Total No. of Questions : 5] **[Total No. of Pages : 2**

P903

[3929] - 101

M.Sc. (Sem. - I)

ELECTRONIC SCIENCE

EL1 UT01 : Foundation of Semiconductor Devices

(New 2008 Pattern)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Draw neat diagrams wherever necessary.***
3) ***Use of non-programmable calculator is allowed.***

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

a) What is distribution function? Explain Fermi Dirac probability function. Discuss it for Fermi energy and its dependance on temperature.

b) Explain with diagram reverse biased diode characteristics. with I-V characteristics and energy band diagram, explain zener breakdown effect.

c) Mathematically discuss position of Fermi level for n-type and p-type semiconductor. Comment on variation of E_F with doping concentration and temperature.

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

a) State the advantages of using equivalent circuit models for BJT analysis. Explain in detail hybrid P_i model for it.

b) List frequency limitation factors in MOSFET. Obtain relation for cut off frequency in ideal case.

c) Explain how field effect transistors can be built with rectifying metal semiconductor gates. Discuss its types and applications in detail.

Q3) Attempt any four of the following : **[4 × 4 = 16]**

a) Discuss imperfection and impurities in solids.

b) What is effective mass? State its importance in semiconductor.

c) Write short note on C-V characteristics of a p-n junction diode.

d) Differentiate between HBT and BJT.

e) Explain low frequency and high frequency small signal equivalent circuit for MOSFET. Discuss ac response from it.

P.T.O.

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

a) Discuss the concept of unit cell in crystal structure. State its advantage.

b) In a bipolar transistor biased in the forward active region the base current is $i_B = 8.0\ \mu A$ and the collector current is $880\ \mu A$. Determine α, β, and i_E.

c) An electron has a kinetic energy of 20 MeV. Determine the de Broglie wavelength.

d) Explain the effect of narrow channel on the working of MOSFET.

e) Explain Eber Moll model for BJT. How it is used to define equations for I_E and I_C with transistor circuit analysis in SPICE program.

Q5) Attempt any four of the following : **[4 × 4 = 16]**

a) Write an equation to estimate energy levels of an electron in an infinite potential well. Calculate first three energy states of an electron in an infinite potential well of width $10A^o$.

Given : $\hbar = 1.054 \times 10^{-34}$

$m = 9.11 \times 10^{-31}$kg

b) From thermal equilibrium energy band diagram for n-type and p-type semiconductor, explain the concept of Quasi Fermi energy levels.

c) Discuss internal quantum efficiency of LED. How it is maximized?

d) Write short note on modern FET structure with respect to small dimension effect.

e) Explain with diagram working of SCR. with the help of I-V characteristics define various switching terms related to SCR.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P903

[3929] - 101
M.Sc. (Sem. - I)
ELECTRONIC SCIENCE
EL1 UT01 : Principles of Semiconductor Devices
(Old)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

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

Q1) Attempt any two : **[2 × 8 = 16]**

a) What is the importance of pure crystal in semiconductor technology? List various methods used in growth of semiconductor material. Explain any one in detail.

b) What is Hall effect? Obtain relations for Hall voltage, hole mobility and electron mobility.

c) Describe internal pinch-off voltage and pinch-off voltage with appropriate diagrams, mathematical equations in case of JFET.

Q2) Attempt any two : **[2 × 8 = 16]**

a) Explain the concept of wave-particle duality with the help of suitable example. Discuss with the help of appropriate diagram in detail.

b) Discuss reverse bias generation current in p-n diode. Obtain the relation for ideal total reverse bias current density.

c) What is CMOS technology? With the help of neat diagram describe operation of CMOS inverter integrated circuit.

Q3) Attempt any four : **[4 × 4 = 16]**

a) The uncertainty in position of an electron is 12A^{o}. Determine the minimum uncertainty in momentum and corresponding uncertainty in kinetic energy.

b) What is the meaning of Fermi-Dirac probability function.

c) Discuss turn-off transient response in a p-n junction.

d) Differentiate between depletion mode MOSFET and enhancement mode MOSFET.

e) What are LASER diodes? How do they differ from LED's?

P.T.O.

Q4) Attempt any four : **[4 × 4 = 16]**

a) Describe the procedure for finding the volume density of atoms in a crystal.

b) Assuming Boltzmann approximation obtain relation for n_o, p_o in terms of fermi energy.

c) State the boundary conditions for minority carrier concentrations at the edge of the space charge region.

d) Define transconductance for JFET. State its significance.

e) Discuss the operation of photo transistor.

Q5) Attempt any four : **[4 × 4 = 16]**

a) Write a short note on binary and ternary compounds.

b) What is effective mass? Explain in short.

c) How linearly graded junction is formed in semiconductor?

d) State advantages of HEMT over MESFET.

e) What is optical absorption? Define photon absorption coefficient.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P904

[3929] - 102

M.Sc. (Sem. - I)

ELECTRONIC SCIENCE

EL1-UT02 : Analog Circuit Design and Analysis

(New Course) (2008 Pattern)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Use of log table/non-programmable calculator is allowed.***

Q1) Solve <u>any two</u> :

a) i) What is meant by transfer function? Define poles and zeroes of such a function. Explain their significance. **[6]**

ii) Fast op-amp operation means high output current comment. **[2]**

b) i) What is a two-port network? Explain what are its transmission and admittance parameters. **[4]**

ii) Design an inverting amplifier with a gain of –20. It must have an input impedance of 10kΩ. If 741 op-amp is used estimate offset error of the circuit. For IC 741, Ib^{-} = 80 nA, Vio = 2 mV. **[4]**

c) i) Define Laplace transform. Explain any two theorems regarding Laplace transform. **[4]**

ii) What are equalisers? Explain shunt equaliser. **[4]**

Q2) Solve <u>any two</u> :

a) Explain large signal time response characteristics of an op-amp. **[8]**

b) i) Explain the effect of negative feedback on amplifier parameters. **[4]**

ii) Design a second order butterworth low-pass filter for cutoff frequency of 4 kHz. **[4]**

c) i) What is supply independent biasing? How is it achieved? **[4]**

ii) What is an ideal current source? Explain the working of Widlar current source. What is its advantage? **[4]**

P.T.O.

Q3) Solve any two :

a) Explain how a transistor can be used as a logging device? Draw the diode and transdiode configurations for log amplifiers. Obtain their output equations and compare their performance. **[8]**

b) i) What are practical difficulties in use of op-amp differentiator circuit? What are its applications? **[4]**

ii) Explain the causes of instability in op-amp amplifier circuits. What is meant by the term frequency compensation. **[4]**

c) Explain device mismatch effects in differential amplifiers. **[8]**

Q4) Solve any two :

a) i) What makes an op-amp programmable? Which of its parameters can be programmed? How? Give applications of such an op-amp. **[4]**

ii) Explain shielding and guarding techniques used in op-amp circuits. For what applications they are necessary. **[4]**

b) When is it required to boost output voltage and current of a general purpose op-amp? Explain the working of one circuit each for this purpose.What precautions must be taken while using voltage boosting circuit? **[8]**

c) i) Show how you would use a single op-amp to generate the relationship $e_0 = -\int_0^t (e_1 + 3e_2 + 6e_3)dt$

Find component values if the integrating capacitor has a value of 1μf. Assume ideal op-amp. **[4]**

ii) Draw the circuit diagram of input stage of op-amp 741. Explain its working. **[4]**

Q5) Solve any four :

a) Compare the performance of different types of A/D converters. **[4]**

b) Explain the working of weighted capacitor DAC. **[4]**

c) Explain the need of following functions in a Σ - Δ ADC. **[4]**

i) Over sampling

ii) Decimation.

d) Explain bandgap voltage reference circuit. **[4]**

e) Explain pipeline ADC architecture. What is its advantage? **[4]**

f) Using 741 op-amps design an audio amplifier with a gain of 60 dB. Sketch its magnitude plot. **[4]**

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Total No. of Questions : 5] **[Total No. of Pages : 3**

P904

[3929] - 102

M.Sc.

ELECTRONIC SCIENCE

EL1-UT02 : Analog Circuits : Design and Analysis

(Old Course) (Sem. - I)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

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

Q1) Solve any four of the following :

a) Giving a flowchart explain circuit level design process. **[4]**

b) Explain high frequency ac model of a diode. **[4]**

c) Explain the working of fixed shift and variable shift clamper circuits using diode. **[4]**

d) Describe hybrid-π model of a BJT. **[4]**

e) Draw the circuit diagram and explain the working of an op-amp summing amplifier for three input signals. Obtain the equation for output. **[4]**

Q2) Solve any two of the following :

a) Give the circuit diagram, dc and ac equivalent circuits for an emitter follower circuit. Obtain expression for its input resistance, output resistance and no load voltage gain. **[8]**

b) i) What is an ideal current source? Explain the working of Widlar current source. **[4]**

ii) Design a Wein-bridge oscillator circuit using op-amp for frequency of 1 KHz. **[4]**

P.T.O.

c) Explain the following characteristics of op-amp. **[8]**
   - Differential and common mode input resistance.
   - Input bias current and input offset current.
   - Open-loop frequency response.
   - CMRR.
   - Full power bandwidth.

Q3) Solve <u>any two</u> of the following :

a) i) Explain how to estimate lower cutoff frequency f_1 and overall gain for a three stage RC-coupled amplifier. **[4]**

ii) Explain how to find lower cutoff frequency of a common-base BJT amplifier. **[4]**

b) i) Explain following biasing schemes for a JFET.
   - Self and fixed bias – Self bias **[4]**

ii) Discuss the following frequency compensation technique
   - Addition of a dominant pole. **[4]**

c) i) Discuss the effect of negative series and shunt voltage feedback on input and output impedance of an amplifier. Give suitable examples of op-amp circuits. **[4]**

ii) Derive an expression for output of an op-amp subtractor circuit. State expressions for its differential and common mode input resistance. **[4]**

Q4) Solve <u>any two</u> of the following :

a) What is an active filter? What is the order of a filter? State advantages of active filters over passive filters. Design a 2^d order high pass filter for a cutoff frequency of 10 kHz and pass-band gain of 3. **[8]**

b) i) Explain the concept of switched capacitor resistor. What are advantages and limitations of switched capacitor filters? **[4]**

ii) Explain the design of an inductance simulator circuit using op-amp. **[4]**

c) i) How does a wideband amplifier differ from a tuned amplifier? Explain application areas for the two types. What is meant by transient response of a wideband amplifier? **[4]**

ii) Explain interstage coupling methods used in multistage tuned amplifiers. **[4]**

Q5) Solve any two of the following :

a) What is neutralisation in tuned amplifiers? Discuss the problem of instability in tuned amplifiers. State the condition for predicting such instability. **[8]**

b) i) Explain low frequency compensation of wideband amplifier. **[4]**

ii) In case of single stage transistor amplifier gain-bandwidth product is usually not a useful parameter. Comment why and explain with necessary graph. **[4]**

c) i) The slew rate of a unity gain op-amp is SR = 0.5 V/μsec. The input frequency is f_s = 100 kHz. Calculate the maximum possible sinusoidal input voltage V_s (max). **[2]**

ii) Define the terms gains margin and phase-margin. **[2]**

iii) What are the frequency ranges in which RC and LC oscillators are commonly used? Derive an expression for frequency of oscillation for phase-shift oscillator. **[4]**

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Total No. of Questions : 5] [Total No. of Pages : 4

P905

[3929] - 103
M.Sc. (Sem. - I)
ELECTRONIC SCIENCE
EL1UT03 : Instrumentation and Measurement Techniques
(2008 Pattern) (New)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***All questions carries equal marks.***
3) ***Draw neat labeled diagram wherever necessary.***
4) ***Use of logarithmic table and non-programmable calculator is allowed.***

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

a) State different static and dynamic characteristics of measurement instrumentation system. Explain any one of each with suitable example.

b) Describe loading effect due to shunt connected and series connected instrument. Give suitable examples to support your answer.

c) Explain the phenomenon of Hysteresis in measurement systems. Explain the terms threshold. Dead zone and Back lash.

d) Define limiting errors write the expression for relative limiting error. Three resistors of 250Ω, 500Ω and 375Ω with fractional errors of + 0.025, – 0.036 and + 0.014 respectively are connected in parallel. Determine the total resistance neglecting error, total resistance considering errors and fractional error of the total resistance based on the rated values.

e) Calculate the time constant of a first order mercury in glass thermometer. Inside diameter of the bulb is 4 mm, assuming the bulb to be spherical density of mercury is 13600 kg/m^3, specific heat is 0.15 kJ/kg°C and the heat transfer coefficient is 40 W/m^2-°C. If the thermometer bulb had been cylindrical in shape having the same volume and diameter as the spherical bulb. What would be the time constant

   i) neglecting both the end area of the cylinder.

   ii) accounting for one end area.

P.T.O.

Q2) Answer <u>any four</u> of the following : **[4 × 4 = 16]**

a) With constructional details explain the working principle of thermal conductivity gage used for low pressure measurement.

b) Give classification of transducer according to :

   i) The transduction principle.

   ii) Requirement of excitation for their operation.

   iii) The type of energy conversion.

   iv) Type of output signal conversion

   write at least two examples of each type.

c) With circuit diagram, derive an expression for transfer function of LVDT, when voltmeter with resistance R_m is connected to measure output. State different application of LVDT.

d) List the applications of capacitive transducer. Calculate the capacitance of parallel plate capacitive transducer with plate area 500 mm^2 each and the separation distance is 200 μm. The transducer is used in air. Permitivity of free space = 8.85×10^{-12} f/m calculate the change in capacitance if a linear displacement reduces the distance between the plates to 180 μm. Also calculate the sensitivity.

e) i) Describe semiconductor strain gauge. State the advantages and applications of it.

   ii) Classify pressure transducers and state application of pressure transducers.

Q3) Answer <u>any four</u> of the following : **[4 × 4 = 16]**

a) Give working principle of McLeod gauge used for pressure measurement. For McLeod gauge with capilary of 1 mm diameter and effective bulb volume of 80 cm^3. Find the reading as indicated by mercury column due to pressure of 10 Pa.

b) State the working principle of :

   i) Expansion thermometer.

   ii) Resistance temperature detector.

   iii) Semiconductor resistance sensor (thermistors).

   iv) Radiation pyrometer.

c) A copper constantan thermocouple was found to have a linear calibration between 0° to 500°C with emf at maximum temperature is 40.68 mV with reference junction at 20°C.

   i) Determine the correction, which must be made to indicate emf, if the cold junction temperature is 25°C.

   ii) If the indicated emf is 8.92 mV in the thermocouple circuit, determine the temperature of hot junction.

d) Describe the following flow meters with their construction diagram and applications.

   i) Turbine flow meter.

   ii) Magnetic flow meter.

e) List the vibration sensors. Give working principle of piezoelectric transducer. An LVDT is used in an accelerometer to measure seismic mass displacement. The LVDT and signal conditioning outputs 0.31 mv/mm with ±2 cm maximum core displacement. The spring constant is 240 N/m and the core mass is 0.05 kg. Find

   i) The relation between acceleration in m/s^2 and output voltage.

   ii) The maximum acceleration.

   iii) The natural frequency in Hz.

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

a) With neat circuit diagram explain the working of Buffer amplifier with gain and without gain. State its use in instrumentation system.

b) Describe the working of chopper-stabilized amplifier with circuit block diagram. Give application of it.

c) State different telemetry channels used. Explain wire line channels telemetry with their advantages.

d) With neat block diagram describe PMC telemetry system. State its advantages.

e) Describe the basic strip chart recorder with block diagram. Explain the different stylus mechanism used.

Q5) Answer <u>any four</u> of the following : **[4 × 4 = 16]**

a) Describe the advantages of digital indicating instruments over analog indicating instruments.

b) Draw the block diagram of DFM. State the different modes of measurement with the help of block diagram explain frequency measurement with period trigger and multiple period trigger mode of operation.

c) Give the working principle of Galvanometer type recorder. The coil of recording ammeter is 65 mm long and 25 mm wide. The rated current of the coil is 10 mA. The flut density in the air gap is 4.6×10^{-3} wb/m^2 and the damping constant is 8×10^{-3} N-m/rarS^{-1}. The moment of inevtia is 8×10^{-3} kg-m^2 and spring constant is 16×10^{-3} N-m/rad and the coulomb friction is 0.2×10^{-6} N-m.

   i) Determine if the meter is underdamped, critically damped or over damped.

   ii) Determine the current required to over come coulomb friction.

d) Describe the basic components of tape recorder. State the advantages of magnetic tape recorders.

e) Derive the expression of first order thermal system. A temperature sensing device can be modelled as a first order system with a time constant of 6 sec. It is suddenly subject to a step input of 25°C to 150°C. What temperature will be indicated in 10 sec after the process has started.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P905

[3929] - 103
M.Sc. (Sem. - I)
ELECTRONIC SCIENCE
EL1 UOT01 : Network Analysis and Synthesis
(2005 Pattern) (Old)

Time : 3 Hours] ***[Max. Marks :80***

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 non-programmable calculator is allowed.***

Q1) Solve any Four. **[4 × 4 = 16]**

a) Find the Laplace transformation for

i) Unit Ramp function ii) Cosine wave

b) Define the following terms

i) Graph ii) linear graph iii) tree

c) Write synthesis of RC driving point impedance. List the properties of RC driving point impedance.

d) Design a band elimination filter having a design impedance of 600Ω and cutoff frequencies $F_1 = 2$ kHz and $F_2 = 6$ kHz.

e) Compare constant K-filter and m-derived filters. Write the advantages of m-filter over constant K-filter.

Q2) Solve any Four : **[4 × 4 = 16]**

a) A system oscillates with frequency 2 rad/sec. Find values of 'k-marginal' and 'p' number of poles in R.H.S.$G(S) = K(s + 1) / (s^3 + ps^2 + 2s + 1)$.

b) Assume $L_1 = 1H$, $L_2 = 2H$, $M = 1.2H$ and inductance coils to be ideal of isolation transformer. Find the amount of energy stored after 0.1sec of the circuit connected to a DC source of 10V.

c) Design an 'm' derived high pass filter with a cutoff frequency, 10 kHz, design impedance of 1000Ω and m = 0.4.

d) A system oscillates with frequency 4 rad/sec. Find values of 'K-marginal' and 'p' number of poles in R.H.S.

$G(s) = K(s + 1) / (s^3 + ps^2 + 2s + 1)$

e) Explain Star-Delta conversion theorem with the help of suitable example.

P.T.O.

Q3) Solve any Four : **[4 × 4 = 16]**

a) What is Equalizer? Explain series equalizer in short.

b) Explain Time- variant property of a system. Determine the given system time variant or not. $T[X(n)] = e^{X(n)}$

c) Find the Laplace transformation

i) $X(t) = \cos(t-(2\pi/7))$

ii) $X(t) = (t-3)^2$

d) Explain the linearity property of a system. Determine the following system is time variant or invariant. $Y(n) = X(-n)$

e) What are "Hurwitz polynomial" . Test the following polynomial

$P(s) = s^4 + s^3 + 4s + s^2 + 3$ is Hurwitz.

Q4) Solve any two : **[2 × 8 = 16]**

a) What is positive real function? List the properties of positive real function check $F(s) = (3s^2 + 5) / (s + (s^2 + 1))$ is a positive real.

b) State and prove convolution theorem with the help of suitable example determine inverse Laplace transformation using it.

c) State and prove maximum power transfer theorem for A.C. circuit. Discuss its different possible cases.

Q5) Solve any two : **[2 × 8 = 16]**

a) Find time domain response for transfer function

$Y(S) = 10s / [(s+5+j15)(s+5-j15)]$

b) Give the qualitative sinusoidal steady state analysis of the following:

i) Purely inductive circuit

ii) Purely capacitive circuit

c) A RLC series circuit has $R = 10\Omega$, $L = 0.5H$ and $C = 10\mu F$ connected across a 200V, 50Hz supply. Find

i) Reactance. ii) Impedance.

iii) Current. iv) Phase angle.

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Total No. of Questions : 5] [Total No. of Pages : 2

P905

[3929] - 103
M.Sc. (Sem. - I)
ELECTRONIC SCIENCE
EL1 UOT02 : Optoelectronics
(2005 Pattern) (Old)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

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

[e =1.602 $\times$ 10^{-19} coulomb, h = 6.626 $\times 10^{-34}$ J.s, C = 3 $\times$ 10^{8}m/s]

Q1) Attempt any two : **[2 × 8 = 16]**

a) State different types of light sources. Explain the important characteristics of light sources. State the advantages of LED over other light sources.

b) What is intermodal dispersion? Describe in case of multimode step index fiber and multimode graded index fiber.

c) With an aid of diagram discuss in detail the PIN photodiode with regard to performance and compatibility requirement in photo detection.

Q2) Attempt any two : **[2 × 8 = 16]**

a) With the help of suitable diagram discuss the principles of operation of the injection laser. The longitudinal mode of GaAs injection laser emitting at a wavelength of 0.87nm are separated in frequency by 278 GHz. Determine the length of optical cavity and number of longitudinal modes emitted. (refractive index of GaAs = 3.6).

b) Describe any two methods of manufacturing of optical fiber in short.

c) Define quantum efficiency and responsivity of a photodetector. Derive an expression for the responsivity of an intrinsic photodetector in terms of the quantum efficiency and the wavelength at which quantum efficiency and responsivity are equal.

P.T.O.

Q3) Attempt any two : **[2 × 8 = 16]**

a) When the mean optical power launched into an 8km length of fiber is 120μW, the mean optical power at the fiber output is 3μW. determine

   i) The overall signal attenuation in dB through the fiber (assuming that there are no connectors or splices).

   ii) The signal attenuation per km for the fiber.

   iii) The overall signal attenuation for 10 km optical link using the same fiber with splice at 1 km interval, each giving an attenuation of 1 dB.

   iv) The numerical input-output power ratio in (iii).

b) Given the following measurement were taken for an APD, calculate the multiplication factor for the device. Received optical power at 1.35 μm = 0.2 μw corresponding output photo current = 4.9μA (after avalanche gain). Quantum efficiency at 1.35 μm = 40%.

c) List operating parameters of photodiodes. Which photodiodes are preferred for short distance and long distance application?

Q4) Attempt any two : **[2 × 8 = 16]**

a) State various types of losses involved in optical fiber communication in detail.

b) Discuss with the aid of suitable diagram the cut-back technique used for the measurement of total attenuation in an optical fiber.

c) Briefly outline the principle behind the calorimetric method used for the measurement of absorption loss in optical fiber.

Q5) Attempt any two : **[2 × 8 = 16]**

a) Explain with the help of diagrams the techniques used for measurement of numerical aperture of the fiber.

b) With the aid of diagram outline the principal components of an optical fiber communication system in detail.

c) A step index fiber has an acceptance angle in air of 22° and relative refractive index difference is 3%. Estimate the numerical aperture and the critical angle at the core-cladding interface.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P906

[3929] - 201
M.Sc. - I
ELECTRONIC SCIENCE
EL2 UT04 : Applied Electromagnetics, RF and Microwave
(New) (2008 Pattern) (Sem. - II)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Log-book / Nonprogrammable calculator is allowed.***

Q1) Attempt <u>any two</u> of the following : **[2 × 8 = 16]**

a) For an electromagnetic wave with E polarized and perpendicular to the plane of incidence, show that $R_{\perp} + T_{\perp} = 1$.

b) Starting with Maxwells equations for a plane wave in nonconducting media obtain an expression for intrinsic impedence of a medium. Explain the importance of intrinsic impedence in tree space medium.

c) Explain in detail retarded potentials. Obtain equations for the same.

Q2) Attempt <u>any two</u> of the following : **[2 × 8 = 16]**

a) How antennas are classified? Discuss rectangular, Pyramidal horn antenna with respect to directivity, bandwidth and field pattern.

b) Draw energy band diagram for tunnel diode. With the help of it and I-V characteristics explain the operating principle of tunnel diode.

c) Explain rectangular waveguides as transmission lines. Obtain expression for cutoff frequency for it.

Q3) Attempt <u>any four</u> of the following : **[4 × 4 = 16]**

a) State and prove poynting vector theorem.

b) Write short note on shielding of transmission line.

c) Explain microstrip transmission line. Discuss its field map, line impedence and fringing fraction.

d) Show that the skin depth in case of good conductor is represented by

$$\delta = \sqrt{\frac{2}{\mu\omega\sigma}} \ .$$

e) Explain Gunn diode as microwave device.

P.T.O.

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

a) Show that two equal and opposite travelling waves results in a pure standing wave.

b) Explain optical fiber as rod waveguide.

c) With neat diagram explain Yagi-Uda end fire antenna. How the directivity is more in this type of antenna?

d) A transmission line with characteristic impedence of 75 ohms has a minimum impedence of 40Ω. What is the SWR in dB?

e) A transmitting antenna has an effective height of 6-14 meters, fed with a current of 50 Amp (rms) at a wavelength of 625 meters,

find i) Radiation resistance of an antenna,

ii) Power radiated.

Q5) Attempt any four of the following : **[4 × 4 = 16]**

a) Write a short note on Reflex Klystron.

b) Explain electromagnetic effects in high speed digital system. How they can be minimized?

c) Explain with neat diagram transmitting and receiving antenna. Elaborate the term radiation resistance R_r for the antenna.

d) A 30 m long loss less transmission line with $Z_o = 50\Omega$ operating at 2MHz is terminated with a load $Z_L = 60 + j40\Omega$. If $\mu = 0.60$ on the line, find

i) The reflection coefficient T.

ii) The standing wave ratio S.

e) A rectangular waveguide has a = 3.0 cm, b = 1.5 cm, $\mu = 1$ and $\varepsilon = 2.25$.

Calculate :

i) The cutoff wavelength,

ii) The cutoff frequency for TE_{10}, TE_{20} and TM_{11} modes.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P906

[3929] - 201

M.Sc.

ELECTRONIC SCIENCE

EL2 UT04 : Applied Electromagnetics, RF, Microwave

(2004 Pattern) (Old) (Sem. - II)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Use of non-programmable calculator is allowed.***
3) ***Draw a neat diagram wherever necessary.***

Q1) Solve any two : **[8 Marks Each]**

a) Obtain an expression for Brewster angle. Explain its significance and possible uses.

b) Discuss Smith chart with reference to following points

i) Mathematical formulation.

ii) Important characteristics.

iii) Any two types of applications.

c) Draw I-V characteristics of Gunn diode. With the help of diagram explain how the device can be used as an amplifier.

Q2) Solve any four : **[4 Marks Each]**

a) State Maxwell's equations in both differential and integral form. Explain their association with various laws of physics.

b) What are the different types of losses in microstriplines?

c) Write a short note on Faraday's rotation.

d) With the help of schematic explain Global positioning system.

e) How electromagnetic radiation at microwave frequencies is attenuated using metallic film coatings on glass and plastic substrates.

P.T.O.

Q3) Solve <u>any four</u> : **[4 Marks Each]**

a) What is stub matching? What is meant by single stub matching?

b) What are the basic rules for boundary conditions at the surface between two different materials?

c) Describe the basic materials for MMICs in brief.

d) Explain how a magic tee may be used to couple two transmitters to an antenna.

e) How pulse Doppler radar can be used for weather forecasting?

Q4) Solve <u>any four</u> : **[4 Marks Each]**

a) Explain how antenna is used to measure a distant temperature.

b) Write a short note on magnetic navigation of birds.

c) Determine the phase velocity of an electromagnetic wave propagating in a non-magnetic medium with

i) $\varepsilon_r = 1$ (air) ii) $\varepsilon_r = 12$ (silicon) iii) $\varepsilon_r = 81$ (water).

d) Give the applications of microwave frequencies in its various frequency bands.

e) Define the term SWR of a transmission line. How it is related with reflection coefficient? A transmission line has reflection coefficient $T = 0.377 \angle -42.7°$, calculate VSWR.

Q5) Solve <u>any two</u> : **[8 Marks Each]**

a) Discuss four different termination schemes that can help to eliminate the problem of reflections that exist in improperly terminated lines.

b) Prove that Lorentz Gauge condition can be related to the principles of electromagnetic theory like Coulomb's law, Biot-Sawart's law and principle of conservation of energy.

c) A dipole antenna of length 5 cm is operated at a frequency of 100 MHz with terminal current $I_o = 120$ mA. At time t = 1S, angle $\theta = 45°$ and distance r = 3m.

Find i) E_r ii) E_θ iii) $H\phi$

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P907

[3929] - 202

M.Sc. - I (Sem. - II)

ELECTRONIC SCIENCE

EL2-UT05 : Communication Electronics

(2008 Pattern) (New)

Time : 3 Hours] ***[Max. Marks :80***

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) Explain the terms :

   i) Thermal noise.

   ii) Noise voltage.

b) Draw and explain the working of any one type of AM generation.

c) Explain the working of RF tuned amplifier.

d) Describe any two line coding formats in short.

e) Explain the working of XMODEM in short.

f) Write short note on Infrared data association module.

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

a) With the help of neat diagram, explain the working of delta and adaptive delta modulation.

b) i) Explain the working of digital exchange in short.

   ii) Describe any two applications of ISDN in short.

c) With the help of diagram, explain the working of FSK modulator and demodulator.

P.T.O.

Q3) Write any four of the following : **[4 × 4 = 16]**

a) What is sampling theorem? Mention its importance in digital communication.

b) Determine the image frequency for a standard broadcast band receiver using a 455kHz If and tuned to a station at 620 kHz.

c) Draw the circuit diagram of any one neutralization method and explain its working in short.

d) Explain any one method of error detection in digital communication.

e) With the help of diagram, explain the working of QAM.

Q4) Attempt any two of the following : **[2 × 8 = 16]**

a) i) Describe the utility of time domain and frequency domain in the analysis and design of communication system.

ii) The signal power at the input to an amplifier is 200 μW and the noise power is 2μW. At the output, the signal power is 1W and noise power is 30 mW. Calculate the noise figure of an amplifier.

b) Draw the block diagram of super heterodyne receiver and explain it in detail.

c) i) Explain the working of synchronous stagger tunning in short.

ii) Draw and explain cascade tuned amplifier.

Q5) Write any four of the following : **[4 × 4 = 16]**

a) Draw the block diagram of FM receiver and explain it in short.

b) Write short note on RF integrated circuit amplifier.

c) Describe the data compression techniques.

d) Draw the HDLC basic format and explain the importance of each field in short.

e) Explain the following terms with reference to sattelite communication

i) Up-link ii) Down-link

iii) Cross talk iv) Propagation delay

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Total No. of Questions : 5] [Total No. of Pages : 2

P907

[3929] - 202

M.Sc.

ELECTRONIC SCIENCE

EL2-UT04 : Design and Implementation of Digital Circuits

(Old Course) (2004 Pattern) (Sem. - II)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

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

Q1) Attempt any two : **[16]**

a) Design a circuit for displaying two 2-digit BCD counters one at a time.

b) Design a circuit for half subtracter. How you will implement full-subtracter with two half-subtracters.

c) Consider a digital thermostat in which the measured room temperature is converted to a 8-bit digital number and applied to the A inputs of a comparator. The desired room temperature, entered from a keypad, is stored in a register that is connected to B inputs. If $A<B$, the furnace should be activated to heat the room. The furnace should continue to heat while $A = B$ and shut off when $A > B$. As the room cools off, the furnace should stay off while $A = B$ and turn ON again when $A < B$. Design a circuit using 4-bit magnitude comparator.

Q2) Attempt any two : **[16]**

a) Design a sequence generator using Jk flip-flop, to rotate stepper motor in clockwise and counterclockwise direction use sequence for the output
BA : 11, 10, 00, 01, 11, 10,......with D = 1.
BA : 11, 01, 00, 10, 11, 01, ... with D = 0.

b) Explain, and illustrate on timing diagram terms-setup time, hold time and clock to output delay of a flip-flop.
A D flip-flop has setup time of 4ns, a hold time of 2ns and propagation delay of 10ns. What must be minimum clock period for proper operation of D flip-flop?

P.T.O.

c) Consider a magical vending machine that when given Rs. 3, will output a chocolate after a button has been pressed. The machine can only take Rs. 1 and Rs. 2 coins, and if more than Rs. 3 is input, the remainder must be returned. Design a finite state machine to model this vending machine.

Q3) Attempt <u>any two</u> : **[14]**

a) Give the design of arithmetic and logic circuit of the processor unit. How will you combine logic and arithmetic circuits to form ALU? Illustrate with block diagram.

b) Explain with neat diagram the design of processor unit using scratchpad memory. Give the sequence of micro operations to perform the operation $R_3 = R_1 + R_2$.

c) Realize the following functions using PLA

$F_1 = \Sigma\, m\, (2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$

$F_2 = \Sigma\, m\, (2, 3, 5, 6, 7, 10, 11, 14, 15)$

$F_3 = \Sigma\, m\, (6, 7, 8, 9, 13, 14, 15)$

Q4) Attempt <u>any two</u> : **[16]**

a) What is DRAM? Show with neat diagram cell arrangement in 16×1 DRAM? What is function of $\overline{RAS}$ and $\overline{CAS}$ in DRAM? What do you mean by refreshing of DRAM?

b) Draw function block architecture of FPGA. Explain the method of designing a digital system with FPGA.

c) Explain how data is stored in PROM. PROM devices are referred as OTP ROMS. Comment.

Q5) Attempt <u>any three</u> : **[18]**

a) Write a VHDL code for 2 to 4 decoder using structural style of modeling.

b) Write a VHDL code for 4-bit up-down counter with up/down control using process statement.

c) What is procedure in VHDL? How it is different from function? Write a procedure to add two 4-bit vectors and a carry and returns 4-bit sum and carry.

d) Explain the procedure for compilation and simulation of VHDL code. Explain how hardware is described in VHDL.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P908

[3929] - 203
M.Sc. - I (Sem. - II)
ELECTRONIC SCIENCE
EL2UT06 : Digital System Design Using VHDL
(New Course) (2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the 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 : **[2 × 8 = 16]**

a) Compare procedure and function in VHDL. Write VHDL function bin-gray to convert 4-bit binary number to gray code. Write a call to this function in architecture of your VHDL code.

b) What is entity and architecture in VHDL? Write VHDL code for 8:1 multiplexer using process statement.

c) List different operaters in VHDL. Write VHDL code for halfadder using process statement. Write VHDL code for full adder using halfadder from above code as a component.

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

i) Design 4 line to 2 line priority encoder.

ii) Design bcd adder to add two bcd digits using 4-bit parallel adders.

iii) Design bank token display & system to display 2 digit token number using multiplexed display.

b) Attempt any one of the following : **[1 × 4 = 4]**

i) Write VHDL code for bcd to seven sequent decoder using data flow style of modeling.

ii) Design 4-bit adder / subtractor circuit using full adders.

P.T.O.

Q3) Attempt <u>any two</u> of the following : **[2 × 8 = 16]**

a) Design sequence generator to generate 3, 6, c, g and repeat using D flip-flops.

b) Explain with neat diagram 3-bit up/down asynchronous counter.

c) Write VHDL code for chocklet vending machine.

Q4) Attempt <u>any two</u> of the following : **[2 × 6 = 12]**

a) Explain with neat diagram bus organization for 4 processor registers.

b) What is programmable logic array? Draw block diagram of PLA. Implement $F_1(A, B, C) = A\overline{B} + AC$

$F_2(A, B, C) = AC + BC$

using PLA.

c) Explain with neat diagram one stage of logic circuit for OR, XOR, AND, NOT operations.

Q5) Attempt <u>any two</u> of the following : **[2 × 8 = 16]**

a) With neat diagram explain architecture of typical FPGA. Compare FPGA and CPLD.

b) Draw diagram of basic SRAM memory cell. Draw memory write timing diagram. Show write cycle time, address setup time, data setup time in timing diagram.

c) Explain how data is stored in EPROM, EEPROM. What is flash memory? Write applications of ROM.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P908

[3929] - 203

M.Sc. (Sem. - II)

ELECTRONIC SCIENCE

Communication Electronics (Old)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

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

Q1) Solve <u>any four</u> : **[4 × 4 = 16]**

a) Give the block diagram of a typical communication system. Explain the function of each block. What is the main aim of designing such a system.

b) Give the theory of amplitude modulation. What are sidebands?

c) Explain the terms quantisation of signal and quantisation error. State sampling theorem.

d) Explain the process of POLL and SELECTION in case of asynchronous protocol.

e) Explain the principle of synchronous demodulation for suppressed carrier signals.

f) Explain the working of an electronic telephone exchange.

Q2) Solve <u>any two</u> : **[2 × 8 = 16]**

a) What are stereo signals? With a neat block diagram explain the working of FM stereo receiver.

b) Explain superheterodyne action. With a neat block diagram explain the working of AM receiver. What is the need for AGC?

c) Write short notes on :

i) Manchester code.

ii) Threshold and capture effects of FM.

P.T.O.

Q3) Solve any two : **[2 × 8 = 16]**

a) What is TDM? What role does it play in telephony? Draw the frame format for DS - 1 signal and explain the process of TDM for it.

b) Explain the importance of bit oriented protocol. Draw the basic format for SDLC and HDLC messages and give the significance of each field.

c) What is ISDN? How is it different from switched telephone network? List various applications of ISDN. Explain any two of them in brief.

Q4) Solve any two : **[2 × 8 = 16]**

a) What is delta modulation? Explain the working of a delta modulator system. What is slope overload error? How can it be avoided?

b) Explain the working of a typical satellite communication system. Give special reference to the transponder.

c) Explain any two methods of FM demodulation. Why is deemphasis required after FM demodulation?

Q5) Solve any four : **[4 × 4 = 16]**

a) What is pulse code modulation? Explain the working of a PCM encoder (transmitter).

b) Give the significance of information theory in communication.

c) Write a short note on VSAT.

d) Explain the concept of preemphasis and deemphasis in FM systems. What are their time constants for FM broadcast receiver?

e) Explain in brief what is XMODEM protocol.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P908

[3929] - 203
M.Sc. - I (Sem. - II)
ELECTRONIC SCIENCE
Instrumentation (Old)

Time : 3 Hours] ***[Max. Marks :80***

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 <u>any four</u> : **[4 × 4 = 16]**

a) For an instrumentation system, define the following :

i) Accuracy, ii) Precision,

iii) Sensitivity, iv) Resolution.

'Precision has no gurantee of Accuracy' Comment.

b) Classify transducers. Explain the important parameters one should look while choosing a transducer for the measurement. Give suitable example.

c) What is the advantage of using differential output rather than single output for measurement of displacement?

d) List different types of strain gauges. Distinguish between bonded and un-bonded strain gauges.

e) List four types of electrical pressure transducers. Describe one application of each.

Q2) Answer <u>any four</u> : **[4 × 4 = 16]**

a) What is the need of flow measurement? Explain in detail the principle of ultrasonic flow meter.

b) Explain thermocouple, thermopiles and thermowell. State application of each.

c) What are different parameters of photo detectors? Explain the principle of photoconductive transducer.

d) What is pH of a solution? Explain different methods of pH measurement.

e) Explain any method for measurement of respiration.

P.T.O.

Q3) Answer <u>any four</u> : **[4 × 4 = 16]**

a) State different types of Relays. Explain the working principle of electromagnetic relay. State important parameters of relay.

b) Explain the need of guarding and shielding of instrumentation system. Explain the different techniques used.

c) What are active filters and digital filters? State at least two applications of each.

d) What is wave analyzer? With the help of neat circuit diagram, explain the working of basic wave analyzer.

e) Explain the digital fourier analyzer in detail.

Q4) Answer <u>any four</u> : **[4 × 4 = 16]**

a) What is the difference between a strip chart recorder and x-y recorder?

b) Explain in detail any two applications of strip chart recorder.

c) Draw the block diagram of a function generator and explain the method of producing sine wave.

d) With the help of neat diagram, explain the working of a vector impedance meter.

e) Explain working principle of Q-meter. How can a Q-meter be used for the measurement of stray capacitance.

Q5) Answer <u>any four</u> : **[4 × 4 = 16]**

a) Explain instrumental methods of chemical analysis and classification of the methods.

b) What is conductivity cell? Explain any one method of measurement of conductivity of solution.

c) What do you understand by flame photometry? State limitations of flame photometry.

d) Draw the general block diagram of medical instrumentation system. What do you understand ECG, EEG and EPG measurement?

e) Explain the methods of measurement of moisture in grain storage. What are the advantages of moisture measurement in the post harvest techniques?

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Total No. of Questions : 5] [Total No. of Pages : 2

P909

[3929] - 301
M.Sc. - II (Sem. - III)
ELECTRONIC SCIENCE
EL3 UT05 : Embedded Systems
(New Course) (2008 Pattern)

Time : 3 Hours] *[Max. Marks :80*

Instructions to the candidates:

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

Q1) Attempt any four of the following : **[4 × 4 = 16]**

a) Write any four differentiating points between microprocessor and microcontroller.

b) Describe interfacing of DAC with 8051 microcontroller.

c) Explain the terms : compiler and simulator.

d) Explain interrupt structure of PIC microcontroller.

e) Describe any four addressing modes of AVR microcontroller with suitable example.

Q2) Write any four of the following : **[4 × 4 = 16]**

a) Draw and explain reset circuit of 8051 microcontroller.

b) Write short note on WDT.

c) Explain different methods of program burning in 8051 microcontroller.

d) Explain the features of ADC in AVR microcontroller.

e) Write an assembly / 'c' program to flash 55H and AAH alternately on 8 LEDs connected to port 0 of 8051 microcontroller.

Q3) Attempt any two of the following : **[2 × 8 = 16]**

a) Explain in detail timer/counter modes of 8051 microcontroller.

b) Describe SPI and CAN with reference to embedded system design.

c) Write short note on

   i) Logic analyzer.

   ii) In circuit emulator.

P.T.O.

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

a) Explain interrupt structure of 8051. Enlist the steps in execution of an interrupt.

b) Describe Rs. 232 communication standard in short.

c) Write an assembly/ 'c' program for PIC microcontroller to initialize LCD.

d) Write an assembly / 'c' program for 8 bit binary counter using eight LEDs connected to PORTD of AVR microcontroller.

e) Write an assembly / 'c' program for 8051 microcontroller to generate a triangular wave using DAC interface.

Q5) Attempt any two of the following : **[2 × 8 = 16]**

a) Explain memory organization of PIC microcontroller.

b) Describe different instructions related to program memory and data memory of AVR microcontroller.

c) Draw the interfacing diagram of 4 × 4 keyboard to 8051 microcontroller and write a 'c' program to read key and display it on port 0.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P910

[3929] - 401

M.Sc. - II

ELECTRONIC SCIENCE

EL4-UT-06 : Control Systems : Theory and Applications

(New Course) (2008 Pattern) (Sem. - IV)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

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

Q1) Solve any two : **[2 × 8 = 16]**

a) Explain the concept of feedback control. Describe various elements used in feedback control system. Explain the terms nominal load and dead time.

b) i) Elaborate the following statement. 'Evolution of process control has been from manual to computer to network control'.

ii) In what ways PLCs are different from general purpose computer.

c) i) Explain the following block diagram reduction rules.

– Shifting a summing point behiend a block.

– Shifting take off point behiend a block.

ii) Define transfer function. Explain its features and advantages.

Q2) Solve any two : **[2 × 8 = 16]**

a) Explain the following terms :

– Stable system – Unstable system

– Critically stable system – Conditionally stable system.

b) i) Write a note on special cases of Routh's criterian.

ii) For a unity feedback system

$$G(s) = \frac{k}{s(1+0.4s)(1+0.25s)}$$

Find range of values of k, marginal value of k and frequency of sustained oscillations.

P.T.O.

c) i) Define the term root-locus. Explain the essential conditions that every point on a root-locus must satisfy.

ii) What are minimum area and quarter amplitude criteria for control system evaluation?

Q3) Solve any two : **[2 × 8 = 16]**

a) Explain Zeigler-Nichols method for process loop tuning.

b) Give special features of proportional, integral and derivative control modes. Give a circuit for PID controller and equation for its output. What is derivative overrun?

c) i) Give the design of an ON-OFF controller circuit using LM35 temperature sensor.

ii) Design a proportional-integral controller with a proportional band of 30% and an integration time of 10 sec. The 4-20 mA input converts into 0-2 volt error signal. The output is to be between 0-10 volt.

Q4) Solve any two : **[2 × 8 = 16]**

a) Draw and explain architecture of PLC.

b) i) How is event sequence description obtained with the help of narrative statements? Explain it for a bottle filling plant.

ii) Draw PLC ladder diagram to realise 4:1 multiplexer.

c) Explain any three data handling instructions for a PLC.

Q5) Solve any four : **[4 × 4 = 16]**

a) Explain On-Delay timer instruction.

b) Explain how to select a correct PLC processor for an application.

c) Why is it necessary to add documentation to a PLC program? What information does it contain?

d) Write a short note on annunciator.

e) Explain what is meant by 'user defined files' in a PLC processor.

f) What is handheld programming terminal? Describe dumb terminal.

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Total No. of Questions : 5] **[Total No. of Pages : 2**

P910

[3929] - 401
M.Sc. - II
ELECTRONIC SCIENCE
EL4-UT-06 : Control Systems : Theory and Applications
(Old Course) (2005 Pattern) (Sem. - IV)

Time : 3 Hours] ***[Max. Marks :80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Use of log-table, calculator is allowed.***

Q1) Solve any two : **[2 × 8 = 16]**

a) Draw block diagram of a feed back control system. Explain the function of various parts in it. State various types of controllers used in it.

b) i) Write a short note on transfer function.

ii) Give advantages and disadvantages of block diagram for control systems.

c) i) Compare continuous and discrete state process control systems.

ii) Discuss control system evaluation. What is quarter amplitude criterian?

Q2) Solve any two : **[2 × 8 = 16]**

a) Explain frequency response method for analysis of control system stability. What are gain and phase margins?

b) i) In a low-pass RC circuit values of R and C are 1 MΩ and 1 μf respectively. Obtain the expression for current flowing in the circuit if it is supplied with an input step voltage of 1V at time t = 0.

ii) Using Routh's method examine the stability of a system having the characteristic equation

$s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$ Find the number of roots of this equation with positive, zero and negative real part.

c) i) Define the term root-locus. State the essential conditions that every point on a root-locus must satisfy.

ii) Comment on the following

– Derivative control mode can't be used alone.

– The addition of a pole will make a system more stable.

P.T.O.

Q3) Solve <u>any two</u> : **[2 × 8 = 16]**

a) Explain PID control mode. How would you implement it using op-amps? What is meant by derivative overrun? How can it be prevented?

b) i) Explain how a PLC interacts with input and output status files.

ii) Draw PLC ladder diagram to realise 4:1 multiplexer.

c) i) Which type of controller mode builds up corrective action proportional to the length of time the disturbance persists? What are the two key characteristics of this mode? What are its applications?

ii) Design an ON-OFF controller circuit using op-amp. Use LM35 temperature sensor.

Q4) Solve <u>any two</u> : **[2 × 8 = 16]**

a) Describe processor operating modes for a typical PLC.

b) i) What type of module should be selected in order to interface following field devices to PLC.

– Push button – Level switches

– Alarm – Speed control into a drive

– Pressure sensor.

ii) Explain soft PLC.

c) i) How would you choose a PLC processor for a particular application?

ii) Compare conventional ladder logic with PLC ladder logic.

Q5) Answer <u>any four</u> : **[4 × 4 = 16]**

a) Explain advantages and disadvantages of using smart handheld programming terminal.

b) Explain how to connect a PLC to PC through a hardware interface.

c) Write a short note on feed forward control strategy.

d) Explain interfacing to non-RS232 PLC processors.

e) What information should be included in PLC documentation?

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