

Question 4.

(a). Determine whether the hydro-power project with the following details is economically viable:

<i>Item Description</i>	<i>Values as indicated</i>
Capital cost	\$1.5 million
Annual maintenance cost	\$25,000.00
Interest rate	6% per annum
Useful life of project	100 years
Power potential	200 kW
Power rate	\$ 0.10 per kWh

(b) A 100 kW hydropower plant project has the following two alternatives for the conveyance of water from the reservoir to the power house. Which of the alternatives is more economical? Take annual interest rate as 6%.

<i>Alternative I, a lined tunnel</i>	<i>Alternative II, a power channel and penstocks</i>
Initial cost of tunnel = \$1 million Useful life = 100 years Annual maintenance cost = \$ 15,000.00	(i) Cost of power channel = \$ 400,000.00 Useful life = 100 years (ii) Cost of lining = \$ 100,000.00 Useful life = 50 years Annual maintenance cost = \$ 6,000.00 (iii) Cost of penstocks = \$ 200,000.00 Useful life = 50 years Annual maintenance cost = \$ 7,000.00

(c) In a particular region the mean annual precipitation is 66.04 cm and the mean annual runoff is 11.45 cm. How much additional runoff will occur if a cloud-seeding program is in effect during a year when the annual precipitation would have been 50.8 cm? Assume the program increase the annual precipitation by 10%. (30 marks)

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UNIVERSITY EXAMINATIONS
RAIN SEMESTER, 2015/2016 SESSION
April, 2017

AEE 514: Water Resources Development

INSTRUCTIONS

- * TIME ALLOWED: 2½ HOURS
 - * ANSWER ONLY THREE (3) QUESTIONS
Question 1 is Compulsory
(Please be precise in ALL discussion questions & all calculations must be legible enough)
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Question 1. (Short Discussions - 6 points each) Total =30 marks.

- (a) The scope of water resources engineering and the job of a water resources engineer can be explained by a number of *pertinent* questions. List, in fair details, these questions.
- (b) The thought that opportunities for further work must be negligible in water resources engineering is a misconception. Discuss concisely.
- (c) Compare and contrast in a tabular form, the power cost of thermal versus hydro-electric plant.
- (d) The planning of water-resources development project always forms the basis for the decision to accept or to reject a particular project. What are the systematic considerations/ steps involved?
- (e) The various purposes served by water-resources development projects can be broadly classified as: main, secondary and miscellaneous purposes. Discuss. (30 marks).

Question 2.

- (a). A 30 cm diameter well penetrates vertically through an aquifer to an impermeable stratum which is located 18 m below the static water table. After a long period of pumping, at a rate of 1m³/min, the drawdown in test holes 14 and 40 m from the pumped well is found to be 2.62 and 1.50 m, respectively. Determine (i) the coefficient of permeability of the aquifer in m/day (ii) the transmissibility of the aquifer in m³/day/meter, and (iii) drawdown in the pumped well.
- (b) A 10 cm diameter well was pumped at a uniform rate of 500l/min, while observations of drawdown were made in an observation well located at a distance of 50-m from the well. The original head of water, measured from the top of the impervious layer was 25-m. The hydraulic conductivity of the aquifer was 1.83 x 10⁻³ m/min. Determine the drawdown at the face of the well, assuming that the flow to the unconfined aquifer is under steady state.

- (c) Assume that a sandbag holds 0.0283 m³ of earth and is about 33.56 cm wide when filled. How many sandbags would be required to raise the level of a 1.609 km of levee by 0.61 m if three rows of sandbags were used? (30 marks)

Question 3.

- (a). A power company is considering the construction of a 100,000 kW power plant. The engineer’s estimates are as follows:

Estimates	Thermal	Hydro-electric
First cost	N10 million	N24 million
Estimated life	25yrs	50 yrs
Taxes & Insurance	4%	3.55%
Fuel (annual)	N 1.5 million	0
Labour, maintenance	N 350,000	N 140,000
Extra transmission facilities (first cost)	0	N400,000

- (i) If the minimum attractive return is 10%, which plant would be the better selection? (ii) What is the annual cost per kilowatt of installed capacity for each plant? Assume no energy loss in transmission.

- (b). Cost and benefit data for the units of a small development are tabulated below. The costs are mutually exclusive at each site. Assuming a project life of 50 years and an interest rate of 7%, rank the projects or combinations in order of preference.

Project Unit	First Cost, '000 Naira	Annual Operation Cost, '000 Naira	Annual Benefit, '000 Naira
1A	1,000	50	100
1B	800	45	85
2A	1,550	85	140
2B	600	22	62
1A, 2A			220
1A, 2B			150
1B, 2A			235
1B, 2B			147

30 marks