UNIVERSITY OF BALOCHISTAN QUETTA
MA / MSc (ANNUAL) EXAMINATION .2015.

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Subject:- **PHYSICS** Paper:- **I (Prev:)**
Time Allowed :- 3 Hours **Mathematical Method of Physics** Max : Marks : 100

Note :- Attempt 05 Questions. in All But Question No. 1- in section –I is compulsory and the time for Section-I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 20 MARKS)

Q.No.1 Write short answers of the followings. (Attempt any 10 Questions)

i. Write down the 4 properties of Beta function .
ii. The main objective to use Rodriquez's formula define Also write the formula for legnder and legueare polynomials .
iii. State the recursion Relatation of Legendre polynomials .
iv. If $\mathcal{L}^{-1}\{F(S)\,G(S)\} = f(t) * g(t)$ what would be the result according to the convolution theorem .
v. If $A = i + 2j + 3k$, $B = 2i - 3j + k$, and $c = 3i + j - 2k$ find A . (BxC) = ?
vi. Write down the Fourier sine and cosine Transforms ?
vii. Define the polay form of Cauch's Riemann equation .
viii. Define the necessary condition for a function to be analytic .
ix. What is an Argand plane ? Define the modulus IZI and principal agreement .
x. Evaluate. $\sqrt{-1/2}$
xi. Explain Singularity of the functional the Harmonic function
xii. Write down the orthogonalty and Normalization property of Hermite function .
xiii. State Green theorem .
xiv. Give an expression for $\mathcal{L}\{f^n(t)\}$ ' ? Laplace Transformation of n^{th} derevatives .
xv. Write down the Jacobi's Series.
xvi. Calculate the residue of $f(z) = \frac{1}{z^2+9}$ at $z = 32$
xvii. Define 2nd Shifting property .

SECTION –II(SUBJECTIVE PORTION 80 MARKS) TIME ALLOWED 2:20
Attempt any Four (04) questions.

Q.2. .a) if $f = (3xy - 5z + 10x)$ Calculate $\int_0^2 f.\,dx$ along a curve $x = t^2+1, y = 2t^2$ and $z = t^3$
b) State and prove Gauss's divergence theorem .

Q.3. a) Find the Fourier sine and cosine transforms of the following function :-
$F(t) = \sin t$ for $0 \le t \le x$
$= 0$ Otherwise
b) Obtain a Fourier series for the periodic function
$f(x) = \begin{cases} -K & \text{for } -\pi < t < 0 \\ K & \text{for } 0 < t < \pi \end{cases}$
if K=1 in Fourier series then deduce the series for $\frac{\pi}{4}$ at $t = \pi/2$

Q.4. a) Find the Laplace Transformation of the following :-
$\mathcal{L}^{-1}\left\{\frac{1}{S^3(S^2+1)}\right\}$
b) $\mathcal{L}^{-1}\left\{\ln\left(\frac{S+2}{S+1}\right)\right\} = \frac{e^{-t} - e^{-2t}}{t}$

Q.5. a) Deduce a relation for Laplace Transformation of the n^{th} derivatives as
$\mathcal{L}\{f^n(t)\} = S^n F(s) - S^{n-1} f(0) - S^{n-2} f(0) - S^{n-3} f''(0) - \cdots - f^{n-1}(0)$
b) Solve for $\mathcal{L}\{\text{Cost Cos2t cos3t}\}$

Q.6. a) Find the solution for

i) $\int_0^{\pi/2} \text{Cos}^5 \Theta \, \text{Sin}^2 \Theta \, d\Theta$

ii) $\int_0^{2} \frac{X^2 \, dx}{\sqrt{2 - x}}$

b) Evaluate $\sqrt{-1/2} = \sqrt{\pi}$

Q.7. a) State and prove the Normalization property of legurre polynomials.
b) Using Rodrigue's formula obtain the hermite polynomails

$H_0(x)$, $H_1(x)$, $H_2(x)$ and $H_3(x)$

Q.8. Deduce Cauchy's Riemann equation :
a) What is the importance of CR equation ?
b) Check the differentiability of the given complex function
$F(Z) = 4x + y + i(-x+4y)$.

Q.9. Evaluate the following

a) $\int_0^{\infty} \frac{\text{Cosax}}{X^2 + 1} \, dx = \frac{\pi}{2} e^{-a} \quad a \geq 0$

b) Define and prove Cauchy's Residue theorem.

Q.10. Write short notes on any two of the following topics :
a) Convolution Integral theorem.
b) Laplace 1st, 2nd shifting property .
c) Orthogonal curvilinear coordinates.

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Subject:- **PHYSICS .** Paper:- II **(Prev:)**

Time Allowed :- 3 Hours **Classical Mechanics** Max : Marks : 50

Note :- Attempt 05 Questions. in All But Question No. 1- in section –I is compulsory and the time for Section-I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 10 MARKS)

Q. 1. Attempt ten (10) questions in all.

1.Define D'Alembert's Principle.
2.Define cyclic coordinates.
3. Prove H=T+V
4. Define central force.
5. Define the impact parameter in scattering of particle.
6. Define rigid body.
7. State Euler's theorem.
8. Differentiate between Newtonian and Lagrangian Mechanics.
9. Differentiate between Laboratory and Center of mass coordinate systems.
10. What do you mean by generalized coordinates?
11. Define the term Moment of inertia also write down the mathematical expression for it.
12.What is the principle of least action.

SECTION-II

MARKS 40, TIME ALLOWED 2:20 min

Note. Attempt four questions in all. All question carry equal marks.

Q.2 Explain the Rutherford's scattering experiment, derive the scattering formula, and discuss it's main results.

Q.3 Set up equations of motion of a double pendulum using Langrange's equation.

Q.4 Derive the Lagrange's equation of motion from D'Alembert Principle.

Q.5 (a) State and prove Hamilton's principle.

(b) Show that the shortest distance between the two points is the straight line.

Q.6 (a) Define canonical transformation and derive transformation equations for the generating function $F_1=F_1(q,Q,t)$.

(b) Show that the transformation $Q=\log[\sin p/q]$,$P=q\cot p$ is a canonical transformation.

Q.7 (a) Show that the fundamental Poisson brackets are invariant under canonical transformation.

(b) Define and explain the legendre transformation

Q.8 Write note on any two of the following

(a) Euler's Equations

(b) Coriolis Force.

(c) Kepler's 2nd and 3rd law of motion.

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Subject:- **PHYSICS.** Paper:- III (Prev)

Time Allowed :- 3 Hours **THERMAL & STATISTICAL PHYSICS .** Max : Marks : 50

Note :- Attempt **5** Questions. in All But Question No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 10 MARKS)

Q. No-1 (Attempt any **TEN**)

1. Define Gibb's function.
2. Free energy is also called _____ energy.
3. Using the First law of thermodynamics explain why the total energy of a isolated system is always constant.
4. Give an example of an irreversible process that occurs in nature.
5. Why is the following situation impossible ?
   " A team of researchers discover a new gas which has a value of $\Upsilon = Cp/Cv$ of 1.75 ".
6. What do you understand by the absolute scale of temperature ?
7. What is reversible thermodynamic process ?
8. What do you understand by the internal energy of the system ?
9. What are isothermal and adiabatic changes ?
10. What is meant by the Thermo dynamical equilibrium ?
11. Distinguish between classical and quantum statistics.
12. What is Joule Thomson's Effect ?
13. The molar specific of ideal monoatomic gas at constant volume is $Cv = 3/2\ R$; the molar specific heat at constant pressure is $Cp = 5/2\ R$, the ratio $\Upsilon = Cp/Cv =$ _____
14. What is wrong with the following statement :
    "Given any two bodies , the one with the higher temperature contains more heat".
15. Differentiate between microstates and macro states

SECTION – II (Subjective portion 40 marks) Time allowed 2.20.

Attempt ant **FOUR** questions from this part.

Q. No-2.(a.)Define Entropy. What is its physical significance ? Show that the entropy of a perfect gas remains constant in a reversible process but increases in a irreversible process.

(b.) Calculate the change in entropy when 100 g of water at 15° is mixed with 160 g of water at 40°. Specific heat of water may be assumed as equal to 1.

Q. No-3.(a.) What is meant by the order of a phase change? Discuss it giving examples.

(b.) State and discuss Zeroth law of Thermodynamics.

Q. No-4.(a.) Deduce Maxwell's thermo dynamical relations.

(b.) Show that

$$(\partial T/\partial V)_V (\partial S/\partial V)_P - (\partial T/\partial V)_P (\partial S/\partial P)_V = 1$$

Q. No-5. Establish the distribution law of Maxwell and Boltzmann.

Q. No-6. What is Black Body radiations ? State Stefan's law of radiations and prove it from thermo dynamical considerations.

Q. No.-7. Discuss Wien's displacement and Rayleigh Jeans law. How is Planck's law applicable for all wave lengths.

Q. No-8. Write comprehensive note on any **two** of the following:

1. Lattice Vibrations
2. Velocity Space
3. Thermodynamic Fluctuations

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Subject:- **PHYSICS.** Paper:- IV(Prev:)

Time Allowed :- 3 Hours **ELECTROMAGNETIC .** Max : Marks : 100

Note :- Attempt Five Questions. in All But Question No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 20 MARKS)

Q.No.1 Short Questions (Attempt any 10)

i. What is Electric Field .
ii. Write the integral form of electric field intensity $\vec{E}$
iii. What is divergence Theorem .
iv. Write down the expression for electric flux .
v. Write down the Maxwell's equations in integral form .
vi. Write the pointing vector in mathematical form .
vii. What is electric potential energy .
viii. What is refraction ?
ix. What is Poisson equation
x. What is optical fibers
xi. What is H?
xii. Write down the formula for power losses in case of resonator cavity .
xiii. What is electric dipole .
xiv. What is Magnetic dipole .
xv. What is dense medium .
xvi. Where does the origion of special theory of relativity lies .
xvii. What is Ether ?
xviii. What is Lorentz Transformation ?
xix. Write down the expression for Group velocity in vawum in terms of speed of light .
xx. Write the matric representation of Lorantz transformation

SECTION –II(SUBJECTIVE PORTION 80- MARKS) TIME ALLOWED 2:20

Attempt any Four (04) questions.

Q.2. a) What is the magnetic field B ? Derive the expression for the magnetic force of a moving charge .
b) A Uniform magnetic field B of magnitude of 1.2mT, points vertically upward through a room a proton with a kinetic energy of 5.3 mev Moves horizontally to the north through a certain point in the room what magnetic deflecting force act on the proton as II passes through this point ?

Q.3. a) Briefly explain the differential form of Maxwell's equation in a medium .
b) The electric field of an electromagnetic wave is given by $E = E_o \cos(kz - wt)$. calculate the pointing vector for this wave .

Q.4. Solve the laplace equation in cylindrical coordinate .

Q.5. Find an expression for $\vec{E}$ and $\vec{B}$ in a cylindrical wave guide .

Q.6. Differentiate the Laplace and poission Equation for an arbitrary vector A .

Q.7. Consider the waves between two parallel plates , derive the curl of Maxwell's Equation for it and discuss its significance .

Q.8. Explain the Einstein's postulates of special theory of relativity in detail .

Q.9. Explain the Lorentz transformation in detail .

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SUBJECT: - **PHYSICS** PAPER-V (Prev) **ELECTRONICS**

TIME ALLOWED: **3 HOURS** MAX: MARKS:-**100**

Note:- ***Attempt any five Questions in all, including Question No.1,which is compulsory. Time for question No. 1 is 30 minutes. After 30 minutes paper must be returned to the centre superintendent or the invigilator.***

SECTION – I (20 MARKS)

Q. No.1 Select the most appropriate option from each of the following.

1- When PN Junction is forward biased
(a) The only current is hole current (b) The only current is electron current
(c) The only current is due to majority carrier (d) The current is due to both holes and electron

2- For a Germanium diode, the typical value of forward biased voltage
(a) Must be greater than 0.7 V (b) Must be greater than 0.3 V
(c) Depends on the width of depletion region (d) Depends on the concentration of majority carrier

3- The average value of half wave rectified voltage with a peak of 100V
(a) 31.8 V (b) 0 V (c) 63.7 V (d) 70.5

4- The dynamic resistance can be important when a diode is
(a) reverse-biased (b) forward-biased (c) in reverse breakdown (d) unbiased

5- The average value of a half-wave rectified voltage with a peak value of 200 V is
(a) 63.7 V (b) 127.2 V (c) 141 V (d) 0 V

6- When operated in cutoff and saturation, the transistor acts like a
(a) linear amplifier (b) switch (c) variable capacitor (d) variable resistor

7- In a voltage-divider biased npn transistor, if the upper voltage-divider resistor (the one connected to V_{CC}) opens,
(a) the transistor goes into cutoff (b) the transistor goes into saturation
(c) the transistor burns out (d) the supply voltage is too high

8-The common emitter amplifier is unique because the input and output voltages are out of phase by
(a)120° (b) 180° (c) 90° (d) 150°

9- A Thyristor has
(a) two pn junctions (b) three pn junctions(c) four pn junctions (d) only two terminals

10- The SCS differs from the SCR because
(a) it does not have a gate terminal (b) its holding current is less
(c) it has two gate terminals (d) it can handle much higher currents

11- In cut off region, V_{CE} is
(a) 0 V (b) Minimum (c) a and b (d) Equal to V_{CC}

12- In saturation region, V_{CE} is
(a) 0.7 V (b) Equal to V_{CC} (c) Minimum (d) Maximum

13- E-MOSFETs are generally used for switching applications because of their
(a) Threshold characteristic (b) high input resistance (c) linearity (d) high gain

14- The parameter h_{fe} corresponds to
(a) β_{DC} (b) β_{ac} (c) r_e' (d) r_c'

15- An n-channel D-MOSFET with a positive V_{GS} is operating in
(a) The depletion mode (b) The Enhancement mode (c) Cut off (d) Saturation

16- A certain common emitter amplifier has a voltage gain of 100. If the emitter bypass capacitor is removed
(a) The current will become unstable (b) The voltage gain will decrease
(c) The voltage gain will increase (d) Q point will shift

17- Instrumentation amplifiers are used primarily in
(a) High noise environment (b) Medical equipment (c)Test instruments (d)Filter circuit

18- A voltage follower (in case of op)
(a) has gain of one (b) is non-inverting (c) has no feedback resistor (d) has all of these

19- The operation of a relaxation oscillator is based on
(a) a very stable supply voltage (b) a highly selective resonant circuit
(c) low power consumption (d) the charging and discharging of a capacitor

20- Which of the following characteristics does not necessarily apply to an op-amp?
(a) High gain (b) Low power (c) High input impedance (d) Low output impedance

SECTION- II (MARKS-80)

Note: Attempt any four questions from this section. All question carry equal marks.

Q.2. (i) Explain Intrinsic and Extrinsic semiconductors. How P-type and N-type semiconductors are formed? Compare the depletion region in forward and reverse biasing. (12)

(ii) Describe the current-voltage characteristics of simple semiconductor diode and Zener diode. (08)

Q.3. (i) Explain Base bias and Emitter bias with circuit diagram. (12)

(ii) Calculate the value of V_{CE} and I_C for collector feedback biasing if V_{CC}= 10V, R_C =10KΩ, RB =100KΩ, β_{DC}=100 (08)

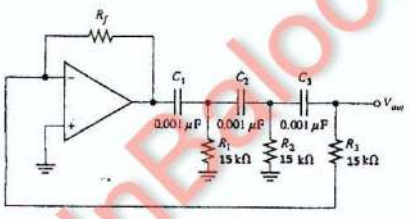
Q. 4. (i) Explain the operation of emitter follower with the help of circuit diagram. Derive the relations for input impedance, output impedance, and voltage gain. (12)

(ii) Explain the function of common collector circuit as Darlington pair (08)

Q. 5. (i) What is positive feedback? Explain the circuit and operation of Wein Bridge Oscillator (10)

(ii) What is Barkhausen criterion? Draw only the circuit diagrams of Hartley oscillator and Colpitts oscillator. (06)

(ii) Determine the value of R_f necessary for the circuit below to operate as an oscillator. [A_{cl}= 29] (04)



Q. 6. (i) What is FET? Classify FET into different types, Explain JFET construction, drain characteristic curve and transfer characteristic curve. (12)

(ii) Give at least four differences of BJTs and FETs (08)

Q. 7. (i) What do you mean by four layer diode? Explain the construction and operation of SCR. Briefly explains any one application of SCR. (12)

(ii) What is Triac? Briefly explain the operation of Triac. (08)

Q. 8. (i) What is Operational amplifier? Explain the function of non-inverting amplifier and find out the equation for its closed loop gain. (12)

(ii) Use Operational amplifier as Summing Amplifier with Unity Gain (04)

(iii) Define the term CMRR and Slew rate. (04)

Q. 9. Explain any two of the following. (10+10)

(i) The Colpitts Oscillator

(ii) Silicon controlled switch (SCS)

(iii) Op-Amp as an Integrator

---------THE END ----------

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Subject:- **PHYSICS .** Paper:- VI(Prev:)
Time Allowed :- 3 Hours Solid State Physics Max : Marks : 100

Note :- Attempt Five Questions. in All But Question No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 20 MARKS)

Q.No.1 Short Questions :- (Attempt Any 10)

(i). What is motif?
(ii). Draw the plane with miller indices (100).
(iii). What is meant by group velocity?
(iv). Define space charge polarization.
(v). What is thermal conductivity?
(vi). What is law of mass action?
(vii). What is the effect of temprature on fermi energy?
(viii). How we can determine the effective mass of electron & holes?
(ix). Under what conditions we can observe cyclotron resonance?
(x). What is disperssion?
(xi). Give the relation between refractive index and dielectric constant.
(xii). Differntiate between optical and acoustical phonon.
(xiii). Give two uses of Hall effect.
(xiv). Draw the graph showing the variation of specific heat with temprature.
(xv). Write mathematical of bloch's function.

SECTION –II(SUBJECTIVE PORTION 80- MARKS) TIME ALLOWED 2:20
Attempt any Four (04) questions.

Q.2. (a).Define packing fraction and prove that the packing fraction of Fcc structure is 0.74. (10)
(b).Explain the structure of Zinc Blend with neat and clean diagram. (10)

Q. 3. (a).Derive an expressiopn for the mean energy of quantized harmonic oscillator. (10)
(b).Give the main assumptions of Eienstein's theory of specific heat. (10)

Q.4. Discuss in detail the elastic wave propogation in one dimension diatomic lattice. (20)

Q.5. Derive an expression for concentration of electron in conduction band of intrinsic semiconductors. (20)

Q.6. What is Bloch's function? Prove and explain Bloch's theorem. (20)

Q.7. (a).Explain thermionic emission of metals using free electron theory. (15)
(b). Give the main assumptions of sommer's field theory (05)

Q.8. (a).What is local field & internal field?Derive the expressions. (15)
(b). Differentiate between ionic & orientational polarization. (05)

Q.9. Write Notes on any two of the following. (10+10)
(a). Effective mass of electron (b). Complex polarizability
(c). Normal & Umklap proces.

THE END

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Subject:- **PHYSICS,** Paper:- VIII **(Final)**
Time Allowed :- 3 Hours **Quantum Mechanics** Max : Marks : 100

Note :- Attempt **05** Questions in All But Question No. 1- in section –I is compulsory and the time for Section-I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 20 MARKS)

Q.No.1 Write short answers of the followings. (Attempt All Questions)

i. How many spaces are in Quantum mechanics define each space briefly
ii. Define wave function (Ψ)
iii. Define operator in Quantum Mechanics why we use operators .
iv. What is the hermition operator .
v. Define Eigen function and Eigen values as well as expected values .
vi. Write down postulates of Quantum Mechanics .
vii. Why we use variational method for approximation method .
viii. Define symmetry and anti symmetry .
ix. Define cross section area in scattering of particles .
x. Write down Schrodinger time dependent and time independent equation .
xi. Quantum Mechanics is represented by three pictures define each pictures.
xii. Why classical mechanics fails to define the microscopic phenomenon .
xiii. Define perturbation , give types of perturbations.
xiv. Define Born approximation .
xv- Define degeneracy and two fold degeneracy

SECTION –II(SUBJECTIVE PORTION 80 MARKS) TIME ALLOWED 2:20

Attempt any Four (04) questions.

Q.2. a) Consider a potential barrier having potential (V_o) a incident wave of energy $E > Vo$ strikes on the barrier from the right side , Now calculate transmission and reflection coefficient respectively.
b) Derive Schrodinger time independent equation for free particle .

Q.3. a) Angular momentum $\vec{L}$ is defined classically as $L = r \times p$ Define the angular momentum in operator representation with spherical polar co- ordinates .
b) Prove that
i) $\frac{-\hbar^2}{2m}\nabla^2 = \frac{P^2_r}{2m} + \frac{L^2}{2mr^2}$ and
ii) $[L_x, L_y] = i\hbar L_z$

Q.4. a) Briefly define postulates of Quantum Mechanics .
b) Discuss in detail the uncertainty principle .

Q.5. a) Discuss the perturbation theory , Briefly define the time independent perturbation theory .
b) Discuss in detail the W.K.B approximation .

Q.6. a) Analysis the plane wave in term of partial waved after scattering
b) Discuss the scattering experiment and cross- section .

Q.7. a) How we separate the Schrodinger equation for Cartesian Co- Ordinated for free particle.
b) Analysis the three dimensional square well potential .

Q.8. Discuss in full length the classical equation of motion can be replace by the Quantum Mechanical expectation values .

Q.9. a) Discuss the Quantum dynamics of identical particles .
b) Discuss the symmetry and anti – Symmetry of states .

Q.10. Write short notes on any two of the followings :-
a) Klerin – Gordon Eqn . b) Schrodinger , Dirac and Heisenberg Pictures .
c) Born approximation Method . d) Hydrogen atom .

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Subject:- **PHYSICS** Paper:- IX (Final)

Time Allowed :- 3 Hours **NUCLEAR PHYSICS** Max : Marks : 50

Note :- Attempt Five Questions. in All But No. 1- in section –I is compulsory and the time for Section- I is only 40 Minutes. After Expiry of the Time paper should be handed over to the supervisory staff.

SECTION –I (OBJECTIVE PORTION 10 MARKS)

Q.No.1 Give short answers:- (Attempt any Ten)

i. Why are very heavy Niclei unstable ?
ii. Why is the value of binding energy per nucleon low at low mass numbers and at high mass numbers ?
iii. State clearly (a) binding energy b) Mass defect with respect to the nucleus .
iv. What are α, β and γ- rays ? Is there any similarity between any of these radiations and X-rays .
v. Why do the stable medium nuclei possess excess of neutrons ??
vi. What is the magic about magic numbers ?
vii. What is meant by alpha disintegration energy ?
viii. Why do the protons in the nucleus of an atom not fly apart ?
ix. Draw a binding energy curve . What information do we get from such a curve ?
x. What are internal conversion and pair conversion phenomenon ?
xi. Compare and contrast the properties of a photon and a neutrino .
xii. What is Q-Value of a nuclear reaction ?

SECTION –II(SUBJECTIVE PORTION 40- MARKS) TIME ALLOWED 2:20

Attempt any Four (04) questions.

Q.2. Discuss various factors which contribute to the binding energy of nuclei and derive a formula for the atomic mass M(A,Z) of an nucleus based on these considerations .

Q.3. Explain qualitatively various characteristics features of nuclear forces . How does Yukawa's theory of nuclear forces explain the presence of strong forces between nucleons ? Why are virtual mesons not ordinarily observed .

Q.4. Explain how shell model of the nucleus accounts for the existence of magic numbers "

Q.5. Derive an expression for the decay constant for alpha emission by a radioisotope on the basis of Gammw's theory of α - decay How is Geiger – Nuttal law obtained from this theory .

Q.6. Describe Fermi's theory of beta decay . How does this theory lead to the continuous momentum spectrum of beta particles .

Q.7. By using semi-empirical mass formula
a) Show that A =2 z for light nuclei .
b) Show that neutron excess (A-2z) is approximately directly proportional to $A^{5/3}$ for medium nuclei.

Q.8. Write notes on any tow of the following:-
a) Electric Quadruple moment
b) Parity non conservation in β- decay .
c) Interaction of gamma radiations with matter .