



VIT

Vellore Institute of Technology

Course: BMAT101L - Calculus

Class NBR(s): 1212 / 1213 / 6584

Time: Three Hours

Slot: E1+TE1

Max. Marks: 100

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

Answer ALL Questions

(10 X 10 = 100 Marks)

- (i) Find the critical points of $f(x) = x^3 - 12x - 5$ and identify the open intervals [5]
on which f is increasing and on which f is decreasing.

(ii) Verify Lagrange's Mean value theorem for the function [5]
 $f(x) = x^2 + 2x - 1$, $[0,1]$ and find the value of C .
- The region bounded by the curve $y = x^2 + 1$ and the line $y = -x + 3$ is revolved [10]
about the x -axis to generate a solid. Find the volume of the solid.
- (i) Check the continuity of the function $f(x, y) = \begin{cases} \frac{x-y}{x+y}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ [5]
at the point $(0, 0)$.

(ii) If $u = \sin^{-1}(x - y)$, $x = 3t$, $y = 4t^3$, Find $\frac{du}{dt}$. [5]
- Find the Taylor series polynomial upto the degree three for the function [10]
 $f(x, y) = 2x^3 + 3y^3 - 4x^2y$ about the point $(1, 2)$.
- The temperature T at any point (x, y, z) in space is given by $T = 400xyz^2$. [10]
Find the highest temperature on the surface of the unit sphere $x^2 + y^2 + z^2 = 1$.
- Sketch the region and evaluate the integral $\int_0^2 \int_{x^2}^{2x} (4x + 2) dy dx$ by changing [10]
the order of integral.
- Find the volume of the region cut from the cylinder $x^2 + y^2 = 4$ by the plane [10]
 $z = 0$ and the plane $x + z = 3$.
- (i) Evaluate $\int_0^{\frac{\pi}{2}} \sqrt{\tan x} dx$. [10]

(ii) Express $\int_0^1 x^m (1 - x^p)^n dx$ in terms of Beta function and hence evaluate the
integral $\int_0^1 x^{\frac{3}{2}} (1 - \sqrt{x})^{\frac{1}{2}} dx$.

6. Complete the given table by finding out the missing terms.

Decimal	Binary	Octal	Hex
		123.1	
13.25			
		252.04	AA.1

7. Construct a 4-input (A,B,C and D) logic circuit employing only a minimum number of NAND gates which implements the following conditions:

- i) The output has to be HIGH (1) when all inputs are low (0).
- ii) The output has to be HIGH (1) when only one of the 4 inputs is HIGH (1).
- iii) For all other cases, the output has to be low (0).

8. a) For an ideal transformer fed by a sinusoidal voltage, prove that the ratio of the primary to secondary voltage is equal to the ratio of the number of coil turns in the primary to the number of coil turns in the secondary. [4]

b) Consider an ideal transformer fed by a sinusoidal source of 110 V_{RMS} and 60 Hz (in the primary). The ratio of number of turns in primary to that of the secondary is 5:1. A load of 10 Ω resistor is connected at the secondary. Determine the RMS values voltage at the secondary and the current in the primary. [6]

9.a) State Fleming's left hand rule and with a simple schematic, explain how this law governs the motoring action in a DC machine.

OR

9.b) Describe briefly the construction of a 3-phase induction motor and the principle of operation. State some of its applications.

10. Draw the circuit to obtain the characteristics of the BJT under common emitter configuration and explain the resulting characteristic curves.