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| **Debre Markos University****College of Agriculture and natural resource** |
| **Course title**  | **Integrated Watershed Management**  |
| **Course code**  | **EnSc5142** |
| **Instructor**  | **Million G.**  |
| **Year semester**  | **Year I, Semester II** |
| **Degree program** | **M.Sc. in Environmental Sciences (REGULAR)** |
| **Credits** | **3 (2+1)** |

Instruction for home take assignment

1. Before any work started the student should read and understand the given ppt
2. Each of the question should done clearly showing all steps
3. Unreadable or unclear step may reduce the mark assigned for it
4. The possible answers should be clearly shown
5. Clear expression should be indicated (if needed)
6. The assignment should be sent through email before June first week 2012
7. A copy paste type of answer can reduce the marks so each student expected to do the assignment by himself because the assignment will be weighted from (20-30%) = needs care!!!!

**Home take Sample exercise on watershed related issues**

1. In a reservoir dam, the average area of water surface is 35 km2 for October, and at this time, average inflow and outflow to the reservoir are 15 and 20 m3/s, respectively. If precipitation is 10cm in October and the reservoir storage decreases 15 x 106m3 due to other phenomena, using a water balance equation calculate the evaporation during the month (take 30 days for a month) assuming that the groundwater state is constant (3pts)
2. A storm has an average rainfall depth of 9 cm over a 200 km2 watershed. What size reservoir would be required to contain completely 20% of the rain? (2 pts)
3. There are four rain gauges in a watershed named A, B, C, and D. A specific storm event for gauge A is missing. Data from other neighboring gauges for the storm event as well as the long-term normal annual rainfall of all gauges are given in Table below. Estimate the missing data at gauge A. (2 pts)

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| Gauge station | Rainfall at one storm event (mm) | Normal annual rainfall |
| A | ? | 1290 |
| B | 123 | 1510 |
| C | 148 | 1680 |
| D | 119 | 1375 |

1. For the illustrated catchment in Figure below, estimate the mean areal rainfall of the watershed using the Thiessen method. (1 pt)



(where R is mean rainfall in millimeters and A is polygon area in square kilometers in the figure).

1. In a watershed, the number of streams of orders 1 to 6 is 56, 42, 19, 9, 3, and 1, respectively. Compute the bifurcation ratio.(1pt)
2. The area of a watershed whose properties are shown in Table below is 25 km2. Calculate the bifurcation ratio and drainage density for each order and watershed. (2 pts)

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| **Order** | **1** | **2** | **3** | **4** | **5** |
| Number of streams | 140 | 41 | 15 | 6 | 1 |
| River length (km) | 30 | 18 | 7 | 3 | 1 |

1. Find the drainage density for the given watershed in Figure below. The reach lengths, in kilometers, are shown in the figure and the area of the watershed = 800 km2.(1pt)



1. Using the figure below, determine the watershed’s bifurcation ratio and stream frequency. Assume an area of 1,000 km2 **(2pts)**



1. Given the following information for a watershed (hypothetical):

Area = 150 km2

Perimeter = 30 km

Length of the watershed = 15 km

Elevmax = 1,200 masl

Elevmin = 5 masl

No. of 1st order stream = 8, 2nd order stream = 3, 3rd order stream = 1

Total stream length = 15 km

Calculate: (1 pt each)

a. Shape factor

b. Circularity ratio

c. Elongation ratio

d. Relief ratio

e. Drainage density (in km/km2)

f. Bifurcation ratio

g. Length of overland flow

1. A basin has an area of 26560 km2, perimeter 965 km and length of basin (Lb), (i.e., the distance from the outlet point to the most remote point on the basin) is 230 km. Determine the following watershed geometries: (1 pt each)
2. Form factor,
3. Compactness coefficient,
4. Elongation ratio, and
5. Circularity ratio.
6. The area of a particular watershed in Northern Ethiopia is 442 Km2 and the number of streams and the streams length of its orders 1 to 6 is given in the table below, then:
7. Compute the bifurcation ratio for each order and for the watershed **(2 pts)**
8. Compute the drainage density for the watershed **(1 pt)**
9. Compute stream frequency for the watershed **(1 pt)**
10. Calculate the stream length ratio (RL) of the watershed **(1 pt)**

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| **Order** | **1** | **2** | **3** | **4** | **5** | **6** |
| Number of streams | 1662 | 443 | 102 | 23 | 4 | 1 |
| Stream length (km) | 545 | 299 | 155 | 78 | 53 | 20 |