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III SEMESTER B.TECH (MECH/AUTO/AERO/MT/IP)

END SEMESTER MAHEUP EXAMINATIONS DEC 2017

SUBJECT: ENGINEERING MATHEMATICS III(MAT 2101)

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates

- Answer ALL the questions.

1A.	Solve $y'' = xy, y(0) - y'(0) = 1, y(1) = 1$ with $h = 0.5$	3
1B.	Find the Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}, a > 0$	3
1C.	Verify the divergence theorem for $\vec{F} = 4xi - 2y^2j + z^2k$ taken over the region bounded by $x^2 + y^2 = 4, z = 0$ and $z = 3$	4
2A.	Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0, 0 < x < 1, 0 < y < 1, u(x,1) = u(0,y) = 0, u(1,y) = 9(y - y^2), u(x,0) = 9(x - x^2)$ and $h = \frac{1}{3}$	3
2B.	Verify stoke's theorem for $\vec{F} = xz\boldsymbol{i} - y\boldsymbol{j} + x^2y\boldsymbol{k}$, where S is the surface of the region bounded by $x = 0, y = 0, z = 0, 2x + y + 2z = 8$, which is not included in the xz plane.	3
2C.	Find the fourier transform of $f(x) = e^{-a^2x^2}, a > 0$. Hence find the value for a so that $f(x)$ is self-reciprocal	4
3A.	Solve $\frac{\partial u}{\partial t} = \frac{1}{16}\frac{\partial^2 u}{\partial x^2}, 0 < x < 1, t > 0, u(x,0) = 0, u(0,t) = 0, u(1,t) = 100t$. Compute u for one time step with $h = \frac{1}{4}$. $K \simeq 1.$	3

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3B. Prove that $\vec{F} = (2xy + z^3)i + x^2 j + 3xz^2 k$ is a conservative force field. Hence

i) Find the scalar potential for $\vec{F}$
ii) Find the work done in moving an object in this field from $(1, -2, 1)$ to $(3,1,4)$

3

3C. Obtain the Fourier series for the function

$$f(x) = \begin{cases} \pi x, & 0 \le x \le 1 \\ \pi(2 - x), & 1 \le x \le 2 \end{cases}$$

4

4A. Find the constants a and b so that the surface $ax^2 - byz = (a + 2)x$ will be orthogonal to the surface $4x^2y + z^3 = 4$ at the point $(1, -1, 2)$

3

4B. Derive D' Alembert's solution of the wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$

3

4C. Solve the wave equation $\frac{\partial^2 u}{\partial t^2} = 16 \frac{\partial^2 u}{\partial x^2}, 0 < x < 5, t > 0, u(x, 0) = x^2(5 - x),$

$\frac{\partial u}{\partial t}(x, 0) = 0, u(0, t) = u(5, t) = 0, h = 1.$ Find u for 4 time steps

4

5A. Obtain the Fourier expansion of $xsinx$, as a cosine series in the interval $(0, \pi)$

3

5B. Obtain the first two coefficients in the Fourier sine series for y, where y is given in the following table

x°	0	30	60	90	120	150	180
y	0	5224	8097	7850	5499	2626	0

3

5C. Solve $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ using method of separation of variables.

4

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