Khulna University of Engineering & Technology
B.Sc. Engineering 3rd Year 2nd Term (Regular) Examination 2018
Department of Electrical and Electronic Engineering
EE 3201
Control System Engineering

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 mark.
iii) Normal and Semilog graph papers will be supplied on request.

Section A

Q1. (a) Draw the generalized block diagram of a closed loop control system and explain each term in the diagram. (08)

(b) Mention whether the following systems are open-loop or closed-loop systems with explanation of your answer: (17)
i) Air Conditioner, ii) Ceiling Fan, iii) Refrigerator and iv) TV Remote Control.

(c) Explain the design step of control system. Name the approaches to the mathematical modeling of control system. (10)

Q2. (a) A standard closed loop system is given in the following specifications: (25)
Plant: a dc motor with inertia and friction as motor load,
Controller: a P-controller with K_p gain, Feedback: unity, Input: Armature voltage, Output: angular velocity. i) Determine the performance equation of the system. ii) Determine the transfer function. iii) Write down the state equation. iv) Determine the steady state output for a step input. Assume any data for designing your system.

(b) Find ζ, ω_n, ω_d and t_p for the following transfer function: $\frac{C(s)}{R(s)} = \frac{10}{4s^2+13s+20}$ (10)

Q3. (a) Determine the poles and zeros of the following system. also establish the differential equation. (08)

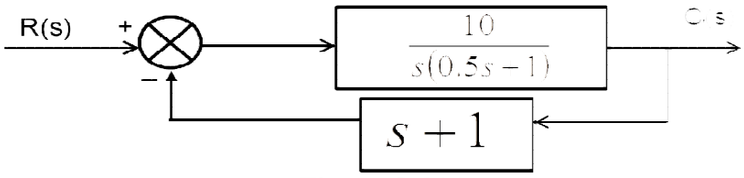

Figure Q 3(a)

(b) For the following circuit of Fig 3(b), draw the signal flow graph and determine the transfer function, $\frac{V_o(s)}{V_i(s)}$. (18)

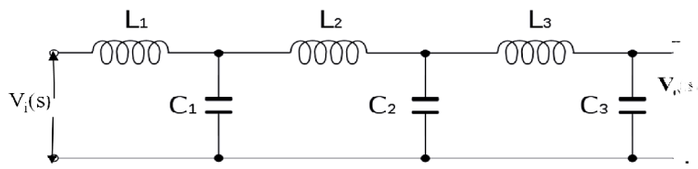

Figure for Q 3(b)

(c) Determine the value of K for which the system is slightly stable. (09)
$$\frac{C(s)}{R(s)} = \frac{K(s+2)}{s(s+5)(s^2+2s+5)+K(s+2)}$$

Q4. (a) Define absolute stability and relative stability. What are the different ways to check the stability of a system? (07)

(b) For the system represented by the following block diagram of Fig 4(b), determine: i) open loop transfer function ii) feed forward transfer function iii) control ratio iv) feedback ratio v) error ratio vi) closed loop transfer function vii) characteristic equation, viii) closed loop poles and zeros if K=10. (16)

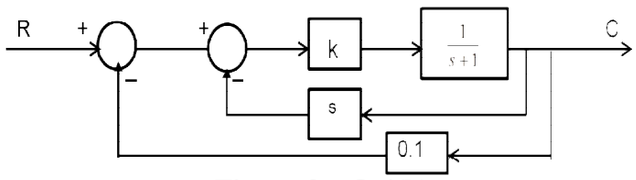

Figure for Q 4(b)

(c) Simplify the block diagram then obtain the closed loop transfer function $\frac{C(s)}{R(s)}$ of Fig 4(c). (12)

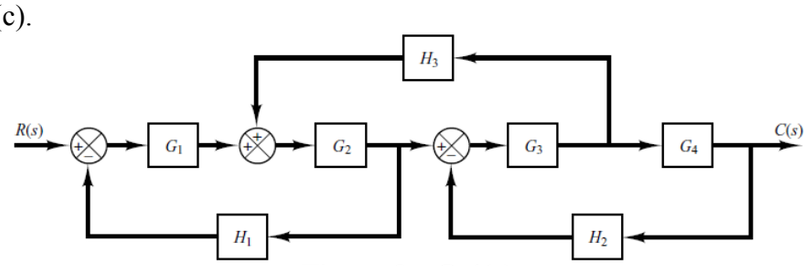

Figure for Q 4(c)

Section B

Q5. (a) Define root locus, breakaway point and angle of departure. (09)

(b) Sketch the root locus of the unity feedback system having the open loop transfer function as follows: $G(s)H(s)=\frac{k}{s^2(s+2)}$. Comment on the stability of the system. (20)

(c) What are the effects adding poles and zeros to open loop transfer function? (06)

Q6. (a) Explain how asymptotic approximations are made for 1st and 2nd order factors to draw the log magnitude plot of Bode diagram. (15)

(b) Draw the bode diagram of the following transfer function and comment on the stability $G(s)H(s)=\frac{54(s+4)}{s(s+1)(s^2+1.8s+36)}$. What are the gain and phase margins of this system? (20)

Q7. (a) What do you understand by lead, lag and lead-lag compensators? What are their applications? (12)

(b) Draw an op-amp lead compensator and derive the transfer function. (11)

(c) Explain how a lag compensator can reduce the steady state error. Calculate the zero-to-pole ratio to have steady-state error=0.1 for the following system: $G(s)=\frac{5s^2+6s+2}{4s^2+s+3}$ (12)

Q8. (a) Consider a unity feedback system with open loop transfer function $G(s)=\frac{4}{s(s+2)}$. Design a lead compensator so that the following requirements are met: i) $k_v=20\sec^{-1}$, ii) phase margin = 50° iii) gain margin = 20dB. (20)

(b) Consider the regulator system shown in figure below: (15)

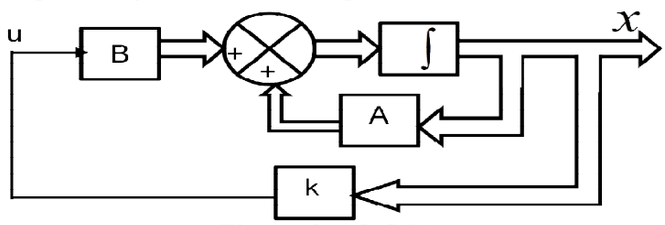

Figure for Q 8(b)

The plant is given by $\dot{x}=Ax+Bu$ where $A=\begin{bmatrix}0&1&0\\0&0&1\\-1&-5&-6\end{bmatrix}$, $B=\begin{bmatrix}0\\1\\1\end{bmatrix}$. By using the state-feedback control $u=-kx$, it is desired to have the closed-loop poles at $s=-2\pm j4$, $s=-10$. Determine the state-feedback gain matrix.

Khulna University of Engineering & Technology
B.Sc. Engineering 3rd Year 2nd Term (Regular) Examination 2018
Department of Electrical and Electronic Engineering
EE 3203
Power System Analysis-I

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 mark.

Section A

Q1. (a) What do you mean by skin effect and proximity effect? Explain their role in power system analysis. (08)

(b) What is line compensation? Describe series and shunt compensation with practical implications. (10)

(c) Explain why a charging current exists in a line even when it is open circuited at the load end. (07)

(d) Find the GMR of the each of the conductors shown in **Fig Q1(c)** in terms of the radius *r* of an individual strand. (10)

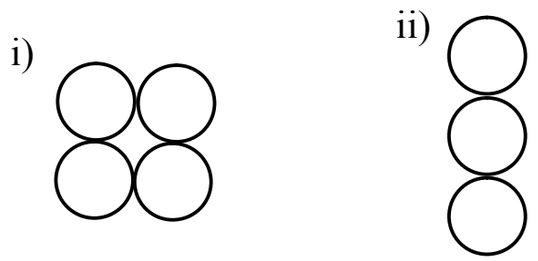

Fig. for Q1(c)

Q2. (a) What do you mean by transposition of conductors? Derive an expression for the inductance of three phase lines with unsymmetrical spacing. (13)

(b) What is mean by "coupling factor" between two overhead conductors? How can it be used to determine the voltage induced in a low voltage telephone line when running near a high voltage line? (10)

(c) A *3-φ* 60 Hz transmission line has its conductors arranged in a triangular formation so that two of the distances between conductors are *25 ft* and the third distance is *42 ft*. the conductors are ACSR Osprey. Determine the inductance and inductive reactance per phase per miles (Given GMR, D_s=*0.0284 ft*) (12)

Q3. (a) What is charging current? Find the capacitance of a three phase line with equilateral spacing and also find the equations of charging current. (12)

(b) "The effect of earth increases the capacitance of the line"- Justify the statement mathematically. (15)

(c) Calculate the capacitance to neutral in farads per meter of a single phase line composed of two single strand conductors each having a diameter of *0.229 in*. The conductors are *10 ft* apart and *25 ft* above ground. Compare the values considering the effect of ground and without the effect of ground. (08)

Q4. (a) Draw the phasor diagram of a short line and derive the expression for voltage regulation. (11)

(b) What is a receiving end circle diagram? How can it be drawn? What information does it provide? (09)

(c) The constants of a *3-φ* line are $A = 0.9\angle 2°$ and $B = 140\angle 70°$ *ohm* per phase. The line delivers *60 MVA* at *132 kV* and *0.8p.f.* lagging. Draw the circle diagram and find: i) Sending end voltage and power angle; ii) The sending end power and power factor; iii) Line loss. (15)

Section B

Q5. (a) What do you mean by visual critical voltage and critical disruptive voltage? Mention the method of reducing corona. (10)

(b) Explain the causes of failure of insulators. Also explain different types of test conducted on insulators. (13)

(c) A certain *3-φ* equilateral transmission line has a total corona loss of *53 kW* at *106 kV* and a loss of *98 kW* at *111 kV*. What is the disruptive critical voltage? What is the corona loss at *113 kV*? (12)

Q6. (a) What do you mean by sag and tension? Mention the effects of sag. (09)

(b) Derive the expression to calculate the sag and tension at the time of erection. Explain the techniques to reduce sag. (16)

(c) A transmission tower on a level ground gives a minimum clearance of *8 meters* for its lowest conductor with sag of *10 m* for a span of *300 m*. If the same tower is to be used over a slope of *1 in 15*, find the minimum ground clearance obtained for the same span, same conductor and same weather-conditions. (10)

Q7. (a) Mention basic requirements of underground cables. Explain the constructional details of underground cables. (11)

(b) "A graded cable can be used to work at more voltages than non-graded cable"- Justify the statement. Mention the limitation of intersheath grading. (15)

(c) Estimate the charging current drawn by a cable with three cores and protected by a metal sheath when switched on to an *11 kV*, *50 Hz* supply. The capacitance between two cores with the third core connected to the sheath is measured to be *3.7 μF*. (09)

Q8. (a) How corona is formed? Mention the effect of corona. How can the corona effect be minimized? (11)

(b) "Dielectric losses in a single core cable are directly proportional to the square of the system voltage"- Justify the statement. Use relevant diagram in your illustration. (14)

(c) A *132 kV* line with *1.956 cm* diameter conductors is built so that corona takes place if the line voltage exceeds *210 kV (rms)*. If the value of potential gradient at which ionization occurs can be taken as *30 kV/cm*, find the spacing between the conductors. (10)

Khulna University of Engineering & Technology
B.Sc. Engineering 3rd Year 2nd Term (Regular) Examination 2018
Department of Electrical and Electronic Engineering
EE 3205
Communication Engineering-I

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 mark.

Section A

Q1. (a) What are the basic components of a communication system? Explain the principle of a basic communication system depicting the functions of each part. (08)

(b) What is modulation? Why is modulation necessary in communication system? Define AM, FM and PM with necessary waveforms. (09)

(c) Describe the operation of an amplifier modulator for AM. (09)

(d) The equation of an AM wave is given by $s(t) = 20\left[1 + 0.8\cos\left(2\pi \times 10^3 t\right)\right]\cos\left(4\pi \times 10^5 t\right)$. Find the carrier power, the total sideband power and the bandwidth of AM wave. (09)

Q2. (a) Describe the process of generating frequency modulated signals. (08)

(b) What is superhetrodyne principle? Explain the function of each stage of superhetrodyne receiver with the help of a block diagram. (13)

(c) Write down the names of different detection techniques. How does a quadrature detector work? (10)

(d) Write down the merits and demerits of SSB. (04)

Q3. (a) What is noise in communication system? Describe its significance in evaluating the performance of a communication system. What are the common sources of electrical noise? (10)

(b) Derive the equation of equivalent noise resistance when two amplifiers are connected in cascade. (10)

(c) Calculate the noise voltage at the input of a television RF amplifier using an amplifier device having equivalent noise resistance of 180Ω and input resistance of 400Ω. The bandwidth of the amplifier is 7 MHz and the temperature is 305° K. (10)

(d) Derive the expression of maximum possible channel capacity for a Gaussian channel. (05)

Q4. (a) Define information rate and channel capacity. Show that the capacity of a white, band-limited Gaussian channel depends on bandwidth and SNR. (14)

(b) "The entropy will be maximum for equally likely events" – Justify the statement. (07)

(c) An alphabet consist of letters A,B,C,D. For transmission, each letter is encoded into a sequence of two binary (on-off) pulses. The A is represented by 11, the B by 10, the C by 01 and the D by 00. It takes 24 msec to transmit the alphabet set ABCD at a time. If the letters have equal pulse interval, calculate the average rate of transmission if the letters are equally likely to occur. (09)

(d) Prove that periodic functions do not contain information. (05)

Section B

Q5. (a) State and explain Nyquist sampling theorem with mathematical explanation. Show aliasing effect with time domain and frequency domain illustrations. With neat sketching mention different type of sampling. (14)

(b) Show that the quantization noise of a uniform quantizer is given by $\frac{\Delta^2}{12}$, where Δ is the step size of the quantizer. Also, derive the expression for output signal to noise ratio for a sinusoidal input. (11)

(c) A sampler is used to sample signals from four input channels having frequencies 1.0 kHz, 2.0 kHz, 3.0 kHz and 4.0 kHz. The signals are sampled at minimum Nyquist rate and encoded by 256-level encoder. If the obtained PCM sequences are time multiplexed, calculate the number of bits in a PCM frame, frame rate and bit rate. (10)

Q6. (a) Why non-uniform quantization scheme is used in voice communication? What is companding? Show the typical companding characteristics of a μ-law compander. (10)

(b) Why so many PCM waveforms are available? What properties must a PCM waveform have? Explain in details with necessary illustrations. (15)

(c) What is specialty of HDB signaling in comparison to bipolar signaling? Represent the HDB2 signaling for the following binary digits 10110000101101000000101000 01. (10)

Q7. (a) Mention different modulation techniques used in digital communications. Draw the modulated waveforms for the following binary sequence 01001101 for basic digital modulation system. (07)

(b) Compare the nominal bandwidth required for ASK, FSK and PSK modulations when logic '1'and '0' are modulated by carriers with frequencies 1.15 MHz and 1.0 MHz, respectively. Assume that the bit rate of the signal is 2.0 kb/s. (05)

(c) Explain, why frequency and phase synchronized carrier is required in synchronous detection system? Answer with necessary example. What are the techniques to be used for that purpose? (13)

(d) What is stuffing? Why it is needed? 24 voice channels with bandwidth 3.4 kHz are sampled at minimum Nyquist rate and encoded by 1024-level encoded. Calculate data rate at 1^{st} level (T-1 MUX) and 2^{nd} level (T-2 MUX) multiplexers. Assume that a framing bit and 136 kb overhead bits are needed, respectively, in 1^{st} level and 2^{nd} level multiplexers. (10)

Q8. (a) Describe M-ary QAM modulation system with necessary diagram of the receiver and transmitter. (14)

(b) What are M-ary modulations? Show that the bandwidth occupation in M-ary ASK/PSK modulation is reduced by a factor of '1/n' and increased by 'n' in M-ary FSK modulation, where 'n' is the number of bits used to form a symbol. (08)

(c) Calculate the separation between two symbols for 16-ary PSK and 16-ary QAM when symbols are formed by the bits having bit rates 300 kb/s and power 1 mW. From the results comment on the probability of error of the modulation systems. (08)

(d) What is BER? Calculate BER of a digital communication system whose SNR is 20 dB. (05)

Khulna University of Engineering & Technology
B.Sc. Engineering 3rd Year 2nd Term (Regular) Examination 2018
Department of Electrical and Electronic Engineering
EE 3213
Microprocessors, Microcontrollers and Peripherals

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 mark.

Section A

Q1. (a) Describe the architectural features of 8085 microprocessor. Explain the functions of flags and instruction pointer in the program control. (10)

(b) Draw the timing diagram of the instruction MOV A, 55H. Explain all the signals and activation of the signals. Is it wise to use same pins of 8085 to carry address and data information? (10)

(c) Explain the technique by which a microprocessor differentiates data from instruction and recognizes number of bytes of instruction. (07)

(d) The strong room of a bank is operated by a microprocessor based door lock system controlled by the manager, senior officer and cashier. They are all connected to a parallel input port of address $4D_H$. Write an assembly language program to implement it. (08)

Q2. (a) Explain the technique of generating 20 bit physical address using segment registers. (05)

(b) Describe the addressing modes of 8086 microprocessors. (10)

(c) Explain the applications of GPRs and instruction stream byte queue during program execution. (06)

(d) What are the differences between the 8086 and 8088 microprocessors? (06)

(e) Write down a simple assembly language program in 8086 to multiply two 32 bit numbers stored in memory and to store the 64 bit result in memory. (08)

Q3. (a) Show that the RISC processors are more suitable for high performance computing applications. Explain their advantages over CISC applications. (08)

(b) Explain the meanings of the following instructions: (i) MOV [7632_H], CX (ii) OUT DX,AL (iii) XCHG CH ES [BX], (iv) CORRECTION FACTOR EQU 0A H. (08)

(c) Describe the different data types of 8087 microprocessor. Show the stocks of 8087 and use of stack registers in computation. (10)

(d) Write an assembly language program in 8086 that reads the temperature of a cleaning bath solution and lights one of the two lamps according to temperature read. If the temperature is $< 30^\circ$ C a yellow lamp will be turned on. If the temperature is $\geq 30^0 C$ a green lamp will be turned on. (09)

Q4. (a) Draw the architectural block diagram of 80286 and explain the blocks. (10)

(b) Show the register organization of 80386. Explain the protected virtual addressing of 80386 microprocessor. (13)

(c) Describe the following features related to advanced microprocessors: i) Cache memory ii) Pipelining iii) Pagination. (12)

Section B

Q5. (a) Mention the differences between a microprocessor and a microcontroller. Write down the major features of a standard microcontroller. (12)

(b) Write down the assembly language program using ATmega microcontroller for controlling speed of a dc motor. (13)

(c) Define bit rate and band rate. What is asynchronous and synchronous data communication? Explain the operation of an 8251. (10)

Q6. (a) What are the modes of data transfer? Make a comparison table among polled I/O, interrupt-driven I/O and direct memory access I/O. (12)

(b) Specify the handshake signals and their functions if port of the 8255 is set up as an output port in Mode 1. (15)

(c) Describe the function of the following lines- RESET of 8255, I/O Read, I/O Write, A_0, A_1 of 8255 chip. (08)

Q7. (a) What is he necessity of having DMA in microprocessor environment? (05)

(b) Showing the main block diagram describe the DMA transfer steps with associated signals and controllers. (18)

(c) What are meant by vectored and non-vectored interrupts? (06)

(d) What is a protocol? Show the high level data link control protocol. (06)

Q8. (a) What are meant by ROM, PROM, EPROM, EEPROM? (04)

(b) What is a memory map? Design a memory map of 1 Kbyte memoy with CS and decoder (3×8). Set the CS logic when line 4 of decoder is set and mention the lower and higher address. (12)

(c) Draw a timing diagram of interrupt process when INTR and $\overline{INTA}$ lines are working sequentially. (08)

(d) Show internal configuration of ATMEL328 microcontroller. (11)

Khulna University of Engineering & Technology
B.Sc. Engineering 3rd Year 2nd Term (Regular) Examination 2018
Department of Electrical and Electronic Engineering
EE 3219
Electrical Engineering Materials

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 mark.

Section A

Q1. (a) Define Bravais lattice and unit cell. How the direction of crystal is defined? Draw the following: i) *(120)* and ii) *(110)* planes in the unit cell of a cubic crystal. (10)

(b) What is the condition of forming a bond when two atoms of infinite distance come closer? Describe the Van der Waals bonding. (11)

(c) With neat sketch, briefly discuss the major crystal defects. Also explain the effects of these defects in electrical properties. (14)

Q2. (a) Mention the drawbacks of classical free electron theory. From classical Drude model show that the conductivity of a metal is $\frac{ne^2\tau}{m}$, where the symbols have their usual meaning. (17)

(b) Briefly describe the analogy between Ohm's law and Fourier's law. (08)

(c) Given that the mean speed of conduction electrons in copper is $1.5\times10^6 ms^{-1}$ and the frequency of vibration of the copper atoms at room temperature is about $4\times10^{12} s^{-1}$, estimate the drift mobility of electrons and conductivity of copper. The density, *d* of copper is $8.96\ gcm^{-3}$ and the atomic mass, M_{at} is $63.56\ g\ mol^{-1}$. (10)

Q3. (a) Find the expression for electron wave function and energy trapped in an infinite potential well, with respect to well width. From these expression, show that the energy of the confined electron is quantized. (17)

(b) What is electron effective mass? How can we get electron effective mass from electronic band structure? (08)

(c) Briefly explain how the discrete energy levels or wave function of individual atoms form energy bands in a crystal. (10)

Q4. (a) Briefly explain the significance of nanotechnology and its trends. (10)

(b) Derive the E-K relationship for an one dimensional system bound by infinite potential (infinite quantum well) and show that both energy and momentum of a particle present if the system is quantized or discrete. (15)

(c) Why organic materials are becoming popular in emerging electronics? Mention some applications of organic material in devices. (10)

Section B

Q5. (a) What is dielectric material and dielectric constant? "The dielectric constant of a material has a real and imaginary component". Write down their significance. Also show the frequency dependent plot of these components. (10)

(b) Derive the Clausius-Mossotti equation and show that it allows the calculation of macroscopic property from microscopic polarization phenomenon. (15)

(c) How dipolar polarization can take place in a dielectric? Mention its application. (10)

Q6. (a) What is dielectric loss? Explain its frequency dependence. Show that the dielectric loss per unit volume is given by $W_{vol} = \omega E^2 \varepsilon_0 \varepsilon_r' \tan\delta$, where the symbols have their usual meaning. (18)

(b) Establish the boundary conditions of Gauss's law for parallel plate capacitor having multiple layers of dielectrics. (10)

(c) How partial discharge can make a dielectric breakdown of material? (07)

Q7. (a) "Material crystal structure of hexagonal unit cell satisfy the orientation of showing piezoelectricity".- Justify with schematic illustration. (08)

(b) Explain the Meissner effect in superconductor. The Meissner effect does not seem to be used as primary source of levitation in MagLev trains. Why is that? (10)

(c) What is type I and type II superconductors? Why do all engineering applications of superconductors invariably use type-II materials? (10)

(d) A toroidal coil with a ferrite core of *300 turns* is used in HF work with small signals. The mean diameter of the toroid is *2.5 cm* and the core is *0.5 cm*. if the core is Mn-Zn ferrite. What is the approximate inductance of the coil? (07)

Q8. (a) Why the electronic polarization within an atom is quite small compared with the polarization due to the valence electrons in the covalent bonds within solid? (09)

(b) Briefly explain different types of magnetic materials with proper examples and applications. (14)

(c) Explain the photon absorption process in a semiconductor. What do you mean by thermalization? (12)