K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

Supplementary Exam August 2023
Program: B.Tech. Scheme: II
Examination: FY   Semester: I
Course Code: BSC101 and Course Name: Engineering Mathematics I

Date of Exam: 07-08-2023   Duration: 2.5 Hours   Max. Marks: 60

Instructions:
(1) All questions are compulsory.
(2) Draw neat diagrams wherever applicable.
(3) Assume suitable data, if necessary.

		Max. Marks	CO	BT level
Q 1	**Solve any six questions out of eight:**	12		
i)	If $z = 1 + i\sqrt{3}$ and $\bar{z}$ is the conjugate of z, find the value of $z^8 + z^{-8}$.	02	C01	A
ii)	Find all the roots of the equation $x^6 + 1 = 0$.	02	C01	A
iii)	Find the value of $\tanh(\log x)$ if $x = \sqrt{3}$.	02	C02	A
iv)	Find the value of $\log(-5)$	02	C02	A
v)	If $z = ax^2 + by^2 + 2abxy$, find $\frac{\partial z}{\partial x}, \frac{\partial z}{\partial y}$	02	C03	A
vi)	If $u = x^{3/2}\left(\frac{x+y}{x-y}\right)$, find the value of $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$.	02	C03	A
vii)	Find n^{th} derivative of $y = \cos 2x \cos 3x$.	02	C04	A
viii)	Determine whether the matrix $A = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$ is orthogonal?	02	C05	A
Q.2	**Solve any four questions out of six.**	16		
i)	Solve $x^5 = 1 + i$ and find the continued product of all the roots.	04	C01	A
ii)	If $x + iy = 2\cosh\left(\alpha + i\frac{\pi}{4}\right)$ then prove that $x^2 - y^2 = 2$	04	C02	A
iii)	If $u = f(r)$ and $r^2 = x^2 + y^2$, prove that $u_{xx} + u_{yy} = f''(r) + \frac{1}{r}f'(r)$.	04	C03	A
iv)	If $y = a\cos(\log x) + b\sin(\log x)$, prove that $x^2 y_{n+2} + (2n+1)xy_{n+1} + (n^2+1)y_n = 0$.	04	C04	A

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v)	Find the maxima and minima of $x^2 + y^2 + 8x + 6y + 6$	04	C04	A
vi)	Express the following matrix as $P + iQ$ where P and Q both are Hermitian matrices. $\begin{bmatrix} 1-i & 2+3i & 3-i \\ 2 & 2-i & 1+2i \\ 3i & 0 & 1+i \end{bmatrix}$	04	C05	A
Q.3	**Solve any two questions out of three.**	16		
i)	Using De Moivre's Theorem prove that, $cos^6\theta + sin^6\theta = \frac{1}{8}(3\cos 4\theta + 5)$	08	CO1	A
ii)	Separate into real and imaginary parts of $\text{sech}(x + iy)$.	08	CO2	A
iii)	Investigate for what value of k, the equations below have a solution and solve them in each case. $x + 2y + z = 3$, $x + y + z = k$, $3x + y + 3z = k^2$.	08	CO4	A
Q.4	**Solve any two questions out of three.**	16		
i)	Verify Euler's theorem for Homogeneous functions for function $u = x^3 \tan^{-1}\left(\frac{x}{y}\right)$.	08	CO3	A
ii)	Divide 120 into three parts such that their product is maximum.	08	CO4	A
iii)	Reduce the following matrix to normal form and hence find its rank. $\begin{bmatrix} 1 & 3 & 5 & 7 \\ 4 & 6 & 8 & 10 \\ 15 & 27 & 39 & 51 \\ 6 & 12 & 18 & 24 \end{bmatrix}$	08	CO5	A

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