INTERNAL EXAMINATION'2021
SEMESTER : 3 (Honours), PAPER : CC5
Mathematical Physics II (Theory)

(Each question carries two marks)

Answer any ten of the following

1 . Write down the Dirichlet's conditions to be fulfilled for a function to be expanded in Fourier's series.
2. Explain the necessity of periodicity for a function to be expanded in Fourier's series.
3. Find out the general expression for the Fourier's coefficients for for an even function.
4. Explain half range Fourier's series with an example.
5. Explain how one can guess about nature of Fourier's coefficients of Fourier's expansion of a function.
6.Transform the differential equation

$$y''(x) + p(x)y'(x) = q(x)y^n(x)$$

to a linear equation. Here prime is the first order complete derivative and *n* is a number independent of *x* and *y*.

7.What is the condition under which two functions *a(x)* and *b(x)* are linearly independent ?

8.The differential equation

$$y''(x) + p(x)y'(x) + qy(x) = 0$$

has the general solution $y(x) = A e^{\alpha x} + B e^{\beta x}$ where *A* and *B* are constants. Explain the discrepancy that arises when $\alpha = \beta$.

9.What is the condition that a second order linear homogeneous differential equation will have at least one power series solution ?
10.Consider the differential equation

$$y''(x) + p(x)y'(x) + qy(x) = 0$$

and the solution is being searched around an ordinary point $x = x_0$. If one applies the Frobenius method with a trial solution

$$y(x) = \sum_k a_k (x - x_0)^{k+m} ; a_0 \neq 0$$

what one should conclude about the possible values of *m* ?

11. Write down the Laplace's equation and its general solution in Cartesian coordinate.
12. Write down the Laplace's equation and its general solution in Spherical polar coordinat
13. Write down the equation of motion for the vibrating String and its general Fourier series solution.
14. Write down the wave equation for membrane and its general solution.
15. Write down the diffusion equation. What is the general solution of this equation under steady state?

INTERNAL EXAMINATION'2021
PAPER : CC6
SEMESTER- 3 (HONOURS)
THERMAL PHYSICS
Answer any 10

EACH QUESTION CARRIES 2 MARKS

1. Define entropy and explain its physical significance.
2. Write down the relation between pressure and volume in adiabatic state for ideal gas.
3. Write zeroth law of thermodynamics.
4. Write down the expression of efficiency for Carnot's engine explaining the symbols.
5. What do you mean by isothermal and adiabatic changes?
6. Write down the expression for thermal diffusivity.
7. What is the coefficient of performance of a refrigerator?
8. What are intensive and extensive variables?
9. What do you mean by internal energy?
10. What is a state function? Give an example.
11. Write down the Maxwell Boltzmann distribution for molecular velocities explaining its various parameters.
12. Draw the above distribution for two different temperatures.
13. Define mean free path of molecules.
14. What are the corrections made by Van der Waal to Ideal gas equation ?
15. What is Boyle temperature?
16. Define Enthalpy.
17. What is Gibb's free energy?
18. Write down the Clausius Clapeyron Equation.

PHSA SEM 3-CC 7 - INTERNAL EXAMINATION

F.M:20

GROUP –A (Q.M) - 10 MARKS

Symbols have their usual meaning everywhere

Answer ***any five*** from the following

1. $\psi_1(x)$ and $\psi_2(x)$ are eigenstates of the Hamiltonian with eigenvalues E_1 and E_2.Is $\psi(x,t) = C_1\psi_1(x)e^{i\left(\frac{-E_1 t}{\hbar}\right)} + C_2\psi_2(x)e^{i\left(\frac{-E_2 t}{\hbar}\right)}$ a stationary state?

2. For free particle, show that each positive energy eigenvalue is doubly degenerate.

3. Show that the momentum operator is a Herm itian operator.

4. Show that if H is Hermitian then e^{iH} is unitary.

5. Show that the de Broglie wavelength of an electron is equal to its Compton wavelength when its speed is $\frac{c}{\sqrt{2}}$.

6. Find the momentum representation of the position operator $\hat{x}$?

7. What is tunnel effect? How it explains alpha emission?

8. It is given that $\left[x, p_x^n\right] = i\hbar n p_x^{n-1}$. (It can be proved using $\left[x, p_x\right] = i\hbar$).Using this result or in any other way, prove that $\left[x, \sin p_x\right] = i\hbar \cos p_x$

GROUP –B (Nuclear Physics, Radioactivity, Laser)

Answer ***any five*** from the following.

$2\times5 = 10$

1. Explain the term 'binding energy' of a nucleus.

2. The nature of the binding energy per nucleon (binding fraction) curve is complementary to the nature of the packing fraction curve. Explain why it is so?

3. Calculate the binding energy in MeV of ^{4}He from the following data: Mass of ^{4}He = 4.003875 amu; Mass of proton = 1.008145 amu; Mass of neutron = 1.008986 amu.

4. Find out the necessary condition (in terms of disintegration energy) for β^+ decay.

5. Write down the properties of neutrino.

6. Write a short explanatory note on: Interaction of γ -rays with matter

7. Using Shell Model, predict the ground state spin of $^{27}_{13}Al$.

8. Write a brief note on Population inversion.

SEC Sem 3(Hons):
Renewable Energy
Answer any ten questions
Each question carries 2 marks

1. What is tidal energy?
2. Where is the source of Oceanic Thermal Energy Conversion in India?
3. What is the origin of geothermal energy?
4. What is the source of hydrothermal energy?
5. What is the approximate power output of wind turbine in India?
6. Which is more effective- Vapour dominated or liquid dominated hydrothermal system?
7. What is petrothermal energy source system?
8. Describe a solar cooker.
9. What is a solar pond ?
10. What are the characteristics of photovoltaic systems?
11. What is geothermal energy?
12. Write two uses of fuel cell
13. Is carbon capture storage is a ‘zero emission ‘solution?
14. What is energy harvesting?
15. What is vibrational energy harvesting?
16. Draw the circuit diagram of a piezoelectric generator.