SHRIMATI INDIRA GANDHI COLLEGE

(Nationally Accredited at 'A' Grade (3rd Cycle) By NAAC)

Tiruchirappalli – 2.

QUESTION BANK FOR

M.Sc PHYSICS STUDENTS

2017-2018

DEPARTMENT OF PHYSICS

CONTENT

M.Sc Degree Examination-Mathematical Physics

Code : P16PY11

TIME: 3 Hrs **MAX MARKS: 75**

SECTION – A (10X2=20)

ANSWER ALL THE QUESTIONS.

1. Calculate $\nabla.\boldsymbol{r}$ where **r** is the position vector
2. Find the unit vector perpendicular to the surface $x^2+y^2-z=1$ at point p(1,1,1)
3. Find the characteristic equation of the matrix $A=\begin{matrix}1 & 2 & -2\\ 1 & 1 & 1\\ 1 & 3 & -3\end{matrix}$
4. Write the associative and inverse properties of a group
5. Prove that a cyclic group is necessarily abelian.
6. Show the function e^x (cosy+isiny) is an analytic function.
7. Write Laurent series for $0<|z-z_0|<R$ if $Z=Z_0$ is removable singularity and simple pole.
8. Define contraction of Tensors with an example.
9. Find the value of $\beta(1/2,1/2)$.
10. 0.Write the lagurre polynomial of degree n, $L_n(x)$ and find $L_1(x)$

SECTION – B (5X5=25)

ANSWER THE FOLLOWING QUESTIONS.

11. a)Construct an orthonormal basis by the Schmidt orthogonalization process for given vectors $A=\vec{i}+2\vec{j}$, $B=\vec{k}-\vec{j}$ and C=i-j+k

(or)

b)Show that $\nabla^2(1/r)=0$ where $r=(x^2+y^2+z^2)^{1/2}$

12. a)Find the inverse of the matrix $A=\begin{matrix}2 & 0 & 1\\ -2 & 3 & 4\\ -5 & 5 & 6\end{matrix}$ using Cayley Hamilton theorem

(OR)

b).Define symmetric tensor and prove that $A^{\mu\gamma\sigma}=A^{\gamma\mu\sigma}$

13. a)Prove that the covering operations of an equilateral triangle from a group of homomorphic into the group of (1,-1) (OR)

b)What is the use of character table?Write simple rules to construct a character table.

14. a)Derive necessary and sufficient conditions for the derivative of the function f(z)=u+iv to exist for all values of z..

(OR)

b) Find the residue for a function f(z)=$\frac{1}{(z-1)2(z-3)}$.

15. a)Show that (1-2μh+h^2)$^{-1/2}$ = $\sum_{h=0}^{\infty} Pn(\mu)h^n$ (OR)

b) Derive the solution for Laguerre equation

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16.Use green's theorem to evaluate

(a)$\oint$ y^{3}dx-x^{3}dy, where c is positively oriented circle of radius 2 centered at the origin.

(b))$\oint$ x^{2}ydx+x^{2}dy, where c is boundry described contour clockwise of triangle with vertices (0,0),(1,0) and (1,1).

17. Let A(μ,γ,σ) *be an entity.Test whether* this entity is a tensor or not using quotient law.What is the type of tensor.

18.Explain the symmetry elements of a square.

19. Derive Cauchy's integral theorem and integral formula.

20. Prove that $H_n(x)$ is a solution for Hermite equation using recurrence formulae.

M.Sc DEGREE EXAMINATION,NOVEMBER 2016

CLASSICAL DYNAMICS AND RELATIVITY

Code : P16PY12

TIME: 3 Hrs **MAX MARKS: 75**

SECTION – A (10X2=20)

ANSWER ALL THE QUESTIONS.

1. State and explain D'Alembert's principle.
2. What is the number of degrees of freedom for
3. The particle moving on the circumference of a ring? Explain.
4. How total energy is connected with eccentricity values of different trajectories?
5. State and prove Virial Theorem.
6. What are Euler's angle?Indicate with a neat sketch
7. What are the normal modes of vibration in a linear three particle system which connected with springs and first particle is fixed at wall?
8. Distance from the sun to Neptune is roughly 30 times the distance of the earth from the sun.Use kepler's third law to make an estimate of the period of Neptune in years.
9. What are the advantages of Hamiltonian formalism over Newton's formalism?
10. State the postulates of special theory of relativity
11. What is the Time Dilation? Give examples.

SECTION – B (5X5=25)

ANSWER THE FOLLOWING QUESTIONS.

11. a) Derive Lagrange equation from Hamiltonian priniciple.

(OR)

b) Obtain equation of motion for a simple pendulum using lagrangian formalism

12. a)Prove that under central force,any two body problem can be reduced to one body problem.

(OR)

b) With energy consideration discuss the classification of orbits with neat diagrams.

13. a) Obtain Euler's equation of motion for a general three dimensional rigid body.

(OR)

b) Define normal frequency ,normal modes,normal coordinates,stable equilibrium and unstable equilibrium.

14. a) Derive Hamiltonian equation from variational principle.

(OR)

b) Solve the problem of the linear harmonic oscillator using action angle variable.

15. a) Explain the five principles that are used in the development of Einstein's general theory of relativity.

(or)

b) Show that the sum of any two orthogonal time like vectors is time like.

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16. Using lagrange's equation of motion ,obatin equation of motion for

a)Particle moving in space(Cartesian and polar cocordinates)

b)Particle moving under central force.

17. Derive an expression for the eccentricity of planet orbit from inverse square law.

18.Obtain normal modes of vibration for a double pendulum.Assume that the mass of both bobs are same.

19.Solve the Kepler's problem by Hamiltonian Jacobi method and discuss the result.

20.Derive Lorentz transformation for x,y,z and t for the postulate of special theory of relativity.

SUB CODE-P16PY13

M.Sc DEGREE EXAMINATION NOVEMBER 2016

Physics- ELECTRONICS

Time : Three hours Maximum : 75 marks

SECTION A – (10*2 = 20)

Answer ALL questions

1..What is a light emitting diode and give its symbol?

2.Give the basic construction and symbol of DIAC

3.What are the requirements for oscillations?

4. List the various A/D conversion techniques.

5. Define a digital comparator

6. What do you mean by an encoder?

7 What is a shift register?

8. What are the difference between synchronous and asynchronous counter?

9. Give the drawbacks of monolithic ICs

10. Draw the pin diagram of 555 timer

PART B – (5*5 = 25)

Answer ALL questions choosing either (a) or (b)

11. (a) Discuss the operation of a Gunn diode

Or

(b).An ac voltage v = 250sin314t is applied to an SCR. The SCR has a forward breakdown voltage of 200v. Find the time during which SCR remains off

12 (a).How phase shift oscillator works?

Or

(b)Explain the operation of R-2R ladder digital to analog convertor

13. (a) Discuss the working of BCD to decimal decoder with a neat circuit diagram

Or

(b) Write note on JK master – slave flip-flops

14 (a) Briefly explain the working of a parallel – in serial – out shift register

Or

(b) Discuss the working of up/down counter

15. (a) Describe the process of masking and etching.

Or

(b) Explain the operation of monostable multivibrator using 555 timer

PART C – (3*10 = 30)

Answer any THREE out of Five

16. Define MOSFET. Examine in detail the enhancement and deletion types of MOSFET

17. Discuss the working of square – wave generator and triangular wave generator

18. Give a detailed description of parity generator/checker

19. Write note on :

(a) Synchronous counters

(b) Asynchronous counters

20. (a) Explain the fabrication process of a transistor for monolithic circuits

(b) Obtain the equations for the impurity profile in a monolithic integrated transistor

(c) If the phosphorous diffusion is conducted at 1100° C, how long does the diffusion continues?

M.Sc DEGREE EXAMINATION,APRIL 2017

Methods of spectroscopy

Code : P16PY14 **TIME: 3 Hrs** **MAX MARKS: 75**

SECTION – A (10X2=20)

ANSWER ALL THE QUESTIONS.

1. What are the different ways in which orbital and spin momentum can be coupled in atwo electron system
2. Describe the term symbols for a particular atomic state
3. What are called Hot Bands in vibrational spectroscopy and sketch two hot band transitions.
4. What is the basic difference between wave mechanics and classical mechanics approaches to molecular vibration
5. Write the selection rules for Raman active transition between rotational energy levels of a symmetric top molecule.
6. Define polarisability ellipsiod
7. =Two nuclei with even mass number,however withodd and even charges have……and ……spin values, respectively.
8. Define chemically equivalent nuclei with an example
9. State Laporte and spin allowed transitions in absorption spectroscopy
10. What are the main advantages of the first derivative curve obtainedin ESR spectroscopy.

SECTION – B (5X5=25)

ANSWER THE FOLLOWING QUESTIONS.

11. a)**Describe the Graphical method** to deduce the different allowed values of total angular momentum of an electron.

(or)

b)Describe the consequences of spin orbit coupling to the hydrogen atom spectrum with illustrations

12. a)Write the selection rule for a diatomic vibrating rotator and derive an analytical expreesion for the spectrum considering the $\gamma=0$ to $\gamma=1$ transitions.

(OR)

b)Describe the influence of rotation on the perpendicular vibration of a linear and polyatomic molecule

13. a)List the Raman active and inactive vibrational modes of planar and pyramidal AB3 type molecules

(OR)

b)Draw a schematic diagram of a Raman spectrometer and list any two approaches employed to overcome the fluorescemce problems to the measured spectrum

14. a)Write a note on non radiative relaxation processes of nuclei in an applied magnetic field

(OR)

b) Calculate the resonance frequency of aprotron subjected to a magnetic field of 2.348T at room temp;erature Also show that proton spin distribution between to be allowed energy levels is close to unity(g factor= 5.585)

15. a) State Beer Lambert,s law.The transmittance of aan aqueous solution of KMno4 at a certain wavelength is 1% for a molar solution in a 1cm cell. What are the molar absorption coefficient of KMno4

b) Write a note on the effect of solvents on the energy of$\pi\pi^*$ and n orbital and the transition between them

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16. State the Selection rule and derive the spectral frequencies for electronic transition from K,L,M and N shells of an atom
17. Describe the factors influencing the intensities of rotational spectral lines of a diatomic molecule
18. Compare pure rotation and rotation –vibration Raman spectra of diatomic molecule with appropriate derivation of spectral line.
19. Write a note on shielding constants and factors determining the same in NMR spectroscopy

20. Describe the effect of electron –nucleus and electron-electron coupling in ESR spectroscopy

M.Sc DEGREE EXAMINATION,APRIL 2017

Electromagnetic theory

Code : P16PY21

TIME: 3 Hrs **MAX MARKS: 75**

SECTION – A (10X2=20)

ANSWER ALL THE QUESTIONS.

1. What is the meaning of electrostatic energy?
2. Write a note on Note quadrapole moment tensor.
3. Write the Laplace equation.
4. Give the boundary conditions.
5. Difference between magnetic scalar and vector potential.
6. Define magnetic susceptibility
7. "All potentials in this restricted class are said to belong to the Lorentz gauge".How is it possible?
8. Write Maxwell's equation.
9. Write any two relations for TEm,n modes in rectangular waveguides.
10. Give the plane wave equation.

SECTION – B (5X5=25)

ANSWER THE FOLLOWING QUESTIONS.

11. a)***Explain Claussius Mossotti relation***

(or)

bDerive equation of the electric field inside and outside the dielectric sphere.

12. a)Explain potential at a point due to uniformly charged disk.

(OR)

b)Explain Laplace equation in rectangular coordinates.

13. a)Find the vector potential of an infinite solenoid with N turns per unit length radius R and current I.

(OR)

b)Magnetic susceptibility and permeability of magnetic materials.

14. a)Derive Poynting theorem.

(OR)

b) Maxwell's equations and their physical significance.

15. a) Explain electromagnetic waves in free space.

(OR)

b) Discuss TM and TE modes.

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16.Derive –Multipole expansion of a charge distribution.

17. Point charge in the presence of a grounded conducting sphere.

18.Obtain the Poisson's equation for vector potential.

19. Explain Coulomb gauge.

20. Derive reflection and transmission coefficients at the interface between two non-conducting media.

M.Sc DEGREE EXAMINATION,APRIL 2017
Quantum Mechanics

Code : P16PY22
TIME: 3 Hrs **MAX MARKS: 75**

SECTION – A (10X2=20)
ANSWER ALL THE QUESTIONS.

1. Mention any two properties of Hermitian operators.
2. How do you represent a state vector and its conjugate in Dirac's notation.
3. Are there unbound states for a simple harmonic oscillator potential? How many bound states are there?
4. What is tunnel effect?
5. Why Stark effect is absent in ground state?
6. What is Harmonic perturbation?
7. Write the validity of born approximation?
8. List the commutation rules for angular momentum.
9. What is a hole?
10. Give any two properties of Dirac matrices.

SECTION – B (5X5=25)
ANSWER THE FOLLOWING QUESTIONS.

11. a)Explain the physical significance of wave functions.(or)

b) Discuss the Heisenberg picture of representing dynamical variables.

12. a)Discuss the motion of a particle constrained to move in a rectangular box. Find its energy and wave function.

(OR)

b)Solve the Schrodinger equation of a rigid rotator with free axis and obtain the energy eigen values and the eigen functions.

13. a)Develop the first order perturbation theory for non degenerate case.

(OR)

b)Discuss the time dependent perturbation theory and arrive at Fermi's golden rule.

14. a) Discuss the born approximation to obtain the Scattering amplitude.

(OR)

b) Obtain the Eigen values and Eigen function of L^2 and L_Z.

15. a) Derive the Klein-Gordan equation for a free particle. (OR)

b) Write a note an negative energy states.

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16. State Heisenberg's uncertainty principle.Derive a mathematical proof of the position momentum uncertainty relation.
17. Establish Schrodinger Equation for a linear harmonic oscillator and solve it to obtain its eigen value and eigen functions. Discuss the significance of zero point energy.
18. Give the theory of first order Stark effect on the basis of quantum mechanics and discuss splitting of the energy levels.
19. Explain the importance aspects of scattering bya square –well potential.
21. Show that how the spin orbit interaction comes out automatically from Dirac's equation.

M.Sc DEGREE EXAMINATION,APRIL 2017
NUMERICAL METHODS AND C++ PROGRAMMING

Code : P16PYE2

TIME: 3 Hrs **MAX MARKS: 75**

SECTION – A (10X2=20)
ANSWER ALL THE QUESTIONS.

1. Define:Functions.
2. State multi-dimensional array.
3. Find the roots of theequation by Newton's method Cos $x=x^2$
4. Explain the method of fitting a curve $y=ax^b$
5. Write the interactive formula for Newton Raphsonmethod
6. Write the general form of the Augmented Matrix from for the Gauss Elimination method
7. Express the equation for composite form of the Trapezoidal rule.
8. Write the two point formula for the first derivative.
9. Show the equation for the improved Euler's method.
10. Write down the Runge-kutta formula of 4^{th} order to solve $dy/dx=F(x,y)$ with $y(x_o) =y_o$

SECTION – B (5X5=25)

ANSWER THE FOLLOWING QUESTIONS.

11. a)Program to find the sum of numbers using functions.

(OR)

b) Write a program to arrange 10 numbers using arrays.

12. a)Write the principle of least square.

(OR)

b)Using Newton's formula. Find the pressure of the steam for a temperature of 142^0

Temperature ^0C : 140 150 160 170 180

Pressure KgF/cm^2:3.685 4.854 6.302 8.076 10.225

13. a)Solve the following equations by Gauss Elimination method:2x+y+4z=12;8x-3y+4z=12;4x+11y-z=33

(OR)

b)Derive the Gauss Elimination procedure to the find the value of x,y and z using backward substitution method.

14. a) Using Trapezoidal rule,find $\int_{1/2}^{1} \frac{1}{x} dx$, dividing the range into four equal parts.

(OR)

b) Write down the formula for Simpson's 1/3 rule.

15. a)Given y'=x+y , y(0)=1 , find y(0,1) by Euler's method.

(or)

b) State improved Euler's method to find the numerical solution of a first order differential equation.

SECTION – C (3X10=30)

ANSWER ANY THREE QUESTIONS.

16. Write a C++ program for checking a given number is Amstrong or not using While – do – While function.

17. For the following table of values estimate F(7.5)

X : 1 2 3 4 5 6 7 8

Y=F(x): 1 8 27 64 125 216 343 512

18. Find a real root of the equation X^3-X-1=0 usig Newton Raphson method. Correct to four decimal places.

19. Dividing the range into 10 equal parts .Find the approximate value of $\int_0^{\pi} sinx\ dx$ by

(a) Trapezoidal rule

(b)Simpson's rule.

20. .Solve the system of differential equations dy/dx=xz+1 , dz/dx=-xy for x=0.3 (0.3) 0.9 using fourth order Runge-kutta method.[x=0 , y=0 , z=1]