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B.E. (1st Sem.) (CGPA) Civil Engg. Exam.-2015

ENGINEERING MATHS-I

Paper : CE-101

Time Allowed : Three Hours  
Maximum Marks : 60

Note : Attempt all the questions.  
Each question carry equal marks.

Q.1 Objective / True or False / Short answers— 1 each

(i) The Taylor's series expansion of  $x^{8/3}$  about  $x=0$  is

(a)  $x + \frac{x^{1/3}}{3!} + \frac{x^{2/3}}{6!} + \dots$  (b)  $x - \frac{x^{1/3}}{3!} + \frac{x^{2/3}}{6!} + \dots$

(c)  $1 + \frac{x^{2/3}}{2!} + \frac{x^{4/9}}{3!} + \dots$  (d)  $1 - \frac{x^{2/3}}{2!} + \frac{x^{4/9}}{3!} + \dots$

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(ii) If  $u = \tan^{-1}(x+y)$ , then the value of  $u_x - u_y$  is equal—

- (a) 1
- (b) -1
- (c) 0
- (d)  $\sin u$

(iii) If  $z = x^3 \cos\left(\frac{y}{x}\right)$  then  $x \frac{\partial z}{\partial x} + y \frac{\partial z}{\partial y} = \dots$

(iv) The error in the common logarithm of a number will be produced by an error of 1% in the number is 1. (True/False)

(v) Find out the saddle point for the function  $x^3 - y^2 - 3x$ .

(vi) The radius of curvature of the curve  $s = a \sec \psi \tan \psi + a \log(\sec \psi + \tan \psi)$  is—

- (a)  $a \sec^2 \psi$
- (b)  $\frac{a}{2} \cos \psi$
- (c)  $2a \sec^3 \psi$
- (d)  $2a \sec \psi$

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(vii) Let  $f(x) = \int_x^5 3t^2 dt$ , then the value of  $f'(2)$  is—

- (a)  $\frac{1}{81}$
- (b)  $\frac{1}{27}$
- (c)  $-\frac{1}{81}$
- (d) None of these

(viii) The value of the integral  $\int_0^\infty x^{2n+1} e^{-x} dx$  is—

- (a)  $\sqrt{2n}$
- (b)  $\sqrt{2n+1}$
- (c)  $\frac{1}{2} \sqrt{n+1}$
- (d) None of these

(ix) A closed curve has—

- (a) Unique asymptote
- (b) One asymptote
- (c) Infinite asymptote
- (d) No asymptote

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(x) Envelope of the family of straight lines  $y = mx + a/m$  is—

- (a)  $x^2 + y^2 = a^2$
- (b)  $xy = a^2$
- (c)  $y^2 = 4ax$
- (d)  $x^2 = 4ay$

Q.II (a) Find the expansion of  $(\sin^{-1}x)^2$  up to  $x^6$  by forming a second order differential equation and using leibnitz's rule.

(b) Find an approximate value of  $[(3.82)^2 + 2(2.1)^3]^{1/5}$

or

(a) Expand  $(1+x+2x^2)^{1/2}$  about the point at  $x = 1$ .

(b) Explain the mean value theorem. Verify mean value theorem for the function  $f(x) = \sqrt{x^2 - 4}$ ;  $a = 2$  and  $b = 3$ . Also find the value of  $C$ .

Q.III (a) If the relation between sub-normal  $SN$  and subtangent  $ST$  at any point  $S$  on the curve  $by^2 = (x+a)^3$  is  $\lambda(SN) = \mu(ST)^2$  then find the value of  $\frac{\lambda}{\mu}$ .

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(b) Find the value of  $\delta$  for the curve  $r = ae^{\delta \cot \alpha}$  and show that the radius of curvature subtends a right angle at the pole.

or

(a) Prove that the points on curve  $r = f(\theta)$ , the circle of curvature at which passes through the origin are given by the equation  $f(\theta) + f''(\theta) = 0$ .

(b) If two tangents to the cardioide  $r = a(1 + \cos \theta)$  are parallel, show that the line joining their points of contact subtends an angle  $\frac{2\pi}{3}$  at the pole.

**Q.IV** (a) State and prove Euler's theorem, and verify for

$$u = \frac{x}{y} + \frac{y}{z} + \frac{z}{x}$$

(b) Examine the curve  $x^3 + y^3 - 3axy = 0$  for its asymptotes.

or

(a) Divide 24 into three parts such that continued product of first, square of second and cube of third is a maximum.

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(b) Find the envelope of the straight line  $\frac{x}{a} + \frac{y}{b} = 1$ , when  $ab = c^2$ , where  $c$  is constant.

**Q.V** (a) Evaluate  $\int_a^b \cosh 2x \, dx$  as the limit of a sum.

(b) Find the area bounded by the curve  $4a^2(2a-x) = xy^2$  and its asymptote.

or

(a) Find out the sum of the series—

$$\lim_{n \rightarrow \infty} \left( \frac{n!}{n^n} \right)^{\frac{1}{n}}$$

(b) Find the volume of the solid obtained by the revolution of the curve  $y^2(2a-x) = x^3$  about its asymptote.

**Q.VI** (a) Prove that  $2^{2n-1} \beta(n, n) = \frac{\sqrt{n} \sqrt{(n)}}{\sqrt{\left(n + \frac{1}{2}\right)}}$

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(b) Evaluate  $\iint xy \, dx \, dy$  over the area bounded by the parabolas  $y=x^2$  and  $x=-y^2$ .

or

(a) Evaluate the integral  $\int_0^{\infty} \int_0^{\sqrt{y}} \exp\left(-\frac{x^2}{y}\right) dx \, dy$  by changing of the order of integration.

(b) Prove that —

$$\int_0^{\infty} \int_0^{\sqrt{y}} \exp\left(-\frac{x^2}{y}\right) dx \, dy = \frac{\pi}{m} \cdot 2^{1-4m}$$