**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOOL OF MATHEMATICS AND ACTUARIAL SCIENCE**

**UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE ACTUARIAL**

**2ND YEAR 1ST SEMESTER 2021/2022**

**REGULAR (MAIN)**

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**COURSE CODE: WAB 2201**

**COURSE TITLE: FINANCIAL MATHEMATICS I**

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

**DATE:** **EXAM SESSION:**

**TIME: 2.00 HOURS**

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**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**

a. Define the following terms (7marks)
   i. An equity
   ii. An annuity-certain
   iii. An 'interest-only' loan
   iv. A repayment loan (or mortgage)
   v. A pure endowment
   vi. An endowment assurance
   vii. A term assurance

b. An investment of £1,000 accumulates to £2,500 after 5 years.
   (i) Calculate the accumulation factor A(0,5) .
   (ii) ( Calculate the simple annual interest rate that would give the accumulation factor in part (i).
   (iii) Calculate the annual compound interest rate that would give the accumulation factor in part (i). (6marks)

c. An investor must make a payment of £5,000 in 5 years' time. The investor wishes to make provision for this payment by investing a single sum now in a deposit account that pays 10% per annum compound interest.
   Calculate the initial investment required to meet the payment of £5,000 in 5 years' time.

   (2marks)

d. €500 is invested in an account that pays nominal interest of 8% pa convertible half-yearly. Calculate the accumulated amount in the account after 3 years. (2marks)

e. A payment of $800 is due in 5 years' time. Calculate the present value of this payment using an interest rate of 9% pa convertible monthly. (2marks)

f. Calculate the annual effective rate of discount that is equivalent to a rate of interest of 4% pa convertible monthly. (4marks)

g. Calculate the annual effective interest rate that is equivalent to:
   (i) a nominal rate of interest of 10% per annum convertible monthly (2marks)
   (ii) a nominal rate of interest of 10% per annum convertible quarterly. (2marks)

h. Show that $d=iv$ where:- $i$ is the interest rate
$-d$ is the discount rate

(3marks)

**QUESTION TWO**

a. £4,600 is invested at time 0 and the proceeds at time 10 are £8,200.
Calculate A(7,10) if A(0,9)= 1.8, A(2,4)= 1.1, A(2,7) =1.32, A(4,9) =1.45. (5marks)

b. Calculate the effective annual rate of interest for:
(i) a transaction in which £200 is invested for 18 months to give £350.
(ii) a transaction in which £100 is invested for 24 months and another £100 is invested for 12 months (starting 12 months after the first investment) to give a total of £350.

(10 marks)

c. An investor's bank balance at various times is as follows:

| 1 Jan 2017 | 1 Jul 2017 | 1 Jan 2018 |
|---|---|---|
| £3,000 | £3,100 | £3,300 |

Calculate the:
(i) effective six-monthly rate between 1 January 2017 and 1 July 2017
(ii) effective annual rate between 1 January 2017 and 1 January 2018.

(5marks)

**QUESTION THREE**

a. State and explain 3 types of contingent annuities.

(6marks)

b. (i)Given $\delta=8\%$ , calculate i , $i^{(4)}$ and $d^{(12)}$ . (3marks)
(ii) Given i=7%, calculate d ,$d^{(4)}$ , $i^{(2)}$ and $\delta$. (3marks)
(iii) Given d=9%, calculate i ,$d^{(2)}$ , $i^{(12)}$ and $\delta$ (3marks)
Where $i$ is the interest rate, $\delta$ the force of interest and d is the discount rate.

c. The force of interest at time $t$ is:

$$\delta(t)=\begin{cases} 0.04 & 0 \le t < 6 \\ 0.2-0.02t & 6 \le t \end{cases}$$

Calculate the accumulated value at time 8 of a payment of $400 at time 3.

(5marks)

**QUESTION FOUR**

a. A loan provider quotes an interest rate of 1% per day effective.
(i) Calculate the annual effective interest rate on this loan. (1mark)
(ii) Comment on why the loan provider has chosen to quote the interest rate as a daily rate.(I mark)
(iii)A motorist borrows £5,000 to buy a car. The loan is repaid by level payments of £458.33 at the end of each of the next 12 months. Calculate the APR paid by the motorist. (3marks)

b. A bank account pays an effective annual interest rate of 10% over 5 years. Calculate the equivalent:
(i) simple annual interest rate
(ii) effective monthly interest rate
(iii) effective two-yearly interest rate
(iv) effective annual discount rate
(v) simple annual discount rate. (10 marks)

c. Show that the effective rate of interest, when accumulating using a constant simple interest rate, decreases over time. (5marks)

**QUESTION FIVE**

a. A 182-day treasury bill, redeemable at \$100, was purchased for \$96.50 at the time of issue and later sold to another investor for \$98 who held the bill to maturity. The rate of return received by the initial purchaser was 4% per annum effective.
(i) Calculate the length of time in days for which the initial purchaser held the bill.
(ii) Calculate the annual simple rate of return achieved by the second investor.
(iii) Calculate the annual effective rate of return achieved by the second investor. (15 marks)

b. The force of interest at time t is given by $\delta(t)=0.01t+0.04$. Calculate the corresponding nominal rate of discount convertible half-yearly for the period $t=1$ to $t=2$ (5 marks)