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First Semester B.F. Degree Examination, June/July 2019
Calculus and Linear Algebra

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE MI questions, choosing ONE full question from each module.

Module-1

1 a. With usual notation, prove that $\tan(\phi) = r\frac{d\theta}{dr}$. **(06 Marks)**

b. Find the radius of curvature of $a^2y = x^3 - a^3$ at the point where the curve cuts the x-axis. **(06 Marks)**

c. Show that the evolute of the parabola $y^2 = 4ax$ is $27ay^2 = 4(x - 2a)^3$. **(08 Marks)**

OR

2 a. Prove that the pedal equation of the curve $r^n = a^n\cos n\theta$ is $a^n.p = r^{n+1}$. **(06 Marks)**

b. Show that for the curve $r(1 - \cos\theta) = 2a$, p^2 varies as r^3. **(06 Marks)**

c. Find the angle between the polar curves $r = a(1 - \cos\theta)$ and $r = b(1 + \cos\theta)$. **(08 Marks)**

Module-2

3 a. Expand $\log(1+\cos x)$ by Maclaurin's series up to the term containing x^4. **(06 Marks)**

b. Evaluate $\lim_{x \to 0} \frac{ax + b}{3}$ **(07 Marks)**

c. Find the extreme values of the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$. **(07 Marks)**

OR

4 a. If $u = f\begin{pmatrix} x & y & z \\ y & z & x \end{pmatrix}$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z} = 0$ **(06 Marks)**

b. If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$. Evaluate $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ at the point (1 -1, 0). **(07 Marks)**

c. A rectangular box, open at the top, is to have a volume of 32 cubic feet. Find the dimensions of the box, if the total surface area is minimum. **(07 Marks)**

Module-3

5 a. Evaluate by changing the order of integration

$$\int_0^a \int_{x^2}^{ax} dy\,dx, \quad a > 0$$ **(06 Marks)**

b. Find the area bounded between the circle $x^2 + y^2 = a^2$ and the line $x + y = a$. **(07 Marks)**

c. Prove that $I_{3(m,n)} = \frac{\Gamma(l+1)}{\Gamma(m+n)}$ **(07 Marks)**

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OR

6 a. Evaluate $\int_{-c}^{c}\int_{-h}^{h}\int_{a}^{a}(x^{\cdot}+y^{\cdot}+z^{\cdot})\,dz.dy.dx$ **(06 Marks)**

b. Find the area bounded by the ellipse $\frac{x}{a^{\cdot}}+\frac{y^{2}}{b^{\cdot}}=1$ by double integration. **(07 Marks)**

c. Show that $\int_{0}^{\frac{d0}{\sqrt{\sin 0}}} \text{x J,/sin 0.d0} =$ **(07 Marks)**

Module-4

7 a. Solve $(1+e')dx+e''\left(1-\frac{x}{y}\right)dy=0$ **(06 Marks)**

b. If the air is maintained at 30°C and the temperature of the body cools from 80°C to 60°C in 12 minutes. Find the temperature of the body after 24 minutes. **(07 Marks)**

c. Solve $yp^{2}+(x-y)p-x=0$. **(07 Marks)**

OR

8 a. Solve $\frac{dy}{dx}+y\cdot\tan x=y\cdot\sec x$ **(06 Marks)**

h. Find the orthogonal trajectory of the family of the curves $rn\cdot\cos nO=a^{n}$, where a is a parameter. **(07 Marks)**

c. Solve the equation $(px\ y)\cdot(py+x)=2p$ by reducing into Clairaut's form taking the substitution $X=x^{\cdot}$, $Y=y^{2}$. **(07 Marks)**

Module-5

9 a. Find the rank of the matrix

$$A=\begin{vmatrix} 1 & 2 & -2 & 3 \\ / & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{vmatrix}$$

by applying elementary Row transformations. (06 Marks)

b. Solve the following syste n of equations by Gauss-Jordan method:
$x+y+z=9,\ 2x+y-z=0,\ 2x+5y+7z=52$ **(07 Nlarks)**

c. Using Rayleigh's power method find the largest eigen value and corresponding eigen vecto of the matrix $A=\begin{vmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{vmatrix}$ with $X'^{\circ}=(1, 0, 0)^{1}$ as the initial eigen vector carry out 5 iterations. **(07 Marks)**

OR

10 a. For what values of and t the system of equations.
$x+y+z=6,\ x+2y+3z=10,\ x+2y+X.z=j_t$ may have
i) Unique solution ii) Infinite number of solutions iii) No solution. **(06 Marks)**

b. Reduce the matrix $A=\begin{vmatrix} -1 & 3 \\ 2 & 4 \end{vmatrix}$ into diagonal lbrm. **(07 (harks)**

c. Solve the following system of equations by Gauss-Seidel method
$20x+y-2z=17,\ 3x+20y-z=-18,\ 2x-3y+20z=25$. Carry out 3 iterations. **(07 Marks)**

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