GOVERNMENT POLYTECHNIC, GAYA
Mid Term Examination for 1st Semester Students

Course Name : Engineering Mathematics

Instructor: Mritunjay Kumar Singh

Date of Examination: 01 - 11 - 2018

Maximum Marks: 20

Time Allowed: $1\frac{1}{2}$ hours

Branch: Civil + Electronics

Notations have their usual meanings.

Section A

Attempt all problems. Each problem caries one mark.

1. For a one-one function $f(x)$, which of the following is true :
   (a) $f(x_1) \neq f(x_2) \implies x_1 = x_2$ (b) $f(x_1) = f(x_2) \implies x_1 = x_2$
   (c) $f(x_1) = f(x_2) \implies x_1 \neq x_2$ (d) None .

2. The value of $\lim\limits_{x \to 0} \frac{1}{x^2+1}$ is :
   (a) 1   (b) 0   (c) ∞ (d) Does not exists .

3. If $f(x) = x^3 \tan x$, then $f'(0) =$
   (a) 1   (b) -1 (c) 0   (d) 2.

4. The smallest value of the polynomial $x^3 - 18x^2 + 96x$ in $[0, 9]$ is :
   (a) 126   (b) 128   (c) 135   (d) 160.

5. The value of $(1+i)(1+i^2)(1+i^3)(1+i^4)$ is :
   (a) 0   (b) 1   (c) 2   (d) i.

Section B

Solve any three problems. Each problem carries three marks.

6. Show that the function $f : \mathbb{R} \to \mathbb{R}$ given by $f(x) = x^3$ is injective.

7. Evaluate $\lim\limits_{x \to \infty} \dfrac{2x^2 + 3x - 1}{3x^2 - 2x + 1}$.

8. Show that $f(x) = |x|$ is not differentiable at $x = 0$.

9. Find the radius of curvature at $(a, 0)$ on $y = x^3(x - a)$.

10. Using De Moivre's theorem prove that $\left(\dfrac{\cos \theta + i \sin \theta}{\sin \theta + i \cos \theta} \right)^4 = \cos 8\theta + i \sin 8\theta$.

Section C

Solve any one problem. Each problem caries six marks.

11. Find $\dfrac{dy}{dx}$, when $y = \left(x + \frac{1}{x} \right)^x + x^{\left(x + \frac{1}{x} \right)}$.

12. Find the minimum and maximum value of function $2x^3 - 21x^2 + 36x - 20$.

13. The volume of a cube is increasing at the rate of 8 cm^3/sec. How fast is the surface area increasing when the length of an edge is 12 cm.

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