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14ELD11

First Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
Advanced Mathematics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Construct QR factorization for the matrix :

$$A = \begin{bmatrix} -4 & 2 & 2 \\ 3 & -3 & 3 \\ 6 & 6 & 0 \end{bmatrix}.$$

(10 Marks)

b. Solve the system of equations :
$x_3 + 2x_4 = 1$
$x_1 + 2x_2 + 2x_3 + 3x_4 = 2$
in the least – square sense. **(10 Marks)**

2 a. Apply the shifted QR algorithm to the matrix $A = \begin{bmatrix} 3 & 1 \\ 1 & 5 \end{bmatrix}$. Carry out three iterations. **(10 Marks)**

b. Find the singular – value decomposition of the matrix $A = \begin{bmatrix} -3 & 1 \\ -2 & 1 \\ -1 & 1 \\ 0 & 1 \\ 1 & 1 \\ 2 & 1 \\ 3 & 1 \end{bmatrix}$. **(10 Marks)**

3 a. Derive Euler – Lagrange's formula in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y^1}\right) = 0$. **(06 Marks)**

b. Find the extremum of functional : $v\int[y(x) = \int_0^1 \frac{\sqrt{1+(y')^2}}{x} dx$, given $y(0) = 0$ and $y(1) = 1$. **(07 Marks)**

c. Solve the variation problem $v\int_1^2 \left[x^2(y')^2 + 2y(x+y)\right] dx = 0$, given that $y(1) = y(2) = 0$. **(07 Marks)**

4 a. Find the function y(x) for which $\int_0^{\pi} \left[(y')^2 - y^2\right] dx$ is stationary. Given that $\int_0^{\pi} y dx = 1$ and $y(0) = 0$, $y(\pi) = 1$. **(10 Marks)**

b. Find the extremals of the functional : $I = \int_0^{\pi/2} \left[(y')^2 + (z')^2 + 2yz\right] dx$, given that $y(0) = 0$, $y\left(\frac{\pi}{2}\right) = 1, z(0) = 0, z\left(\frac{\pi}{2}\right) = -1$. **(10 Marks)**

5 a. Using the Laplace transform method, solve $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$, $0 < x < 1$, $t > 0$ subject to boundary conditions $(0, t) = u(1, t) = 0$ for $t > 0$ and initial conditions $u(x, 0) = \sin \pi x$, $\frac{\partial u}{\partial t}(x,0) = -\sin \pi x$ for $0 < x < 1$. **(10 Marks)**

b. Using the Fourier sine transform find the temperature u(x, t) in a semi infinite medium $0 \le x \le \infty$ determined by the PDE : $K u_{xx} = u_t$, $0 < x < \infty$, $t > 0$ subject to $u(0, t) = u_0$ for $t \ge 0$ and $u(x, 0) = 0$ for $0 < x < \infty$, u and u_x both tend to zero as $x \to \infty$. **(10 Marks)**

6 a. Solve : $\nabla^2 u = 0$, $-\infty < x < \infty$, $0 < y < \infty$ under the conditions $u(x, 0) = f(x)$, $-\infty \le x \le \infty$ and the limiting conditions $u(x, y) \to 0$ as $y \to \infty$; u and $\frac{\partial u}{\partial x}$ both vanish as $|x| \to \infty$. **(12 Marks)**

b. If ϕ is the harmonic function in R and $\frac{\partial \phi}{\partial \eta} = 0$ on ∂R then prove that ϕ is a constant in $\overline{R}$.

(08 Marks)

7 a. A farmer bakes two types of cakes (chocolate and vanilla) to supplement his income. Each chocolate cake can be sold for Rs. 50/- and vanilla cake for Rs 25/-. Each chocolate cake requires 20 minutes of baking time and need 4 eggs. Each vanilla cake requires 40 minutes of baking time and requires one egg. The farmer has 8 hours of bake time and 30 eggs with him available. Formulate the LPP and solve for maximizing sales using Simplex method. **(08 Marks)**

b. Use two – phase method to :
Maximize $Z = -4x_1 - 3x_2 - 9x_3$
Subject to $2x_1 + 4x_2 + 6x_3 \ge 15$
$6x_1 + x_2 + 6x_3 \ge 12$
$x_1, x_2 x_3 \ge 0$. **(12 Marks)**

8 a. Solve the following non – linear programming using Lagrangean method :
Maximize $z = 4x_1 - 0.02x_1^2 + x_2 - 0.02x_2^2$
$x_1 + 2x_2 = 120$
$x_1, x_2 \ge 0$. **(10 Marks)**

b. Using Kuhn – Tucker conditions :
Maximize $Z = x_1^2 + x_1x_2 - 2x_1^2$
Subject to $4x_1 + 2x_2 \le 24$
$5x_1 + 10x_2 \le 30$
$x_1, x_2 \ge 0$. **(10 Marks)**

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14ECS12

First Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
Antenna Theory and Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. What is an antenna? Explain the basic principle of radiation mechanism, with a suitable example. **(07 Marks)**

b. Calculate the directivity of an antenna whose power pattern is given by :

$$U(\theta,\phi) = \begin{cases} \sin\theta\sin\phi & 0 \le \theta \le \pi;\ 0 \le \phi \le \pi \\ 0 & 0 \le \theta \le \pi;\ \pi \le \phi \le 2\pi \end{cases}$$ **(07 Marks)**

c. Explain briefly the following terms with respect to antennas
   i) Polarization
   ii) Antenna Impedance
   iii) HPBW. **(06 Marks)**

2 a. What are resonant antennas? Explain briefly and give examples. **(06 Marks)**

b. Show that a half wave folded dipole provides a four fold increase in impedance over its dipole version. **(06 Marks)**

c. With neat diagram explain construction and working principle of $\lambda/2$ (half –wave) length microstrip antenna. **(08 Marks)**

3 a. What is an antenna array? Derive the expression for the normalized array factor for uniformly excited, equally spaced linear array of 'N' elements. Write the conclusions drawn from array factor plots for various valued of "N". **(10 Marks)**

b. Two identical point sources separated by a distance 'd' are having the field pattern given by $E_1 = E_2 = E = E_0 \sin\theta$. If $d = \frac{\lambda}{2}$ and phase angle $\alpha = 0$, Derive an expression for total field pattern. **(06 Marks)**

c. Briefly explain the effects of mutual coupling on array performance. **(04 Marks)**

4 a. What do you mean by a broadband antenna? **(04 Marks)**

b. Design a helical antenna operating in the axial mode that gives directivity of 14dB at 2.4GHz. For this Helical antenna, calculate the input impedances, HPBW, BWFN and the axial ratio. **(08 Marks)**

c. What is a Travelling wave antenna? Explain with the help of diagram its radiation pattern. **(08 Marks)**

5 a. Explain the operation of pyramidal Horn antenna. Describe the steps used in the optimum Horn design. **(10 Marks)**

b. What is the parabolic reflector? Explain its principle of operation with neat sketches. **(05 Marks)**

c. Explain following briefly.
   i) Dual reflector antennas
   ii) Rectangular Horn antennas **(05 Marks)**

6 a. Explain the antenna pattern synthesis by the Dolph-Chebyshev Linear array method to achieve narrow main beam and low side lobes. **(10 Marks)**

b. Explain briefly the following line source shaped beam synthesis methods.
   i) The Fourier – Transform method
   ii) Woodward – Lawson sampling method. **(10 Marks)**

7 a. Explain and derive the Kirchoff's Network equations from integral equations. **(10 Marks)**

b. Explain the different types of source modeling with suitable sketches. **(10 Marks)**

8 a. Explain the Geometrical optics wedge diffraction theory. **(10 Marks)**

b. Write Explanatory notes on:
   i) FDTD method
   ii) Uniform theory of wedge diffraction. **(10 Marks)**

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14ECS14

First Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
Advanced Digital Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. In the on–off keying version of an ASK system, symbol '1' is represented by transmitting a sinusoidal carrier of amplitude $\sqrt{\frac{2E_b}{T_b}}$ where E_b is the bit energy and T_b is the bit duration. Symbol '0' is represented by switching off the carrier. Assume that symbols 1 and 0 occur with equal probability. Find the probability of error of this system with coherent detection in an AWGN channel. **(08 Marks)**

b. Compare MPSK and MFSK system performances in the context of channel capacity theorem. **(08 Marks)**

c. Briefly explain m–QAM scheme. **(04 Marks)**

2 a. What is the principle of minimum shift keying? Explain the use of phase trellis in MSK scheme with relevant equations. **(10 Marks)**

b. Draw the signal space diagram for octaphase shift keying. Explain the reconstruction process to recover the binary data. **(10 Marks)**

3 a. Find the output of a (2, 1, 3) convolutional encoder with generator sequences $g_1 = [1\ 0\ 1\ 1]$ and $g_2 = [1\ 1\ 1\ 1]$ using transform domain approach clearly indicate the transform domain generator matrix and the output sequence V(D) and the code word corresponding to the input sequence u = [1 1 0 0 1 1]. Draw the state table for the above encoder. **(08 Marks)**

b. Given a convolutional encoder with generator sequence $g_1 = [1\ 1\ 1]$ and $g_2 = [1\ 0\ 1]$ construct the tree diagram for this encoder. Using sequential decoding, illustrate the path along the tree diagram for the received sequence [1 1 0 0 0 1 1 0 0 1]. The backup criterion is three disagreements. **(12 Marks)**

4 a. Explain the concept of maximum likelihood receiver comment on its performance. **(08 Marks)**

b. Describe how the viterbi algorithm can be used with discrete time noise filter model. **(07 Marks)**

c. What is equalization? Brief the principles of decision feedback equalization. **(05 Marks)**

5 a. Explain zero forcing algorithms. **(08 Marks)**

b. Describe with a block diagram and relevant equations, the LMS algorithm for recursively adjusting the tap weight co-efficient of an equalizer. **(08 Marks)**

c. Briefly explain the principles of blind equalization. **(04 Marks)**

6 a. What is the working principle of a spread spectrum communication system? Derive an expression for the code word error probability with respect to direct sequence spread spectrum communication system. **(10 Marks)**

b. Explain frequency hopped spread spectrum communication system. Give examples of the hopping patterns in the 2 types of FHSS systems. **(10 Marks)**

7 a. Discuss the reasons for fading of received signals and diversity schemes that are used to overcome this problem. **(10 Marks)**

b. Write a descriptive note with relevant block diagram and equations, on the channel model used in frequency selective slowly fading channel. **(10 Marks)**

8 a. Explain the steps involved in viterbi convolutional decoding algorithm. **(07 Marks)**

b. Write a note on adaptive decision feedback equalization. **(06 Marks)**

c. What are the phases of time synchronization of the receiver in SS systems? Explain how delay locked loop is used in this context. **(07 Marks)**

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14ECS154

First Semester M.Tech. Degree Examination, Dec.2015/Jan.2016
CMOS VLSI Design

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Draw CMOS inverter transfer characteristics and indicate the different regions of operations. Also derive the output voltage equations for region 'C' operation. **(08 Marks)**

b. Calculate the threshold voltage with $\varepsilon_{si} = 11.7\varepsilon_0$, $\varepsilon_{ox} = 3.9\varepsilon_0$, for an nMOS transistor with $N_A = 2\times10^{17}/cm^3$, $t_{ox} = 190°A$. Assume $\phi_{ms} = -0.85V$, $Q_{fe} = 0$, $N_i = 1.45 \times 10^{10}/cm^3$. **(06 Marks)**

c. Explain any four second order effects in MOSFET. **(06 Marks)**

2 a. With neat sketches explain the working principle of Pseudo-NMOS inverter. Also determine the expression for V_{out}. **(07 Marks)**

b. Draw and explain the circuit diagram of a BICMOS inverter. Write the circuit diagram of BICMOS NAND gate. **(06 Marks)**

c. Describe the construction, working and characteristics of enhancement mode MOSFET with the relevant sketches. Also compare the characteristics of depletion and enhancement mode MOSFET. **(07 Marks)**

3 a. Explain the nMOS fabrication process steps with neat sketches. **(10 Marks)**

b. Describe the lambda based design rules for the different layers associated with CMOS process. **(05 Marks)**

c. What is noise margin? Explain the same with suitable diagram. **(05 Marks)**

4 a. Draw the stick diagram, circuit diagram for the given logic function $F = \overline{A(D+E)+BC}$, by constructing Euler graph for the pull up and pull down device. **(06 Marks)**

b. Obtain the scalling factors for the following
   i) Gate capacitance (C_g)
   ii) Maximum operating frequency (f_o)
   iii) Power dissipation per unit area (P_a)
   iv) Gate delay (T_d) **(04 Marks)**

c. Estimate the parasitic device capacitance of two input CMOS NOR gaze. Also derive the threshold voltage V_t. **(10 Marks)**

5 a. Explain AOI and OAI logic with suitable example. **(06 Marks)**

b. Derive on expression for the dimensions and the number of inverters needed to drive a large capacitive load C_α in a cascades configuration. **(06 Marks)**

c. Explain the principle of pass transistor logic. Describe how logic 'O' and 'I' takes place in pass transistor. **(08 Marks)**

6 a. Describe the behavior of bistable element. Derive the expression for O/P voltage. **(06 Marks)**

b. With neat diagram explain how the cascade transistor shields the I/P device from voltage variations at the O/P. **(06 Marks)**

c. Explain the different types of current mirror circuits. How can these be used in the design of a differential amplifier. **(08 Marks)**

7 a. Describe CMOS Bulk technology for P-well, N-well and twin tub processes. **(10 Marks)**

b. Describe the cause of latch up and guide lines for avoiding latch up. **(10 Marks)**

8 a. What is scaling? List the advantages of scaling. **(04 Marks)**

b. Draw the CMOS logic for the function $f = \overline{ab+ac+bd}$ using minimum number of transistor. **(05 Marks)**

c. Describe different clock distribution schemes. **(11 Marks)**

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