UNIVERSITY EXAMINATIONS: 2015/2016

**ORDINARY EXAMINATION FOR BACHELOR OF SCIENCE
ACTUARIAL SCIENCE**

BAS 1303 FINANCIAL MATHEMATICS II

DATE: AUGUST, 2016   **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO.

QUESTION ONE

a. Money is invested for 3 years at an interest rate of 4% effective. If inflation is 5% per year over this period, what percentage of purchasing power is lost?   (5 Marks)

b. Find the duration and convexity of a 20 year zero coupon bond assuming that the interest rate is 7% effective.   (5 Marks)

c. A 100 par value 4% bond with semi-annual coupons is callable at the following times:
    - At 109.00, 5 to 9 years after issue
    - At 104.50, 10 to 14 years after issue
    - At 100.00, 15 years after issue (maturity date)

d. What price should an investor pay for the callable bond if they wish to realize a yield rate of:

    i.   5% payable semi-annually   (4 Marks)

    ii.   3% payable semi-annually   (4 Marks)

e. Distinguish between futures and forwards   (6 Marks)

f. An investor sells 20 million yen forward at a forward price of $0.0090 peryen. At expiration, the spot price is $0.0083 per yen.

    i.   What is the long position payoff?   (3 Marks)

    ii.   What is the short position payoff?   (3 Marks)

QUESTION TWO

a. What is meant by "term structure of interest rates"?   (4 Marks)

b. The current price of a bond is $110 and its yield is 7%. The modified durationis 5. Estimate the price of the bond if its yield falls to 6%.   (2 Marks)

c. You are given the following spot interest rates:

Term (in years)	Spot Rate
1	7%
2	8%
3	8.75%
4	9.25%
5	9.5%

d. Find the price of a $1000 two-year bond with annual 5% coupon usingthe spot rates given above.   (4 Marks)

e. Compute the yield to maturity (4 Marks)

f. A $10,000 serial bond is to be redeemed in $1000 installments of principal per half-year over the next five years. Interest at the annual rate of 12% is paid semi-annually on the balance outstanding. How much should an investor pay for this bond in order to produce a yield rate of 8% convertible semi-annually? (6 Marks)

QUESTION THREE

a. A common stock is currently earning $1 per share and the dividend is assumed to increase by 5% each year forever. Find the theoretical price to earn an investor an annual effective yield rate of 10%. (4 Marks)

b. Suppose that it is August 16 2007 and, firm A; a company based in the US knows that it will pay $10 million on November 16, 2007 for goods it haspurchased from a British firm. Firm A can buy pounds from a bank in athree-month forward contract and thus hedge against foreign exchange risk.Suppose the agreement is to buy $1 for $1.55.

   i. What would the firm A pay on November 16, 2007? (3 Marks)

   ii. Suppose that on November 16, 2007 the exchange rate is $3 for $1. Whatwould firm A pay on November 16, 2007 in the absence of hedging? (3 Marks)

c. On July 5, 2007, John instructs his broker to buy two gold futures contracts (each contract with nominal amount of 100 ounces of gold) on the NewYork Commodity Exchange with futures' price of $400 per ounce.The annual continuously compounded rate of return is 1.5%.

   i. How many ounces of gold has John contracted to buy at the price of $400per ounce?
   (2 Marks)

ii.   What is the notional value of the two contracts?   (2 Marks)

iii.   Suppose that the exchange requires 5% margin with daily settlement.What is the initial
       margin?   (2 Marks)

iv.   Suppose that on July 6, 2007, the futures price of gold has dropped from$400 to $397.
       What is the balance in John's margin account after settlement?   (2 Marks)

v.   Suppose that on July 7, 2007, the futures price of gold has risen to $400.What is the
       balance in John's margin account after settlement?   (2 Marks)

QUESTION FOUR

a. A common stock pays annual dividends at the end of each year. The earnings per share for
    the most recent year were 8 and are assumed to grow at a rate of 10% per year, forever. The
    dividend will be 0% of earnings for each of the next 10 years, and 50% of earnings
    thereafter. What is the theoretical price of the stock to yield 12%?   (6 Marks)

b. Discuss the following concepts in Finance:
    i.   Redington Immunization.   (2 Marks)

    ii.   Full immunization.   (2 Marks)

    iii. Convexity.   (2 Marks)

    iv.   Macaulay Duration.   (2 Marks)

c. Find the convexity of the following investments,assuming the effective rateof interest is 8%:

    i.   A money market fund.   (2 Marks)

ii.   A 10-year zero coupon bond.   (2 Marks)

iii.   A preferred stock paying level dividends into perpetuity   (2 Marks)

QUESTION FIVE

a. Define the following terms in finance:
   i.   Forward rate.   (2 Marks)

   ii.   Spot Rate.   (2 Marks)

   iii. Inverted yield curve.   (2 Marks)

   iv.   Flat yield curve.   (2 Marks)

b. Let the real rate of interest be denoted by ρ, the inflation rate be denoted by π, and the nominal rate of interest by r. Show that the real rate if interest is approximately $\rho = r - \pi$

                                                                             (5 Marks)

c. A common stock is currently earning $4 per share and will pay $2 per share in dividends at the end of the current year. Assuming that the earnings of the corporation increase at the rate of 5% for the first five years, 2.5% for the second five years and 0% thereafter. Assume that the corporation plans to continue to pay 50% of its earnings as dividends, find the theoretical price to earn an investor an annual effective yield rate of 10%.   (7 Marks)