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MANIPAL INSTITUTE OF TECHNOLOGY

III SEMESTER B.TECH (CHEMICAL/BIOTECHNOLOGY)

MAKE UP END SEMESTER EXAMINATIONS, DEC/JAN – 2015-16

SUBJECT: ENGINEERING MATHEMATICS III [MAT 2103]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	State Dirichlet's condition. Also find the Fourier series representation of $f(x) = x - x^2,\ f(x+2\pi) = f(x)$ in $(-\pi, \pi)$.	**4**
1B.	Given a conservative vector field $\boldsymbol{F} = (2xy + z^3)\boldsymbol{i} + x^2\boldsymbol{j} + 3xz^2\boldsymbol{k}$, Find its scalar potential and also find the work done in moving an object in this field from (1, -2, 1) to (3, 1, 4).	**3**
1C.	Solve by the method of separation of variables $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 2(x+y)u.$	**3**
2A.	State Gauss divergence theorem. Hence evaluate $\iint_S \boldsymbol{F}.\boldsymbol{n}ds$ where $\boldsymbol{F} = 4x\boldsymbol{i} - 2y^2\boldsymbol{j} + z^2\boldsymbol{k}$ taken over the region bounded by $x^2 + y^2 = 4$, $z = 0\ \ and\, z = 3.$	**4**
2B.	Let $f(z) = u + iv$ be an analytic function, show that $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial x^2}\right)\lvert f(z)\rvert^2 = 4\lvert f'(z)\rvert^2$	**3**
2C.	Using Fourier integral representation, Prove that $\int_0^\infty \frac{\cos sx + s\sin sx}{1+s^2}ds = \begin{cases} 0 & x<0 \\ \frac{\pi}{2} & x=0 \\ \pi e^{-x} & x>0 \end{cases}$	**3**

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3A.	State Cauchy's residue theorem and find the residues of $f(z) = \frac{z^2-16}{(z+4)(z-1)^2}$ at all the singularities.	**4**
3B.	Find the Fourier transform of $f(x) = e^{-a^2x^2}, a > 0$. Hence show that $e^{\frac{-x^2}{2}}$ is a self-reciprocal function.	**3**
3C.	Form a partial differential equation by eliminating arbitrary function $f(x^2+y^2,\ z-xy)=0$	**3**
4A.	Find all possible expansion of the following: i. $\frac{1}{z^3-z}$ about $z=1$ ii. $zsinz\ about\ z=\frac{\pi}{2}$	**4**
4B.	Obtain the half range cosine series of $f(x) = \begin{cases} kx & 0 < x < \frac{l}{2} \\ k(l-x) & \frac{l}{2} < x < l \end{cases}$	**3**
4C.	Prove that $\nabla^2 r^n = n(n+1)r^{n-2}$.	**3**
5A.	Solve $u_{xx} + 2u_{xy} + u_{yy} = 0$ using the transformation $v = x$ and $z = x - y$	**4**
5B.	Find the values of the constants a, b, c such that the directional derivative of $\emptyset = axy^2 + byz + cz^2x^3$ at (1, 2, -1) has maximum magnitude of 64 in a direction parallel to z axis.	**3**
5C.	Solve $\int_c \frac{z+4}{z^2+2z+5} dz$ where c is i. |z|=1 ii. |z+1-i|=2 iii. |z+1+i|=2	**3**