(3 Hours) Max Marks: 80

Note:
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

Q.1. (A) State Central limit theorem and give its significance. (05)

(B) State the three axioms of probability. (05)

(C) State various properties of autocorrelation function and power spectral density function. (05)

(D) State and explain Bayes Theorem. (05)

Q.2. (A) A random variable has the following exponential probability density function: $f(x) = Ke^{-|x|}$. Determine the value of K and the corresponding distribution function. (10)

(B) A distribution has unknown mean μ and variance 1.5. Using Central Limit Theorem find the size of the sample such that the probability that difference between sample mean and the population mean will be less than 0.5 is 0.95. (10)

Q.3. (A) Explain Ergodicity in Random Process. (10)
A Random process is given by $X(t) = 10cos(50t + Y)$
where ω is constant and Y is a Random variable that is Uniformly distributed in the interval $(0, 2\pi)$. Show that $X(t)$ is a WSS process and it is Correlation ergodic.

(B) If X and Y are independent Random variables and if $Z=X+Y$, then show that the pdf of Z is given by the convolution of the pdf of X and pdf of Y. (10)

Q.4. (A) The transition probability matrix of Markov Chain is given by, (10)

$$P = \begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array} \begin{array}{c} \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} 0.5 & 0.4 & 0.1 \\ 0.3 & 0.4 & 0.3 \\ 0.2 & 0.3 & 0.5 \end{bmatrix} \end{array}$$

Find the limiting probabilities?

(B) Explain Strong law of large numbers and weak law of large numbers. (05)

(C) If A and B are two independent events then prove that $P(A \cap \overline{B}) = P(A).P(\overline{B})$ (05)

Q.5. (A) State and prove Chapman-Kolmogorov equation. (10)

(B) In a communication system a zero is transmitted with probability 0.4 and a one is transmitted with probability 0.6. Due to noise in the channel a zero can be received as one with probability 0.1 and as a zero with probability 0.9, similarly one can be received as zero with probability 0.1 and as a one with probability 0.9. If one is observed, what is the probability that a zero was transmitted? (10)

Q.6. (A) Explain power spectral density function. State its important properties and prove any two of the property. (10)

(B) Explain (i) M/G/1 Queuing system. (05)
(ii) M/M/1/∞ Queuing system.

(C) Write short notes on Gaussian distribution. (05)

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XTC/SEM II/ Paper / Subject Code: 30603 / R F MODELING AND ANTENNAS / MAY 2019

CBSGS

Q.P.Code: 37721

(3 Hours) [Total Marks 80]

N.B. : (1) Question **No. 1** is **compulsory**.
(2) Solve **any three** questions from the remaining **five**
(3) Figures to the right indicate full marks
(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt **any four** out of the remaining **five** **[20]**
a) Explain Stripline and Microstrip line.
b) Compare Binomial filter with Chebyshev filter
c) Explain near field and far field radiation related to antenna.
d) Explain pattern multiplication for antenna array.
e) What are characteristics of Log periodic antenna ?

Q.2 a) Explain with equivalent circuits the RF behaviour of resistor, capacitor and inductor. **[10]**
b) Design a composite high pass filter by the Image parameter method with the following specification. **[10]**
R_0=75 Ω, f_c=50 MHz, f_∞=48MHz

Q.3 a) Design a LPF whose input and output ports are matched to 50 Ω impedance with cutoff frequency of 3 GHz, equi ripple of 0.5 dB and rejection of atleast 40 dB at approx twice the cutoff frequency. **[10]**

b) Explain the following terms related to basic antenna concepts with relevant equations. **[10]**
[i] Gain and Directivity
[ii] Radiation Pattern
[iii] Radiation Resistance
[iv] Antenna Efficiency
[v] Effective aperture

Q.4 a) Derive radiation resistance of infinitesimal dipole. **[10]**

b) What is maximum power received at a distance of 0.75 Km over free space for 1 GHz frequency. The system consists of transmitting antenna with 3 dB gain and receiving antenna with 17dB gain and antenna is fed with 200 W power. **[10]**

Q.5 a) Explain working principle of Yagi-Uda antenna and draw its radiation pattern. Mention its applications. **[10]**
b) Draw the structure of Microstrip antenna. Discuss its characteristics, limitations and applications. **[10]**

Q.6 Write short notes on the following : **[20]**
a) Hazards of electromagnetic radiation
b) Friss transmission formula
c) Helical antenna
d) Principle of Parabolic reflector antenna

(3 Hours) [Total Marks: 80]

N.B.: (1) Question No. 1 is compulsory.
(2) Solve any three questions from the remaining five.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt any 4 questions:

(A) Draw a neat circuit of Voltage to Current converter with floating load. Give its output expression. **[05]**

(B) Draw a neat diagram of non-inverting Schmitt trigger and its voltage transfer characteristics. **[05]**

(C) Discuss the various parameters of op-amp. **[05]**

(D) Draw the functional block diagram of IC 723. **[05]**

(E) Draw a neat circuit of half wave precision rectifier. Draw its input and output waveforms. **[05]**

Q.2 (A) What is an instrumentation amplifier? Design an instrumentation amplifier using 3 op-amps for gain variation of 0.5 to 100. **[10]**

(B) With the help of a functional block diagram explain the working of voltage regulator LM317 to give an output voltage variable from 5 V to 10 V to handle maximum load current of 500 mA. **[10]**

Q.3 (A) Draw a neat circuit with all the component values of astable multivibrator using IC 555 to obtain 40% duty-cycle. **[10]**

(B) Design a second order Butterworth high pass filter for cut off frequency of 1 kHz and pass-band gain of AF=2. **[10]**

Q.4 (A) Draw the circuit diagram of a square and triangular waveform generator using op-amps and explain its working with the help of waveforms. For variation in duty cycle what is the modification needed in the circuit. **[10]**

(B) Design a voltage regulator using IC 723 to give V_o = 10 V to 32 V and output current of 2 A. **[10]**

Q.5 (A) Draw a neat circuit diagram of *RC* phase shift oscillator using op-amp. Derive its frequency of oscillation. What are the values of R and C if its frequency of oscillation is 2 kHz? **[10]**

(B) Draw a mod-7 counter using IC 7490. Draw its timing diagram. **[10]**

Q.6 Write short notes on: (Attempt any two)

(A) Power amplifier LM380. **[10]**

(B) IC 74181 Arithmetic Logic Unit. **[10]**

(C) Internal structure of IC 7493. **[10]**

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