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18MAT21

Second Semester B.E. Degree Examination, Dec.2019/Jan.2020
Advanced Calculus and Numerical Methods

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Find the directional derivative of(= $4xz^3 - 3x^2y^2z$ at (2, -1, 2) along 2i 3j + 6k . **Marks)**

b. If f = V(x^3 y +7.^{3} —3xyz) find di v f and curl f **(07 Marks)**

c. Find the constants a and b such that F = (axy + z^3)i + (3x' — z)j+ (bx y)fc is irrotational. Also find a scalar potential 4:1 if F = V. **(07 Marks)**

OR

2 a- If = xyi + yz j + zxk evaluate F.dr where C is the curve represented by x = t,. y = t ˉ, 1. **(06 Marks)**

b. Using Stoke's theorem Evaluate F.dr if F = (x^2 +3/^{2})i —2xy j taken round the rectangle **bounded** by x = 0, x a, y 0, y = b_ **(07 Marks)**

c. Using divergence theorem, evaluate S ∫ F.11 ds if F ² — yz)i y zx)j + (z^2 — xy)lc taken around 0 < x 1, 0 < y < 1, 0 < z < 1. **(07 Marks)**

Module-2

3 a. Solve ($4D^4$ -$8D^3$ -$7D^3$ +11D+6)y = () **(06 Marks)**

b. Solve (D^2 + 4D +3)y = e' **(07 Marks)**

c. Using the method of variation of parameter solve y" + 4y = tan2x. **(07 Marks)**

OR

4 a. Solve (D^3 — 1)y = 3 cos2x **(06 Marks)**

b. Solve x^2y" Sxyr + 8y= 2 lOgx **(07 Marks)**

C. The differential equation of a simple pendulum is $\frac{d^2x}{dt^2} + W_0^2 x = F_0 Sinnt$, where W_0 and F_0 are constants. Also initially x = 0, $\frac{dx}{dt} = 0$ solve it. **(07 Marks)**

Module-3

5 a. Find the PDE by eliminating the function from z = y ˉ + 2f $\left(\frac{}{x} + \log y\right)$ **(06 Marks)**

b. ~~Solve $\frac{a^2z}{Nay} = \sin x \sin y$ given $\frac{dz}{dy} = -2 \sin y$, when x = 0~~ and z = 0, when y is odd multiple of $\frac{}{2}$ **(07 Marks)**

c. Derive one-dimensional wave equation. **(07 Marks)**

2. Any reveal

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OR

6 a. Solve $\frac{a^2z}{x^2} = a^2 z$ given that when $x = 0$ $\frac{az}{ax} = a \sin y$ and $z = 0$. **(06 Marks)**

b. Solve $x(y - z)p + y(z - x)q = z(x - y)$. **(07 Marks)**

c. Find all possible solution of $U_t = C^2 U_{xx}$ one dimensional heat equation by variable separable method. **(07 Marks)**

Module-4

7 a. Test for convergence for

$$\frac{2^1}{2^2} + \frac{3^1}{3^3} + \frac{4^1}{4^4}$$ **(06 Marks)**

Find the series solution of Legendre differential equation $(1 - x^2)y'' - 2xy' + n(n + 1) = 0$ leading to $P_n(x)$. **(07 Marks)**

c. Prove the orthogonality property of Bessel's function as

$$\int_0^1 x J_n(\alpha x) J_n(\beta x)\,dx = 0 \quad \alpha \neq \beta$$ **(07 Marks)**

OR

8 a. Test for convergence for

$$\sum_{n=1}^{\infty} \left(\frac{1}{n}\right)^{3/2}$$ **(06 Marks)**

b. Find the series solution of Bessel differential equation $x^2y'' + xy' + (n^2 - x^2)y = 0$ Leading to $J_n(x)$ **(07 Marks)**

c. Express the polynomial $x^3 + 2x^2 - 4x + 5$ interms of Legendre polynomials. **(07 Marks)**

Module-5

9 a. Using Newton's forward **(06 Marks)**

x	40	50	60	70	80	90
f(x)	184	204	226	250	276	304

b. Find the real root of the equation $x \log_{10} x = 1.2$ by Regula falsi method between 2 and 3 (Three iterations). **(07 Marks)**

c. Evaluate $\int_4^{5.2} \log x\,dx$ by Weddle's rule considering six intervals. (07 **Marks)**

OR

10 a Find t19) from the data by Newton's divided difference formula:

x	5	7	11	13	17
f(x)	150	392	1452	2366	5202

(06 Marks)

b. Using Newton – Raphson method, find the real root of the equation $x \sin x + \cos x = 0$ near x **(07 Marks)**

c. By using Simpson's rule, evaluate $\int_0^6 \frac{dx}{1 + x^2}$ by considering seven ordinates. **(07 Marks)**

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