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AAC-2117 Seat No. _____

M. Sc. (Sem. IV) Examination

April - 2019

Mathematics : MTHE C-11

(Mathematics of Money)

Time : **3** Hours] [Total Marks : **70**

Instructions : (1) All question are compulsory.
(2) Standard notations and conventions are followed.

1 (1) State and prove the Simple Interest Theorem. What does tha simple interest theorem say ? **14**

(2) If i^m is positive and independent of m, $m \geq 1$, then show that the Sequence $\left\{\left(1+\frac{i^m}{m}\right)^m\right\}$ is increasing and bounded above by e^{i^m}, and $\lim_{m\to 0}\left\{\left(1+\frac{i^m}{m}\right)^m\right\} = e^{i^m}$

(3) Sdtate and prove the IRR Uniqueness Theorem II.

OR

1 (1) WashingtonFederal Savings offers a CD with a nominal rate of 4.88% compounded 365 times a year. What is the EFF ? **14**

(2) How long will it take for an investement of $1,000 to increase to $1,500 at a nominal interest rate of 7% compounded semi-annually? What is the IRR for this investment ?

(3) If the EFF of an investment is 8%, then what is the nominal interest rate, if interest is compounded monthly ?

2 (1) State and prove the Future Value of an Ordinary Annuity Theorem. **14**

(2) Helen Kendrick wishes to borrow $50,000 when the interest rate is 7.5% . She needs cash and is only willing to pay interest and principal at the end of the fourth year. Construct the payment schedule for this loan.

(3) A college education is expected to cost $20,000 per year in 18 years. How much money should be deposited at the end of each for 18 years in an account earning 10% compounded monthly so that balance of the account after 18 years covers the cost of a college education?

OR

2 (1) Derive the formula for the future value of Annuity Due and the formula of Annuity Due. **14**

(2) Today Amanda Kendrick pays \$7 for a movie ticket. In 20 years, how much does she pay in today's dollars if inflation runs at %?

(3) Hugh Kendrick expects to replace his car in 5 years. He estimates that he needs \$20,000. How much per month must he put into a sinking fund at a nominal rate of 6% compounded monthly to replace his car?

3 Answer the following : (any **three**) **14**

(1) For a given p_n by $p_n = \left(P_0 - \frac{M}{i}\right)(1+i)^n + \frac{M}{i}$, prove the following results.

(i) If the periodic payment exceeds the initial periodic interest owed, then the outstanding principal decreases.

(ii) If $M = iP_0$ then $P_n = P_{n+1}$.

(iii) If the periodic payment is less than the initial periodic interest owed, then the outstanding principal decreases and is never paid off.

(2) State and prove Credit Card Theorem and also derive the formula of Amortization Theorem.

(3) Amanda wants to borrow the same \$10,000 at the same annual interest rate of 10%, but she wants to extend her payments over 30 years. How much is her monthly payment ?

3 (1) How do you calculate the final payment on a loan ? Derive the formula. Also explain the LUHN ALGORITHM for credit card in detail. **14**

(2) Helen is in the market for a new car. She sees an advertisement that offers either a \$1,500 discount for paying cash or 0.9% nominal interest on a 60-month amortized loan. Which is the better deal if saving accounts are currently earning 5% per year?

(3) Let $f(x)$ be a twice differentiable function on the closed interval $[a, b]$ with the property that $f^n(x) > 0$ for all x in the open interval (a, b). Then for any point l in the open interval (a, b), prove that

$$f(l) < \frac{b-1}{b-a} f\ (a) + \frac{b-1}{b-a} f\ (b)$$

4 Answer the following : (any **three**) **14**

(1) State and prove bond theorem and long sale maintenance theorem.

(2) What is Yield to maturity of 9% noncallable bond with 20 years to maturity and face value of 1000 $ if the price is 77.43?

(3) What are the semi-annual coupon payments and the price of a 9% non callable bond with 20 years to maturity and face value of 1000 $ if the yield to maturity is 12%; what are the nominal and current yields for bond? Is the bond selling at par, at a premium, or at a discount ?

(4) State and prove the short sale maintenance theorem.

(5) State and prove the T-bill Theorem and the credit card theorem.

(6) Explain the Price-Yield Theorem. If the yield to maturity is 6%, then what is the duration of years to maturity? Which bond is less risky?

5 Answer the following : (any **six**) 14

(1) State and prove Tax Theorem.

(2) Hugh Kendrick expects to replace his car in 5 years. He estimates that he needs $20,000. How much per month must he put into a sinking fund at a nominal rate of 6% compounded monthly to replace his car ?

(3) How do you calculate the present value of an ordinary annuity? An annuity due?

(4) What is sinking fund and what is a perpetuity ?

(5) If 4591150107308815 have a valid checksum using the Luhn Algorithm, will 4591150107308815? Justify.

(6) Helen and Hugh pay $500 a month on a 30 year home loan for $48000. What interest rate are they being charged ?

(7) What does the credit card theorem say?

(8) Sometimes in the Luhm algorithm the "multiply by two and add the digits" rule, is replaced by "multiply be two and, if the resulting number is greater than 9, subtract 9" rule. Are these rules the same ?

(9) What is difference between a callable and a non-callable bond? Explain with suitable examples.
