b) If $u=\frac{yz}{x}, v=\frac{zx}{y}, w=\frac{xy}{z}$ show that $\frac{\partial(u,v,w)}{\partial(x,y,z)}=4$

c) Find the extreme values of the function $f(x, y)=x^4+y^4-2x^2+4xy-2y^2$ 7

6\. a) If u=f(x-y, y-z, z-x) then find the value of $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}$ 6

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 (1,-1,0). 7

c) A rectangular box open at the top is to have volume of 32 cubic ft. Find the dimensions of the box requiring least material for its construction. 7

Unit – IV

7\. a) Find angle between the curves r = a (1 + cosθ) and r = b (1 - cosθ). 6

b) Find $\frac{ds}{dx}$ and $\frac{ds}{dy}$ for the curve $x^{2/3}+y^{2/3}=a^{2/3}$ 7

c) Find the radius of curvature at any point on the curve $x=a\cos^3\theta,\ y=a\sin^3\theta$, 7

8\. a) State and prove Lagrange's mean value theorem. 6

b) Verify Rolle's theorem for the function $(x-a)^m(x-b)^n$ in (a, b), where m and n are positive integers. 7

c) State Cauchy's mean value theorem. Verify Cauchy's mean-value theorem for the functions e^x and e^{-x} in the interval (a ,b) 7

Unit – V

9\. a) Evaluate $\int_0^{\infty}\frac{x^2}{(1+x^2)^{7/2}}dx$ 7

b) Obtain the reduction formula for $\int \sin^n x\,dx$ and hence evaluate $\int_0^{\pi/2}\sin^n x\,dx$ 6

c) Trace the curve $y^2(a-x) = x^2(a+x)$ 7

10\. a) Evaluate $\int_0^{\pi}\frac{\sqrt{1-\cos x}}{1+\cos x}\sin^2 x\,dx$ 6

b) Find the surface area of the solid formed by revolving the cardioide r = a (1+cosθ) about the initial line. 7

c) Find the area included between the curve $y^2(2a-x)=x^3$ and its asymptote. 7

BT* Bloom's Taxonomy, L* Level

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester B.E. (Credit System) Degree Examinations

Supplementary Examinations – July 2018

17MA101 – ENGINEERING MATHEMATICS - I

ration: 3 Hours | …s: 100

***Note:** Answer Five full questions choosing One full question from each Unit.*

Unit – I

Marks BT*

a) Find the rank of the matrix $\begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 3 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$ by reducing it to echelon form. 6 L*2

b) Solve the following system of equations by Gauss- Seidal method.
$10x+y+z=12$, $x+y+10z=12$, $x+10y+z=12$, $x + 10y + z = 12$
Take $x^{(0)}=y^{(0)}=z^{(0)}=0$ and carry out four iterations. 7 L3

c) Using the Rayleigh's power method, find the largest eigen value and the corresponding eigen vector with the given initial vector. $A=\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$ and given vector is $[1 \quad 0 \quad 0]^T$. Carryout 5 iterations. 7 L3

a) Reduce the quadratic form $3x^2 + 5y^2 + 3z^2 - 2yz + 2xz - 2xy$ to canonical form. 6 L2

b) Show that the transformation,
$y_1=2x_1 + x_2 + x_3$, $y_2 = x_1+x_2+2x_3$, $y_3 = x_1 - 2x_3$ is regular. Write down the inverse transformation. 7 L3

c) Diagonalize the matrix $A=\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ 7 L3

Unit – II

a) Test for the convergence of the series,
$\frac{1}{2\sqrt{1}}+\frac{x^2}{3\sqrt{2}}+\frac{x^4}{4\sqrt{3}}+\frac{x^6}{5\sqrt{4}}+\ldots\ldots\infty$ 6 L3

b) If $x=\sin t$, $y=\sin pt$ prove that $(1-x^2)y_{n+2} - (2n+1)xy_{n+1} + (p^2-n^2)y_n=0$ 7 L3

c) Find the Maclaurin series expression of $f(x)=\sqrt{1+\sin 2x}$ up to the term containing x^4. 7 L3

a) Test the convergence of the series.
$\left(\frac{2^2}{1^2}-\frac{2}{1}\right)^{-1}+\left(\frac{3^3}{2^3}-\frac{3}{2}\right)^{-2}+\left(\frac{4^4}{3^4}-\frac{4}{3}\right)^{-3}+\ldots\ldots.$ 6 L4

b) Obtain the n^{th} derivative of $\log(ax+b)$ 7 L3

c) Expand $\log x$ in powers of $(x-1)$ up to 3^{rd} degree terms. 7 L3

Unit – III

a) Show that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=2u\log u$ where $\log u=\frac{x^3+y^3}{3x+4y}$. 6 L3

P.T.O.

Unit – V

		Marks	L*	CO*	PO*
9.	a) Find the surface area of the solid generated by the revolution of the cardioid $r = a(1-\cos\theta)$ about the initial line.	6	L1	5	2
	b) Prove that $\beta(m,n) = \dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$ with usual notations.	7	L1	5	1
	c) Obtain the reduction formula for $\int \cos^n x\,dx$. Hence evaluate $\int_0^{\frac{\pi}{2}} \cos^n x\,dx$.	7	L1	5	1
10.	a) Evaluate i) $\int_0^{\infty} x^6 e^{-2x}\,dx$ using gamma function. ii) $\int_0^{\frac{\pi}{2}} \sin^7\theta\cos^9\theta\,d\theta$ using beta & gamma function.	6	L1	5	2
	b) Find the volume generated by revolving one arch of the cycloid $x = a(\theta+\sin\theta)$, $y = a(1+\cos\theta)$ about the x-axis.	7	L1	5	2
	c) Using reduction formula evaluate i) $\int_0^{\frac{\pi}{6}} \sin^3 6x\cos^4 3x\;dx$ ii) $\int_0^{\pi} \dfrac{\sin^4\theta}{(1+\cos\theta)^2}\,d\theta$	7	L1	5	2

Bloom's Taxonomy, L* Level; CO* Course Outcome; PO* Program Outcome

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4. a) State Rolle's theorem. Verify Rolle's theorem for $(x+2)^3(x-3)^4$ in $[-2,3]$ 6 L1 2

b) Obtain Taylor's series expansion of $\sin x$ in powers of $(x-\frac{\pi}{2})$ up to terms containing $\left(x-\frac{\pi}{2}\right)^4$. 7 L3 2

c) Discuss the convergence of the series

i) $1+\frac{x}{2}+\frac{x^2}{3^2}+\frac{x^3}{4^3}+\ldots\ldots\ldots\ldots, x>0$.

ii) $\sum_{n=1}^{\infty}\sqrt{\frac{3^n-1}{2^n+1}}$ 7 L3 2

Unit – III

5. a) If $u=e^x\sin(yz)$ where $x=t^2, y=t-1, z=\frac{1}{t}$ then find $\frac{du}{dt}$ at $t=1$. 6 L1 3

b) If $\tan u=\frac{x^3+y^3}{x-y}$ then prove that $x\frac{\partial u}{\partial x}+y\frac{\partial u}{\partial y}=\sin 2u$ and $x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=2\cos 3u\sin u$. 7 L3 3

c) If the perimeter of a triangle is constant then prove that the area of this triangle is maximum when the triangle is equilateral. 7 L1 3

6. a) Find the unit vector normal to the surface $xy^3z^2=4$ at (-1,-1,2). 6 L1 3

b) A particle moves along the curve $x=t^3+1,\ y=t^2,\ z=2t+3$, where t is the time. Find the components of its velocity and acceleration at time t=1 in the direction $\hat{i}+\hat{j}+3\hat{k}$. 7 L3 3

c) Find $div\vec{F}$ and $curl\vec{F}$ where $\vec{F}=grad(x^3+y^3+3xyz)$. 7 L1 3

Unit – IV

7. a) Evaluate $\iint_D xy\,dx\,dy$ over the first quadrant of the circle $x^2+y^2=a^2$. 6 L1 4

b) Using double integral find the area of the cardioid $r=a(1+\cos\theta)$. 7 L1 4

c) Find the volume common to the cylinders $x^2+y^2=a^2$ and $x^2+z^2=a^2$. 7 L2 4

8. a) Evaluate $\int_0^1\int_0^x\int_0^{x+y}(x+y+z)\,dz\,dy\,dx$. 6 L1 4

b) Evaluate $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}\,dx\,dy$ by changing to polar coordinates. 7 L1 4

c) Show that the area between the parabolas $y^2=4ax$ and $x^2=4ay$ is $\frac{16a^2}{3}$. 7 L2 4

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NMAM INSTITUTE OF TECHNOLOGY, NITTE

(An Autonomous Institution affiliated to VTU, Belagavi)

First Semester B.E. (Credit System) Degree Examinations

November - December 2018

18MA101 – ENGINEERING MATHEMATICS - I

...tion: 3 Hours Max. Marks: 100

*Note: Answer **Five full** questions choosing **One full** question from **each Unit.***

Unit – I

		Marks	BT*	CO*	PO*
a)	Find the rank of the following matrix using elementary row transformation. $\begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$	6	L*1	1	2
b)	Test for consistency and solve the system of equations by Gauss elimination method. $2x-7y+4z=9$, $-3x+8y+5z=6$, $x+9y-6z=1$	7	L3	1	2
c)	Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$.	7	L1	1	2
a)	Find the spectral and modal matrix for $\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$.	6	L1	1	2
b)	Find the inverse of the following matrix by using elementary row operations. $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$.	7	L3	1	2
c)	Show that the equations $y_1 = 2x_1+3x_2+4x_3$ $y_2 = 4x_1+3x_2+x_3$, $y_3 = x_1+2x_2+4x_3$ represent a regular linear transformation. Find the inverse of this transformation.	7	L1	1	2

Unit – II

a)	(i) State D'Alembert's ratio test. (ii) Test for the convergence of the series $1+\frac{2!}{2^2}+\frac{3!}{3^3}+$................	6	L3	2	2
b)	State and prove Cauchy's mean value theorem.	7	L1	2	1
c)	Obtain the Maclaurin's expansion of $e^x \cos x$ up to third degree terms.	7	L1	2	2