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III SEMESTER B. TECH END SEMESTER EXAMINATIONS NOVEMBER 2018
SUBJECT: **ENGINEERING MATHEMATICS III - [MAT 2103]**
(COMMON TO BT/CHE)

Date of Exam: 24.11.2018 Time of Exam: 9.00-12.00 Max. Marks: **50**

Instructions to Candidates: Answer ALL the questions

1A.	Find the Fourier series expansion of $f(x) = 2x - x^2,\ 0 < x < 2$, $f(x+2) = f(x)$ and hence show that $\sum_{n=1}^{\infty}\frac{1}{n^2} = \frac{\pi^2}{6}$.	**4**
1B.	Find the half range Fourier Cosine series expansion of $f(x) = 1 - \frac{x}{l}$, $0 < x < l$. Also draw the graph of corresponding periodic extension of f(x).	**3**
1C.	Find the Fourier transform of $f(x) = \begin{cases} 1 - x^2, & \lvert x\rvert \le 1 \\ 0, & \lvert x\rvert \ge 1 \end{cases}$ and hence evaluate $\int_0^{\infty}\frac{\sin t - t\cos t}{t^3}\,dt$.	**3**
2A.	a) Obtain first harmonic in the Fourier series of amplitude A <table><tr><td>t sec:</td><td>0</td><td>$T/6$</td><td>$T/3$</td><td>$T/2$</td><td>$2T/3$</td><td>$5T/6$</td><td>T</td></tr><tr><td>A amp:</td><td>1.98</td><td>1.30</td><td>1.05</td><td>1.30</td><td>-0.88</td><td>-0.25</td><td>1.98</td></tr></table>b) Find the bilinear transformation which maps $z = 0, 1, \infty$ to $w = -5, -1, 3$. What are invariant points in this transformation?	**4**
2B.	Find the cosine transform of $f(x) = e^{-ax}, a > 0$ and hence find $F_c\left\{\frac{1}{a^2+x^2}\right\}$.	**3**
2C.	If $f(z) = u + iv$ is an analytic function of z=x+iy, show that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)\lvert f(z)\rvert^2 = 4\lvert f'(z)\rvert^2$.	**3**
3A.	Find an analytic function $f(z) = u + iv$ for which $u = \frac{\sin 2x}{\cos 2y + \cos 2x}$	**4**
3B.	Find all possible series expansion of $f(z) = \frac{1}{z^2+3z+2}$ *about* z=0.	**3**
3C.	Evaluate $\oint_C \frac{z^2}{(z+1)(z^2+4)}dz$ where $C: \lvert z - 2i\rvert = 3$.	**3**
4A.	Show that $\vec{A} = r^n\vec{r}$ is irrotational. Find the value of n for which the vector $\vec{A} = r^n\vec{r}$ is also solenoidal, where $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$.	**4**
4B.	Find the equation of tangent plane and normal line to the surface $x^2 + 2xy^2 - 3z^3 = 6$ at point (1, 2, 1).	**3**

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4C.	Evaluate $\oiint_S \vec{A} \cdot \hat{n}\ dS$ where $\vec{A} = (2x - y)\hat{\imath} - 2y\hat{\jmath} - 4z\hat{k}$ and S is the surface of the region bounded by $x = 0, y = 0, z = 0, z = 3$ and $x^2 + y^2 = 16$ lying in the first octant.	**3**
5A.	Verify Green's theorem for $\oint_C (xy + y^2)dx + x^2dy,$ where C is bounded by $y = x$ and $y = x^2$.	**3**
5B.	Solve $u_x + u_y = 2(x + y)u$ by separating the variables.	**3**
5C.	Solve the partial differential equation $u_{tt} = c^2u_{xx}$ using the transformations $v = x + ct$ and $w = x - ct$ subject to the conditions $u(x, 0) = f(x)$ and $u_t(x, 0) = g(x)$.	**4**