FACULTY OF COMMERCE

DEPARTMENT OF FINANCE

BACHELOR OF COMMERCE HONOURS DEGREE IN FINANCE

PART IV 1ST SEMESTER FINAL EXAMINATION – DECEMBER 2015

FINANCIAL ENGINEERING [CFI4106]

TIME ALLOWED: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE (1)** and any other **THREE (3)** questions.
2. Show all workings.
3. Write neatly and legibly.

INFORMATION FOR CANDIDATES

1. This paper contains **FIVE (5)** Questions.
2. Each full question carries a total of **25 marks** and part marks are indicated in brackets at the end of each part question.
3. Normal Distribution tables are attached
4. This paper contains **TEN (10)** printed pages including the cover page.

QUESTION 1 - COMPULSORY   [TOTAL 25 MARKS]

1.1. Prior to expiration;
  A. the intrinsic value of a call option is greater than its actual value.
  B. the intrinsic value of a call option is always positive.
  C. the actual value of call option is greater than the intrinsic value.
  D. the intrinsic value of a call option is always greater than its time value.
  E. none of the above

1.2. If the stock price increases, the price of a put option on that stock _____ and that of a call option _____.
A. decreases, increases
B. decreases, decreases
C. increases, decreases
D. increases, increases
E. does not change, does not change

1.3. If the stock price decreases, the price of a put option on that stock _____ and that of a call option _____.
A. decreases, increases
B. decreases, decreases
C. increases, decreases
D. increases, increases
E. does not change, does not change

1.4. Other things equal, the price of a stock call option is positively correlated with the following factors except
A. the stock price.
B. the time to expiration
C. the stock volatility.
D. the exercise price.
E. none of the above.

1.5. *Delta is defined as*
A. the change in the value of an option for a dollar change in the price of the underlying asset.
B. the change in the value of the underlying asset for a dollar change in the call price.
C. the percentage change in the value of an option for a one percent change in the value of the underlying asset.
D. the change in the volatility of the underlying stock price.
E. none of the above.

1.6. A hedge ratio of 0.70 implies that a hedged portfolio should consist of
A. long 0.70 calls for each short stock.
B. short 0.70 calls for each long stock.
C. long 0.70 shares for each short call.
D. long 0.70 shares for each long call.
E. none of the above**.**

1.7. A hedge ratio for a call is always
A. equal to one.
B. greater than one.
C. between zero and one
D. between minus one and zero.
E. of no restricted value

1.8. A hedge ratio for a put is always
A. equal to one.
B. greater than one.
C. between zero and one
D. between minus one and zero.
E. of no restricted value

1.9. *The gamma of an option is*
A. the volatility level for the stock that the option price implies.
B. the continued updating of the hedge ratio as time passes.
C. the percentage change in the stock call option price divided by the percentage change in the stock price.
D. the sensitivity of the delta to the stock price.
E. A and C.

1.10*. Delta neutral*
A. is the volatility level for the stock that the option price implies.
B. is the continued updating of the hedge ratio as time passes.
C. is the percentage change in the stock call option price divided by the percentage change in the stock price.
D. means the portfolio has no tendency to change value as the underlying portfolio value changes.
E. A and C.

1.11. *Dynamic hedging is*
A. the volatility level for the stock that the option price implies.

B. the continued updating of the hedge ratio as time passes.
C. the percentage change in the stock call option price divided by the percentage change in the stock price.
D. the sensitivity of the delta to the stock price.
E. A and C.

1.12. Portfolio A consists of 150 shares of stock and 300 calls on that stock. Portfolio B consists of 575 shares of stock. The call delta is 0.7. Which portfolio has a higher dollar exposure to a change in stock price?
A. Portfolio B
B. Portfolio A
C. The two portfolios have the same exposure
D. A if the stock price increases and B if it decreases.
E. B if the stock price decreases and A if it increases**.**

1.13. If the hedge ratio for a stock call is 0.30, the hedge ratio for a put with the same expiration date and exercise price as the call would be _____.
A. 0.70
B. 0.30
C -0.70
D. -0.30
E. -.17

1.14. A put option on the S&P 500 index will best protect _____.
A. a portfolio of 100 shares of IBM stock.
B. a portfolio of 50 bonds.
C. a portfolio that corresponds to the S&P 500.
D. a portfolio of 50 shares of AT&T and 50 shares of Xerox stocks.
E. a portfolio that replicates the Dow.

1.15. Options sellers who are delta-hedging would most likely .

A**.** sell when markets are falling
B. buy when markets are rising
C. both A and B.
D. sell whether markets are falling or rising.
E. buy whether markets are falling or rising

1.16. In volatile markets,dynamic hedging may be difficult to implement because
A. prices move too quickly for effective rebalancing.
B. as volatility increases, historical deltas are too low.
C. price quotes may be delayed so that correct hedge ratios cannot be computed.
D. volatile markets may cause trading halts.
E. all of the above**.**

1.17. The short in a deliverable forward contract;

A. has no default risk
B.receives a payment at contract initiation
C. is obligated to deliver a specified asset
D. makes a cash payment to the long.
E.none of the above

1.18. In a Bear Call spread;
A. sell a call with lower strike and buy a call with higher strike price
B.sell a call with higher strike price and buy a call with lower strike price
C. sell a call with lower strike and buy a put with higher strike price
D. sell a call with higher strike and buy a put with lower strike price
 E.none of the above

1.19. A decrease in the market rate of interest will;

A. Increase put and call prices
B. decrease put and call prices.
C. Decrease put prices and increase call prices
D. Increase put prices and decrease call prices

1.20. A forward rate agreement is equivalent to the following interest rate options;

A.Long a call and a put
B. Short a put and a call
C.Short a call and long a put
D.Long a call and short a put

1.21. Consider a $2m Forward Rate Agreement with a contract rate of 5% on a 60 day LIBOR. If 60 day LIBOR is 6% at maturity, the long will

A. pay $3,300
B.pay $3,333
C.receive $3,300
D. receive $3,333

1.22. Party A has entered into a forward contract to purchase P10 million at an exchange rate of $0.98 per peso. At settlement, the exchange rate is $0.97 per peso. If the contract is settled in cash, Party A will;

A. make a payment of $100,000
B. receive $100,000
C. make a payment of $103,000

D. receive $103,000

1.23. A company treasurer needs to borrow $10m for 180 days ,60 days from now. The type of FRA and position the treasurer should take to hedge interest rate risk are;

A. 2 against 6 long
B.2 against 6 short
C.2 against 8 long
D. 2 against 8 short

1.24. The short in a deliverable forward contract;

A. has no default risk
B.receives a payment at contract initiation
C. is obligated to deliver a specified asset
D. makes a cash payment to the long.

1.25. In a covered call , the investor ;

A. is long on a call and asset
B. long on call and short in an asset
C. short in a call and long in an asset
D. short asset and short in a call

QUESTION 2 [TOTAL: 25 MARKS]

(a)(i) Using relevant arguments, derive the Risk-neutral formula for pricing options & show that

$$\text{Call value} = e^{-rt}(C_u P + (1 - P)C_d)$$

where P = Probability of stock going up, Cu and Cd being difference between strike price and spot price at each up and down node respectively.

 (ii) Hence find the value of a Put Option on an asset whose current price is $40 and may

 increase to $42 or decline to $38 at t=1. Risk free rate of return is 8% and strike price is $39**.**

[3marks; 2marks]

(iii) Using the above derivation or any other strategy, design a Delta-hedged portfolio for a put

buyer on day 1 (i.e. t=0) and evaluate the effectiveness of this portfolio if price of asset

increasesto$40.75onday2.   **[3marks]**

(b) Suppose a stock is currently trading at $50 and the price can either increase or decrease by

10% and 6% respectively. Also suppose that this happens every three months. The risk free

rate for a three-month period is 5%. Assume a three period binomial tree where the strike price at t=3 is $56.

(i) Draw a stock price tree for the three periods **[2marks]**

(ii) Construct a call price tree for the three periods **[3marks]**

(iii) If the portfolio is to be delta-hedged between t=0 and t=1, How many shares should be bought by a writer of a call assuming that the strike price at is $52. **[3marks]**

(iv) How much will a put writer charge as premium at t=0 given a strike of $52? **[2marks]**

(c) A fund manager has a well-diversified portfolio that mirrors the performance of the S&P 500 and is worth $360 million. The value of the S&P 500 is currently 1200 points and the portfolio manager would like to buy insurance against a reduction of more than 5% in the value of the portfolio over the next 6 months. The risk-free interest rate is 6% per annum. The dividend yield on both the portfolio and the S&P 500 is 3% and the volatility of the index is 30% per annum. Each index point is worth $10.

  (i)   What options strategy can be used to hedge this position? **[2marks]**

  (ii) How many option contracts will be bought? **[2marks]**

  (iii) Hence calculate the total cost of the strategy. **[2marks]**

  (iv) If the index closed at 987 points, how effective was the hedge put in place in (a) above?

[3marks]

QUESTION 3 [TOTAL: 25 MARKS]

(a) Suppose that Zimnat Asset Managers have a $20m, well diversified equities portfolio on the Johannesburg Stock Exchange (JSE) whose performance is likely to be bearish for the next three years. The Asset Manager therefore considers divesting 75% of the portfolio. The portfolio consists of mainly strategic assets. Expected returns on the JSE for the next three years are 9.5%, -16.5% and 26.5% respectively. The Asset Managers have been bullish about returns on a variable rate bond which is promising returns of 0.5%, 0.8% and 0.45% above LIBOR, for the next 3 years.

(i) What three main risks are faced by the asset manager in divesting the portfolio?

[6marks]

(ii) Advise the Asset Manager on a possible strategy to avoid risks in (a) above**. [4marks]**

(iii) Evaluate the performance of your strategy in (b) above if LIBOR=15%. **[4marks]**

(b) Investor XYZ is expecting a cash inflow of $1m in 1-years' time and is considering lending the funds at that time, for 1-year at 11%. He is however sceptical about the possibility of getting the 11% rate at that future point. For companies with a credit rating equal to that of XYZ, borrowing rates are at 9% while lending rates are at a premium of 1%. How best can XYZ guarantee itself of lending at a rate equal to 11% in 1-years' time for 1-year?

[3marks]

(c) You are given the information below about Time Bank.

Balance Sheet

Assets	Value(millions)	Risk Weight
Cash	100	0%
Government TBs	50	0%
Mortgage loans	120	50%
Commercial loans	200	100%

Suppose the equity capital of the bank is currently $20m. Also assume that the risk–weighted capital for regulatory purposes should be 8%.

(i) Assess the position of Time Bank with respect to the expectations of the regulator.

[3marks]

(ii) Suggest a strategy that can be used to ensure that the bank just meets the requirement of the regulator without going to external sources of capital. **[5marks]**

QUESTION 4 [TOTAL: 25 MARKS]

(a) CBZ sells a "4 against 12" FRA for $2m at an annualized rate of 7.0%. Three months after the sale, interest rates have the following term structure:

Maturity (in months)	rate (%)
4	9
8	8.5
12	11
16	12

(i) How much cash does the bank pay to, or receive from, the FRA buyer? **[2marks]**

(ii) What is CBZ's effective lending rate for the 240-day lending period? **[1mark]**

(b) Global Limited and Alphat Faces Corporation are United States based companies both considering borrowing funds over three years for capital expenditure. Global is AAA rated company which can borrow from fixed rate markets at 8% and from floating rate

markets at MLR + 0.3%. Alphat Faces Corporation, a BBB rated company can borrow at 10.5% and MLR+0.75% from fixed rate markets and floating rate markets respectively.

    (i)   As a Financial Director in Alphat Faces Corporation, convince your counterpart in Global Ltd that there is an opportunity that the two companies can exploit. **[4 marks]**

    (ii)   Show the possible SWAP transaction between the two companies, assuming that an intermediary bank will be involved and will charge a commission of 0.4% which the two companies involved will share in a 35% and 65% proportion for Global and Alphat Faces respectively. **[6 marks]**

    (iii)   Calculate the value of the SWAP to Global Ltd assuming a notional amount of USD$1 million and also assuming that floating rates increase by 0.1%, 0.15% and decrease by 0.2% at the end of year 1, year 2 and year 3 respectively. **[5 marks]**

(c) Given that the current spot price of an asset is 4000 cents. A 3900-strike put option on the same asset is selling for 130 cents. An investor is bearish about the price process of this asset and is therefore seeking to sell a call option. He is however not happy about the call option price indications in the market hence he decides to 'manufacture' his own short call.

    (i) Using information given above, describe the positions that the investor will have to take**.** **[3marks]**

    (ii) Construct a pay-off table and a chart to estimate the price of the call option.
[3marks]

QUESTION 5 [TOTAL: 25 MARKS]

(a) Identify the primary and secondary positions in each of the following strategies clearly explaining the role of each position in the respective strategy.

    (i) Bull–put spread   **[4marks]**

    (ii) Butterfly spread   **[6marks]**

    (iii) Synthetic long Put   **[4marks]**

(b) Suppose you are given the following information about an asset that you have been keen investing in.

	Spot	Strike 1-call	Strike 1-put	Strike 2-call	Strike 2-put
	4500	4550	4550	4700	4300
Premium-call		120	80	90	40

You realise that the information you are getting is not enabling you to explain why certain sections of the market are 'upbeat' about the price process being likely to be bullish while some sections are extremely bearish about it. You are convinced that there would be no meaningful change in the value of the asset. Design a maximum revenue trading strategy for this asset. Evaluate the possible performance of the strategy using a payoff chart and diagram. **[3marks; 3marks]**

(c) Consider a situation where the South African government has imposed restrictions on capital movements and hence the borrowing of United States dollars is prohibited for a period of time t=t. This being done to avoid depreciation of the South African Rand and also minimize capital flight. Company XYZ, based in South Africa still wants to borrow USD. The company approaches you, as a financial engineer, for advice. Write a brief report to Company XYZ, giving details of your strategy. **[5marks]**

END OF EXAM OF EXAMINATION PAPER