UNIVERSITY OF THE PUNJAB

Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics **MAX. TIME: 3 Hrs.**

PAPER: I (Solid State Physics-II) **MAX. MARKS: 50**

NOTE: Attempt any FOUR questions, in all by selecting at least ONE question from each section.

Section -1

Q.1 (a) Define Fermi sphere and calculate Fermi velocity of $E_F = 5eV$ (4)

(b) Plot the optical absorption curves for the direct and indirect gap materials. (2)

(c) What is meant by energy gap and why energy gaps appear due to Bragg reflection at Zone boundary? (6.5)

Q.2 (a) What is Hall effect? Give an elementary theory of it. Mention its important uses. (6)

(b) State Fermi Dirac distribution function and describes how it is affected by change in temperature . Use graphs to illustrate your answer. (6.5)

Q.3 (a) Explain the origin of paramagnetic behavior of the conduction electron of metal and derive an expression for Pauli spin magnetization of the conduction electrons. (6.5)

(b) Using Langevin's classical treatment, show that the orbital motion of the electron gives rise to a diamagnetic susceptibility under the influence of a magnetic field. (6)

Q.4 (a) Show that the effective mass of an electron in a crystal depends on the curvature of energy band. Discuss the physical basis for the effective mass of an electron in a crystal. (6)

(b) Calculate the heat capacity of the electron gas by using Fermi Dirac distribution function. Explain why experimental results do not agree with the results obtained by using classical statistics. (6.5)

Section-11

Q.5 (a) Distinguish between intrinsic and extrinsic semiconductors. (3)

(b) Prove that $E_F = E_g/2$ for intrinsic semiconductor. (3)

(c) Derive an expression for intrinsic carrier concentration in a semiconductor. (6.5)

Q.6 (a) How is p-n junction formed? (3)

(b) Starting with the Poison's differential equation and assuming an abrupt p-n junction show that $N_d d_n = N_a d_p$ where $x = -d_p$ and $x = d_n$. Also find the length of depletion region on n and p sides. (9.5)

Q.7 Write notes on the following. (6.5, 6)

(i) Donors and acceptors

(ii) Electrical resistivity of metals

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: VI (Nuclear Physics)

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FOUR questions selecting at least ONE from each section. All questions carry equal marks. Please read question carefully and answer accordingly.

Section I

Question 1: (8 + 12 + 5 = 25)

(a):Explain the terms mass defect and binding energy of the nucleus. Draw binding-energy per nucleon versus mass-no graph and discuss its main features.

(b): What is semi-empirical mass formula? Explain how it can be used to predict the most stable isobar against β-decay. Also discuss how this prediction differs for even- and odd-A nuclei.

(c): Using the liquid drop model, find the most stable isobar for A = 118.

Question 2: (12 + 13 = 25)

(a): What is the principle, construction and working of a Van de Graff accelerator? Also write down its uses..

(b): What are semiconductor detectors? Describe the principle and working of these.

Section II

Question 3: (10 + 15 = 25)

(a): What is alpha decay? Why does it occur? Find the expressions for the Q-value and kinetic energy of alpha particle in an alpha-decay process.

(b): For a beta-decay process, use Fermi's Golden rule to derive the relation for the partial decay rate.

Question 4: (10 + 15 = 25)

(a): Write down two main differences between scattering of identical nucleons (p-p, n-n) and the non-identical nucleons (n-p).

(b): What are limitations and successes of shell model? How does collective model combine the liquid-drop model and shell model to explain the magnetic dipole moment and electric quadrupole moment of nuclei?

P.T.O.

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: II (Statistical Physics)

MAX. TIME: 3 Hrs.

MAX. MARKS: 50

NOTE: Attempt FOUR questions, in all by selecting at least ONE question from each section. Try to be focused and give only precise answers, of the asked questions.

Section-I

Q.1.

(a) State the Liouville's theorem and define the meaning of each individual terms in its equation. (3)

(b) What is the basic difference in the definition of calculating the average from ordinary method and then by Ensemble method? (3)

(c) Define Statistical Physics and derive the elementary equation of statistical physics. Also explain the logical physics explained in the result of this elementary equation. (3.5)

(d) Use the formula derived for Maxwellian's velocity distribution to deduce the probability $\omega(E)dE$ for energy distribution. (3)

Q.2.

(a) The entropy of a two dimensional gas of particles in an area A is given by the expression,

$$S=NK_B\{\log(\frac{A}{N}) + \log(\frac{mU}{2\pi\hbar^2 N}) + 2\}$$

where N is the number of particles and U is the energy of the gas. Calculate the temperature of gas and the chemical potential. (3)

(b) Why is the quantity $h/(2\pi MkT)^{1/2}$ identified with a wavelength? (2)

(c) Distinguish between micro-canonical and canonical ensemble by stating their respective distribution function. (4)

(d) Planck's formula for the blackbody radiation is

$$u_\lambda \, d\lambda = \frac{8\pi hc}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1} d\lambda$$

- Show that for long wavelengths and high temperatures, it reduces to Rayleigh-Jean's law.
- Show that for short wavelengths, it reduces to Wien's distribution law.

(3.5)

Q.3.

(a) How can you calculate the energy for a free atom? What do you know about the specific heat, Einstein solid and Dulong's Petit's Law? Also plot the behavior of both quantum mechanical models. (5)

(b) What do you know about diatomic gas? Write down the failures in the classical theory of specific heat. Also explain the electronic specific heat in this regard. (4)

(c) Show that for Maxwellian distribution of velocities of gas molecules, the root mean square of speed is given by $<v^2>^{1/2} = (3kT/m)^{1/2}$ (3.5)

Q.4.

Write short notes on each of the followings: (6, 6.5)

I. The quantum mechanical description of the specific heat of polyatomic molecules.

II. Energy distribution of conduction electrons in semiconductors.

P.T.O.

Section III

Question 5: $(10 + 15 = 25)$

(a): What are the fundamental assumptions of compound nucleus model? Explain how does a nuclear reaction proceed according to this model? Give an example which shows that a compound nucleus forgets its mean of formation.

(b): Write down different types of nuclear reactions. Explain them with the help of examples.

Question 6: $(12 + 13 = 25)$

(a): How neutrons can be slowed down? For a monochromatic beam of neutrons of energy, E_0, calculate the neutron energy, E, after a single collision.

(b): Describe in detail the practical problems involved in the construction of a controlled nuclear fusion reactor. Which type of fusion reactions is more favorable to be used in such reactors and why?

Question 7: $(10 + 10 + 5 = 25)$

(a): Why nuclei fission? Explain nuclear fission using the liquid drop model and show that fission will proceed spontaneously if $Z^2/A \geq 47$.

(b): Discuss, why ^{235}U may be fissioned using thermal neutrons, while ^{238}U requires fast neutrons for fission?

(c): Give at least five reasons to differentiate between fission and fusion reactions.

Section-II

Q.5.

(a) Show that the total energy density is proportional to the fourth power of temperature T. (3.5)

(b) By using the formula for Fermi-Dirac Statistics, explain its graphical interpretation. Also explain the formula interpretation and distribution statistics in the classical regime for the deduction of Boltzmann Distribution Law. (5)

(c) Classify the following between Bosons and Fermions and state the criterion which statistics has been applied for this classification:

- ❖ Ne-Atoms, Ozone-Atoms, Ni-Atoms, Aliphatic Hydrocarbons.
- ❖ Leptons, Baryons, Mesons, Spin zero particles. (4)

Q.6.

A system of N identical spin zero bosons each of mass m, is confined to a box of volume $V=L^3$ at temperature T>0.

(a) What precaution needs to be observed in writing down an expression for the total number of bosons N valid at low temperatures? (4)

(b) Explain qualitatively, what happens as the temperature of a Bose gas is reduced to the condensation temperature? (4)

(c) Show that the average kinetic energy of a conduction electron in a metal at 0 K is given by $\bar{E} = 3E_F/5$. By way of contrast, note that all of the molecules in an ideal gas at 0 K have zero energy. (4.5)

Q.7.

(a) The mass of the sun is 2×10^{30} Kg, its radius 7×10^8 m and its effective surface temperature 5,700K.

i. Calculate the mass of the sun lost per second by radiation.

ii. Calculate the time necessary for the mass of the sun to diminish by 1%.

(b) Use the thermodynamic relations to show that for an ideal gas: $C_P - C_V = R$.

(c) Planck's formula for the black body radiation is

$$u_\lambda \, d\lambda = \frac{8\pi hc}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1} d\lambda$$

Express this formula in terms of frequency. (4, 4.5, 4)

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: VII (Solid State Physics-I)

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

1. (a) Describe comprehensively the Meissner effect in superconductors. 5

   (b) Following the two fluid models, derive the famous London equations for a superconductor and apply them to a semi-infinite superconducting sample to justify Meissner effect. 15+5

2. (a) Describe the First order phase transition in ferroelectrics according to Landau theory. 10

   (b) Describe the following terms briefly but comprehensively. 15

   (i) Perovskites (ii) Macroscopic and Local electric field

   (iii) Hysteresis in Ferroelectrics

3. (a) What is the difference between Rayleigh and Raman Effect in crystals? Describe with the help of energy conservation rules. Also, draw the schematic energy transitions for Stokes and Anti Stokes lines. 4+2

   (b) Evaluate the necessary condition, in terms of polarizability, required for a material to be Raman active, under the classical description of the Raman Effect? 12

   (c) What do understand by absorption of light in solids? Describe the direct and indirect electronic transitions. 2+5

4. (a) What do you understand by muffin tin potential used in augmented plane wave method (APW)? Describe APW in a comprehensive way. 4+8

   (b) What is independent electron approximation? Derive Hartree equations using variational principle. Discuss the drawback of this method. 2+11

5. (a) Give a brief understanding of single particle tunneling in superconducting junctions? 5

   (b) Discuss in detail the DC and AC Josephson effect with reference to cooper pair tunneling for superconducting junctions. 20

6. (a) How do you differentiate between Frenkel and Wannier Mott excitons? Describe comprehensively. Evaluate the expression for energy spectrum for the Frenkel excitons? 5+10

   (b) Derive Kramers Krong relations for a linear passive system of harmonic oscillators. 10

7. Write note on any two of the followings 12 ½ +12 ½

   (d) Conductivity of collision less electron gas

   (e) The nearly free electron model

   (f) Rochelle salt Ferroelectrics

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics **MAX. TIME: 3 Hrs.**

PAPER: III (Relativity & Cosmology) **MAX. MARKS: 50**

NOTE: Attempt FOUR questions selecting at least ONE from each section.

Section-I

Q1. (a) How the events are causally connected in space-time? Discuss the light cone as a manifestation of causality. [7]

(b) If a telescope observes a star at an inclination θ' to the horizontal, then show that classically the 'true' inclination θ of the star is related to θ' by

$$\tan\theta' = \frac{\sin\theta}{\cos\theta + v/c},$$

where v is the velocity of the telescope relative to the star. Show that the corresponding relativistic formula is

$$\tan\theta' = \frac{\sin\theta}{(v/c)(\cos\theta + v/c)}.$$ [5½]

Q2. (a) What is a paradox? Describe Twin's Paradox in detail. How it is resolved? [6½]

(b) A neutron with kinetic energy of 1.00 BeV strikes a proton which is vibrating about a fixed point in such a way that its maximum kinetic energy is 100 MeV. What are the maximum and minimum values of the relative velocities of the two particles? Assuming that the rest mass energies of neutron and proton are equal and of magnitude 940 MeV. [6]

Q3. (a) How electric and magnetic phenomena can be expressed in the form of an electromagnetic field tensor? Also find the components of electromagnetic field tensor $F_{\mu\nu}$. [6½]

(b) An atom at rest in a laboratory emits a photon and recoils. If its initial mass is m_0 and it losses the rest energy ΔE in the emission, show that the frequency of the emitted photon is given by

$$\nu = \frac{\Delta E}{h}\left(1 - \frac{\Delta E}{2m_0c^2}\right).$$ [6]

Section-II

Q4. (a) What is a metric? Transform $ds^2 = dx^2 + dy^2 + dz^2$ into spherical polar coordinates. [5½]

(b) Why the ordinary derivative is not tensorial? How would you define a tensorial derivative? [5]

(c) What is index free interpretation of a vector field? Show that the expression $X = X^\mu \partial_\mu$ remain invariant under coordinate transformation. [2]

Q5.(a) Show that the Christoffell symbols $\Gamma^\lambda_{\mu\gamma}$ does not follow the coordinate transformation law of a (1,2) tensor. [6½]

(b) Compute the components of Riemann Curvature Tensor $R^\theta_{\phi\theta\phi}$ and $R^\theta_{\phi\phi\theta}$ for a unit 2-sphere $ds^2 = d\theta^2 + \sin^2\theta\, d\varphi^2$. [6]

Q6. (a) Show that for curvature tensor $R_{\rho\mu\nu\lambda} = -R_{\lambda\nu\rho\mu} = -R_{\nu\lambda\mu\rho} = R_{\lambda\nu\mu\rho}$ [4½]

(b) Show that the divergence in Ricci tensor is non-zero but divergence of Einstein tensor is zero. [8]

Q7. Write notes on the following: [4, 4, 4½]

(i) FRW metric (ii) 4 dimensional world view (iii) Gravitational red shift

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: VIII (Solid State Physics-II)

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FOUR questions. All questions carry equal marks.

Q.1 (a) What is phonon? Explain the screening of electron-phonon interactions.
(b) How does Hubbard model can differentiate the metallic and insulating limits. (12.5+12.5)

Q.2 (a) Write down Boltzmann transport equation and apply it to find the conductivity equation.
(b) Discuss Einstein model of specific heat for different temperature ranges. (12.5+12.5)

Q.3 (a) What is magnetotaxis? Explain magnetic bubble domains.
(b) Explain the phenomenon that illustrates the quantization of Hall resistance. (12.5+12.5)

Q.4 (a) Derive a dispersion relation for the ferromagnetic Magnons.
(b) How does the ferromagnetic resonance frequency modify due to shape of the specimen? (12.5+12.5)

Q.5 (a) How does the electron-electron interactions increase mean free path in metals.
(b) Find an expression for the antiferromagnetic resonance frequency of a uniaxial antiferromagnet. (12.5+12.5)

Q.6 (a) Explain antiferromagnetic order. Also discuss its susceptibility below Neel temperature.
(b) Derive a dispersion relation for the antiferromagnetic magnons. (12.5+12.5)

Q.7 Write note on any two of the followings:
(a) Neutron Magnetic Scattering
(b) Optical properties of semiconductors
(c) Free electron approximation in magnetic field (12.5+12.5)

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: IV (Computational Physics)

MAX. TIME: 3 Hrs.

MAX. MARKS: 50

NOTE: Attempt FOUR questions selecting at least ONE from each section.

Section-I

Q.1	Suppose **A** and **B** be 3x3 matrices. Write C^{++} program which reads in entries of A & B and calculate (i) **C = A - B**, (ii) **D= 4A x 8 B** (iii) sum and average of the elements of matrix **C** (iv) square of the elements of matrix C (v) square of the matrix **D**. Write C++ program to calculate surface area and volume of the sphere using functions such that $A = 4\pi r^2$ and $V = 4/3\,\pi r^3$.	08 ½ +4
Q.2.	Write C++ program to evaluate the $\int_1^6 \frac{1}{(1+x^2)} dx$ by Simpson's Rule or Trapezoidal Rule. Your program should ask options from the user to select method for the solution. (Use n=6). Write C++ program to calculate and print the series and sum of the series such that: $S = \frac{1}{2}\sum_{k=1}^{15} k^3$	8+4 ½
Q.3.	Find the roots of the equation **8x – sin x - 22** using simple iterative method using xo = 0.5. Write C++ program to implement the method correct to 3dp. Write C++ program which reads in a value as binary number and converts that number into decimal. Implement your program for 5 iterations.	7+5 ½

Section-II

Q.4. A B	Write MATLAB program to print time against the growth of Current and the decay of current values on a single graph in the RL-circuit using Euler's Method with initial conditions: r=10Ω, L=5H, initial time 0, time step 0.1, maximum time 2.5sec., initial current 0 and voltage v=4 volts. Also plot point of intersection of two curves. Draw estimate graphs with proper labels. How you can get the coordinates of the interaction point? Write MATLAB program to calculate and print out factorial of a number taken from the user by using two methods. Implement your program using functions.	04 ½ +8

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Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: IX (Particle Physics-I)

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FOUR questions selecting at least ONE from each section. All questions carry equal marks. Please read question carefully and answer accordingly.

Section I

Question 1: $(12 + 13 = 25)$

(a): Describe the origin of the following intrinsic quantum numbers; Electron no, Muon no, Baryon no, Strangeness and Isospin no. Explain how are they assigned to various leptons, mesons and baryons?

(b): What are quarks? Explain the quark model. Is there any evidence in this support? Also explain the origin and notion of quark confinement and color hypothesis.

Question 2: $(13 + 12 = 25)$

(a): Describe in detail differences between QED and QCD. Also explain the concept of asymptotic freedom in QCD.

(b): Give the relative strengths, typical lifetimes for decays, ranges and mediating field particles of strong, weak and electromagnetic interactions. Draw the primitive vertices and also give one representative example for each interaction.

Section II

Question 3: $(10 + 10 + 5 = 25)$

(a): What is charge conjugation operation and what are the eigen-values of the corresponding operator? Show that C-parity of a proton-antiproton system in a state of definite orbital angular momentum, l, and spin, s, is $(-1)^{l+s}$.

(b): What is parity? Explain in detail how parity is violated in the weak interaction of cobalt decay. What kind of special characteristics of neutrino make weak processes to violate the conservation of parity?

(c): For a system of two spin-$\frac{1}{2}$ particles, write down the spin triplet ($|1,1>, |1,0>, |1,-1>$) and spin singlet ($|0,0>$) state vectors in terms of the individual particle spin functions ($|\frac{1}{2},\frac{1}{2}> \& |\frac{1}{2},-\frac{1}{2}>$).

Question 4: $(12 + 8 + 5 = 25)$

(a): What is isospin? Comment on isospin symmetry. Using Isospin symmetry find the ratios of the decay rates of the following processes:

$$\Delta^+ \rightarrow p + \pi^0$$
$$\Delta^+ \rightarrow n + \pi^+$$

(b): Using the Lorentz Gauge $\nabla \cdot \mathbf{A} = -\frac{\partial \phi}{\partial t}$, show that $\mathbf{A}$ and ϕ obey the following wave equations

$$\nabla^2 \mathbf{A} - \frac{\partial^2 \mathbf{A}}{\partial t^2} = -\mathbf{j}$$
$$\nabla^2 \phi - \frac{\partial^2 \phi}{\partial t^2} = -\rho$$

(c): Use Maxwell equations to derive the continuity equation.

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Q.5. (A)	What are random numbers? Write syntax for random number generation in MATLAB. Write MATLAB program to plot graph for a particle describing Brownian motion. Also calculate total and average distances traced by the particle. Draw approximate output graph with proper labels.	8+4 ½
(B)	Write a program with function to calculate ***f(x)***, given by: $f(x) = 33x^3 - 44x^2 + 14x + 32$. Calculate, print and plot values for ***x*** and ***f(x)***. Also find out sum, average, minimum of f(x) values for ten different values of x.	
Q.6. (A)	Write down the MATLAB syntax with example for: diff(), cumsum(), pretty() and ginput().	8+ 4 ½
(B)	Write MATLAB program to calculate and print out factorial of a number taken from the user. Implement your program using function.	
Q.7. (A)	Write MATLAB program for the damped harmonic motion (DHM) of a mass attached with a spring using Euler's method under the following conditions: (g=9.8 m/s^2, initial position zero and velocity 15 m/s, time step 0.1 sec. and maximum time 15 sec., k = 1 N/m, m=1kg, damping coefficient = 0.5 N/ms, ω=0.01 s^{-1} and f_0=1.5N.). Calculate and print values for time, position, velocity and acceleration. How you can change the same program for Simple H.M., forced H.M. The necessary equations are as follows: A = (-k x – b v + f_0 cos (wt))/ m, x = x + v h, v = v + a h, t = t + h,	8+ 4 ½
(B)	Write MATLAB program plot curves R, S_1 and S_2, Also determine two close curves among the following data set: (S = 3,2,1,4,6), (R_2=4,4,4,2,3) and (R_2 = 5, 3, 5,2, 3). Note: Plot estimate graph if any.	

Section III

Question 5: $(9 + 9 + 7 = 25)$

(a): Develop Klein-Gordan equation using relativistic expression of energy, write it in covariant form. Also derive its equation of continuity.

(b): Using the anticommutation relations for α_i and β, show that they are hermition and traceless matrices of even dimensionality.

(c): What kind of particles do obey Dirac equation? Explain, how negative energy solutions are interpreted in Dirac hole theory and Feynman Stuckelberg approach?

Question 6: $(12 + 10 + 3 = 25)$

(a): For a proper infinitesimal Lorentz transformation

$$\Lambda^{\nu}_{\mu} = \delta^{\nu}_{\mu} + \epsilon^{\nu}_{\mu},$$

show that an S which satisfies $S^{-1}\gamma^{\nu}S = \Lambda^{\nu}_{\mu}\gamma^{\mu}$ is

$$S = 1 - \frac{i}{4}\sigma_{\mu\nu}\epsilon^{\mu\nu}$$

and hence show that

$$S^{-1} = \gamma^0 S^{\dagger}\gamma^0$$

(b): Derive the completeness relations for Dirac spinors.

(c): Show that $\not{p}\not{p} = p^2$ (where p is 4-momentum and $\not{p} = \gamma^{\mu}p_{\mu}$)

Question 7: $(10 + 10 + 5 = 25)$

(a): Modify Dirac equation for zero-mass fermions.

(b): Define chirality projection operators and chirality eigen states. Show that chirality eigen state become identical to helicity eigen states for a massless particle.

(c): Show that $(\gamma^5)^2 = I$. Also show that $\{\gamma^5, \gamma^{\mu}\} = 0$.

UNIVERSITY OF THE PUNJAB

Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: X (Particle Physics-II)

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FIVE questions selecting at least ONE from each section.

Section I

Q1. For the elastic scattering process. Show that

$$a_{el} = \frac{1\pi}{k^2}(2l+1)\frac{\frac{\Gamma^2}{4}}{(E_R - E)^2 + \frac{\Gamma^2}{4}} \tag{20}$$

Q2. (a). Explain the general process of scattering. Discuss the waveforms which we obtain for incident and scattered waves. Also write down the general expression for incident and reflected wave.

(b). What are the factors on which the total cross section depexplain in detail.

(12+8)

Q3. (a) Define Mandelstam variables and show that for a two body scattering process

$$s + t + u = \sum_{i=1}^{4} m_i^2$$

(b) What are the energies of particles $1, 2, 3, 4$ in terms of Mandelstam variables.

(10+10)

Section II

Q4. Discuss standard model in detail. Explain its significance in Particle Physics.

(20)

Q5. (a). Define the generators of the group $SU(3)$. What are structure constants.

(b). Solve the following commutators

$$[T_1, T_2],$$
$$[T_2, T_5] \tag{12+8}$$

Q6. By using Dirac equation, obtain the expression for four-vector current j^μ for an electron in an electromagnetic field A^μ.

(20)

Section III

Q7. Prove the following trace theorems

(a). $\mathrm{Tr}(ab) = 4a.b$

(b). $\mathrm{Tr}(abcd) = 4\left[(a.b)(c.d) - (a.c)(b.d) + (a.d)(b.c)\right]$

(c). $\mathrm{Tr}(\gamma_5 ab) = 0$

(d). $\mathrm{Tr}(\gamma_5) = 0$

(20)

Q8. (a) Starting with the expression

$$|M|^2 = \frac{e^4}{q^4} L_e^{\mu\nu} L_{\mu\nu}^{muon},$$

write down the expressions for $L_e^{\mu\nu}$ and $L_{\mu\nu}^{muon}$.

(b). Show by using trace theorems that

$$L_e^{\mu\nu} = \frac{1}{2} Tr\left((k' + m)\gamma^\mu (k + m)\gamma^\nu\right) \tag{8+12}$$

Q9. (a) Draw Feynman diagrams for $e^- e^+$ scattering.

(b) Show that for $e^- e^+$ at very high energies

$$\sigma = \frac{4\pi\alpha^2}{3s} \tag{6+14}$$

UNIVERSITY OF THE PUNJAB

Part-II : Supplementary Examination 2018

Examination:- M.A./M.Sc.

Roll No. .....

Subject: Physics

PAPER: XIII (opt-iv) [Advance Electronics]

MAX. TIME: 3 Hrs.

MAX. MARKS: 100

NOTE: Attempt any FIVE questions, All questions carry equal marks.

Q.1 a) Discuss a sweep circuit using UJT and calculate OFF and ON time of the Sweep. What are the uses of sweep circuit? 15, 5

b) Calculate the output Voltage from a non-Inverting OP-Amp circuit for the input 120μA Where R_f=240 KΩ, R_1=2.4 KΩ .

Q.2 a) Explain the working of Clocked J,K master slave Flip flop. Also draw its timing diagram.

b) Express the Boolean function F= A + $\bar{B}$C in a sum of Minterm. 14, 6

Q.3 a) Develop a Logic circuit that has a high output when at least three out of four inputs W,X,Y, Z are LOW by 12,8

i) Developing a truth table.
ii) Writing the Boolean expression
iii) Minimizing the expression by K- map if possible.
iv) Implementing the logic circuit with NAND gate.

b) Simplify the Boolean function, write the Min. and Max- term by using K-map and draw the logic diagram for SOP, and POS.

$$F(A,B,C,D) = \Sigma(1,3,7,11,15)$$

$$d(A,B,C,D) = (0,2,5)$$

Q.4 a) A certain memory chip has a capacity of 64 words of 4 bits each. 6,8,6

i) How many select lines are required to permit each word to be addressed?

ii) How many data input and data output pins are on the chip?

iii) How many memory cells are on the chip?

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b) Find the output voltage of a 6-bit binary "101001" ladder network with the following inputs 0=0V, and 1=+10V.

c) If it is desired to dived an 80 KHz clock signal with flip flops to obtain a 5 KHz signal how many flip-flops are required?

Q.5 a) What is the difference between the Asynchronous and Synchronous Counter? 6,14

b) Design and draw the diagram of Skip synchronous counter of 4,7,3,0,2 with R,S Flip Flop.

Q.6 a) Discuss the working of OP-Amp in Inverting and Non-Inverting mode operation. 8,12

b) What is a microwave? What are its advantage, and applications?

Q.7 a) Explain the role of Ionosphere in communication, Which layer of ionosphere attenuates high frequencies that pass through it ? 12,8

b) What is the meaning of PLD's. Explain the working of PAL and PLA?

Q.8 a) Explain the difference between the FM and AM modulation. 6, 14

b) Draw and explain the working of Superheterodyne AM receiver.

Q.9 Write a Short note on any two of following: 10, 10

i) Microcontroller

ii) Klystron Amplifier

iii) SRAM and DRAM