in water resources assessment
5 and 6	Groundwater: aquifers, yield, hydraulics of groundwater flow-1 Types of groundwater aquifer; types of well; movement of soil water; groundwater hydraulics for subsurface water; yield Pump testing; time drawdown and distance drawdown; salt water intrusion	4	3 lectures 2 tutorial exercise and discussion on ground water aquifer, drawdown and yields
7	Quiz – CA 1		
7	Definition of catchment characteristic catchment characteristics; climatic factors; stage and discharge measurements;	5, 6	1 introductory lecture
9	Surface runoff and Streamflow hydrograph - 1 Relationship between precipitation and runoff;	5, 6	3 lectures

	hydrograph components; recession/depletion curves; streamflow recessions; hydrograph separation ; effective rainfall;		2 tutorial exercises on hydrograph analysis
10	Unit hydrograph: derivation, synthesis and applications Hydrograph synthesis: concept and unit hydrograph; unit rainfall and n-hour unit hydrograph, transformation of unit hydrograph for different time-base; the S-curve technique; synthetic unit-hydrograph; application of unit-hydrograph	5, 6	4 lectures 2 tutorial exercise discussion on hydrograph analysis
11	Reservoir yield and storage Determine water demands, raw water available from streamflow; storage requirement	7	3 lectures 1 tutorial exercise discussion on reservoir design
12 and 13	Flood routing: storage equation, reservoir and channel routing ; Muskingum method in channel routing; flow attenuation, reduction of peak and transformation of hydrographs	8	3 lectures 2 tutorial exercise discussion on transformation of hydrographs, reduction of peak and
13	Quiz – CA 2		