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M.Sc. I

ELECTRONIC SCIENCE

ELIUT01: Foundation of Semiconductor Devices
(2008 Pattern) (Semester - I)

Time : 3 Hours] [Max. Marks : 80

Instructions to the candidates:
1) All questions are compulsory.
2) Figures to the right side indicate full marks.
3) Draw neat diagrams wherever necessary.
4) Use of non-programmable calculator is allowed.

Q1) Attempt any two of the following: [2 × 8 = 16]

a) What is ambipolar transport? Derive the ambipolar transport equation. State application of it.

b) What is distribution function? Explain Fermi-Dirac probability function at absolute zero and higher temperature.

c) Explain low frequency small signal two port equivalent circuit of BJT.

Q2) Attempt any two of the following: [2 × 8 = 16]

a) Define the following terms:
   i) lattice
   ii) basis
   iii) primitive vector.

   For a bcc lattice of identical atoms with a lattice constant of 5A. Calculate maximum packing fraction and radius of atom. Assume atoms are hard spheres with nearest neighbours touching.

b) Explain principle of LED with energy level diagram. Why specific materials are used in LED?

c) Explain depletion mode and enhancement mode of MOSFETS. Show diagrametically $I_D$-$V_{DS}$ relationship for n-channel depletion mode MOSFET.

P.T.O.
Q3) Attempt any four of the following: [4 × 4 = 16]

a) Define Miller indices of crystal planes. What are its applications?

b) Describe concept of excess carrier generation and recombination rate across a semiconductor.

c) Explain concept of buit in potential
   i) under zero bias
   ii) forward bias and
   iii) reversed bias

d) Explain construction and energy level diagram of HBT. What are its special feature over BJT?

e) Explain the operation of MOS capacitor with suitable diagram.

Q4) Attempt any four of the following: [4 × 4 = 16]

a) Explain the position of Fermi-level in extrinsic semiconductor. Draw energy band diagram with suitable equations.

b) Explain zener effect and avalanche effect in a reverse-biased pn junction.

c) Explain SCR structure, obtain relationship for switching action of SCR using two-transistor equivalent model.

d) Following are transistor parameters

\[ I_E = 1\text{mA}, \beta = 100, C_{jc} = 1 \text{PF}, \text{total emitter to collector time delay } \tau_{ec} = 103.9 \text{PS at } T = 300 \text{ k} \]

Find:
   i) emitter resistance \( r_e \)
   ii) cut off frequency \( f_r \)
   iii) beta cutoff frequency \( f_\beta \)

Given \( K = 8.62 \times 10^{-5} \text{ ev/k.} \)

e) Describe internal pinch off voltage and pinch off voltage of JFET, Give suitable mathematical relationships.
Q5) Attempt any four of the following: \[4 \times 4 = 16\]

a) Calculate first three energy levels of an electron in an infinite depth potential well of width 6A.

Given \( h = 1.054 \times 10^{-34} \text{ JS.} \)

\( m_e = 9.11 \times 10^{-31} \text{ kg.} \)

b) Explain concept of effective mass.

c) Draw and explain I-V characteristic of a pn junction diode - obtain expression for ideal - diode equation of pn junction.

d) Explain Eber-moll model for BJT with equivalent circuit diagram.

e) Explain small-signal equivalent circuit for MOSFET amplifier. Obtain drain current relationship with \( V_{gs} \).
M.Sc.

ELECTRONIC SCIENCE

EL1 UT0 2: Analog Circuit Design and Analysis
(2008 Pattern) (Semester - I)

Time : 3 Hours

Instructions to the candidates:
1) All questions are compulsory.
2) Figure to the right indicate full marks.
3) Draw neat diagrams wherever necessary.
4) Use of log table/non-programmable calculator is allowed.

Q1) Solve any Two:

a) Obtain the inverse Laplace transformation for the given function

\[ F(S) = \frac{s + 5}{s(s^2 + 2s + 5)}. \]  [8]

b) Draw the block diagram of operational amplifier and explain function of each block in brief.  [8]

c) i) What is two port network? Explain what are its hybrid parameters. [4]

Q2) Solve any Two:

ii) Explain supply independent biasing. How it is achieved?  [4]

b) i) Obtain Laplace transform of following functions  [4]

1) \( f(t) = e^{-at} \)

2) \( f(t) = \cos wt \)
ii) Draw pole - zero diagram of a network function

\[ F(s) = \frac{4(s + 2)s}{(s + 1)(s + 3)} \]

c) i) Explain following characteristics of operational amplifier

1) Input bias current
2) CMRR
3) Differential and common mode input resistance.

ii) Explain series RLC circuit in brief.

**Q3** Solve any TWO:

a) Explain the working of a two op-amp practical log amplifier circuit. Obtain necessary equation. Explain temperature compensation technique. [8]

b) i) With proper circuit diagram, explain R-2R Ladder in brief. [4]

ii) A 4-bit D/A convertor of type R-2R ladder has digital inputs 1010 and 1110. If \( V_{\text{ref}} = 5V \), \( R_F = 1K\Omega \), \( R = 5K\Omega \), Find output voltage for given digital inputs. [4]

c) i) What is peak detector? With circuit diagram explain peak detector using op-amp. [4]


**Q4** Solve any TWO:

a) Explain the shielding and guarding techniques used in op-amp circuit design. [8]

b) What is an active filter? State advantage of active filters over passive filters. Design 2\textsuperscript{nd} order low pass filter for cut of frequency 1KHz and pass band gain 5. [8]

c) Explain \( \Sigma \) to \( \Delta \) converter in brief. [8]
Q5) Solve any Four:

a) Explain in brief the output current boosting technique for a general purpose OPAMP with proper circuit diagram. [4]

b) State applications of ADC’s and DAC’s. [4]

c) What is programmable OPAMP? Which of its parameters can be programmed? How? [4]

d) Explain with block diagram the working of successive approximation ADC. [4]

e) Draw the practical integrator circuit diagram and explain practical design considerations of it. [4]
M.Sc.

ELECTRONIC SCIENCE

EL1UT03 : Instrumentation and Measurement Techniques
(2008 Pattern) (Semester - I)

Time : 3 Hours] [Max. Marks : 80

Instructions to the candidates:
1) All questions are compulsory.
2) All questions carry equal marks.
3) Draw neat labeled diagrams wherever necessary.
4) Use of logarithmic table and non-programmable calculator is allowed.

Q1) a) Answer any two of the following [2 x 6 = 12]

i) Give the types of measurement systems. Describe any one type with suitable example.

ii) What is static calibration? Give steps considered in performing static calibration.

iii) Describe selection criteria of transducer for the measurement of given physical parameter. List the factors influencing the choice of transducer.

b) Define the following [4]

i) Resolution

ii) Precision

iii) Hysteresis and

iv) Threshold.

Q2) a) Answer any two of the following [2 x 6 = 12]

i) What is loading effect? Explain voltmeter and Ammeter loading effect with suitable example.
ii) Describe the generalized mathematical model of measurement system. Give operational transfer function of measurement system.

iii) Explain zero-order instrument with suitable example.

b) State the advantages and limitations of potentiometric transducer. [4]

**Q3** a) Answer any two of the following [2 x 6 = 12]

i) State different techniques used in flow measurement. Write working principle of:
   1) Hot wire anemometer and
   2) Ultrasonic flow meter.

ii) State different methods (gages) used for vacuum measurement. Explain working principle of thermal conductivity gage.

iii) Give different methods of data transmission. Explain with block diagram of general telemetry system. State different types of telemetry systems.

b) What is wave analyzer? Define the following terms - [4]

i) VSWR

ii) ISWR and

iii) SWR

**Q4** Answer any four of the following: [4 x 4 = 16]

a) Draw neat block diagram of basic strip chart recorder, explain different moving mechanisms used in it.

b) Draw the following OPAMP circuits and write their output equations.

i) Trans impedance amplifier

ii) Voltage follower with gain

iii) Zero crossing detector and

iv) Differential amplifier.
c) A 6.25 mm long RTO with a steady gain of 0.3925°C and a time constant of 5.5 sec experiences a step change of 75°C in temperature. Before temperature change it has a stable 100Ω resistance. Write the time domain equation for resistance and find its value after 15 sec of the application of step input.

d) Define absolute and relative error of measurement. A voltage has a true value of 7.5V. An analog instrument with scale range of 0-10V gives reading of 7.35V. What is the value of absolute error and correction? Express the error as a fraction of true value and FSD.

e) Draw the neat block diagram of DFM. Explain frequency measurement mode in detail.

f) Describe different methods used in magnetic recording. State their advantages.

Q5) Answer any four of the following:  
\[ 4 \times 4 = 16 \]

a) Describe DC signal conditioning system with neat block diagram.

b) State different methods for measurement of unknown force. Explain the force measurement using bonded strain gage.

c) List the temperature transducers. Explain thermocouple temperature transducer. State advantages of it.

d) An amplifier is used to measure the output of LVDT whose gain is 250. The LVDT o/p is 2 mV when the core moves through a distance of 0.5mm. Calculate the sensitivity of LVDT and that of the whole setup.

The millivoltmeter scale has 100 divisions, the scale can be read to \( \frac{1}{5} \th \) of a division. Calculate the resolution of the instrument in mm.

e) Explain FDM and TDM methods of telemetry. State advantages of them.

f) Describe advantages of digital indicating instruments over analog type.
M.Sc. (Electronic Science)
EL2 - UT04: APPLIED ELECTROMAGNETICS, RF & MICROWAVE
(2008 Pattern) (Semester - II)

Time : 3 Hours

Instructions to the candidates:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat diagrams wherever necessary.
4) Use of log tables/non-programmable calculator is allowed.

Q1) Attempt any two of the following: [2 × 8 = 16]

a) Obtain the expression for reflection coefficient for a uniform plane wave incident normally on the plane between two dielectrics. Hence find the transmission coefficient ‘T’.

b) Draw the elementary section of a transmission line and obtain the transmission line equations in voltage form and current form.

c) Explain the structure and working of a tunnel diode with suitable energy band diagrams. Draw the I-V characteristics of the tunnel diode and explain the nature of characteristics.

Q2) Attempt any two of the following [2 × 8 = 16]

a) Describe, with proper diagrams, different methods of excitations of TE and TM modes in rectangular waveguides.

b) Starting with Maxwell’s equation, obtain the expression for poynting theorem in frequency domain.

c) A lossy dielectric has intrinsic impedance of 100∠60° at a certain frequency ω. If the magnetic field component is

\[ \vec{H} = 10e^{-ax} \cos \left( wt - \frac{1}{2} x \right) \hat{\lambda} \frac{A}{m} \], Find \[ \vec{E}, \alpha \].

P.T.O.
**Q3)** Answer any four of the following: [4 × 4 = 16]

a) With a neat diagram explain the working of a reflex Klystron.

b) Find the radiation resistance of a Hertzian dipole antenna if its length is
\[ dl = \frac{\lambda}{10}. \]

c) Write a short note on patch antenna.

d) How can an antenna be used to measure distant temperature?

e) A certain Ga As MESFET has the following parameters: \( g_m = 50 \) mmho
\( C_{gs} = 0.50 \) pF.

Determine its cutoff frequency.

**Q4)** Answer any four of the following: [4 × 4 = 16]

a) What is single stub matching? What is the procedure to do single stub matching?

b) Describe the steps used in fabrication of MMIC.

c) What do you mean by skin depth? Show that skin depth is
\[ \delta = \frac{2}{\sqrt{\omega \mu \sigma}}. \]

d) If \( \gamma = j \omega \mu (\sigma + j \omega \varepsilon) \) and \( \gamma = \alpha + j \beta, \)

Find the expression for \( \alpha \) and \( \beta. \)

e) A plane - wave in a non-magnetic medium has \( \beta = 2. \) Find its \( \omega \) and \( \lambda. \)
Q5) Answer any four of the following: [4 × 4 = 16]

a) An airfilled rectangular waveguide has dimensions 8 × 4 cm, and operates in dominant TE_{10} mode. Its cutoff frequency is 2.5 GHz. Find the phase velocity of the wave in the guide at a frequency of 4 GHz.

b) Describe the process for determination of characteristic impedance of a given transmission line.

c) What are cavity resonators? What is Q of a cavity? How can it be determined?

d) A loss less transmission line has inductance per unit length of 1μH/m and capacitance per unit length of 10PF/m. Find its characteristic impedance.

e) A transmission line has reflection coefficient of 0.35∠–15° Find the standing wave ratio.

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M.Sc.

ELECTRONIC SCIENCE

EL2 UT-0 5: Communication Electronics
(2008 Pattern) (Semester - II)

Time : 3 Hours

Instructions to the candidates:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat diagrams wherever necessary.

Q1) Answer any four of the following [4 × 4 = 16]

a) With the help of diagram, explain the working of FM generation using Varactor diode.

b) Draw the structure of HDLC. Explain each field of it in short.

c) Explain the terms selectivity of the receiver and image frequency in short.

d) Write short note on error detection and error correction.

e) What is wide band amplifier? Describe any two applications of it.

f) What is noise figure? Explain its importance in communication system.

Q2) Answer any TWO of the following: [2 × 8 = 16]

a) What is pulse code modulation (PCM)? Draw the block diagram of it and explain its working.

b) What is time division multiplexing? With the help of neat block diagram, explain its working. Write its advantages and disadvantages.

c) Draw the circuit diagram of balanced modulator. Write its working. Draw and explain the graphical characteristics of it.

P.T.O.
Q3) Write any four of the following:  

[4 x 4 = 16]

a) List the transmission media. With the help of diagram, explain any one of them.

b) Explain the sampling theorem and write the importance of it in communication.

c) Describe internal and external noise in short.

d) With the help of diagram, explain the working of RF tuned amplifier.

e) Explain the role of limiter in FM receivers.

f) With the help of block diagram, write the working of frequency shift keying. (FSK)

Q4) Answer any TWO of the following:  

[2 x 8 = 16]

a) What is delta modulation? With the help of neat diagram, explain the working of adaptive delta modulation. Write the advantages of adaptive over delta modulation.

b) Draw the architecture of ISDN. Explain the function of each block/component in short. Describe any one application of ISDN in detail.

c) Draw the block diagram of high level amplitude modulation transmitter. Explain the working of each block in short.

Q5) Attempt any four of the following:  

[4 x 4 = 16]

a) Describe typical data communication link with special reference to DTE and DCE.

b) Explain the local loop of land line telephone in short.

c) With the help of diagram, explain the working of collector neutralisation.

d) Write the mathematical analysis of amplitude modulator. Write any two advantages of FM over AM.

e) With reference to bluetooth technology, explain the terms piconet and scatternet in short.
EL2 - UT0 6 : Digital System Design Using VHDL
(2008 Pattern) (Semester - II)

Time: 3 Hours

Instructions to candidates:

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Neat diagrams must be drawn wherever necessary.

Q1) Attempt any two of the following:

a) What is procedure in VHDL? Write Syntax for defining a procedure. Write a procedure to add two 4-bit numbers and a carry and returns 4-bit sum and a carry. [8]

b) Explain different types of ROM with special reference to data storage principle of any one. [8]

c) Design an automobile alarm system that detects status of door, the ignition, the seat belts, the head lights. An alarm should be switched ‘ON’ when

i) If the head lights are ON while ignition is off.

ii) The door is open while ignition is ON.

iii) The seat belts are not fastened when ignition ON.

Q2) Attempt any two of the following:

a) i) Compare a signal and a variable in VHDL with reference to their declaration, assignment, scope and behaviour. [4]

ii) Write a VHDL code for full adder using behavioral modelling. [4]
b) A combinational circuit is defined by

\[ F_1 = \Sigma m(3,5,7) \]

\[ F_2 = \Sigma m(4,5,7) \]

Implement the circuit with PLA having 3 inputs, three product terms and two outputs.

c) Design a synchronous counter to generate the following sequence 0,2,4,5,0......... using T-flip-flops.

Give all steps involved in design and draw the final hardware diagram.

**Q3** Attempt any two of the following

a) Explain in detail different classes of VHDL operators. Which operators have highest precedence?

If A = “110”, B = “111”, and C = “011000” then write a result of the following statements.

i) \(((A \text{ and (not B)}) \text{ OR (C ROR 2)})\)

ii) A Srl 3

b) Explain with block diagram CPLD, also explain with diagram typical macrocell of CPLD.

c) Write down VHDL code for ALU having four arithmetic and four logical operations.

**Q4** Attempt any two of the following:

a) Draw the circuit diagram of bipolar static RAM cell. Draw timing diagram of read cycle of static RAM. Define memory access time and complete read cycle time of RAM.

b) What do you mean by parity? Design an even parity generating circuit for three bit data using k-map. Write VHDL code for even parity generator for seven bit data.
c) What is FSM? What are types of FSM? Write VHDL code using FSM for decade up counter. [8]

Q5) Attempt any two of the following

a) Design a four bit parallel adder using full adders. Explain look ahead carry generator. [8]

b) i) Write a VHDL code for full adder. [4]

ii) Write a VHDL code for four bit parallel adder using module defined in (i) as a component. [4]

c) Write a VHDL code for four-bit binary up/down counter using process. [8]
Instructions to the candidates:

1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Draw neat diagrams wherever necessary.

Q1) Attempt any four of the following. [4 x 4 = 16]

a) Write an assembly/C program to rotate stepper motor clockwise contiously. (For 8051).

b) Explain program states word (PSW) of 8051.

c) Draw an interfacing of DC motor to 8051. Write an assembly/C program to rotate it clockwise and anticlock wise with some delay before change of direction.

d) Explain timer 0 for PIC micro controller. Write delay function in C to generate 1 sec. delay.

e) Write short note on programmer as hardware development tool.

Q2) Attempt any FOUR of the following: [4 x 4 = 16]

a) Explain TMOD register of 8051.

b) Explain serial communication in 8051.

c) Explain logic analyzer and general purpose evaluation boards.

d) Explain port registers of PIC microcontroller.

e) Write an assembly ‘C’ program for AVR.

Micro controller to generate RAMP wave using DAC.
Q3) Attempt any two of the following: \[2 \times 8 = 16\]

a) Explain with neat schematic diagram, 8051 target board. List the components used in designing target board.

b) Draw an inter facing of 4 \times 4 matrix keyboard to 8051. Write a procedure to read a key.

c) Explain with neat diagram architecture of AVR microcontroller.

Q4) Attempt any Four of the following: \[4 \times 4 = 16\]

a) Explain interrupts in AVR microcontroller.

b) Write an assembly/‘C’ program for PIC microcontroller to generate sequence wave on a pin of PORTB.

c) Write an assembly/‘C’ program for AVR microcontroller to convert ASCII digits ‘4’ and ‘7’ to packed BCD and display it an PORTB.

d) Write an assembly/‘C’ program that contioniously gets 8-bit data from PO and send it to P1, While simultaneously generating 5KHz square wave of 50% duty cycle on pin P2.1. Assume XTAL = 11.0592 MHz.

e) Explain -Linker and compiler.

Q5) Attempt any TWO of the following: \[2 \times 8 = 16\]

a) Explain with example addressing modes of 8051.

b) Write an assembly/‘C’ program to display “M.Sc.” on first line of LCD. (For PIC microcontroller).

c) Write short note on

i) I2C

ii) SPI

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M.Sc. (Electronic Science)
EL4UT - 06 : CONTROL SYSTEMS THEORY AND APPLICATION (2008 Pattern) (Semester - IV)

Time : 3 Hours]  [Max. Marks : 80

Instructions to the candidates:
1) All questions are compulsory.
2) Figures to the right indicates full marks.
3) Use of non-programmable calculator is allowed.

Q1) Solve any TWO  [2 × 8 = 16]
   a) Giving a neat diagram explain feedback control system. Discuss each block function in detail.
   b) What is block diagram? How it can be used for the analysis of control system? Explain any four rules of block diagram reduction.
   c) Explain frequency response method of control system analysis.

Q2) Solve any TWO  [2 × 8 = 16]
   a) What is PLC processor scanning? Explain the program sweep for series go-30 PLC.
   b) What is meant by PID control mode? How it can be implemented using opamp. List the applications of PID control.
   c) Draw the block diagram of PLC architecture and explain each block of PLC. Why isolation is used to input and output blocks?

Q3) Solve any Four  [4 × 4 = 16]
   a) For \( G(s) = \frac{K}{s(s + 4)} \), test a point \( s = -2 + j5 \) for its existence on root locus and find the value of K.
   b) Evaluate the stability of control system having following characteristics equation
   \( s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0 \)

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c) Write a short note on annuciator.
d) Explain the operation of synchro-servo motor.
e) What is meant by quarter amplitude criterion? Discuss in short.

Q4) Solve any Four \[4 \times 4 = 16\]
a) Explain the working of ON-OFF controller using LM 35 temperature sensor.
b) Justify “Traffic signal system is open loop system”.
c) Explain the terms control log and dead time in process control application.
d) State the advantages and disadvantages of Nyquist plot method.
e) Draw a ladder diagram to realize two input EX-OR Gate.

Q5) Solve any Four \[4 \times 4 = 16\]
a) Compare Continuous Control and discrete state control with suitable example.
b) Explain the nature of bodeplot for
i) Poles at origin
ii) Simple Pole and
iii) Simple zero
c) An integral controller is used for speed control with a set point 12 rpm with range of 10 to 15 rpm. Initial controller output is 22%. The constant \(K_i = -0.15\%\) Controller output per second per percentage error. If speed jumps to 13.5 rpm, calculate the controller. Output after \(z\) seconds for constant \(e_p\) where \(K_i\) is integral gain and \(e_p\) is error.
d) Describe OFF_delay timer instruction of PLC.
e) Write a short note on solenoid.