

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

CLASS: IMSC  
BRANCH: Maths and Computing

SEMESTER : V/ADD  
SESSION : MO/2025

**SUBJECT: MA315 FINANCIAL MATHEMATICS**

TIME: 3 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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|--|-----|----|----|
| Q.1(a) Find the principal to be deposited initially in an account attracting simple interest at a rate of 8% if 1, 000 is needed after three months (91 days).   | [5] | 1  | 2  |
| Q.1(b) What is the interest rate if a deposit subject to annual compounding is doubled after 10 years?   | [5] | 1  | 2  |
| Q.2(a) Define continuous compounding. What is the present value of 900,000, to be received 20 years from now, assuming continuous compounding at 4.5% annual interest?   | [5] | 2  | 2  |
| Q.2(b) A stock is currently priced at $S(0) = 95$ . In a binomial model, the stock price can move up by a factor $u$ or down by a factor $d$ in each time step. After one time step, the possible prices of the stock are:<br>$S(1) = 102$ (up)<br>$S(1) = 88$ (down)  | [5] | 2  | 3  |
| After two-time steps, the highest possible stock price is:<br>$S(2) = 110$ .   |     |    |    |
| (a) Assuming the binomial model holds, find the values of the up-factor $u$ and down-factor $d$ .  |     |    |    |
| (b) Compute the lowest possible value of $S(2)$ in this model.   |     |    |    |
| Q.3(a) Suppose a stock that pays no dividends is trading at 58 per share. European call options on the stock with a strike price of 55 and an exercise date in three months are trading at 6.40. The continuously compounded annual interest rate is 4.6%. What is the price of a European put with the same strike price and expiration date?                           | [5] | 3  | 3  |
| Q.3(b) For any $t$ such that $0 \leq t \leq T$ , the time $t$ value of a long forward contract with forward price $F(0, T)$ is given by:<br>$V(t) = [F(t, T) - F(0, T)]e^{-r(T-t)}$  | [5] | 3  | 4  |
| Q.4(a) Prove that for a stock paying no dividends: $F(0, T) = S(0)e^{rT}$ , where $F(0, T)$ is the forward price, $r$ is the constant risk-free investment under continuous compounding and $T$ is the expiration time.<br><br>A share of Reliance stock costs ₹ 2,400 today, or ₹ 2,520 three months from now. Which is the spot price, and which is the forward price? | [5] | 4  | 3  |
| Q.4(b) What do you mean by American and European put? Consider the Binomial Model with step size 1. Assume that the stock price at time 1 is increased by a factor $(1+u)$ , such that $S(1) = S(0)(1+u)$ . Show that the price of a call option increases with $u$ , while the other variables remain constant.   | [5] | 4  | 3  |

PTO

Q.5(a) Consider two scenarios:

[5] 5 2

- $\omega_1$  with probability 0.3
- $\omega_2$  with probability 0.7

Return on security 1:

- $K_1(\omega_1) = -3\%$
- $K_1(\omega_2) = 9\%$

Return on security 2:

- $K_2(\omega_1) = -6\%$

Find  $K_2(\omega_2)$  such that the two securities have equal risk (equal variance).

Q.5(b) Compute the weights in a portfolio consisting of two kinds of stock if the expected return on the portfolio is to be  $E(K_v) = 15\%$ , given the following information on the returns on stock 1 and 2:

[5] 5 3

Scenario	Probability	Return $K_1$	Return $K_2$
W1	0.2	-5%	12%
W2	0.5	5%	18%
W3	0.3	20%	30%

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