U.S.N

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

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester, B.E. - Semester End Examination; May - 2022

Engineering Mathematics - I

(Common to all Branches)

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1 – Find the radius of curvature of the functions.

CO2 – Obtain Taylor's series of the functions.

CO3 – Explain the concept of partial differentiation.

CO4 – Derive reduction formula of the functions.

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

II) PART - B*: Answer any* ***Two*** *sub questions (from a, b, c) for a 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 to the curve $r = 2\sin\theta$.	2	L1	CO1	PO1
b.	State the Lagrange's mean value theorem.	2	L1	CO2	PO1
c.	If $u = 2hxy + x^2 + 2y^2 + 3xy^3$, find $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ where h is a constant.	2	L1	CO3	PO1
d.	Write reduction formula for $\int_0^{\pi/2} \sin^n x\,dx$.	2	L1	CO4	PO1
e.	Verify the following differential equation for exactness, $(2xy + y - \tan y)\,dx + (x^2 - x\tan^2 y + \sec^2 y)\,dy = 0$.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	i) Find the angle between the curves $r = a(1+\sin\theta)$ and $r = a(1-\sin\theta)$. ii) Obtain the Pedal equation of the curve $r = a\,e^{m\theta}, m$ – constant.	9	L1	CO1	PO1
b.	Find the radius of the curvature for the Folium of De-Cartes $x^3 + y^3 = 3axy$ at the point $\left(3a/2, 3a/2\right)$ on it.	9	L2	CO1	PO2
c.	Find the evolutes of the parabola $y^2 = 4ax$ by considering the parametric equations $x = at^2,\ y = 2at$.	9	L2	CO1	PO1
	UNIT - II	**18**			
2 a.	State the Cauchy's mean value theorem. Verify it for the functions, $f(x) = \frac{1}{x^2}$; $g(x) = \frac{1}{x}$ in $[a, b]$, $b > a > 0$.	9	L2	CO2	PO1

b.	Obtain the Taylor's series expansion of $f(x)=\log\cos x$ about the point $x=\dfrac{\pi}{3}$ upto the fourth degree term.	9	L2	CO2	PO2
c.	Evaluate the following : i) $\underset{x\to 0}{lt}\left(\dfrac{\tan x}{x}\right)^{\frac{1}{x}}$ ii) $\underset{x\to 0}{lt}(\cot x)^{\tan x}$	9	L2	CO2	PO1

UNIT - III **18**

3 a.	State the Euler's theorem. Applying Euler's theorem show that, $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}=\dfrac{1}{2}\sin 2u$ for the function $u=\tan^{-1}\left(\dfrac{x^2+y^2}{x+y}\right)$.	9	L2	CO3	PO1
b.	If $u=\tan^{-1}\left(\dfrac{x^3+y^3}{x-y}\right)$ show that, *i)* $xu_x+yu_y=\sin 2u$ *ii)* $x^2u_{xx}+2xy\,u_{xy}+y^2u_{yy}=\sin 4u-\sin 2u$	9	L3	CO3	PO2
c.	If $\vec{F}=(2xy^2+yz)\hat{i}+(2x^2y+xz+2yz^2)\hat{j}+(2y^2z+xy)\hat{k}$, then show that $\vec{F}$ is a conservative force field. Also find the scalar potential for $\vec{F}$.	9	L3	CO3	PO2

UNIT - IV **18**

4 a.	Obtain the Reduction formula for $\int\cos^n x dx$ and hence deduce $\int_0^{\pi/2}\cos^n x\,dx$. Also evaluate $\int_0^{\pi/2}\cos^7 x\,dx$.	9	L2	CO4	PO1
b.	Find the volume of the tetrahedron bounded by the planes $x=0,\ y=0,\ z=0,\ \dfrac{x}{a}+\dfrac{y}{b}+\dfrac{z}{c}=1$.	9	L3	CO4	PO2
c.	Trace the curve $y^2(a-x)=x^2(a+x),\ \ a>0$, which is a strophoid.	9	L2	CO4	PO2

UNIT - V **18**

5 a.	i) Solve $(y\cos x+\sin y+y)dx+(sinx+x\cos y+x)dy=0$. ii) Solve $(x^2-3xy+2y^2)dx+x(3x-2y)dy=0$.	9	L2	CO4	PO1
b.	i) Find the orthogonal trajectories of the family of the curves $y^2=cx^3$ where c is the parameter. ii) Obtain orthogonal trajectories of the polar curve $r^2=a^2\cos 2\theta$.	9	L2	CO4	PO2
c.	If the temperature of the air is 30ºC and a metal ball cools from 100ºC to 70ºC in 15 minutes, find how long will it take for the metal ball to reach a temperature of 40ºC.	9	L3	CO4	PO2

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