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ET-102

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) / B.Tech. (Aerospace Engineering)

Term-End Examination

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June, 2019

ET-102: MATHEMATICS - III

Time: 3 hours

Maximum Marks: 70

Note: Attempt any **ten** questions. All questions carry equal marks. Use of calculator is allowed.

1. Test the convergence of the series:

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$$\frac{1}{1.2.3} + \frac{3}{2.3.4} + \frac{5}{3.4.5} + \dots$$

2. Examine the convergence or divergence of the following series:

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$$1 + \frac{2}{5}x + \frac{6}{9}x^2 + \frac{14}{17}x^3 + \dots + \frac{2^{n+1} - 2}{2^{n+1} + 1}x^n + \dots (x > 0)$$

3. Find the Fourier series for the function

$$f(x) = x + x^2, -\pi < x < \pi.$$

Hence show that

$$\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \dots$$

- Find the transformation which maps the points
 1, i, 1 of the z-plane onto 1, i, 1 of the w-plane respectively.
- 5. Find the Laplace transform of 7 $e^{-3t} (\cos 4t + 3 \sin 4t).$
- **6.** Find the Inverse Laplace transform of 7

$$\frac{15}{s^2+4s+13}.$$

- 7. An electrostatic field in the xy-plane is given by the potential function $\phi = 3x^2y y^3$. Find the stream function.
- 8. If $w = \phi + i \psi$, represents the complex potential for an electrical field and

$$\psi = x^2 - y^2 + \frac{x}{x^2 + y^2},$$

determine the function ϕ .

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Solve: 9.

$$\frac{\mathrm{dy}}{\mathrm{dx}} + y \cot x = \cos x$$

10. Solve:

$$\cos x \frac{dy}{dx} = y \sin x + y^3 \cos^2 x$$

11. Solve:

$$\frac{\mathrm{d}^2 y}{\mathrm{d} x^2} - 6 \frac{\mathrm{d} y}{\mathrm{d} x} + 9y = e^{3x}$$

12. Solve:

$$(x^2 - y^2 - z^2) p + 2xyq = 2xz$$

13. Determine the poles of the function

$$f(z) = \frac{z^2}{(z-1)^2 (z+2)}$$
 and the residue at each pole.

14. If

$$x + \frac{1}{x} = 2 \cos \theta$$
, and $y + \frac{1}{y} = 2 \cos \phi$,

then prove that one of the values of

$$\frac{x^m}{v^n} + \frac{y^n}{x^m}$$
 is $2 \cos{(m\theta - n\phi)}$.

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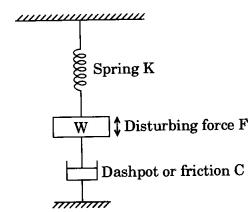
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15. Apply the Hurwitz – Routh criterion to determine the stability of the systems whose characteristic equation is given by

$$s^4 + 5s^3 + 2s + 10 = 0.$$

16. For the following system, we assume that the weight (w) is guided so that only vertical motion, without swinging is possible. Obtain the differential equation representing this system.



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