



W1-2-60-1-6

**JOMO KENYATTA UNIVERSITY
OF
AGRICULTURE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS 2017/2018
SECOND YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF
BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE
&
BACHELOR OF SCIENCE IN FINANCIAL ENGINEERING
STA 2220: FIXED INCOME SECURITIES ANALYSIS
STA 2290: FINANCIAL MATHEMATICS II**

DATE: JANUARY, 2018

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

- 1. Answer question ONE (section A) and any other two questions in section B.*
- 2. Be neat and show all your workings*
- 3. All questions except question one carry equal marks*

This paper consists of 3 printed pages.

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SECTION A (30 MARKS)

1. (a) Define spot rates and forward rates of interest [2 marks]
- (b) Differentiate between fixed-income markets, capital markets and financial markets. [3 marks]
- (c) Explain why the term to maturity of a bond is important with respect to bond valuation. [3 marks]
- (d) Short-term one year annual effective interest rates are currently 8%. They are expected to be 7% in one years time, 6% in two years time and 5% in three years time. Calculate the spot rates of interest applicable for 1, 2, 3 and 4 years. [6 marks]
- (e) A fixed interest stock with a coupon of 8% per annum payable half yearly in arrears can be redeemed at the option of the lender at any time between 10 and 15 years from the date of issue. What price should an investor subject to tax at 25% on income, who wishes to obtain a net yield of at least 7% per annum, pay for shs 100 nominal of this stock? [4 marks]
- (f) On 15 July 2012 an investor purchases a six year stock with half yearly coupon payments of 13% p.a. The investor pays 33% tax on income and capital gains. What price should the investor pay for shs 100 nominal of the stock if she requires a yield of 10% per annum? [4 marks]
- (g) Consider a shs 100 nominal value bond with coupon rate of 4% per annum payable semi-annually. The spot rates of interest convertible semi-annually are given as:

year t	0.5	1	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
i_t	3.0	3.0	3.5	3.5	4.0	4.4	4.5	4.5	5.0	5.0

Find the price of the bond if it matures in (a) 3 and (b) 5 years respectively and comment on your answer [8 marks]

SECTION B (20 MARKS EACH)

2. (a) The n -year spot rate of interest y_n is given by the formula.

$$y_n = 0.050 + \frac{n}{500} \quad \text{for } n=1,2,3$$

- i Calculate the implied one year forward rates applicable at times $t=1$ and $t=2$ [3 marks]
 - ii An investor purchases a three year bond that provides coupons of 6% p.a payable annually in arrears and is redeemable at par. Find the fair price for this bond per shs 100 nominal [2 marks]
 - iii Calculate the investors gross redemption yield [3 marks]
 - iv Calculate the par-yield of this bond [3 marks]
- (b) A loan of nominal amount shs 100,000 is to be issued bearing coupons payable quarterly in arrears at the rate of 5% per annum. Capital is to be repaid at 103 on a single coupon date between 15 and 20 years after the date of issue, inclusive. The date of redemption is at the option of the borrower.
- An investor liable to income tax at 20% and capital gains tax of 25% wishes to purchase the entire loan at the date of issue. Calculate the price which the investor should pay to ensure a net effective yield of at least 4% per annum. [9 marks]

3. (a) An investor bought a five year forward contract on 1 May 2006 to buy *shs* 400 nominal of a stock that pays coupons of 4% per annum payable quarterly on 31 March, 30 June, 30 September and 31 December. The stock is also expected to pay out a lump sum of *shs* 50 on 1 August 2010. The stock is expected to yield 4.5% per annum effective if purchased on 1 May 2006 and held forever.

i Calculate the forward price for the contract, given that the risk free rate of interest 5% [5 marks]

- 8 ii What is the value of the forward contract on 1 September 2008 when the stock price is *shs* 140? [5 marks]

(b) State and explain five risks associated with investing in bonds [10 marks]

4. (a) An insurance company has liabilities of £10 million due in 10 years and £20 million due in 15 years time, and assets consisting of two zero-coupon bonds, one paying £7.404 million in two years and the other paying £31.834 million in 25 years time. The current interest rate is 7% per annum effective.

i Show that Redington's first two conditions for immunization against small changes in the rate of interest are satisfied for this insurance company. [7 marks]

- 18 ii Determine the profit or loss expressed as a present value, that the insurance company will make if the interest rate increases immediately to 7.5% per annum effective. [3 marks]

- (b) A government bond pays a coupon half-yearly in arrears of *shs* 10 per annum.. It is to be redeemed at par in exactly 10 years. The gross redemption yield from the bond is 6% per annum convertible half yearly.

i. Calculate the duration of the bond in years [8 marks]

- ii. Explain why the duration of the bond would be longer if the coupon rate was *shs* 8 per annum instead of *shs* 10 per annum [2 marks]

THE END

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