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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; Dec. 2019

Engineering Mathematics - I

(Common to all Branches)

Time: 3 hrs *Max. Marks: 100*

Course Outcome

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, one question from each unit

ii) Part - B : Answer Two sub-questions for Maximum of 18 marks from each unit.

Q. No.		Questions	Marks	BLs	COs
		I : PART - A	**10**		
I.	a.	Find the angle between radius vector and the tangent for the curve $r = a\sin\theta$	2	L1	CO1
	b.	State Lagrange's mean value theorem.	2	L1	CO2
	c.	Compute U_{xx} if $u = x^3 - 3xy^2 + x + e^x \cos y + 1$	2	L1	CO3
	d.	Evaluate $\int_0^{\pi/2} \cos^6 x dx$	2	L1	CO4
	e.	Check whether the given differential equation is exact or not: $\left(y^3 + 3x^2 y\right)dx + \left(3xy^2 - x^3\right)dy = 0$	2	L1	CO4
		II : PART - B	**90**		
		UNIT - I	**18**		
1	a.	i) Show that the pairs of curves interest each other orthogonally, $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ ii) For the equiangular spiral $r = ae^{\theta\cot\alpha}$ where a and α are constants find pedal equation.	9	L1	CO1
	b.	i) Find the radius of curvature for the curve $y = ax^2 + bx + c$ at $x = \frac{1}{2a}\left(\sqrt{a^2 - 1} - b\right)$ ii) Show that for the curve $r^n = a\cos\theta$, e is a constant.	9	L2	CO1
	c.	Find the evolute of the parabola $y^2 = 4ax$ by considering the parametric equations $x = at^2,\ y = 2at$.	9	L2	CO1
		UNIT - II	**18**		
2	a.	State Cauchy's mean value theorem and verify the same for e^x and e^{-x} in $[3,7]$	9	L2	CO2
	b.	Obtain the Maclaurin's expression of the function $\log(1+x)$ and hence deduce that, $\log\sqrt{\frac{1+x}{1+x}} = x + \frac{x^3}{3} + \frac{x^5}{5} + ...$	9	L2	CO2

Contd…2

c.	Evaluate the following indeterminate forms: i) $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{1/x^2}$ ii) $\lim_{x\to \frac{\pi}{2}}\left(2x\tan x-\pi\sec x\right)$	9	L2	CO2
	UNIT - III	**18**		
3 a.	i) Apply Euler's theorem to compute the value of xU_x+yU_y for the function $u=\sec^{-1}\left(\frac{x^2+y^2}{x-y}\right)$. ii) Using the concept of total derivatives, find $\frac{dz}{dt}$ if $z=xy^2+x^2y$ where $x=at,\ y=2at$.	9	L2	CO3
b.	i) If $u=f\left(x/y,\ y/z,\ z/x\right)$ then by using the definition of composition function prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}+z\frac{\partial u}{\partial z}=0$. ii) A particle moves along the curve $C: x=t^3,\ y=t^2-2t,\ z=10t$ where 't' is the time. Find the component of velocity at t = 2 in the direction of $i+2j+3k$.	9	L3	CO3
c.	Compute a, b and c such that $\vec{F}=(x+y+az)i+(bx+2y-z)j+(x+cy+2z)k$ is irrotational. Also find scalar potential ϕ such that $\vec{F}=\nabla\phi$.	9	L3	CO3
	UNIT - IV	**18**		
4 a.	Obtain the reduction formula for $\int \sin^n x dx$ and $\int_0^{\pi/2} \sin^n x dx$ where n= 1, 2, 3,…. hence evaluate $\int_0^{\pi/2} \sin^5 x dx$	9	L2	CO4
b.	Apply differentiation under integral sign, evaluate $\int_0^1 \frac{x^\alpha-1}{\log_e x}dx,\ \alpha\ge 0$ where α is a parameter. Hence compute $\int_0^1 \frac{x^3-1}{\log x}dx$	9	L3	CO4
c.	Tracing the curve $y^2(a-x)=x^3, a>0$ (cissoid).	9	L3	CO4
	UNIT - V	**18**		
5 a.	i) Solve: $\left(x^2+y^2+x\right)dx+xydy=0$ ii) Solve: $e^y\left(\frac{dy}{dx}+1\right)=e^x$	9	L2	CO4
b.	i) Show that the orthogonal trajectories of the family of parabolas $y^2=4a\left(x+a\right)$ forms self orthogonal. ii) Test for self orthogonality $r^n=a\sin n\theta$	9	L2	CO4
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

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