P.A.H. Solapur University, Solapur

School of Physical Sciences

M. Sc.-I, SEM. II, Physics (Applied Electronics)

HCT - 2.1: Quantum Mechanics

Question Bank

Unit I: Operator Formalism

Four marks questions

1. Write a note on linear vector spaces.
2. Prove Schwartz inequality.
3. Discuss scalar product of state vectors.
4. Write a note on state vectors.
5. Write the definitions of norm, basis, orthogonal and orthonormal vectors.

Eight marks questions

1. Explain the operators.
2. Explain the commutator and its properties.
3. Prove the uncertainty relations between the operators.
4. Explain the unitary transformations and its properties.
5. What is the matrix representation of kets, bras, and operators? Explain in detail the matrix representation of operators.
6. Discuss Dirac notations? Explain its properties.
7. Explain vectors.
8. What is the Hermitian adjoint? Explain the properties of the Hermitian conjugate rule.
9. Discuss the eigenvalues and eigenvectors of an operator and prove, for a Hermitian operator, all of its eigenvalues are real and the eigenvectors corresponding to different eigenvalues are orthogonal.

Unit II: Introductory Quantum Mechanics

Four marks questions

1. Discuss the probability interpretation.
2. Prove the time-independent Schrodinger equation.
3. Write an expression for the Schrodinger equation for a particle subject to forces.
4. Write the postulates of quantum mechanics.
5. Discuss the conservation of probability.

Eight marks questions

1. Derive expression for time dependent Schrodinger equation for one dimension.
2. Write the proof for Ehrenfest's theorem.
3. Explain the postulates of quantum mechanics.
4. Discuss in detail box normalization.
5. Explain the Schrodinger and Heisenberg pictures.
6. Explain the interaction picture.
7. Discuss in detail position and momentum representations.
8. Develop the connection between position and momentum representations.
9. Express the position operator in momentum representation and momentum operator in position representation.
10. Explain the admissibility condition of the wave function.

Unit III: Solution of Schrodinger equation for some solvable systems and Angular Momentum Algebra

Four marks questions

1. Explain the properties of the wave functions in infinite square well.
2. Prove $[L¿¿x, L_y]=i\hbar L_z¿$.
3. Show that $[L^2, L¿¿x]=0¿$
4. If f is an eigenfunction of the $L^2$and L_z, show that $L_{\pm}f$ is also an eigen function.
5. Write a note on angular momentum.

Eight marks questions

1. Explain the infinite square potential well.
2. Explain the finite square potential well.
3. Find the solution of harmonic oscillator using operator method.
4. Derive the expressions for the simultaneous eigenfunctions of the L^2 and L_z operators.
5. Derive the expressions for the eigenvalues of the L^2 and L_z operators.
6. Prove the relations $[L¿¿x, L_y]=i\hbar L_z¿$ and $[L¿¿y, L_z]=i\hbar L_x¿$.
6. Show that $[L^2, L¿¿x]=0¿$ and $[L^2, L¿¿\pm]=0¿$.
7. Explain with diagram ladder of the angular momentum states.
8. Explain with diagram ladder of the stationary states for the simple harmonic oscillator.
9. What is the angular momentum? Explain the commutation relations for the angular momentum.
10. Explain the algebraic method for the harmonic oscillator.

Unit IV: Addition of Angular Momenta and approximation methods

Four marks questions

1. Write a note on the total angular momentum eigenstates
2. Show that $[J^2, J¿¿x]=0¿$
3. Discuss algebraic theory of spin.
4. Write a note on Pauli's matrices.
5. Discuss the validity of WKB approximation.

Eight marks questions

1. Express the J^2 and J_z in terms of matrices.
2. Express the Pauli's spin operators in matrix representation.
3. Prove the theorem $E_g \leq \langle H \rangle$ and find the ground state energy for the one-dimensional harmonic oscillator.
4. Find the general solution of Schrodinger equation in classical region using WKB approximation.
5. Find the allowed energy levels in potential well with two vertical walls using WKB approximation.
6. Prove that: a) $[S¿¿x, S_y]=i\hbar S_z¿$ and $\sigma_j \sigma_k = \delta_{jk} + i \sum_l \epsilon_{jkl} \sigma_l$.
7. An electron is in spin state $\chi = A \begin{pmatrix} 3i \\ 4 \end{pmatrix}$:
   a) Determine the normalization constant A. b) Find the expectation values of S_x, S_y and S_z.

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HCT - 2.2: Electrodynamics

Question Bank

Unit-I: Electrostatics and Magnetostatics:
4 Marks Questions.

1. A long cylinder carries a surface charge density that is proportional to the distance from the axis: $\rho = \sigma k$ for some constant k. Find the electric field inside the cylinder.
2. Find the vector potential of an infinite solenoid with n turns per unit length, radius R and current I.
3. State and explain the Biot-Savart law.
4. Write a short note on Dirac delta function.
5. Deduce an expression for differential form of Ampere's law.

8 Marks Questions.

1. State and explain Gauss's law in differential form and deduce an expression for the Poisson and Laplace's equations.
2. Find the electric field inside a sphere which carries a charge density proportional to the distance from the origin, for some $\rho = \sigma k$constant k.
3. Write a note on method of images and multipole expansion in electrostatic field.
4. A electric dipole consists of two equal and opposite charges ($+q$) separated by distance d. Find the approximate potential at points far from the dipole.
5. Derive an expression for Ampere's law and Differential form of Ampere's law.
6. Explain in brief the boundary condition in electrostatics and magnetostatics.
7. Discuss in detail uniqueness theorems and method of images.
8. Deduce vector potential and explain in brief magnetic field of a localized current distribution.
9. Find the magnetic field at the center of a square loop, which carries a steady current I. Let R be the distance from center to side.
10. Use of Gauss's law to find the electric field inside and outside a spherical shell of radius R, which carries a uniform surface charge density σ.

Unit-II: Time varying fields and Energy, force, momentum relations:

4 Marks Questions.

1. Write a short note on Maxwell's equations.
2. An infinitely long straight wire carries a slowly varying current *I(t).* Determine the induced electric field, as a function of the distance s from the wire.
3. Derive an expression Poynting's theorem.
4. Elaborate on the concept of Displacement current.
5. Derive an expression for energy stored magnetic field.

8 Marks Questions.

1. Derive an expression for energy stored in electric and magnetic field.
2. How the Maxwell corrected Ampere's law? What is the physical significance of displacement current?
3. Derive an expression Poynting's theorem.
4. Give full account of Maxwell's equations in matter.
5. Give brief account of magnetic interaction of two current loops.
6. Define and explain electromotive force. What is the Faraday"s law of electromagnetic induction and Lenz"s law?
7. Give an energy relation in quasi-stationary current systems,
8. Derive the general expression for electromagnetic energy.
9. A long coaxial cable carries current *I* (the current flows through down the surface of inner cylinder, radius *a*, and back along the outer cylinder, radius *b*). find the magnetic energy stored in a section of length *l.*
10. Discuss in detail scalar and vector potentials.

Unit-III: Electromagnetic wave equations:
4 Marks Questions.

1. Discuss in detail Lorentz's gauges.
2. Discuss in detail Coulomb's gauges.
3. Discuss in detail Skin effect and skin depth.
4. Express the electromagnetic wave equations in D' Almbertian Operator.
5. Discuss the case of oblique incidence of electromagnetic wave at boundaries.

8 Marks Questions.

1. What are the Gauge transformations? Explain the (a) Coulomb Gauge and (b) Lorentz Gauge.
2. Explain in brief the reflection and refraction of electromagnetic waves at plane boundaries.

3. Explain electromagnetic wave equations. Deduce an expression for electromagnetic plane waves in conducting medium.
4. Derive an expression for coefficient of Reflection (R) and Transmission (T).
5. Calculate the coefficient of reflection (R) at the interface for pair of media having refractive indices n_1 = 1.50 and n_2 = 1.33.
6. Explain electromagnetic wave equations. Deduce an expression for electromagnetic plane waves in stationary medium.
7. Write a note on wave equations in terms of electromagnetic potentials? What is D'Alembertian operator?
8. Discuss the case of Normal and oblique incidence of electromagnetic wave at boundaries.

Unit IV: Radiation emission:
4 Marks Questions.

1. Explain Larmor's formula.
2. Write a short note on electric dipole radiation.
3. Explain in detail the radiation from a half wave antenna.
4. Write a short note on angular distribution of radiation.
5. Write a short note on magnetic dipole radiation.

8 Marks Questions.

1. Explain in detail the concept of radiation damping.
2. Write a note on electric dipole, electric quadrupole and magnetic dipole radiation.
3. Deduce an expression for Lienard-Wiechert potentials of a point charge.
4. Explain in the radiation by a moving charge and derive Larmor's formula.
5. Deduce an expression for Larmor's formula and write a note on angular distribution of radiation.
6. Explain in brief the radiation by a moving charge.
7. Explain angular distribution of radiation. and gives a short note on fields and radiation of a localized oscillating source.

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OET 2.1 Fundamental of Electronics

Question Bank

Each question having four marks.

1) A certain soldering iron has a resistance of 600 ohms when operated from a 230 volts power line. How much current does it take from the power line?
2) Calculate the energy used (in kWh) to run twelve 150 W light bulb for ten hours?
3) State and Explain Thevenin's theorem?
4) State and explain Kirchhoff 'current law?
5) Discuss briefly the Kirchhoff's voltage law?
6) Define the term i) Cycle ii) time period
7) Explain the difference phase and phase term?
8) What is meant by intrinsic semiconductor?
9) Explain what is Hole in Brief?
10) What is PN junction Diode? Explain it?
11) What are the important application of diode?
12) What id ideal diode and real diode?
13) What is Zener diode? Draw circuit diagram?
14) Define the term Common mode rejection ratio?
15) What is differential amplifier? Can be used in single ended input configuration?
16) Describe the block diagram of op-amp?
17) What is voltage Follower?
18) Explain switching action of a transistor?
19) Draw the switching waveform for the astable multivibrator?
20) Explain operation of an astable multivibrator?

Each question having eight marks

1) What is nonsinusoidal oscillator? Explain it briefly?
2) Draw a circuit of astable multivibrator and explain its working?
3) Sketch a transistor Schmitt trigger circuit and briefly explain its operation giving input output waveform?
4) Draw an internal operational circuit of timer IC 555?
5) Explain the operation of a bisatble multivibrator?
6) Distinguish between a bistable and monostable multivibrator?
7) Discuss the principle of transistors bistable multivibrator?
8) What is multivibrator? Explain the difference between the three types of multivibrators?
9) Explain in details of switching action of a transistor?
10) What is essential difference between direct current and altering current?
11) State and explain the three version of ohms's law relating voltage, current and resistance?
12) Briefly define each of the following, giving its unit and symbol: Charge, Potential, Potential difference, Current resistance and Conductance?

13) What is maximum power transfer theorem? Show that power lost in the internal resistance of a source is equal to the power delivered to the load the power efficiency is only 50%?
14) Explain briefly the following;
    i) Linear resistor ii) Non-linear resistor
15) What is capacitor? Give its three application?
16) Write a short note on a variable capacitor?
17) What is difference between an ideal current source and a practical current source?
18) Draw V-I characteristics of a junction diode when it's a) forward biased b) reverse biased
19) Briefly explain (without derivation) the behaviour of junction in forward bias and reverse bias mode and draw its volt-ampere characteristics?
20) What is PN junction diode? How its terminal are identified?
21) In What respect is an LED different from an ordinary PN junction diode? State application of LEDs.
22) Explain with the help of neat diagrams, the structure of a N-channel FET, and its volt-ampere characteristic. In what way it is different from a bipolar junction transistors?
23) Distinguish between FET and BJT?
24) Describe some of the characteristics of a practical op-amp?
25) What is voltage followers? Describe its main characteristics?
26) Explain in details of instrumentation amplifier?
27) Distinguish between operation amplifier and Instrumentation Amplifier?
28) Explain in details ideal characteristics of op-amp?
29) Explain comparator Schmitt trigger wave generator (Square wave and Triangular wave)?
30) Discuss the term in details of DC and AC characteristics of op-amp?
31) Define the term a) LED b) Solar Cell c) Photodiode
32) Explain in details first order low pass and high pass filter?
33) Discuss V to I and I to V converter precision rectifier?
34) Explain the effect of temperature on the volt-ampere characteristic of diode?
35) Draw a block diagram of IC 555 and explain in details?
36) Explain the application of network laws to simple dc network?
37) Distinguish between monostable and astable multivibrators?
38) **Why the Reset pin of IC 555 is normally connected to Vcc, and why the control voltage (pin 5) of 555 timers is connected to ground through a 0.01 µf capacitor?**
39) **Explain in details p-n junction with terms of unbiased and biased junctions?**
40) **How PN junction diode is working? Draw and explain V-I characteristic of PN diode with neat diagram?**

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SCT 2.1 Statistical Physics

Question Bank

04 marks

1) Distinguish between different ensembles.
2) Distinguish between 1^{st} and 2^{nd} order phase transitions.
3) Explain the concept of microstates and macro states.
4) Explain the concept of statistical equilibrium.
5) What is an ensemble? Explain the concept of Canonical Ensemble.
6) Write Liouville's theorem in classical mechanics
7) Write a note on a PV diagram.
8) Write a note on grand canonical ensembles.
9) Explain the P.T. curve.
10) what is phase equilibrium.
11) Write a note on the canonical ensemble and state its partition function.
12) Write a note on the laws of thermodynamics.
13) What are the thermodynamic systems and equilibria?
14) Explain the Nearst's heat theorem.
15) Explain the concept of equipriori probability.
16) Explain the concept of microstates.
17) Explain the law of corresponding states.
18) Explain Gibbs's free energy.
19) Explain phase space and quantum state.
20) State and explain the third law of thermodynamics.

08 marks

1) How the paradoxical situation arises when we mix the samples of the same gas.
2) Explain the second-order phase transition.
3) Derive Ehrenfest equation for second-order phase transition.
4) Show that during the first-order phase transition, Gibb's function is continuous, but the first derivative of Gibb's function changes discontinuously.
5) Explain the canonical ensemble. Obtain an expression for canonical distribution.
6) Write a note on microcanonical, canonical and grand canonical ensembles
7) Write laws of thermodynamics and their consequences.
8) Explain the Second latent heat equation.
9) Show that during the second-order phase transition.
$$(\partial^2 G_1/\partial T^2) \neq (\partial^2 G_2/\partial T^2)$$
10) Explain the first-order phase transition.

11) Derive Clausius Clapeyron equation.
12) Give the condition for B E condensation.
13) Derive Ehrenfest equations.
14) What is the Gibbs paradox and how it is resolved?
15) Give the condition for ideal Bose gas.
16) By using the Vander Waals equation at reduced states calculate the values of critical constants.
17) Show that the average energy of a single particle of ideal fermi is 3/5 times the Fermi energy of the system.
18) Explain strongly degenerate fermi gas.
19) Explain weakly degenerate fermi gas.
20) Express elliptical motion of 1D harmonic oscillator in phase space.
21) Write about MB statistics.
22) Write about BE statistics.
23) Write about FD statistics.
24) Write about classical ideal gas.
25) Obtain Plank's law for black body radiation.
26) Connection between free energy and themodynamical quantities.
27) Write a note on black body radiations.
28) Write about thermodynamical potentials.
29) Write about Maxwell's relations.
30) Write about the paradoxical situation given by Gibbs.

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HCT - 4.2: Nuclear and Particle Physics

Question Bank

UNIT I PROPERTIS OF NUCLEAR FORCES

Each question having four marks.

1) Write a note on radioactive dating.
2) Explain binding energy curve.
3) Explain nuclear stability.
4) Explain nuclear composition.
5) Explain Beta decay with an example.

Each question having eight marks

1) Discuss two nucleon system with potential.
2) Discuss properties of nuclear forces.
3) Write a note on radioactivity and explain their types in grate details.
4) Explain p-p interaction at different energies.
5) Discuss meson theory of nuclear interaction.
6) An ${}_{8}O^{16}$ nucleus is spherical and has charge radius R and volume $V=4/3\pi R^3$, according to empirical observation of the charge radii, the volume of the ${}_{54}Xe^{128}$ nucleus assume to be spherical.
7) In deep inelastic scattering electron are scattered off proton to determine if a proton has any internal structure, how much will be the energy of the electron.
8) What should be the minimum K.E of the electron to probe the size of ${}_{20}Ca^{40}$ nucleus.

UNIT II NUCLEAR MODELS

Each question having four marks.

1) Describe prolate and oblate structure of nucleus with stigmatic diagram with Q value condition.
2) Write a semi-empirical mass formula.
3) What is Spin orbit interaction?
4) Explain superconductivity model of nucleus.
5) Explain magic numbers, what is the significance of it.

Each question having eight marks

1) Explain in grate details liquid drop model.

2) Discuss extreme single particle shell model.
3) Write a note on Collective nuclear model.
4) Derive an expression for bethe-Weizsacker formula.

UNIT III NUCLEAR REACTIONS

Each question having four marks.

1) Describe conservation lows.
2) Nuclear reaction with heavy ions.
3) Give the few examples of transmutation of α particles.
4) Describe nuclear fission reaction.
5) Describe nuclear fusion reaction.

Each question having eight marks

1) Discuss types of nuclear reactions.
2) Determine the scattering cross-section of n-p interaction.
3) Discuss nuclear transmutation reactions with examples
4) Derive an expression for breit-wigner dispersion formula.
5) Discuss in detail fusion and fission reaction, with examples.

UNIT IV PARTICLE PHYSICS AND COSMIC RAYS

Each question having four marks.

1) Write a working principle of cyclotron.
2) Write a note on neutrino.
3) Explain four fundamental forces and there properties.
4) Discuss origin of cosmic rays.
5) Discuss conservation laws of particle physics.
6) Explain origin of secondary rays.

Each question having eight marks

1) Draw the tree diagram of classification of elementary particles.
2) Explain quantum chromo dynamics.
3) With the net libelled diagram explain working principle and construction of cyclotron.
4) Check conservation of lepton number of the following reactions?
    1. $P \rightarrow \pi^0 + e^- + e^+$
    2. $N \rightarrow P + e^- + \nu_e$
    3. $K+ \rightarrow \mu^+ + \nu_\mu$

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HCT 4.1 Semiconductor Devices

Question Bank

Unit 1

1) Write a note on CMOS devices. 4

2) Write a note on charge trapping in MOSFET. 4

3) Show schematic of P- channel depletion MOSFET and explain in brief. 4

4) What is the effect of work function difference on threshold voltage of MOSFET? 4

5) Show schematic of N- channel enhancement MOSFET and explain in brief. 4

6) Explain MS structure with band diagram. Explain current flow mechanism in MS junction. 8

7) Explain MOS structure. Draw necessary band diagram. Obtain voltage relationship of MOS structure. 8

8) Explain Depletion type MOSFET. What is the effect of gate voltage on drain current? Obtain an expression of drain current. 8

9) Explain in detail about the MIS capacitances. 8

10) Explain Enhancement type MOSFET. What is the effect of gate voltage on drain current? Obtain an expression of drain current. 8

11) Explain in detail about the MOSFETS capacitances. 8

12) Discuss the quantitative analyses of I-V characteristics in P-channel and N-channel depletion and enhancement mode MOSFETs. 8

Unit 2

1) Discuss in brief various methods of triggering pnpn device. 4

2) Write a note on di/dt protection. 4

3) Write a note on dv/dt protection. 4

4) Write a note on reverse conducting thyristor. 4

5) Write a note on Programmable UJT. 4

6) Write in detail about LASCR and FETSCR. 8

7) Explain working principle of SCR and its IV characteristics. 8

8) Draw and explain IV characteristics of SCR Explain two transistor model of SCR. 8

9) Discuss with suitable diagrams the IV characteristics of the DIAC and TRIAC. 8

10) Explain in detail about the construction and working of DIACs and TRIACs. 8

11) What are the power diodes and power transistors? Explain their working principles. 8

12) Write the principle and working of programmable unijunction transistors using suitable diagram. 8

13) What are static induction thyristors? Discuss the Thyrister circuit that delivers variable power to a load. 8

Unit 3

1) Write a note on two phases CCD. 4

2) Write a note on dynamic effect in CCD. 4

3) Explain about the transistors and quenched diodes. 4

4) Write a note on NDR device. 4

5) Explain various steps of formation and transfer of domain in Gunn diode? 4

6) Describe the basic structure of Charge Coupled Devices and its dynamic effect. 8

7) How the performance of CCD is improved. 8

8) What are the transferred electron devices? Discuss in detail the periodic oscillating behavior of n GaAs Gunn diode. 8

9) What is Gunn effect? Explain two valley model of Gunn diode. 8

10) Explain GaAs Gun Oscillator modes in terms of

a) space charge accumulation, b) Quenched domain mode, c) Delayed domain mode. 8

11) With the help of neat diagrams explain build up and drift of space charge domain in GaAs. 8

12) Write in detail about the frequency responses and overall performance of Gunn devices. 8

Unit 4

1) Write a note on radiative and non-radiative transitions. 4

2) Write a note on Heterostructures Laser. 4

3) Draw block diagram, doping profile, electric field distribution in p-i-n diode. 4

4) Draw the band gap and wavelength scales and show the band gaps of some common semiconductors relative to the optical spectrum. 4

5) Write a note on absorption in semiconductor. 4

6) What is luminescence? Compare fluoresce and phosphorescence. 4

7) What is Luminescence? Give different types of luminescence. Discuss in detail the process of light emission in LED. 8

8) What is Luminescence? Give different types of luminescence. Explain IR and Visible LED. 8

9) Explain the conditions of absorption of light by semiconductor and discuss non radiative transitions. 8

10) What is Laser diode? Discuss the mechanism of stimulated emission of light in GaAs laser diode. 8

11) Explain the operating principle of photodiode based on p n junctions, pin configuration and multilayer heterojunction. Sketch the relative band diagrams and IV characteristics. 8

12) What is solar cell? Discuss IV characteristics of solar cell. Derive an expression for open circuit voltage and short circuit current. 8

13) What is solar cell? Discuss IV characteristics of solar cell. Derive an expression for quantum efficiency of solar cell. 8

14) What is the Quantum well hetero structures? Explain in detail about the effect of temperature

on them. 8

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HCT 4.3 Microwave Devices & Circuits

Question Bank

4 Mark questions

1) Distinguish between unpolarised EM wave and elliptically polarised wave.
2) Draw a labelled diagram of reflex klystron.
3) For TE mode propagation write the wave equation and boundary condition for circular wave guide.
4) Draw the geometry of dielectric phase shifter.
5) Explain the mode of propagation in strip type transmission line.
6) State the boundary conditions on E and B fields at interface between two media.
7) Draw the diagram showing the structure of two cavity klystron.
8) Write note on coaxial line.
9) Explain the different types of terminations of a transmission line.
10) Draw diagram of wave guide matched termination.
11) Explain the use of microwave for moisture content measurement.
12) Draw a labelled diagram of reflex klystron.
13) For TE mode propagation write the wave equation and boundary condition for circular wave guide.
14) Draw the geometry of wave guide adjustable short.
15) Explain the origin of negative mobility of electron in Gunn diode.
16) Write note on microwave heating.
17) Draw voltage current curve for Gunn diode and indicate its negative resistance.
18) Write note on circular guide.
19) Write note on coaxial line to rectangular wave guide transition.
20) Write note on matched load for wave guide.
21) Explain the principle of microwave oven.
22) Draw the circuit diagram of Gunn oscillator.
23) Explain the mode of propagation in strp type transmission line.
24) Describe the geometry of variable attenuator in wave guide form.
25) Sketch the different band in microwave spectrum.
26) Explain negative differential mobility in Gunn diode.
27) Write note on coaxial transmission line.
28) Write note on coaxial line to rectangular wave guide transition.
29) Draw diagram of adjustable short for a wave guide.
30) Specify the various Microwave freq. bands commonly.
31) What are the three characteristics that differentiate Microwave from Low frequency?
32) Draw the diagram of electromagnetic spectrum (with freq. range and corresponding free space wavelength)

33) Mention various applications of microwave.
    a) A 500 MHX E.M. wave is propagating through a perfect nonmagnetic dielectric having $\in R = 6$ Calculate the wavelength and the phase constant.
34) Write Maxwell's equations in integral form and write equation in differential form.
35) Write short notes on Stripline Attenuators.
36) Complete reflex klystron and TWT.
37) Discuss the planar transmission lines.
38) What are the striplines? Explain.
39) Explain the Gunn Effect.
40) Write a note on standard mismatches.
41) If $\xi_x = \sqrt{2}\, Eo^+ \cos(\omega t - \beta z)$ and $H_y = \sqrt{2}\, Ho^+ \cos(\omega t - \beta z)$, sketch E.M. wave describing above equation.
42) Describe in brief fixed (resistive - card) attenuator in rectangular waveguide.
43) Expalin in brief variable phase shifter which employs change in the effective's dielectric constant of the insulating region within guide.
44) Write note on two-wire transmission line.
45) Mention important properties of high-field domain.
46) If we assume individual waves and their vector phasors for x-component as $\sqrt{3}\, E_O$ and for y-component as E_O determine the resultant wave.
47) Calculate phase constant (β) and cut-off wavelength λ_C for rectangular waveguide.
48) What is the condition of oscillation in a Reflex Klystron
49) What are Gunn domains and how are they formed?
50) Sketch the different bonds in Microwave Spectrum.
51) Draw the geometry of waveguide adjustable short.
52) What is the use of standard mismatches? Draw equivalent circuit
53) What is the use of **flanges** and explain any one type offset.
54) Sketch the type N-Connector, which used for connector with the help of dimension explain Type N-connectors,
    Which used for connector with the help of dimension explain SMA-connector
    Which used for connector with the help of dimension explain APC-connector
55) The wavelength of e.m. in a dielectric medium operator than free space.
56) If a plane wave with a frequency of 3 GHz is propagating in an unbounded material with $\in_r = 7$ and $\mu_r = 3$. Calculate the wavelength, phase velocity, and wave impendance for this wave.
57) What are the three characteristics that differentiate microwave engineering from its L.F. and optical counterparts.
58) Write Maxwells equations in differential form.
59) What are three steps involved in general for solving waveguide problems.
60) What is the requirement of separation between cavities of two cavity klystron?/What are two types of microwave.
61) Explain the mode of propagation in strip type transmission line.
62) Distinguish between unpolarised E.M. wave and circularly/elliptically polarised wave.
63) Sketch the diagram of dual reflex cavity klystron.
64) Write a note on Coaxial line? Explain the mode of propagation strip type transmission line?

65) Draw the geometry of waveguide adjustable short? Variable attenuator in waveguide form.
66) Specify three important characteristics that differentiate microwave engineering from low frequency.
67) Differentiate between lumped and distributed circuits.
68) What is the advantage of microwave freq in point to point communication?
69) Obtain a wave equation for E and B in second order form?
70) Write four Maxwells equation in integral form and differential form.
71) Describe an E.M. wave in terms of phasor quantities at Z=0, Z=$\frac{\lambda}{4}$, Z=$\frac{\lambda}{2}$, Z=$\frac{3\lambda}{4}$, Z=λ
72) Calculate characteristic impedance (Zo) velocity of propagation in case of coaxial lines?
73) Prove for symmetrical strip transmission, (stripline) Zo = $\frac{1}{\vartheta c 1}$
74) Explain the magnetic and electric fields lines associated with TE_{10} mode.
75) Describe matched tee attenuator with its equivalent circuit?

8 Mark questions

1) Derive the wave equation with the help of Maxwell's equations.
2) With heat diagram, explain the construction and working of waveguide phase shifters.
3) A transmission line has the fallowing parameters. R = 2 Ω/m, G = 0.5mho/m, f=1 GHz, L= 8 nH/m, C = 0.23
   a) Calculate the characteristic impedance
   b) The propagation constant
4) Describe the possible domain modes for the Gunn oscillation mode?
5) List the applications of Microwave
6) Using parallel plate capacitor arrangement, explain how electric field is developed in dielectrics.
7) Specify boundary conditions for Electric and Magnetic fields
8) Explain the block diagram microwave oven.
9) A TRAPATT has the following secifications:
   Doping concentration = $2.5 \times 10^{10}/Cm^3$
   Current density = 33 KA/Cm^3
   Calculate the avalanche zone velocity
10) An IMPATT diode has the drift length of 2 μm. Determine the operating frequency of the diode of the drift velocity for Si is 10^7 cms/sec
11) Write the Maxwell's equation on differential form and derive the first-two Maxwell's equations.
12) Write note on circular waveguide.
13) Gunn diode as microwave oscillator
14) Wave propagation in perfect insulator
15) Strip type transmission lines

16) Matched loads
17) Stripline phase shifter
18) Standard coaxial connections
19) Dielectric beed supports

10 Mark questions

1) Describe the various types of waveguides with necessary equations.
2) Derive the equations for losses in coaxial lines
3) Derive the TE mode field equations in a rectangular waveguide
4) With necessary diagram, explain the construction and working of a reflex klystron.
5) Discuss the various coaxial and stripline components
6) With neat diagram , explain the construction and working of waveguide attenuators
7) With neat sketch, explain the working of phase shifters
8) A coaxial line has the following characteristics at 1000 MHz; R= 40 Ohms/m; L = 450 nH/m; G= 7×10^{-4} mho/m; C'= 50 PF/m; calculate Z0, and α.
9) Describe the development of rectangular waveguide form a parallel plate transmission line
10) Explain the construction and working of the rotary vane attenuator.
11) A rectangular waveguide has dimensions 2.5 × 5 cms. Determine the guide wavelength, phase constant β, and phase velocity at a wavelength of 4.5 Cms for the dominant mode.
12) Obtain Helmholtz wave equation for electric and magnetic field in a lossless medium.
13) For a uniform transmission line with circuit representation line being cascade of identical section, obtain phasor form of V, I which will describe forward and reverse voltage waves on the line.
14) For a coaxial line using high frequency inductance and capacitance values obtain characteristic impedance and attenuation per unit length. Explain how voltage breakdown can be avoided.
15) Explain with the help of geometry, type N connector and APC -7 connector.
16) Explain the construction and operation of a two-cavity klystron
17) Explain instantaneous field components for the TE_{10} modes for a rectangular waveguide using transverse field components of TE-modes for +Z directed wave.
18) Obtain the boundary conditions at the surface and define surface impedance.
19) Explain with cross sectional view symmetrical strip transmission line and obtain expression for Z0 and attenuation constant
20) Explain the construction and operation of reflex klystron
21) Explain rotatory phase shifter (with vector phasor representation) to obtain output to be phase delayed additionally by 2θ
22) Explain the construction and working of a waveguide phase shifter

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M. Sc.-II, Sem-VI, Physics (Applied Electronics)

SCT 4.1 Microcontrollers & Interfacing

Question Bank

4 MARKS

1. Explain PSW in 8051
2. Explain 8051 family variants
3. Explain Port 0 structure
4. Explain MOV instruction
5. Explain Direct addressing mode
6. Explain indirect addressing mode
7. Explain DA instruction
8. Explain PUSH & POP instructions
9. Explain stack operations in 8051
10. Explain PC,SP& DPTR
11. Short note on Keil IDE
12. Explain data types in Embedded C
13. Explain Embedded C general programming structure
14. Explain DJNZ instruction
15. Explain JB & JNB
16. Explain SJMP
17. Write a ASM programme to add two 16 bit numbers
18. Write ASM programme to set all bits of PORT1 to HIGH and LOW
19. Explain RR &RL instruction in 8051
20. Explain OR, XOR instruction in 8051

8 MARKS

1. Explain Timer register and modes in details
2. Write ASM programme to generate square wave on port 2 ON time 20ms and OFF time 100 ms using timer
3. Explain Serial communication registers in 8051
4. Write ASM programme to send string “PAHSUS” serially to PC from 8051
5. Interface LCD 16x2 to 8051 and Write ASM programme to display message “Electronics” on Line no. 1 and start position 3.

6. Interface LED to 8051 and write ASM programme to display running led pattern using RL instruction
7. Interface Two switches to 8051 port P1.5 and P1.6 and control the LED ON and OFF action
8. Explain loops and control statements in Embedded C
9. Explain Array and Pointers in Embedded C
10. Interface ADC 0804 to 8051 and write Embedded C programme to take data from ADC and send it to PORT 1
11. Interface DAC 0808 to 8051 and Write Embedded C programme to generate sin wave
12. Interface DC motor using L293D to 8051 and write Embedded C programme to run motor clock wise for 10sec, stop for 5sec and Anti-clock wise for 15sec
13. Interface relay and switch to 8051 and Write ASM programming to control relay action based on switch
14. Interface LM35 using ADC0804 and write the Embedded C programme to get data from ADC convert in temperature in degree C and send it serially to PC using serial communication
15. Write Embedded C programme for the counter to measure 100Hz square wave
16. Explain Interrupts and related register in 8051
17. Explain data serialization in 8051 using ASM or Embedded C
18. Explain Data Conversation in Embedded C
19. Interface stepper motor using ULN2003 and write Embedded C programme to run stepper motor Clock wise, Stop and anti-clock wise
20. Interface Servo motor to 8051 and write Embedded C programme to move stepper motor +90, neutral and -90
21. Interface LCD 16X2 in 4bit mode and Write Embedded C programme to display message “Applied” on line 1 and “Electronics” on line 2