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FIRST SEMESTER **M.Tech.[MOCE]**

SUPPLEMENTARY EXAMINATION **Feburary 2019**

EC-552 Numerical Techniques in Electromagnetism

Time: 3:00 Hours *Max. Marks: 100*

Note:	**Answer all questions**
	Assume suitable missing data, if any.

1. (a) Write the Maxwell's equations in differential as well as integral form.
(b) List and draw the common grid patterns used in the finite difference scheme.
(c) Explain the sources of error that are nearly unavoidable in numerical solution of problems.
(d) Find < u,v> if u =1, v = x^2- $2y^2$ in the rectangular region $0 < x < 1, 1 < y$
(e) Express 10 sin(ωt –kz) a_x + 20 cos(ωt –kz) a_y in phasor form.
(f) Discuss the advantages and disadvantages of finite element method over other modelling techniques.
[6 * 5 = 30]

2. Using the separation of variables technique, obtain the solution to the one dimensional heat equation
$$U_{xx} = U_t, \quad 0 < x < 1, \quad t > 0$$
subject to the boundary conditions U(0,t) = 0 = U(1,t), t >0 and initial condition U(x,0) = 100 , 0<x<1.
[10]

3. Solve the Poisson's equation $\nabla^2 V = -e^{-x}$ subject to the boundary conditions V(0,y,z) = V(a,y,z) = V(x,0,z) = 0 ; V(x,b,z) = V(x,y,0) = V(x,y,c) = 0 and w a=b=c=π, using the series expansion method.
[10]

P. T. O.

4. Solve a boundary value problem defined by

$$\frac{d^2\emptyset}{dx^2} = x + 1$$

subject to $\varphi(0) = 0$ and $\varphi(1) = 1$, use the finite difference method to find $\varphi(0.5)$. Use $\Delta = 0.25$ and perform 5 iterations.

[10]

5. Explain the Yee's finite difference algorithm to solve Maxwell's equations.

[10]

6. Consider the wave equation of the form

$u^2 \frac{\partial^2\emptyset}{\partial x^2} = \frac{\partial^2\emptyset}{\partial t^2}$, where u is the speed of the wave.
Write the equivalent finite difference formula.
Rewrite the equation by choosing the aspect ratio $r = (u\Delta t/\Delta x)^2$
Further draw its computational molecule.
Use the von Neumann approach to determine its stability condition.

[10]

7. Solve the two dimensional Laplace's equation using finite element method.

[10]

8. A potential field is defined over a triangular three node element by

Node i	V_i (V)	x_i(cm)	y_i(cm)
1	40	4	6
2	-10	2	2
3	20	6	2

Calculate the potential and potential gradient at (4, 4) cm.

[10]