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MAL 110: Mathematics I  
Minor II, October 12, 2009

Time: 1 Hr.

Maximum Marks: 25

1. Let  $D = \{(x, y) \in \mathbb{R}^2 \mid xy \geq 0\}$ . Is the function  $f : D \rightarrow \mathbb{R}$ , given by

$$f(x, y) = \sqrt{xy},$$

differentiable at  $(0, 0)$ ? Justify your answer.

[5]

2. Find the quadratic approximation of the function  $f(x, y)$  about  $(-1, 1)$ , where

$$f(x, y) = \int_x^{xy} (3t^2 + 2t + 1) dt.$$

[5]

*-2(y-1) - 2(y-1)^2 + 6(x+1)(y-1)*

3. A person wishes to invest Rs  $x_i$  in asset  $A_i$  ( $i = 1, 2, 3$ ). If the risk of investing in the asset  $A_i$  is  $\frac{(x_i)^2}{i}$  ( $i = 1, 2, 3$ ), then determine the amount to be invested in each asset so that the risk is least, when the total investment to be made by him is Rs 150.

[5]

4. Let  $V = \left\{ \begin{pmatrix} a & b \\ b & -a \end{pmatrix} \mid a, b \in \mathbb{C} \right\}$ . Assuming  $V$  is a vector space over the field of real numbers  $\mathbb{R}$  as well as over the field of complex numbers  $\mathbb{C}$ , determine

- (a) a basis of  $V$  over  $\mathbb{R}$ ;
- (b) a basis of  $V$  over  $\mathbb{C}$ .



[5]

Justify your answers.

5. Let  $T : \mathbb{R}_r^3 \rightarrow \mathbb{R}_r^3$  be given by

$$T(x, y, z) = (x, 4x + 2y, 5y + 3z).$$

Answer the following:

- (a) Is  $T$  a linear transformation?
- (b) Is  $W = \{v \in \mathbb{R}^3 \mid T(v) = 0\}$  a subspace of  $\mathbb{R}^3$  over the field  $\mathbb{R}$ ?
- (c) What is the maximum number of linearly independent vectors in  $W$ ?

Justify your answers.

[5]