PG/IIIS/PHS-304/11

M.Sc. 3rd Semester Examination, 2011

PHYSICS

Full Marks : 40

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

Special Paper : (*Analog Elec.*)

PAPER – PHS - 304A

[*Marks* : 20]

Answer **Q. No. 1** and any **one** from the rest

1. Answer any *five* bits : 2 x 5

(*a*) Explain how a phase locked loop can be used as FM demodulator.

(*b*) Draw the circuit diagram of a simple instrumentation amplifier using one op-amp and mention its demerits.

(*c*) Explain the advantages of bridge amplifiers over single stage amplifiers.

(*d*) Why regulated power supply is necessary for electronic instruments like public address system ?

(*e*) Explain how an analog multiplier can be used as an analog phase detector.

(*f*) Explain how a band reject filter can be designed using a given low pass filter and a high pass filter. What is the necessary condition ?

(*g*) Draw the circuit diagram of a voltage controlled oscillator.

2. (*a*) Draw and explain the circuit diagram of a logarithmic amplifier using matched pair of transistor and derive the expression for the output voltage in terms of input voltage. 5

(*b*) Draw the circuit diagram of a 2nd order low pass Butterworth filter and derive the expression for the transfer function as a function of frequency. 1 + 4

3. (*a*) Draw the circuit diagram of a triangular wave generator using op-amps and explain its circuit operation with proper diagram of output voltages. Derive an expression for the frequency of oscillation. 5

(*b*) Explain the operation of a switching regulator and state the merits of it over series regulators. 5

Special Paper : (*Digital Elec.*)

PAPER – PHS - 304B

[*Marks* : 20]

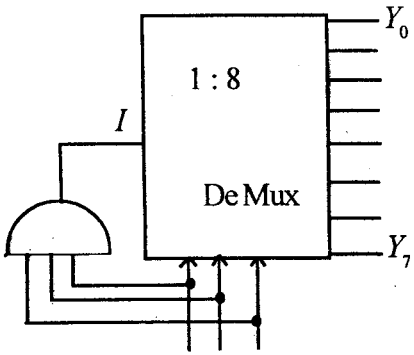
Answer **Q. No. 1** and any **one** from the rest

1. Answer any *five* bits : 2 x 5

(*a*) Design a C-MOS transmission gate.

(*b*) Define 'figure of merit, and compare it for TTL and ECL gates.

(*c*) What will be the outputs for different selectors ?



(*d*) Solve $Y = A\overline{B} + \overline{A}B$ by FPLA circuit.

(*e*) Differentiate SRAM from DRAM.

(*f*) State the principle of optical memory.

2. (*a*) Describe the operation of 4 phase dynamic shift register. 4

(*b*) Give the circuit diagram of DRAM unit cell. How it is advantageous over SRAM unit cell ? 2 + 1

(*c*) What do you mean by MBM ? Mention two distinct differences of MBM from CCD. 2 + 1

3. (*a*) Design a two input TTL NOR gate or three input ECL OR/NOR gate. 3

(*b*) Explain the operation of three input NMOS NAND gate with proper circuit diagram. 3

(*c*) State different uses of multiplexer circuit. 2

(*d*) Show how TTL gate works as current source and current sink. 2

Special Paper : (*Solid State*)

PAPER – PHS - 304

[*Full Marks* : 40]

Answer **Q. No. 1** and any **three** from the rest

1. Answer any *five* bits : 2 x 5

(*a*) What is screw dislocation ?

(*b*) Find the bandwidth in a bcc crystal along [111] direction according to Tight Binding Approximation.

(*c*) Explain how dislocation increases plasticity in a solid.

(*d*) Find the shortest burger vector corresponding to stable dislocation in a FCC crystal.

(*e*) What are the essential conditions of a material to be ferroeletric ?

(*f*) Show the variation of mobility for a non-degenerate semiconductor in the low temperature region.

(*g*) Prove that thermal entropy change in a perfect crystal is zero.

(*h*) What is Polariton ?

2. (*a*) Derive the energy dispersion relation for an electron in a solid according to nearly free electron approximation. 8

(*b*) Show that energy discontinuity occurs at zone boundary. 2

3. (*a*) Derive the LST relation assuming phonon-photon interaction in an ionic crystal. 8

(*b*) What is Mott's Metal-Insulator transition ? 2

4. (*a*) Discuss in details the Landau theory of phase transition for $BaTiO_3$ crystal. 6

   (*b*) What is meant by Polarization Catastrophe ? 2

   (*c*) What is meant by dielectric relaxation ? 2

5. Derive the Landau levels in case of metal placed in a magnetic field at low temperature. 10

6. Derive Boltzmann transport equation and hence find an expression for conductivity in a non-degenerate semiconductor. 10