UNIVERSITY OF SWAZILAND

DEPARTMENT OF GEORAPHY, ENVIRONMENTAL SCIENCE AND PLANNING

MAIN EXAMINATION: DECEMBER, 2016

BSc and BSc Ed. VI

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|---|---|---|
| TITLE OF PAPER | : | WATER RESOURCES PLANNING |
| COURSE NUMBER | : | GEP421 |
| TIME ALLOWED | : | THREE (3) HOURS |
| INSTRUCTIONS | : | ANSWER ONE QUESTION FROM SECTION A<br>ANSWER TWO QUESTIONS FROM SECTION B<br>ILLUSTRATE YOUR ANSWERS WITH APPROPRIATE DIAGRAMS |
| MARKS ALLOCATED | : | QUESTION ONE CARRIES 40 MARKS<br>OTHER QUESTIONS CARRY 30 MARKS EACH |

THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR

**GEP 421: WATER RESOURCES PLANNING** **(December, 2016)**

## SECTION A: COMPULSORY QUESTION

### QUESTION 1

a) Discuss the role of economic analysis in water resources planning. (10 marks)

b) Explain three methods of economic analysis. (10 marks)

c) Floods now occur on the average of one year in 20 in a particular river basin. Two mutually exclusive alternative dam designs are under consideration. Each flood would cause damages of approximately $E10^{10}$. Using the information given in Table 1 below and an interest rate of 10% (Table 2) determine which alternative course of action is economically attractive. (20 marks)

**(40 Marks)**

Table 1 Data for the low and high dam designs

| ITEMS | LOW DAM | HIGH DAM |
|---|---|---|
| Initial cost | E200,000,000 | E500,000,000 |
| Annual O&M | E1,500,000 | E3000,000 |
| Flood Frequency | 1 in 50 yrs | 1 in 100 yrs |
| Life of project | 50 yrs | 50 yrs |

Table 2

Interest Per Period i = .10000

| | Single Payment | | Uniform Series | | | | Gradient | | |
|---|---|---|---|---|---|---|---|---|---|
| n | Compound Amount (F/P) | Present Worth (P/F) | Sinking Fund (A/F) | Capital Recovery (A/P) | Compound Amount (F/A) | Present Worth (P/A) | Uniform Amount (A/G) | Present Worth (P/G) | n |
| 1 | 1.100 | .9091 | 1.00000 | 1.10000 | 1.000 | .909 | .000 | .000 | 1 |
| 2 | 1.210 | .8264 | .47619 | .57619 | 2.100 | 1.736 | .476 | .826 | 2 |
| 3 | 1.331 | .7513 | .30211 | .40211 | 3.310 | 2.487 | .937 | 2.329 | 3 |
| 4 | 1.464 | .6830 | .21547 | .31547 | 4.641 | 3.170 | 1.381 | 4.378 | 4 |
| 5 | 1.611 | .6209 | .16380 | .26380 | 6.105 | 3.791 | 1.810 | 6.862 | 5 |
| 6 | 1.772 | .5645 | .12961 | .22961 | 7.716 | 4.855 | 2.224 | 9.684 | 6 |
| 7 | 1.949 | .5132 | .10541 | .20541 | 9.487 | 4.868 | 2.622 | 12.763 | 7 |
| 8 | 2.144 | .4665 | .08744 | .18744 | 11.436 | 5.835 | 3.004 | 16.029 | 8 |
| 9 | 2.358 | .4241 | .07364 | .17364 | 13.579 | 5.759 | 3.372 | 19.421 | 9 |
| 10 | 2.594 | .3855 | .06275 | .16275 | 15.937 | 6.145 | 3.725 | 22.891 | 10 |
| 11 | 2.853 | .3505 | .05396 | .15396 | 18.531 | 6.495 | 4.064 | 26.396 | 11 |
| 12 | 3.138 | .3186 | .04676 | .14676 | 21.384 | 6.814 | 4.388 | 29.901 | 12 |
| 13 | 3.452 | .2897 | .04078 | .14078 | 24.523 | 7.103 | 4.699 | 33.377 | 13 |
| 14 | 3.797 | .2633 | .03575 | .13575 | 27.975 | 7.367 | 4.996 | 36.800 | 14 |
| 15 | 4.177 | .2394 | .03147 | .13147 | 31.772 | 7.606 | 5.279 | 40.152 | 15 |
| 16 | 4.595 | .2176 | .02782 | .12782 | 35.950 | 7.824 | 5.549 | 43.416 | 16 |
| 17 | 5.054 | .1978 | .02466 | .12466 | 40.545 | 8.022 | 5.807 | 46.582 | 17 |
| 18 | 5.560 | .1799 | .02193 | .12193 | 45.599 | 8.201 | 6.053 | 49.640 | 18 |
| 19 | 6.116 | .1635 | .01955 | .11955 | 51.159 | 8.365 | 6.286 | 52.583 | 19 |
| 20 | 6.727 | .1486 | .01746 | .11746 | 57.275 | 8.514 | 6.508 | 55.407 | 20 |
| 21 | 7.400 | .1351 | .01562 | .11562 | 64.002 | 8.649 | 6.719 | 58.110 | 21 |
| 22 | 8.140 | .1228 | .01401 | .11401 | 71.403 | 8.772 | 6.919 | 60.689 | 22 |
| 23 | 8.954 | .1117 | .01257 | .11257 | 79.543 | 8.883 | 7.108 | 63.146 | 23 |
| 24 | 9.850 | .1015 | .01130 | .11130 | 88.497 | 8.985 | 7.288 | 65.481 | 24 |
| 25 | 10.835 | .0923 | .01017 | .11017 | 98.347 | 9.077 | 7.458 | 67.696 | 25 |
| 26 | 11.918 | .0839 | .00916 | .10916 | 109.182 | 9.161 | 7.619 | 69.794 | 26 |
| 27 | 13.110 | .0763 | .00826 | .10826 | 121.100 | 9.237 | 7.770 | 71.777 | 27 |
| 28 | 14.421 | .0693 | .00745 | .10745 | 134.210 | 9.307 | 7.914 | 73.650 | 28 |
| 29 | 15.863 | .0630 | .00673 | .10673 | 148.631 | 9.370 | 8.049 | 75.415 | 29 |
| 30 | 17.449 | .0573 | .00608 | .10608 | 164.494 | 9.427 | 8.176 | 77.077 | 30 |
| 31 | 19.194 | .0521 | .00550 | .10550 | 181.943 | 9.479 | 8.296 | 78.640 | 31 |
| 32 | 21.114 | .0474 | .00497 | .10497 | 201.138 | 9.526 | 8.409 | 80.108 | 32 |
| 33 | 23.225 | .0431 | .00450 | .10450 | 222.252 | 9.569 | 8.515 | 81.486 | 33 |
| 34 | 25.548 | .0391 | .00407 | .10407 | 245.477 | 9.609 | 8.615 | 82.777 | 34 |
| 35 | 28.102 | .0356 | .00369 | .10369 | 271.024 | 9.644 | 8.709 | 83.987 | 35 |
| 40 | 45.259 | .0221 | .00226 | .10226 | 442.593 | 9.779 | 9.096 | 88.953 | 40 |
| 45 | 72.890 | .0137 | .00139 | .10139 | 718.905 | 9.863 | 9.374 | 92.454 | 45 |
| 50 | 117.391 | .0085 | .00086 | .10086 | 1163.909 | 9.915 | 9.570 | 94.889 | 50 |
| 55 | 189.059 | .0053 | .00053 | .10053 | 1880.591 | 9.947 | 9.708 | 96.562 | 55 |
| 60 | 304.482 | .0033 | .00033 | .10033 | 3034.816 | 9.967 | 9.802 | 97.701 | 60 |

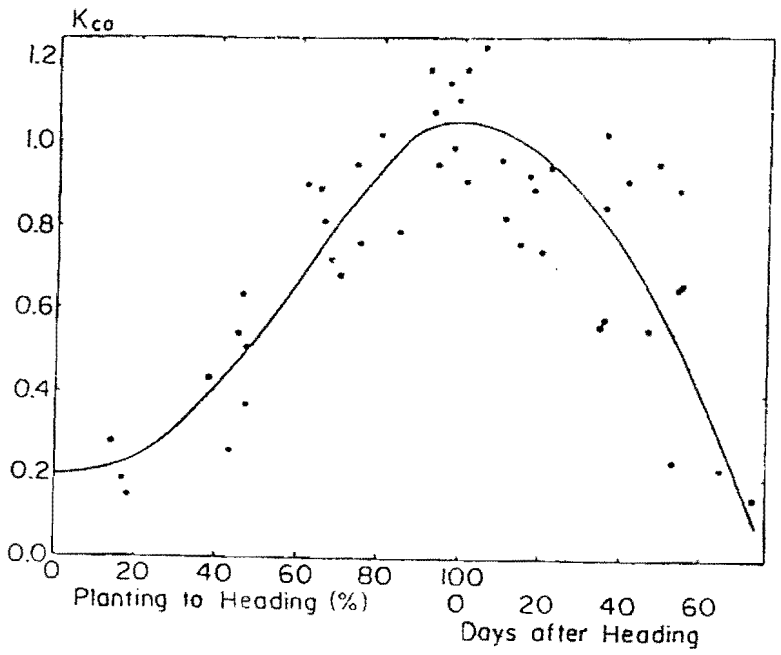
## SECTION B: ANSWER ANY TWO QUESTIONS

### QUESTION 2

Discuss the similarities and differences between convention and integrated water resources planning. **(30 Marks)**

### QUESTION 3

a) Discuss the role of drainage in irrigated agriculture. (10 marks)
b) Explain the different types of land drainage water collection systems. (10 marks)
c) Explain the scatter of the points in Figure 1 below. (10 marks)
**(30 Marks)**




-CROP COEFFICIENTS ($K_{co}$) FOR GRAIN SORGHUM (FROM JENSEN, 1968)

**Figure 1 Relationship between crop coefficient and time from planting to harvesting for Sorghum.**