LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – NOVEMBER 2015

PH 1820 - MATHEMATICAL PHYSICS - I

Date : 11/11/2015 Dept. No. Max. : 100 Marks

Time : 01:00-04:00

PART A

Answer all questions **10 x 2 = 20 marks**

1. Show that the expression $y = ax^2 + bx$ is reducible to linear form
2. Write the algorithm used in modified Euler method
3. Sketch the graph defined by $\bar{z}z = 36$
4. Show that $Ze^{-i\theta}$ acts as an operator when operated on complex number Z_2
5. Write the terms contained in G=$g_{ij}x^i x^j$ for i,j = 3
6. Show that Kronecker delta is a mixed tensor of order 2.
7. Define norm of a vector
8. Show that in R^3, the vectors V_1 = (-1,2,1) and V_2 = (3,1,-2) are linearly independent
9. Show that all the roots of $P_n(x) = 0$ are real and lie between -1 to +1.
10. Express Hankel functions in terms of Bessel polynomials.

PART B

Answer any four questions **4 x 7.5 = 30**

11. Solve $\frac{dy}{dx} = y + x^3$ with h= 0.01 , y(0) = 1 using Euler's method.
12. If $u = x^3 + 3x^2y - 3xy^2 - y^3$, find v such $u + iv$ is analytic.
13. Prove that the set all solutions of the differential equation $a\frac{d^2y}{dy^2} + b\frac{dy}{dx} + cy = 0$ is a vector space.
14. i)Show that a skew-symmetric tensor of the second order has $\frac{n(n-1)}{2}$ different non-zero components
    ii) Prove that the sum (or difference) of two tensors of same order and type is again a tensor of the same order and type.
15. Evaluate $\oint \frac{e^z dz}{(z^2+\pi^2)^2}$; $|z| = 5$
16. Show that in the case of Bessel's polynomials $J_n(x)$ and $J_{-n}(x)$ are related for integral values of n and these two alone cannot be the solution of it.

PART C

Answer any four questions **4 x 12.5= 50**

17. Find the roots of the equation $f(x) = x^3 - x - 11 = 0$ corrected up to 3 decimal places using Bisection method.
18. Using contour integration evaluate $\int_0^{\infty} \frac{dx}{x^6+1}$
19. Evaluate the following expressions i) $\|\vec{u} + \vec{v}\|$ ii) $\|\vec{u}\| + \|\vec{v}\|$ iii) $\|-3\vec{u}\|$ + 3 $\|\vec{v}\|$ iv) $\|\vec{u} - 2\vec{v} + 3\vec{w}\|$ v) $\left\|\frac{\vec{u}}{\|\vec{u}\|}\right\|$ vi) $\frac{\vec{v}}{\|\vec{v}\|}$ for $\vec{u}$ = (1,0,- 1,2); $\vec{v}$ = (2,1,3,-1); $\vec{w}$ = (-3,1,0,-5)
20. Derive the components of moment of inertia tensor when a system consisting of number of point masses are in a rotatory motion.
21. Using the beta and gamma function evaluate i) $\int_0^2 \sqrt[3]{8 - x^3}\, xdx$ ii) $\int_0^4 x^{\frac{3}{2}} (4-x)^{\frac{5}{2}}\, dx$ iii) $\int_0^{\frac{\pi}{2}} \frac{1}{\sqrt{tan\theta}}\, d\theta$
22. Evaluate $\int_c (z^2 + 3z)\, dz$ along a) the circle $|z| = 2$ from (2,0) to (0,2) in counter clockwise direction b) the straight line (2,0) to (0,2) c) the straight line (2,0) to (2,2) and then from (2,2) to (0,2).

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