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## EG-279

### B.E. I Semester (CGPA) Civil Engg. Examination 2018

#### ENGINEERING MATHEMATICS - I

Paper - CE-101

Time Allowed : Three Hours] [Maximum Marks : 60

Note : Attempt all questions. All questions carry equal marks.

#### Unit - I

Q.1. a) Prove by Maclaurin's theorem that

$$e^{\sin x} = 1 + x + \frac{x^2}{1 \cdot 2} - \frac{3x^4}{1 \cdot 2 \cdot 3 \cdot 4} + \dots \quad 6$$

b) Verify Lagrange's mean value theorem for the function  $f(x) = x(x-1)(x-2)$  on  $\left[0, \frac{1}{2}\right]$ .

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OR

- Q.2. a) Obtain the first four terms in the expansion of  $\log^{\sin y}$  in power of  $(x - 3)$ . 6
- b) Expand  $\sin(x + y)$  in powers of  $y$  and deduce that 6
- i)  $\sin(x + y) = \sin x \cdot \cos y + \sin y \cdot \cos x$
  - ii) Obtain the value of  $\sin 31^\circ$  correct to four places of decimals.

#### Unit - II

- Q.3. a) Prove that the angle of intersection of two curves is the angle between the tangents to the two curves at their point of intersection. 6
- b) Prove that the radius of curvature of the catenary  $y = c \cdot \cosh\left(\frac{x}{c}\right)$  is equal to the portion of the normal intercepted between the curve and the x-axis and that it varies as the square of the ordinate. 6

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- Q4. a) Prove that the straight line  $\frac{x}{a} + \frac{y}{b} = 1$  touches

curve  $y = b \cdot e^{\frac{-x}{a}}$  at the point where the curve cuts y-axis. Find also the equation of the normal at the same point. 6

- b) Show that in the curve  $x^{m+n} = a^{m-n} y^{2n}$ , the  $m^{\text{th}}$  power of the subtangent varies as the  $n^{\text{th}}$  power of the subnormal. 6

**Unit - III**

- Q5. a) If  $u = \log(x^3 + y^3 + z^3 - 3xyz)$ , show that

$$\left( \frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z} \right)^2 u = -\frac{9}{(x+y+z)^2} \quad 6$$

- b) Find the extreme values of the function

$$x^3 + y^3 - 3axy \quad 6$$

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- Q6. a) The diameter and altitude of a can in the shape of a right circular cylinder are measured as 4cm and 6cm respectively. The possible error in each measurement is 0.1cm. Find approximately the maximum possible error in the value computed for the volume and lateral surface. 6

- b) Prove that if the perimeter of a triangle is constant, its area is maximum when the triangle is equilateral. 6

**Unit - IV**

- Q7. a) Find the limit when  $n \rightarrow \infty$  of the serial 6

$$\frac{1}{n} + \frac{1}{n+1} + \frac{1}{n+2} + \frac{1}{n+3} + \dots + \frac{1}{3n}$$

- b) Evaluate  $\iint e^{2x+3} dx dy$  over the triangle bounded by  $x=0$ ,  $y=0$  and  $x+y=1$  6

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- Q.8. a) Find the area enclosed by the curve  
 $a^2 x^2 = y^3 (2a - y)$  6
- b) Find the length of the arc of the parabola  
 $x^2 = 4ay$  for the vertex to an extremity of the latus rectum. 6

**Unit - V**

- Q.9. a) Establish the relation between Beta and

Gamma function  $\beta(m, n) = \frac{(m)(n)}{(m+n)}$  6

- b) Find the coordinates of the centre of gravity of the positive octant of the sphere  
 $x^2 + y^2 + z^2 = a^2$ , density being given =  $kxyz$ . 6

OR

- Q.10. a) Evaluate  $\int_0^{\infty} \frac{x^8 (1-x^6)}{(1+x)^{24}} dx$  6

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- b) The mass of a solid right circular cylinder of radius a and height h is M. Find the moment of inertia of the cylinder about 6
- i) Its axis
  - ii) A line through its centre of gravity perpendicular to its axis.



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