Khulna University of Engineering & Technology
B. Sc. Engineering 4th year 1st Term (Regular) Examination, 2018
Department of Electrical and Electronic Engineering

EE 4105
Communication Engineering - II

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) What is PSTN? Draw the typical structure of PSTN network. Show the simplified connection diagram between two users who are in KUET, Khulna and Florida, USA. (09)

(b) Draw internal block diagram of a telephone handset. Show that a microphone is not able to generate speech current without its dc energising current. Use necessary mathematical relationship. (10)

(c) Why loop signalling is necessary in telephone network instead of single-wire signaling. Answer with necessary illustration. (08)

(d) An exchange uses 48 V battery, a resistance of 300 Ω is placed in series with the battery. If the internal resistance of telephone set is 100 Ω, calculate the loop resistance limit for the minimum current requirement of 23 mA for carbon microphone. Also calculate the loop length if 0.41 mm diameter cu wire is used in the loop. (08)

Q2. (a) Define blocking and non-blocking exchange. Classify switching system. What are the basic functions of a switching system? (06)

(b) Describe the operation of different modes of SPC exchange with necessary illustrations. (12)

(c) Explain how the hybrid circuit control the sidetone during transmission and reception of a call. Use necessary illustrations. (09)

(d) Given that MTBF = 2000 hrs and MTTR = 4 hrs. Calculate the unavailability for single and dual processor systems for 10 years and 20 years. (08)

Q3. (a) Mention digital switching techniques. Describe different connection phases of circuit-switched network. Also mention its delay characteristics. (12)

(b) What are the steps to be followed to design a multistage switch? Describe them. (07)

(c) Design a three-stage, 200 × 200 switch with K = 4 and n = 20. Also calculate the minimum number of crosspoints if Clos criteria are used. (10)

(d) Describe the mechanism of time slot interchange in time-division switching. Use necessary illustration. (06)

Q4. (a) What is optical fiber? Show its typical construction. Define the terms: critical angle, numerical aperture, and acceptance angle. (09)

(b) What types of LEDs are used as a light source in optical fiber communication system? Draw the basic structure of a laser. (05)

(c) Write down the names of different dispersion occurred in fiber optic waveguide. Mention different losses in silica fiber? Draw the typical loss vs. wavelength curve of silica fiber. (09)

(d) Describe network topologies with their relative merits and demerits. Answer with necessary illustrations. (12)

Section B

Q5. (a) Define the terms: cell, base station, SIM, and mobile switching center. Determine the procedure of locating co-channel cell. Write down the differences between conventional and cellular mobile systems. (12)

(b) Describe the main parts of cellular system. Also explain the functions of each part. (11)

(c) Show the schematic of timing diagram when a call is initiated from a fixed user to a mobile user. Also shortly describe the process. (12)

Q6. (a) Why hexagonal cells are used in cellular mobile system? Show that the total number of duplex channels in cellular mobile system depend on the number of replication of a cluster. (10)

(b) Why handoff is required in cellular mobile system? Explain the handoff process with neat sketch in GSM system. (10)

(c) A mobile is located 5 km away from a base station and uses a vertical $\lambda/4$ monopole antenna with gain of 2.55 dB to receive cellular radio signals. The E-field at 1 km from the transmitter is measured to be 10^{-3} V/m. The carrier frequency used for this system is 900 MHz. Find the received power at the mobile using the two ray ground reflected model assuming the height of the transmitting antenna is 50 m and the receiving antenna is 1.5 m above the ground. (15)

Q7 (a) Show that 120^0 sectoring technique reduces the co-channel interference 1/3 times from the first tier compared to conventional cell structure. (10)

(b) What are the basic differences between 3G and 4G? Shortly describe LTE system. (10)

(c) What is ISDN? What are the goals of it? Describe different ISDN services. How do you differentiate between ISDN and BISDN? (09)

(d) What is multimedia communication? Describe the basic multimedia networks with proper examples. (06)

Q8 (a) Sketch a typical satellite communication system clearly and explain each block in briefly. (11)

(b) Clearly sketch the block diagram of a RADAR system and describe each block in briefly. What are the applications of RADAR? (12)

(c) Write notes on – (i) Bangabandhu – 1 satellite, (ii) GPS, and (iii) MEO. (12)

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EE 4109
Power Electronics and Industrial Drives

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
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Section A

Q1. (a) What are the steps involved in designing power electronics equipment and what are the peripheral effects of power electronics equipment? (07)

(b) What are the limitations of thyristors as switches? Discuss the gate characteristics and gate control requirements of different types of thyristors. (10)

(c) Explain the v-i characteristic of thyristors. (13)

(d) Draw a snubber circuit. How does the snubber circuit protect a power device from excessive $\frac{di}{dt}$ and $\frac{dv}{dt}$? (05)

Q2. (a) What is the difference between natural and forced commutation? What are the advantages of forced commutation for ac-dc converters? Sketch the relevant waveforms to show the effect of power factor improvements of a single-phase forced-commutated semiconverter. (15)

(b) Draw a three-phase full converter output voltage for delay angle $\alpha = \pi/6$. Also calculate its normalized average output voltage. (20)

Q3. (a) Write down five applications of dc-dc converter. What are the limitations of single-stage dc-dc conversion? (08)

(b) Discuss the principle of operation of a buck-boost regulator with continuous inductor current and capacitor voltage. (17)

(c) The converter in Fig. Q3(c) has a load resistance R = 0.25 Ω and input voltage V_s = 550 V. The average load current i_a = 200 A, and chopping frequency f = 250 Hz. Find the load inductance L which would limit the maximum load ripple current to 10% of i_a. Use the average output voltage to calculate L. (10)

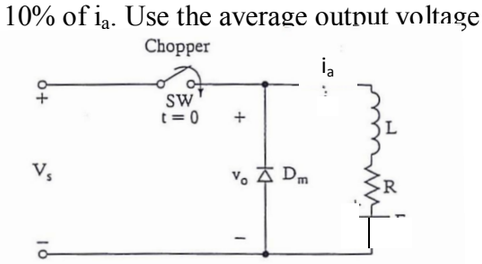


Figure for Q3(c)

Q4. (a) What are the advantages and disadvantages of on-off and phase-angle control? (05)

(b) Draw a three-phase bidirectional controller with Y-connected resistive load. Sketch also its output voltage waveforms with relevant gate pulses. (10)

(c) Define cycloconverter. Explain the principle of operation of a single-phase cycloconverter with relevant waveforms. (10)

(d) An ac voltage controller has a resistive load of R = 10 Ω and the rms input voltage is V_s = 120 V, 60 Hz. The thyristors switch is on for n = 25 cycles and is off for m = 75 cycles. Determine (i) the rms output voltage, and (ii) the input power factor. (10)

Section B

Q5. (a) Define and classify inverters. How is the quality of an inverter normally evaluated? (09)

(b) Discuss the principle of operation of a H-bridge inverter connected with highly inductive load. (10)

(c) Draw the circuit diagram of a 3-φ bridge inverter. Also draw its gating signals, output voltages and current waveforms for 180^0 conduction. Assume the load connected with the inverter is RL type. (16)

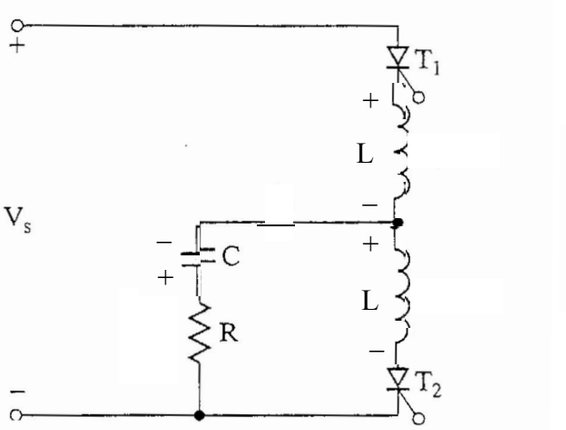
Q6. (a) Why it is necessary to control the output voltage of inverters? What are the methods for voltage control within the inverters? Explain the modified sinusoidal pulse-width modulation technique. Deduce the necessary conditions. (20)

(b) What is SVM? What are the advantages of SVM? (05)

(c) Explain the principle of operation of a 3-phase current source transistor inverter with relevant waveforms, where the load is Y-connected resistive load. (10)

Q7 (a) Show the operating condition of a series resonant inverter. Draw the circuits and write down the current equations for the mode. Deduce the possible frequency of operation. (12)

(b) The series resonant inverter in Fig. Q7(b) produces the output voltage of 7 kHz. The turn-off time of thyristors is 10 μs. Determine the available turn-off time. Also sketch the instantaneous load current, capacitor voltage, and dc supply (13)



Given:

$V_s = 220$ V
$R = 2\ \Omega$
$L = 50\ \mu H$
$C = 6\ \mu F$

Figure for Q7(b)

(c) Show that the rate of dielectric heating may be raised by increasing either frequency or the voltage gradient. (10)

Q8 (a) Mention the advantages and disadvantages of dc drives over ac drives. Write down the electrical and mechanical equations of a separately excited dc motor drive. Explain the different quadrants of operation of the drive. (13)

(b) Discuss the scalar control of poly phase induction motor. What is v/f control? (12)

(c) What are the principles of dielectric and induction heating? Mention the applications area both of them. (10)

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EE 4135
Digital Signal Processing

Time: 3 hours Full Marks: 210

N.B.: (i) Answer **ANY THREE** questions from each section in separate scripts.
(ii) Figures in the right margin indicate full marks.

Section A

Q1. (a) State and explain sampling theorem. (10)

(b) What do you mean by quantization of sinusoidal signals? Show that the SQNR of a linear ADC is given by SQNR = 1.76 + 6.02b, where b is the number of ADC bits. (14)

(c) Consider the analog signal $x_a(t) = 3\cos 100\pi t$ (11)

(i) Determine the minimum sampling rate to avoid aliasing.

(ii) Suppose that the signal is sampled at the rate $F_s = 200Hz$. What is the discrete-time signal obtained after sampling?

(iii) What is the discrete-time signal obtained after sampling if $F_s = 75Hz$?

(iv) What is the frequency $0 < F < F_s/2$ of a sinusoid that yields samples identical to those obtained in part (iii)?

Q2. (a) What do you mean by convolution and correlation? Mention the practical applications of these. Determine the cross-correlation functions of two noisy waveforms. (14)

(b) Determine the impulse response corresponding to the following transfer function and comment on the stability and causality. $H(z) = z^2/(z-1)$ (11)

(c) Find the initial and final value of $x(n)$ if z-transform is $X(z) = 2/\left(z^2 + \frac{z}{6} - \frac{1}{6}\right)$. (10)

Q3. (a) Why DFT and z-transform are used in digital signal processing? Show the relationship between DFT and z-transform. (10)

(b) What do you mean by region of coverage? Find the pole-zero diagram of the following system. $y(n) = x(n) + 6x(n-1) + 12x(n-2) + 8x(n-3)$. (10)

Assume $y(n) = 0$ for $n < 0$. Plot pole-zero diagram and also find the values of $y(n)$ for $n = 0,1,2,3,4,5$ if $x(n) = \delta(n)$.

(c) What do you mean by bit reversal and in place communication as applied to FFT? Show the bit reversed index to combine FFT stages. (07)

(d) Determine the input signal $x(n)$ that will generate the output sequence $y(n) = \{1, 4,8,10,8,4,1\}$ for a system with impulse $h(n) = \{1, 3,4,3,1\}$. (08)

Q4. (a) How can you use DFT for circular convolution? (08)

(b) What do you mean by Twiddle factor? Prove the periodicity property of FFT. (06)

(c) What do you mean by computational complexity? Compare the computational complexity obtained by direct computational and DIT-FFT. (09)

(d) Use the 8-point radix-2 DIT-FFT algorithm and find the DFT of the sequence $x(n) = \{1,1,0,0,-1,-1,0,0\}$. (12)

Section B

Q5. (a) What is digital filter? Write down the input-output relationship of FIR and IIR filter. Discuss the stability features of these two types filter. (13)

(b) What are the basic building blocks of realization structures? Obtain the cascade and parallel realization of the system as shown in below: (15)

$$H(z) = \frac{1+\frac{1}{3}z^{-1}}{\left(1-\frac{1}{5}z^{-1}\right)\left(1-\frac{3}{4}z^{-1}+\frac{1}{8}z^{-2}\right)}$$

(c) What is Gibbs effect? Discuss the reason of it? (07)

Q6. (a) Design a linear phase FIR low pass with 13-coefficients using frequency sampling method. Let the cut-off frequency be 2000Hz and assume a sampling frequency of 8000Hz. (10)

(b) Draw the block diagram of IIR filter design using bilinear transformation. Derive the following relationship between analog (ω_a) and digital (ω_d) frequencies for bilinear transformation, (12)

$$\omega_a = \frac{2}{T}\left(\frac{\omega_d T}{2}\right); \quad T = \text{sampling time.}$$

(c) The desired frequency response of a low pass filter is (13)

$$H_d\left(e^{j\omega}\right) = \begin{cases} 1; & -\pi/2 \le \omega \le \pi/2 \\ 0; & \pi/2 \le \omega \le \pi. \end{cases}$$

Determine $h_d(n)$ for $M = 7$ using a rectangular window.

Q7 (a) What are the requirements for converting a stable analog filter into a stable digital filter? Convert the analog filter to a digital filter whose system function is $H(s) = \frac{1}{(s+2)^2+s+1}$. (15)

(b) What are the effects of windowing? Obtain the frequency domain characteristics of Hamming window function. (10)

(c) Design a band-pass FIR filter with the following specifications using window method: (10)

Lower stopband	0-500Hz
Passband	1600-2300Hz
Upper stopband	3500-4000Hz
Stopband attenuation	50dB
Passband ripple	0.05dB
Sampling rate	8000Hz

Q8 (a) Compare overlap add and overlap save method. Determine the output of the linear FIR filter whose impulse response is $h(n) = \{1, 1, 1\}$ and the input is $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$, use overlap save method. (14)

(b) What do you understand by orthogonality and orthogonal basis? Explain how wavelet can overcome the limitation of short-time Fourier transform. (10)

(c) Design the following IIR filter using pole-zero placement method: (11)

complete signal rejection at DC and 250Hz,

a narrow passband at 125Hz with a 3dB bandwidth of 10Hz,

the sampling frequency is 500Hz.

Also realize the filter in Direct form - I.