2^{nd} Mid Exam

Answer the following questions:

(5 Marks)

1	Show that Laguerre's ODE, Eq. $$xy''(x) + (1-x)y'(x) + ny(x) = 0.$$ may be put into self-adjoint form by multiplying by e^{-x} and that $w(x) = e^{-x}$ is the weighting function.

(5 Marks)

2	To a good approximation, the interaction of two nucleons may be described by a mesonic potential attractive V for A negative. Develop a series solution of the resultant Schrödinger wave equation $$\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + (E-V)\psi = 0 \quad , \quad V = \frac{Ae^{-ax}}{x}$$ through the first three nonvanishing coefficients. $$\psi = a_0\{x + \tfrac{1}{2}A'x^2 + \tfrac{1}{6}[\tfrac{1}{2}A'^2 - E' - aA']x^3 + \cdots\},$$ where the prime indicates multiplication by $2m/\hbar^2$.

(5 Marks)

3	The rate of a particular chemical reaction $A + B \to C$ is proportional to the concentrations of the reactants A and B: $$\frac{dC(t)}{dt} = \alpha[A(0) - C(t)][B(0) - C(t)].$$ Find $C(t)$ for $A(0) \neq B(0)$. The initial condition is that $C(0) = 0$.

(5 Marks)

4	The motion of a body falling in a resisting medium may be described by $$m\frac{dv}{dt} = mg - bv$$ when the retarding force is proportional to the velocity, v. Find the velocity. Evaluate the constant of integration by demanding that $v(0) = 0$.

مع اطيب التمنيات بالنجاح

Mathematical supplement

1- $$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots.$$