Sem-3 Honours Examination, 2020

Internal Examination

Sub – PHSA Paper - CC-5

FM – 20 Time - 30 mins

Answer any ten questions. Each question carries 2 marks.

1. Write down the conditions under which a function can be expanded in terms of sinusoidal functions.

2. Is it possible to expand the function $f(x)=tan(x)$ in Fourier series? State reasons.

3. What is Fourier cosine-transformation?

4. How is the value of a function at a point of discontinuity obtained using Fourier series expansion technique?

5. Write down two applications of Fourier transformations.

6. Explain the scale shifting property of Fourier transform.

7. Explain the phase shifting interpretation of Fourier transform.

8. What is the condition under which two functions $f(x)$ and $g(x)$ are linearly independent.

9. Is it necessary to apply Frobenius method to find a solution of the Bessel equation about $x=0$? If so, state reasons.

10. Apply integral test for convergence to show that Legendre polynomials diverge at $|x|=1$.

11. How is it possible to use Legendre polynomials as basis ?

12. How are Hermite polynomials defined ?

13. Why is it not possible to define $J_{-n}(x)$ from the solution of the indicial equation obtained by applying Frobenius method to the Bessel equation ?

14. Write down the expression of $J_n(x)$ in terms of gamma function an hence Find $J_1(x)$.

15. Write down the wave equation with explanation of the symbols.

Sem-3 Honours Examination, 2020

Internal Examination

Sub – PHSA Paper - CC-6

FM – 20 Time - 30 mins

Answer any ten questions. Each question carries 2 marks.

1. What are thermodynamic Potentials?
2. Write down the two Tds Equations explaining the terms.
3. Write down the two Energy Equations with the relevant explanation.
4. Write down the Maxwell Boltzmann Distribution of Velocities explaining the relevant terms.
5. Under what conditions a real gas behave like an ideal gas.
6. Define Mean Free Path of gas molecules.
7. What is the relation between viscosity, thermal conductivity from the aspect of transport phenomena.
8. State the First Law of Thermodynamics.
9. What is Clausius inequality?
10. What is the difference between State function and Path function?
11. What is the Zeroth Law of thermodynamics?
12. Proof that $C_p - C_V = R$
13. What is meant by Diffusivity?
14. Define Entropy. Is Entropy a state function?
15. What is the difference between Reversible and Irreversible process?

Sem-3 Honours Examination, 2020

Internal Examination

Sub – PHSA Paper - CC-7

FM – 20 Time - 30 mins

Symbols have their usual meaning.

Group-A(Quantum mechanics) - 10 marks
Answer any five questions. Each question carries 2 marks.

1. Let $\psi_1(x)$ and $\psi_2(x)$ are eigenstates of the Hamiltonian with the respective eigenvalues E_1 and E_2 . Is

   $$\psi(x)=c_1\,\psi_1(x)\exp(-iE_1t/\hbar) + c_2\,\psi_2(x)\exp(-iE_2t/\hbar)\ (c_1, c_2 \text{ constants})$$

   a stationary state ?

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

3. Show that the momentum operator is a hermitian operator.

4. Show that if *H* is Hermitian then *exp(iH)* is unitary.

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

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

Group –B (Nuclear Physics, Radioactivity, Laser) - 10 marks
Answer any five questions. Each question carries 2 marks.

1. Find out the approximate density of nucleus.

2. Explain the term mass defect.

3. Predict the ground state spin of $^{17}_{8}O$ nucleus on the basis of shell model.

4. Use the semi empirical mass formula to calculate the binding energy of $^{40}_{20}Ca$. Given $a_v = 15.5\ MeV$, $a_s = 16.8\ MeV$, $a_c = 0.7\ MeV$, $a_a = 23.0\ MeV$ and $a_p = 34.0\ MeV$.

5. Explain the violation of “Law of conservation of angular momentum” during β - decay.

6. What is thermonuclear reaction?

7. What is a metastable state?

Semester-3 Honours Examination, 2020

Sub - PHSA Paper - SEC-A1(Scientific writing)

F.M. - 20 Time - 30 mins.

Answer any **ten** questions. Each question carry 2 marks.

1. Write down a latex code for the following equation.

$$\frac{d^2u}{d\theta^2} + u = -\frac{m}{L^2u^2}(\frac{1}{u})$$

2. Write down a code to attach an image file test.eps into a latex document.
3. How is it possible to attach reference to a particular statement in a latex document ?
4. Write down diffusion equation using latex code.
5. Write down a latex code for the following equations, without using begin{equaiton}

$$L^2(L_\pm\psi) = l(l+1)\hbar(L_\pm\psi)$$
$$L_z(L_\pm\psi) = (m \pm 1)\hbar(L_\pm\psi)$$

6. Show how to create sections and subsections in a latex document.
7. Write down a latex code of the following

$$H = 2(\epsilon + \mu a^\dagger a)\sigma_3 + \lambda[\sigma_+ a(a^\dagger a)^{1/2} + \sigma_-(a^\dagger a)^{1/2}a^\dagger] \quad (1)$$

8. How is it possible to change the width of an image in a latex document ?
9. How to use a pair of curly brackets in a latex document ?
10. Show, by writing a short paragraph of two or three lines, how to apply an indent into a latex document.
11. How to set pagelength and pagewidth of a latex document ?
12. What are the packages necessary for a latex document to recognize mathematical symbols?
13. Write down Poisson's equation in one dimension using latex code.
14. Write a latex code to generate the following.

$$\mu = \left(\frac{\partial T}{\partial P}\right)_H = -\frac{1}{C_P}\left[\left(\frac{\partial U}{\partial P}\right)_T + \left\{\frac{\partial}{\partial P}(PV)\right\}_T\right]$$

15. Write a latex code to place a figure test.eps at any arbitrary coordinate of a pdf latex document.

PHSA SEM 3 SEC-B

Renewable energy and Energy Harvesting

*Answer **any ten** questions.*

Full Marks: 10 × 2 = 20

1. What is fossil fuels? Give two examples.
2. Write two limitations of using fossil fuels.
3. Write two advantages of using nuclear power.
4. Write two disadvantages of using nuclear power.
5. Write down the name of four non-conventional energy sources.
6. Write a short note on offshore/ocean shore wind energy.
7. What is Ocean Thermal Energy Conversion?
8. What is wave energy converting devices (WECDs)? Name such devices.
9. Name two biofuels.
10. Write down the stages of biogas production.
11. Write down the working principle of non convecting solar pond.
12. What is Evacuated Tube Collectors based Solar Water Heaters?
13. What are the advantages of solar water distillation system?
14. Draw the equivalent circuit of a solar cell and explain the symbols used in the figure.
15. What is piezoelectric effect? Name two piezoelectric materials.