JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE ACTUARIAL

3 RD YEAR 1ST SEMESTER 2020/2021

REGULAR (MAIN)

COURSE CODE: WAB 2305

COURSE TITLE: PENSION MATHEMATICS

EXAM VENUE: LAB 17 **STREAM: (BSc Actuarial Science)**

DATE: 14/12/2022 **EXAM SESSION: 9.00-11.00AM**

TIME: 2.00 HOURS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (30 MARKS)

a) What are the key areas of asset and liability consistency?.

i. [4 Marks]

b) State five options that can be availed to members of a pension scheme

[5 Marks]

c) Consider a life aged 35 with current salary of 10,000 who contributes 5% of his salary to a pension scheme.Using pension fund tables, calculate the mean present value of the employee's future contributions

[4 Marks]

d) Suppose contributions are independent of salary and that these are at a fixed annual

e) sum of *F* payable continuously. The mean present value of future contributions is?

[6 Marks]

f) Determine the value of a pension benefit of amount *P* per annum payable from age 65 to an individual currently agedxusing commutation functions approach.

[5 Marks]

g) Distinguish between defined benefit and defined contribution scheme

[6 Marks]

QUESTION TWO [20 Marks]

a) A man who is currently aged 45 and has a salary of 10,000 per annum is entitled to a benefit_ from a scheme of age 65. The present value of this benefit is 60,000. He joined the scheme 10 years ago and the benefit accrues uniformly. Using the Attained Age (AA) method, calculate the level percentage of salary that must be paid until age 65 in order to fund this benefit. Assume that his salary will increase at a rate of 7% p.a. and that the return on the fund will be9% p.a. Ignore all pre-retirement decrements (i.e. mortality before age 65).

[10 Marks]

b) Using the pension fund tables and actuarial tables, calculate the value of an annuity of 12,000 per annum payable at any age of retirement up to 65 due to:
(Assume the current member is aged 50)

(i) Ill -health retirement

[5 Marks]

(ii) Normal age retirement

[5 Marks]

QUESTION THREE [20 Marks]

a) Using the following assumptions and data, calculate the SCR and AL under the Attained Age (AA) method for the following members individually;
Data i = 9% p.a.
e = 7% p.a.
A = 60 (i.e. the accrual rate is 60ths)
R = 65 (i.e. retirement age is 65)
a'R = 12
(Ignore all pre-retirement decrements e.g. mortality, withdrawal, ill health etc)
The members are:

i) 25 year old, no past service salary 20,000

[5 Marks]

ii) 40 year old, 15 years past service, salary is 15,000

[5Marks]

iii) 55 year old, 30 years past service salary is 30,000

[5Marks]

The earnings definition is used for benefit purposes. You may assume for simplicity that contributions are paid continuously and salary growth is continuous.

b) Consider a life aged 35 with current salary of 10,000 who contributes 5% of his salary to a pension scheme. Using pension fund tables, Calculate the mean present value of the employee's future contributions.

[5Marks]

QUESTION FOUR [2O Marks]

a) Data i = 9% p.a.
e = 7% p.a.
A = 60 (i.e. the accrual rate is 60ths)
R = 65 (i.e. retirement age is 65)
a'R = 12
(Ignore all pre-retirement decrements e.g. mortality, withdrawal, ill health etc)
Calculate the AL and SCR under the Current Unit Method for the following members individually;

i) 25 year old, no past service salary 20,000

[5 Marks]

ii) 40 year old 15 years past service salary 15,000

[5 Marks]

iii) 55 year old 30 years past service salary 30,000

[5 Marks]

b) Calculate the CUAL and CUSCR for a scheme that contains only these three members.

[5 Marks]

QUESTION FIVE [20 Marks]

a) Consider a pension of amount *P* per annum payable on ill - health retirement to an individual currently ages *x*. give an expression for the value of the benefit using:
   i) Benefit event approach
   ii) Commutation functions approach

[10 Marks]

b) Derive a relationship between the PUSCRs at successive ages and explain the implications if $i > e$.

[5 Marks]

c) Express the AASCR in terms of the PUSCR at any age x. What can you deduce from this? (State any assumptions that are relevant.)

[5 Marks]