

Bago University
Department of Physics
Second Semester Examination, September 2019

Third Year (BSc)
(Physics Specialization)

Phys 3110
Mathematical Physics
Time Allowed: (3) Hours

Answer any Six questions.

- 1 (a) Find the power series solution of $(1 - x^2)y'' - 2xy' + 2y = 0$, when $x = 0$ is the ordinary point.
 (b) Compute regular singular points of the differential equation.

$$x^2(x - 2)^2y'' + 2(x - 2)y' + (x + 3)y = 0$$
 - 2 (a) Solve $x^2y'' + 4xy' + (x^2 + 2)y = 0$ when $x = 0$ is regular singular point by Frobenius method.
 (b) Find the power series solution of $(1 + x^2)\frac{d^2y}{dx^2} + x\frac{dy}{dx} - y = 0$, when $x = 0$ is the ordinary point.
 - 3 (a) Prove that $x J'_n = n J_n - x J_{n+1}$.
 (b) Using the recurrence relations, show that $4 J''_n(x) = J_{n-2}(x) - 2 J_n(x) + J_{n+2}(x)$.
 - 4 (a) What is the partial differential equation? Explain their methods completely.
 (b) Solve $\frac{\partial^2 z}{\partial y^2} = z$, if $y = 0$, $z = e^x$ and $\frac{\partial z}{\partial y} = e^{-x}$.
 - 5 (a) Solve $(mz - ny)\frac{\partial z}{\partial x} + (nx - lz)\frac{\partial z}{\partial y} = ly - mz$.
 (b) Solve the following partial differential equation.
 (i) $(x - h)^2 + (y - k)^2 + z^2 = a^2$ (ii) $z = f\left(\frac{y}{x}\right)$
 - 6 (a) Name the methods of forming differential equations and then solve $\frac{\partial^3 z}{\partial x^2 \partial y} = \cos(2x + 3y)$.
 (b) Solve $px(z - 2y^2) = (z - qy)(z - y^2 - 2x^3)$.
 - 7 (a) (i) Evaluate $\int_0^\infty \sqrt[4]{x} e^{-\sqrt{x}} dx$.
 (ii) Compute $\int_0^\infty x^{n-1} e^{-h^2 x^2} dx$.
 (b) Evaluate $\int_0^1 \frac{x^{m-1} + x^{n-1}}{(1+x)^{m+n}} dx$.
 - 8 (a) Prove that $\int_0^\pi \sin^p \theta \cos^q \theta d\theta = \frac{\left(\frac{p+1}{2}\right) \left(\frac{q+1}{2}\right)}{2 \left(\frac{p+q+2}{2}\right)}$.
 (b) Show that $\int_0^\pi \sqrt{(\cot \theta)} d\theta = \frac{1}{2} \left[\frac{1}{4} \left| \frac{3}{4} \right. \right]$.
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