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FIRST SEMESTER — **M.Tech. (CE)**

Supplementary Examination — ***Feb. 2019***

ADVANCED MATHEMATICS & NUMERICAL TECHNIQUES

CE-501

Time: 3:00 Hours — *Max. Marks: 100*

Note : Answer ANY FIVE questions. All questions carry equal marks. Assume suitable missing data, if any.

Q.1 [a] Test the consistency and solve

$x + 2y + z = 3;\ 2x + 3y + 2z = 5;\ 3x - 5y + 5z = 2.$

[b] Find the inverse of the matrix using elementary transformation

$$\begin{bmatrix} 2 & -1 & 4 \\ -3 & 0 & 1 \\ -1 & 1 & 2 \end{bmatrix}.$$

Q.2 [a] Find the general solution in series of differential equation

$$4x\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0.$$

[b] Show that $J_{-5/2}(x) = \sqrt{\frac{2}{\pi x}}\left[\frac{3}{x}\sin x + \frac{3 - x^2}{x^2}\cos x\right].$

Q.3 [a] Estimate the values of $f(22)$ and $f(42)$ from the following data.

x	20	25	30	35	40	45
$f(x)$	354	332	291	260	231	204

[b] Probability distribution function values of a normal distribution are *P(0.2)=0.39104; P(0.6)=0.33322; P(1.0)=0.24197; P(1.4)=0.14973; P(1.8)=0.07895.* Find the value of *P(x)* at $x = 1.2$ using Bessel's formula.

Q.4 [a] Show that the expression *A(i,j,k)* is a tensor if its inner product with an arbitrary tensor $B^{jl}{}_{k}$ is a tensor.

[b] Define contravariant tensor of rank two. Show that the Kronecker delta is a mixed tensor of order two.

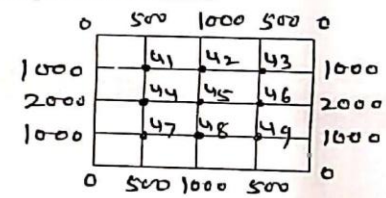
Q.5[a] Evaluate $\int_0^{0.6} e^{-x^2}\, dx$ using Simpson's 1/3rd rule.

[b] Find the first derivative of f(x) at x=1.5 if

x	1.5	2.0	2.5	3.0	3.5	4.0
f(x)	3.375	7.000	13.625	24.000	38.875	59.000

Q.6 [a] Using Runge-Kutta 4th order method, solve $\frac{dy}{dx} = x + y^2$, for $y(0.2)$, given that $y(0) = 1$.

[b] Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the domain of the figure given below up to third iteration.



Q.7 [a] (i) Prove that $\Delta = \frac{1}{2}\delta^2 + \delta\sqrt{1 + \frac{\delta^2}{4}}$.

(ii) Prove that $\mu\delta = \frac{1}{2}(\Delta + \nabla)$.

[b] Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre polynomials.