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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, B.E. - Semester End Examination; April - 2021

Engineering Mathematics - I

(Common to all Branches)

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.

CO2: Explain mean value theorems and evaluate the indeterminate form and power series using Taylors and Maclaurin's series.

CO3: Differentiate the function of several variables differentiate the composite function. Evaluate the vector differentiation.

CO4: Evaluate some standard integrals by applying reduction formula and solve application problems. Solve differential equations of first order and solve application problems in engineering field.

Note: ***I) PART - A*** *is compulsory.* ***Two*** *marks for each question.*

II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for Maximum of* ***18 marks*** *from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Find the angle between radius vector and the tangent for the curve $r = a(1-\cos\theta)$.	2	L1	CO1	PO1
b.	Evaluate $\lim_{x\to 0} x^2 \log x$.	2	L1	CO2	PO1
c.	Find Div $\vec{F}$, where $\vec{F} = \nabla\left(x^3 + y^3 + z^3 - 3xyz\right)$.	2	L1	CO3	PO1
d.	Evaluate $\int_0^{\pi/2} \sin^6 x \cos^2 x dx$.	2	L1	CO4	PO1
e.	Solve: $\left(y^3 - 3x^2 y\right)dx - \left(x^3 - 3xy^2\right)dy = 0$.	2	L1	CO4	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	i) Find the pedal equation of $\frac{2a}{r} = (1+\cos\theta)$. ii) Show that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ intersect each other orthogonally.	9	L2	CO1	PO2
b.	Find the radius of curvature for the curve $y^2 = \frac{4a^2(2a-x)}{x}$, where the curve meets the x-axis.	9	L3	CO1	PO2
c.	Find the evolute of the parabola $y^2 = 4ax$.	9	L3	CO1	PO2
	UNIT - II	**18**			
2 a.	i) State Lagrange's mean value theorem. ii) Verify Cauchy's mean value theorem for the functions, e^x and e^{-x} in $[a, b]$.	9	L2	CO2	PO2

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b. i) State Taylor's series of $f(x)$ about $x=a$ upto fourth degree term. 9 L2 CO2 PO2

ii) Obtain the Maclaurin's expansion of $\log(1+\sin x)$.

c. Evaluate; i) $\lim_{x\to 1}\left[\frac{x}{x-1}-\frac{1}{\log x}\right]$ ii) $\lim_{x\to 0}\left(\frac{\tan x}{x}\right)^{1/x}$ 9 L2 CO2 PO2

UNIT - III **18**

3 a. If $u=\tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$ show that, 9 L2 CO3 PO2

i) $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$ ii) $x^2\frac{\partial^2 u}{\partial x}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=\sin 4u-\sin 2u$

b. Write the total derivative rule.

If $u=f(x-y,\ y-z,\ z-x)$ show that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$. 9 L3 CO3 PO1

c. i) Find the directional derivative of $\phi=x^2yz+4xz^2$ at (1, –2, –1) in the direction of $2i-j-k$. 9 L3 CO3 PO2

ii) Show that the vector field,

$\vec{F}=(x^2-yz)i+(y^2-zx)j+(z^2-xy)k$ is irrotational.

UNIT - IV **18**

4 a. Obtain the reduction formula for $\int \sin^n x\,dx$ and hence $\int_0^{\pi/2}\sin^n x\,dx$, where n is a positive integer. 9 L2 CO4 PO2

b. Evaluate $\int_0^{\infty} e^{-ax}\ \frac{\sin x}{x}\,dx$ and hence evaluate $\int_0^{\infty}\frac{\sin x}{x}\,dx$. 9 L3 CO4 PO2

c. Trace the curve $r=a(1+\cos\theta)$ (cardiode). 9 L3 CO4 PO2

UNIT - V **18**

5 a. i) Solve: $\left(1+e^{x/y}\right)dx+e^{x/y}\left(1-\frac{x}{y}\right)dy=0.$ 9 L2 CO4 PO1

ii) Solve: $y(xy+1)\,dx-x(xy-1)\,dy=0.$

b. i) Solve: $\frac{dy}{dx}+\frac{y}{x}=y^2x.$ 9 L2 CO4 PO2

ii) Solve: $\left(xy^3+y\right)dx+2\left(x^2y^2+x+y^4\right)dy=0.$

c. If the temperature of the air is 30°C and a metal ball cools from 100°C to 70°C in 15 minutes, find how long will it take for the metal ball to reach a temperature of 40°C? 9 L3 CO4 PO2

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