BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 423** (Numerical Methods)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Use Romberg integration scheme to evaluate the following integration: **(13)**

$$I = \int_0^2 xe^x \cos x \, dx$$

Show three calculation steps and use trapezoidal rule for the first step.

(b) Consider the following data table: **(10)**

x_i	1	2.5	4
$f(x_i)$	2	1	–3

Use Bezier curves to approximate the value of f(3).

(c) The current through a circuit from $t_1 = \frac{1}{2}(3 - \sqrt{3})$ to $t_2 = \frac{1}{2}(3 + \sqrt{3})$ time is shown in Fig. 1(c). **(12)**

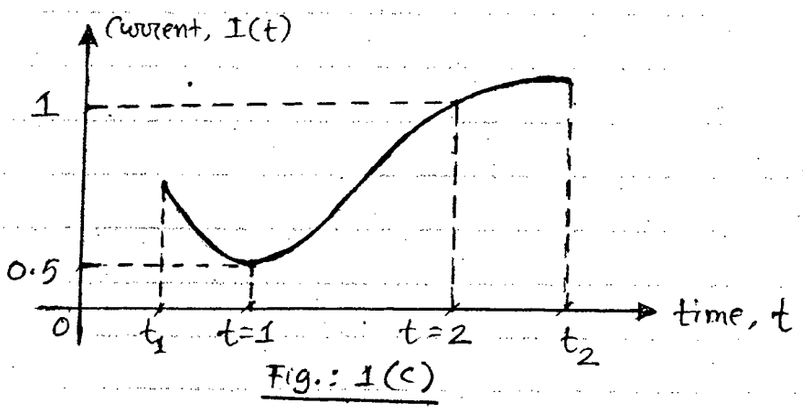

Fig.: 1(c)

Calculate the total charge transferred through the circuit from time t_1 to t_2 $\left[Q(t) = \int_{t_1}^{t_2} I(t)\,dt\right]$. Do not use any assumptions regarding the I(t) curve and use only the two values given in the figure.

2. (a) Consider the following Eigen value problem: **(17)**

$$\frac{d^2\Psi(x)}{dx^2} + \frac{2mE}{\hbar^2}\Psi(x) = 0; \quad \psi(0) = 0, \psi(4) = 0$$

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Contd ... Q. No. 2(a)

The uniform solution space spans from x = 0 to 4 with step size h = 1. Construct the matrix and explain how the Eigen energies, E can be calculated. Here, m and $\hbar$ are constants. Do not use any assumption.

(b) Use Fadeev-Laverrier method to find the characteristic equation of matrix A. **(12)**

$$A = \begin{bmatrix} 6 & 0 & 1 & 0 \\ 0 & 5 & 0 & 2 \\ 1 & 0 & 8 & 0 \\ 0 & 1 & 0 & 4 \end{bmatrix}$$

(c) Suppose it is required to find the roots of the characteristic equation of matrix A in Q. 2(b) using numerical methods. If bracketing methods are to be used, explain how the initial guesses can be selected without plotting the equation. **(6)**

3. (a) Construct the matrix to solve the following 2D Poisson's equation: **(22)**

$$\nabla^2\phi = \frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} = -\frac{\rho}{\epsilon}$$

The geometry, the mesh grid and the boundary values are shown in Fig. 3(a). Consider $\rho = 8$ (constant) and $\epsilon = \begin{cases} 2, & \text{for the shaded region} \\ 1, & \text{elsewhere} \end{cases}$

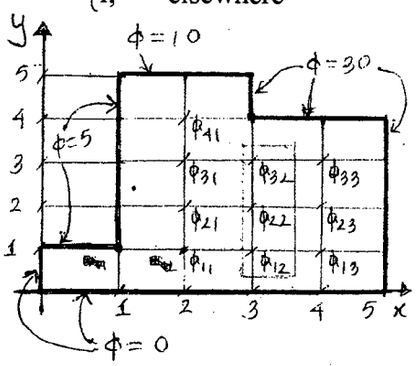

Fig 3(a)

(b) Find the LU decomposition of the following matrix A. Can Cholesky decomposition be used in this case? Justify your answer. **(13)**

$$A = \begin{bmatrix} 2 & 8 & 0 & 0 & 0 \\ 8 & 2 & 8 & 0 & 0 \\ 0 & 4 & 2 & 4 & 0 \\ 0 & 0 & 8 & 2 & 8 \\ 0 & 0 & 0 & 2 & 2 \end{bmatrix}$$

4. (a) Consider the following data table: **(10)**

x_i	−1	0	1	2
$f(x_i)$	8	1	−6	15

Use Lagrange interpolation to find f(0.5).

Contd P/3

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Contd ... Q. No. 4

(b) In which cases will interpolation and least squares regression produce identical curves? **(5)**

(c) Suppose $x_1, x_2, \ldots\ldots, x_n$ are roots of the n^{th} Legendre Polynomial $P_n(x)$ and that for each $i = 1, 2, \ldots\ldots, n$, the numbers, c_i are defined by: **(20)**

$$c_i = \int_{-1}^{1} \prod_{\substack{j=1 \\ j \neq i}}^{n} \frac{x - x_j}{x_i - x_j} \, dx$$

If P(x) is any polynomial of degree less than 2n, then show that

$$\int_{-1}^{1} P(x)\,dx = \sum_{i=1}^{n} c_i \, P(x_i)$$

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

Assume any reasonable value, if necessary.

5. (a) Using RK method of order four, solve the following ODE from x = 0 to 0.4 **(17)**

$$\frac{dy}{dx} = e^{-3x} + x^2 + y - 1$$

Use initial condition y(0) = 0.5 and step size, h = 0.2.

(b) Derive the equation for second order RK method. Show that, the mid point method formula can be obtained from the drived equation. **(18)**

6. (a) Solve the following Neumann boundary value problem using finite element method. **(22)**

$$\frac{d^2y}{dx^2} + 12 = 0, \qquad x = 2 \text{ to } 5, \text{ step size, } h = 1$$

$$\left.\frac{dy}{dx}\right|_{x=2} = 48; \qquad \left.\frac{dy}{dx}\right|_{x=5} = -12$$

Write your answers in tabular form.

(b) Show that, the Newton-Raphson method for solving non-linear equations is quadratically convergent. **(7)**

(c) Find the root of the following non-linear equation using Newton-Raphson method: **(6)**

$$y = x \cos x - \pi/2$$

Use initial guess x = 2.5. Show 2 iterations.

Contd P/4

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7. (a) Consider the following data table: **(17)**

x_i	−1	0	1	2
$f(x_i)$	9	8	9	0

Using divided difference interpolation, find the value of f(1.6). If an additional data point (3, −55) is introduced, what will be the new interpolation value of f(1.6)?

(b) Fit the curve $x^2y^3 = ae^x + bx^2$ through the following data points: **(13)**

x	1	2	3	4
y	6.718	8.695	12.965	20.650

[Hint: Generalized non-linear regression may not be necessary].

(c) How can Lagrange interpolation equations be modified for numerical differentiation? **(5)**

8. (a) Use Richardson extrapolation technique to show that an approximate expression of first derivative is given by: **(14)**

$$f'(x) = \frac{4}{3} D\left(\frac{h}{2}\right) - \frac{1}{3} D(h)$$

Also show that this approximate has an error in order of $O(h^4)$.

(b) Find the root between 0 and 1 of the following equation using Muller's method: **(15)**

$$3x + \sin x - e^x = 0$$

Show 2 iterations.

(c) From the data points of question 7(b), calculate $f'(3.5)$ using center difference formula. **(6)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 425** (Biomedical Instrumentation)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Describe ionic characteristics of a typical human cell. Describe the formation of resting and action potential in cells and write their significance. **(17)**

   (b) Draw a typical ECG and define its parameters. Describe the phenomena that occur in the right portion of heart in a cardiac cycle. **(18)**

2. (a) Define ECG lead and write the necessity of using 12 leads in the process of diagnosis. Explain what possible changes do occur in an ECG due to abnormality and why – explain. **(18)**

   (b) Describe a theory to explain the genesis of QRS complex of ECG. Explain BBB and its consequences. **(17)**

3. (a) Define MHR, IHR and HRV and explain their importance. Describe geometrical method to analyze HRV and show its relation with spectral method. **(20)**

   (b) Define biometrics and describe its design factors. **(15)**

4. (a) Define transducer and electrode. Briefly describe different body-surface electrodes used to measure biosignals. **(18)**

   (b) Describe the method of direct measurement of blood pressure. Explain the operation of a diastolic pressure detector circuit. **(17)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the principal components of an MRI scanner? What are the primary functions of the static magnetic field $\vec{B}_0$ in an MR imaging? **(8)**

   (b) For the following nuclei, do their spin quantum numbers take an integral, half-integral or zero value? For each case, discuss whether the nucleus is NMR-active. **(10)**

   (i) ^{1}H, ^{2}H, (ii) ^{16}O, ^{17}O,

   (iii) ^{12}C, ^{13}C, (iv) ^{31}P, ^{23}Na

   (c) Briefly explain different contrast mechanisms that are used in an MRI. **(12)**

   (d) Explain why shim coils are necessary in an MR imaging. **(5)**

Contd P/2

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6. (a) In radiographic imaging, why are low-energy photons undesired? What measure can be taken to reduce the number of low-energy photons entering the human body? **(10)**

   (b) What is beam hardening? What are the causes of beam hardening? **(8)**

   (c) Why are iodine and barium commonly used as contrast agents? **(9)**

   (d) Why is Compton scattering bad for the images produced by using projection radiography? **(8)**

7. (a) Describe serological and bacteriological tests of blood. Briefly describe the counting of blood cells by aperture impedance cell counter. **(17)**

   (b) With a block diagram, define the transmittance and absorbance of light in a colorimeter and hence write Beer's law. Describe the calibration procedure of a colorimeter. **(18)**

8. Write short notes on: **(12+12+11)**

   (a) Ultrasound imaging modes

   (b) Impedance cardiography

   (c) Noise in ECG measurement

Extra

L-4/T-2/EEE Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 439** (Mobile Cellular Communication)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Answer in brief and to the point.

1. (a) What is GSM? What do you understand by the uplink and downlink frequencies? Why is uplink frequency always kept lower than the downlink frequency in mobile cellular communication? **(6+3=9)**

   (b) Mention the frequency related specifications of the P-GSM 900, GSM 1800 and GSM 1900 standards. If the carrier frequency allocated to a GSM subscriber in downlink is 914.9 MHz, what is the corresponding carrier frequency allocated in the uplink? Why is the difference maintained? **(9+5=14)**

   (c) With a neat sketch enumerate the basic steps of establishing a call from a PSTN subscriber to an MS. **(12)**

2. (a) Differentiate between multiplexing and multiple access techniques. Mention the basic principles of FDMA, TDMA and CDMA. **(4+6=10)**

   (b) With an appropriate block diagram, explain, how the digital signals of two subscribers are transmitted and detected at the corresponding MSs in a DS-SS CDMA system. Assume digital signals and appropriate PN-code sets. **(15)**

   (c) Mention the major advantages of CDMA technique. **(5+5=10)**

   Test whether the following PN-codes are orthogonal.

   $x \equiv \{1, -1, -1, 1\}$ and

   $y \equiv = \{-1, -1, +1, +1\}$

3. (a) Draw the shapes of hexagonal, ideal and real geographical cells for the mobile cellular communication environment. **(6)**

   (b) What is channel allocation? How can the blocking probability for a call originated in a cell can be minimized? **(5+12=17)**

   Name and define the basic channel allocation schemes. Also, mention the relative merits and demerits of FCA and DCA schemes.

   (c) With a neat sketch, describe the special channel allocation scheme for the one-dimensional micro-cellular system in a highway. **(12)**

Contd P/2

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4. (a) Draw the basic block diagram that includes the GSM network sub-systems and mention the function of each block. **(5+9=14)**

(b) What is hand-off or handover? Distinguish between soft handover, hard handover and dropped call. **(8)**

(c) Name the various types of handover schemes possible in terms of its control mechanisms. **(3+10=13)**

With a neat sketch, describe the handover process that take place between cells controlled by different BSCs but the same MSC/VLR.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What circumstances did compel the mobile operators to use the "cellular" concept in mobile wireless communication? Explain what special techniques are used to implement the concept. **(5+7)**

(b) Describe the functions that as MS can undergo in detached, idle and active modes. Describe the sequence of events that take place when a subscriber turns his/her MS ON from an OFF state. **(6+5)**

(c) Distinguish between analog and digital mobile communication systems. **(6+6)**

If a total 7.5 MHz bandwidth is allocated to an analog cellular system (FDMA), which uses 30 KHz wide channel for both voice and control, compute the number of channels per cell if the system uses 7-cell reuse. Also calculate the total capacity if frequency is reused 20 times.

6. (a) What is a co-channel cell? With neat sketches describe the method of locating a co-channel cell in a neighboring cluster. **(10)**

(b) What is co-channel interference? Comment on the acceptable limit of Carrier to Interference (C/I) ratio in a mobile cellular environment. Derive the C/I ratio for a mobile cellular communication system with a frequency reuse factor of N, and show that to meet the minimum acceptable limit of the C/I ratio the required value of N is 7. **(15)**

(c) With necessary diagrams, describe the cell splitting and cell sectoring techniques and comment on how they improve the C/I ratio. **(10)**

7. (a) What is fading? Explain different multi-path fading and their consequences. **(7+5)**

A line of sight communication link operating at 30 MHz has the transmitting antenna height of 30 meters and receiving antenna height of 20 meters. Calculate the maximum distance between the transmitting antennas for reliable communication.

Contd P/3

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Contd ... Q. No. 7

(b) What is shadowing effect? Show the log-distance path loss model for real environment with shadowing. **(7+6)**

What is the received power (in dBm) in the free space of a signal whose transmit power is 1 W and carrier frequency is 2.4 GHz if the receiver is at a distance of 1.8 km from the transmitter? What is the path loss in dB? Assume that the transmitter and receiver antenna gains are 1.7.

(c) Distinguish between diffraction and scattering mechanisms of radio wave propagation. **(5+5)**

What is the coverage area of a base station that transmits a signal at 2 kW given that the receiver sensitivity is –100 dBm, the path loss at the first meter is 32 dB, and the path loss gradient is $\alpha = 4$?

8. (a) Name the types of antenna to be used for the purposes of coverage and interference reduction. What is antenna front-to-back ratio? Mention its special significance. **(6+6)**

Draw the gain patterns of a 6 dB and 9 dB omnidirectional high gain antenna and highlight the difference between the two patterns.

(b) Define isotropic, directional and omnidirectional antennas. Describe the principles of set-up channel antennas and diversity antennas at the cell site. **(5+6)**

(c) Draw the block diagram of a cell-site antenna system to start-up a new BTS (include the diversity receivers). Show the cell site antenna locations for 45 and 90 voice channels. **(5+7)**

EXTRA

L-4/T-2/EEE Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 459** (OptoElectronics)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Discuss basic recombination transitions in semiconductors. How do these transitions contribute to photoemission process? **(15)**

   (b) Compare GaAs, GaP and $GaAs_{1-x}P_x$ as LED materials. Discuss when LEDs are preferred to fabricate on GaP substrates compared to GaAs substrates. **(10)**

   (c) Determine the linewidth in the emission spectrum of LEDs designed to emit peak wavelength of 870 nm and 1500 nm. Assume the width of the relative light intensity spectrum. **(10)**

2. (a) Why DH LED is much more efficient than the homojunction LED? Explain with energy band diagram. **(15)**

   (b) Describe LED structures commonly used for optical-fiber communications and discuss their merits and demerits. **(10)**

   (c) What is luminous efficiency? Design an LED to obtain high luminous efficiency. **(10)**

3. (a) How intrinsic photodetector is different to that of extrinsic photodetector? Draw the schematic of a photodiode structure suitable for detecting 1.55 μm light. **(15)**

   (b) A Si p-i-n photodiode is illuminated by 150 nW of 950 nm light. The quantum efficiency of the device is 60% and its dark current at reverse bias that it is operated is negligible. Calculate the photocurrent and the rms noise current if B = 6 MHz. **(10)**

   (c) Explain the operation of a SAGM avalanche photodiode. Discuss the merits and demerits of super lattice APDs. **(10)**

4. (a) How is the load impedance across a pn-junction solar cell optimized to receive maximum power? Define efficiency of a PV cell. Discuss the factors to be considered to increase efficiency of the cell. **(20)**

   (b) Compare heterojunction and tandem cells. Show schematically the design of a cascaded cell to absorb in the spectral energy range of 0.7 eV to 2.0 eV. **(15)**

Contd P/2

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Prove that for a direct bandgap semiconductor the excess minority carrier lifetime is inversely proportional to the majority carrier concentrations. **(10)**

(b) With a neat diagram explain the Rayleigh scattering process. **(7)**

(c) Explain why the bandgap in a nondegenerate semiconductor is slightly narrower than the bandgap of a degenerate semiconductor. **(6)**

(d) An optical beam irradiating an intrinsic GaAs produces $0.5 \times 10^{23}/cm^3/s$ electron-hole pairs. The steady-state concentration of photoelectrons is $10^4/cm^3$. The intrinsic carrier concentration in GaAs is $10^5/cm^3$. Find the electron/hole recombination lifetime. Also find the radiative recombination coefficient. **(6)**

(e) A 0.46 μm thick sample of GaAs is illuminated with monochromatic light. The absorption coefficient is 5×10^4 /cm. The power incident on the sample is 10 mW. Find the total energy absorbed by the sample per second. **(6)**

6. (a) Consider a He-Ne gas laser operating at 632.8 nm. The tube length is 40 cm, tube diameter is 1.5 mm and mirror reflectances are approximately 99.9% and 98%. The linewidth is 1.5 GHz, the loss coefficient is 0.05/m, spontaneous decay time constant is 300 ns. The refractive index is 1. What is the threshold gain and the population inversion? **(10)**

(b) A quantum well laser has an active InGaAs of bandgap 0.7 eV and thickness 10 nm between two layers of InAlAs (bandgap is 1.45 eV). Effective mass of electrons in InGaAs is 0.04 m_e and that of the holes is 0.44 m_e, where m_e is 9.11×10^{-31} kg. Calculate the first and second electron energy levels above E_c and the first hole energy level below E_v in the quantum well. What is the lasing emission wavelength for this laser? What is this wavelength if the transition were to occur in bulk InGaAs with the same bandgap? The Plank's constant is 6.6261×10^{-34} J s. **(12)**

(c) What is gain guided laser diode? What are the benefits and drawbacks of such lasers? How the efficiency of such lasers can be improved? **(13)**

7. (a) Calculate the approximate Doppler broadened linewidth for the He-Ne laser transition (λ = 632.8 nm) assuming a gas discharge temperature of about 400 K. Take the relative atomic masses of neon to be 20.2 gm/mol. Compare the result with the observed linewidth between the half-intensity points. **(10)**

Contd P/3

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Contd ... Q. No. 7

(b) Consider a double heterostructure InGaAsP semiconductor laser operating at 1310 nm. The cavity length L = 60 μm, width = 10 μm and d = 0.25 μm. The refractive index is 3.5. The loss coefficient is 10/cm. Find the total attenuation coefficient and the photon lifetime. If the threshold current density is 500 A/cm^2 and the electron lifetime is 10 ps then what is the threshold electron concentration? **(10)**

(c) With a neat diagram explain the Poynting vector "walk-off" effect. **(7)**

(d) "Only crystals that are noncentrosymmetric exhibit Pockels effect" – Explain. **(8)**

8. (a) Show that a linearly polarized light wave can be represented by two circularly polarized light waves of opposite direction. **(10)**

(b) Consider a light wave traveling along z with field components E_x and E_y along x and y. The Jones vector, $J = \begin{bmatrix} \cos\theta \\ \sin\theta \end{bmatrix}$. Identify the state of polarization of this light wave. **(10)**

(c) What is photoelastic effect? How a periodic variation in refractive index can be obtained in a piezoelectric crystal? **(10)**

(d) Given that ZnS has Verdet constant of about 22 minutes of arc Gauss^{-1} meter^{-1} at 589 nm. Calculate the necessary magnetic field for a rotation of 1° over a length of 10 mm. Note that 60 minutes of arc = 1°. **(5)**

Extra

L-4/T-2/EEE **Date : 10/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 479** (Power System Reliability)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) A power system has the generator and load model as shown in Fig. for Q. No. 1(a). The LOLP of the system is 3.6024%. Determine the probabilities of occurrence of the load 300 MW and 1000 MW. **(15)**

Generator Model

Generator	Capacity (MW)	FOR
G1	200	0.05
G2	300	0.04
G3	500	0.03

Load Model

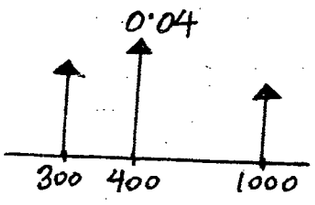

Fig. for Q. No. 1(a)

(b) A power plant consists of three units with probability distributions as shown in Fig. for Q. No. 1(b). **(20)**

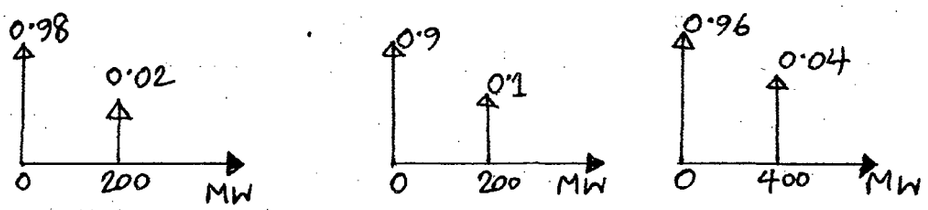

Fig. for Q. No. 1(b)

The peak load for the plant is 400 MW. Calculate the LCC of the plant if an additional unit of 300 MW capacity is added to the plant. The FOR of this additional unit is 0.03.

2. A power system has the generator and load models as shown in Fig. for Q. No. 2. Using cumulant method evaluate the reliability index 'LOLP' for this power system. **(35)**

Generator Model

Generator	Capacity (MW)	FOR
G1	5	0.2
G2	10	0.1

Load Model

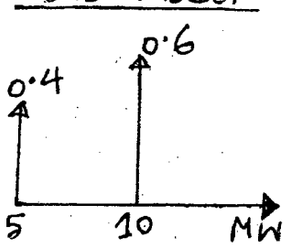

Fig. for Q. No. 2

Contd P/2

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Contd ... Q. No. 2

Given :

$$f(z) = N(z) - \frac{G_1 N^{(3)}(z)}{3!} + \frac{G_2 N^{(4)}(z)}{4!} + \frac{G_3 N^{(5)}(z)}{5!} + \ldots\ldots\ldots\ldots$$

$$N^{(r)}(z) = -(r-1) N^{(r-2)}(z) - z N^{(r-1)}(z)$$

$$t = \frac{1}{1+rz}, \; k_1 = M_1, \; k_2 = M_2, \; k_3 = M_3,$$

$$k_4 = M_4 - 3M_2^2, \; k_5 = M_5 - 10M_2M_3$$

$$r = 0.2326419, \; b_1 = 0.31938153,$$

$$b_2 = -0.356563782, \; b_3 = 1.781477937$$

3. (a) Compare segmentation method with cumulant method. **(5)**

(b) Derive an expression of unit availability (p) and FOR (q) of a generator with the help of "Run-Repair-Run" cycle. **(10)**

(c) A power system planner proposes a plan consisting two generating units of capacities 30 MW and 40 MW with FORs of 10% and 20%, respectively. The forecasted peak demand (L) is Gaussian in nature with the following impulse equation: **(20)**

$$p(L) = 0.3\delta(L-30) + 0.4\delta(L-50) + 0.38\delta(L-70)$$

where p(L) = probability of occurrence of L. Evaluate LOLP of the proposed system.

4. (a) What are the benefits of interconnections in power systems? **(5)**

(b) Two power systems, X and Y, are connected through a tie line of capacity 10 MW. The generator and load data of the two systems are shown below: **(30)**

System	Generator ID	Capacity (MW)	FOR	Peak load (MW)
X	G1	10	0.2	15
	G2	30	0.1	
Y	G3	15	0.1	20
	G4	25	0.3	

Determine $LOLP_X$, $LOLP_Y$, $LOLP_{X|Y}$, $LOLP_{Y|X}$ and $LOLP_G$.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Derive $R_{sys} = f(R_i)$ and $Q_{sys} = f(Q_i)$ for the system shown in Fig. for Q. NO. 5(a). **(15)**

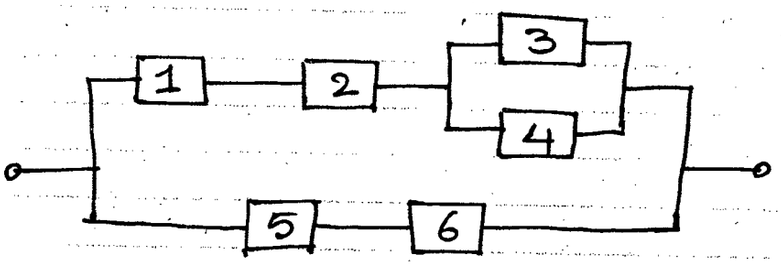

Fig for Q. NO. 5(a)

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Contd ... Q. No. 5

(b) For the generator model and load duration curve (LDC) of a power system as shown in Fig. for Q. No. 5(b), determine LOEP. **(20)**

Generation Model

Generator	Capacity (MW)	FOR
G1	10	0.1
G2	20	0.2
G3	30	0.3

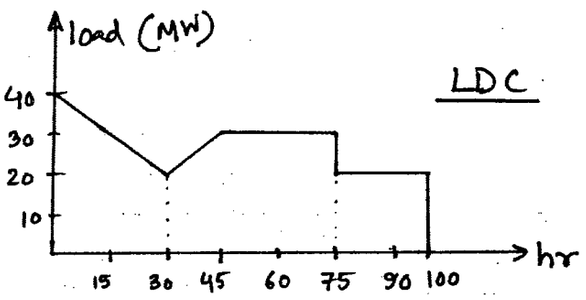


Fig. for Q. No. 5(b)

6. (a) For a continuous time system, if the hazard rate (λ) is independent of time, show that system reliability, $R(t) = e^{-\lambda t}$. **(15)**

(b) The historical average load is shown in Fig. for Q. No. 6(b). Develop the PDF and CDF of load and also evaluate its mean, variance and standard deviation. **(20)**

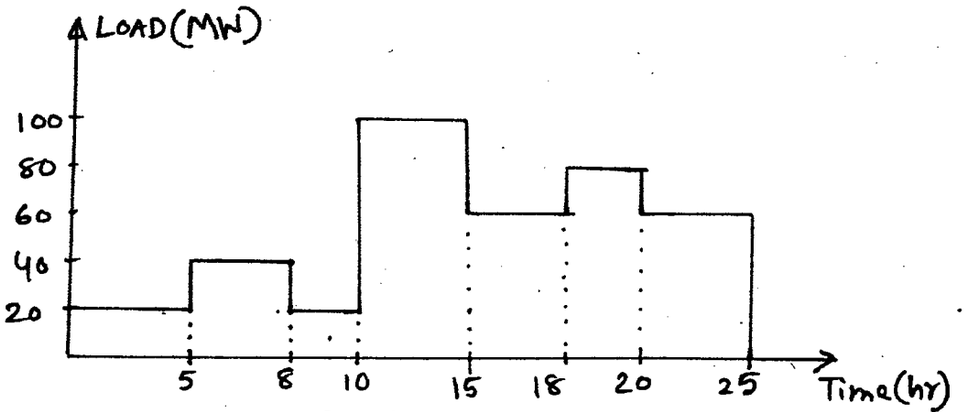


Fig. for Q. No. 6(b)

7. (a) A system has to be designed with overall reliability of 0.978 using the components with individual reliability of 0.85. What is the minimum number of components that must be connected in parallel? **(12)**

What will be the reliability of the system if these identical components are connected in such a way that all components must work for system success?

(b) Using Segmentation method, calculate the reliability index LOLP for the generator and load model as shown in Fig. for Q. No. 7(b). **(23)**

Generator Model

No. of Units	Capacity (MW)	FOR
2	10	0.2
1	25	0.1

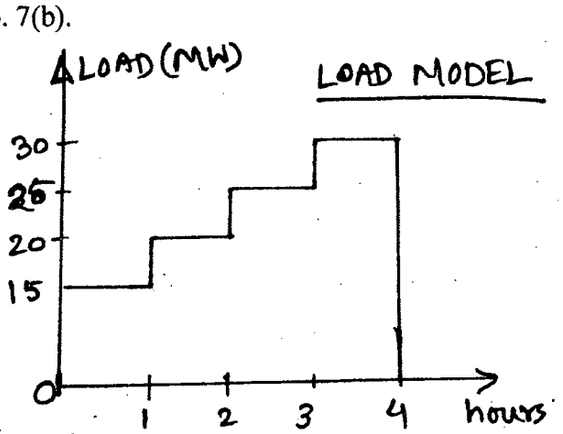


Fig. for Q. No. 7(b)

contd P/4

EEE 479

8. (a) Derive the expression of variance of a random variable, x. **(5)**

(b) The generator and load model of a power system is shown in Fig. for Q. No. 8(b). Calculate 'LOLP' of the system using Recursive technique. **(30)**

Generator Model

Generator	Capacity (MW)	FOR
G1	20	0.1
G2	30	0.3
G3	40	0.2

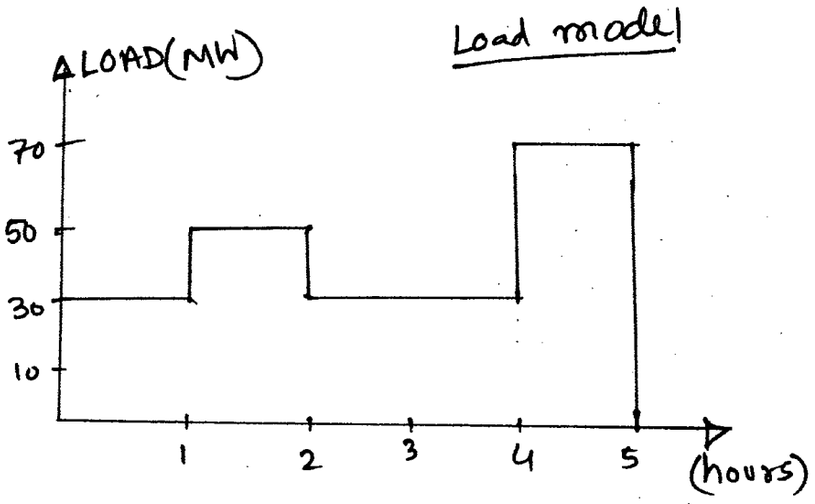


Fig. for Q No. 8(b)

L-4/T-2/EEE Date : 17/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 491** (Multimedia Communications)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Define the following with proper example: strongly periodic media stream, aperiodic media stream, weakly regular media stream. **(8)**

   (b) What are the basic properties of multimedia stream? **(6)**

   (c) What is the significance of chrominance and luminance in a video signal? **(7)**

   (d) Describe briefly how flickering is reduced in the display unit. **(7)**

   (e) What do you mean by entropy encoding technique? Why is arithmetic coding preferred over Huffman coding? **(7)**

2. (a) Briefly describe the steps of JPEG compression technique with contribution towards compression of each step. **(13)**

   (b) How does progressive picture representation provide different QoS (Quality of Service) of images? **(5)**

   (c) Consider three components of an image with the following resolutions: **(10)**

   $H_1 = 250, V_1 = 200;\quad H_2 = 500, V_2 = 100;\quad H_3 = 250, V_3 = 100$

   Show the first 4 MCUs (Minimum Coded Units) and the first block during image preparation of a JPEG image.

   (d) Describe how the Bangladeshi Television Channels are provided to a Bangladeshi locality in USA. How does this scenario differs in a locality where there are very few Bangladeshis? **(7)**

3. (a) Show the difference between H.261 and MPEG video encoding standards with proper explanations. **(10)**

   (b) Which frame in MPEG streams achieves the highest compression? Explain with necessary figures. **(8)**

   (c) Define motion vector for video compression. Show with examples how the motion is calculated from one frame to another while decoding compressed video. **(10)**

   (d) "Digital Television can reduce the cost of Bandwidth" – Justify. **(7)**

Contd P/2

CSE 491 (EEE)

4. (a) H_1, H_2, H_3 are three hosts connected in the following network. Each of them wants to send multimedia stream and receive multimedia stream sent from the others. Show the configuration of routers if no filter reservation scheme is followed using RSVP. **(12)**

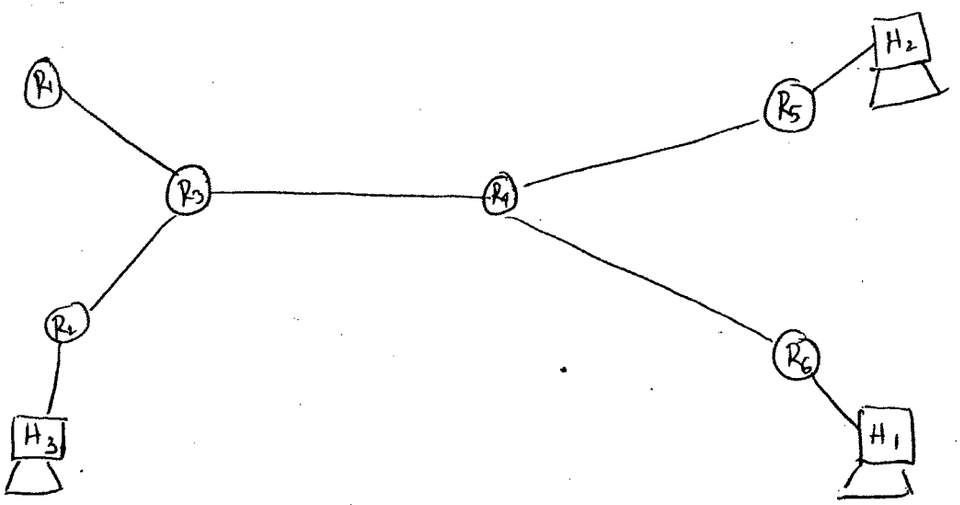


Fig for Q. 4(a)

Describe a scenario in the above mentioned network to demonstrate the difference between fixed filter and dynamic filter reservation scheme.

(b) What is the significance of refreshing in RSVP? **(7)**

(c) What the major issues of Multimedia Database Management Systems in addition to Database Management System? **(6)**

(d) Consider four databases as follows: **(10)**

(i) imagedB containing several still images of a convocation party.

(ii) recorddB containing the records of grades of the students.

(iii) audiodB containing collection of songs

(iv) videodB containing collection of movies

Let there be unified index for recorddB and audiodB. But each of the other two databases has proprietary indexing. Write SQL from this hybrid representation to find the celebrities (singer or movie artist) who have pictures with "University President Jahangir" and CGPA above 3.75. Assume the functions necessary for different databases.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Explain with examples, intra-object synchronization and inter-object synchronization. **(5)**

(b) Discuss the comparative advantages and disadvantages between three main approaches for the delivery of the synchronization information to the sink. **(10)**

(c) What are the requirements that should be fulfilled by multimedia synchronization methods? **(6)**

(d) Show 10 operations in the enhanced interval-based synchronization specification method. What are the drawbacks of this method? **(10+4)**

Contd P/3

CSE 491 (EEE)

6. (a) What are the characteristics of multimedia database management system? **(5)**

   (b) What are the indexing strategies used in multimedia database? Explain. **(10)**

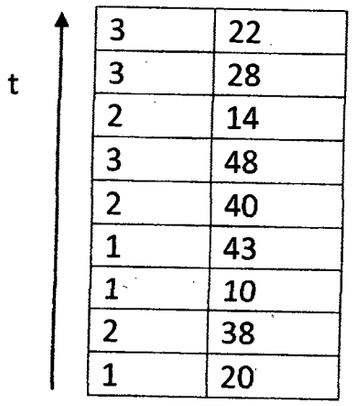
   (c) Show the resource management architecture in multimedia communication systems. What is the goal of the architecture and how can you achieve the goal? **(10)**

   (d) What are the steps that must be executed before the establishment of a multimedia call? **(5)**

   (e) What is the purpose of negotiation in multimedia communication? Show bilateral peer-to-peer negotiation. **(5)**

7. (a) How are continuous media data different from discrete data? **(5)**

   (b) The list of requests with deadline and block number is given in Figure for Q. No. 7(b). Show the Eearliest Deadline First (EDF) disk scheduling for this list. What are the problems of this scheduling? **(10)**



3	22
3	28
2	14
3	48
2	40
1	43
1	10
2	38
1	20

Figure for Q. 7(b): Requests with deadline and block numbers

   (c) How are seek optimization of SCAN and real time guarantees of EDF combined in SCAN-EDF? Give the modification of EDF that is required to implement SCAN-EDF. How can you find more accurate deadline in SCAN-EDF? **(3+3+4)**

   (d) Describe two approaches of non-sequential storage where data items are stored in non-contiguous order. **(10)**

8. (a) What are the methods of controlling animation? How is animation displayed? **(10)**

   (b) Describe the fundamentals of XTP protocol. Justify the reason for applicability of this protocol for multimedia communications. Discuss the problems with XTP in regard to support continuous media data. **(15)**

   (c) Compare EDF and Rate Monotonic algorithm for processor utilization. **(10)**

L-4/T-2/EEE Date : 17/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 441** (Telecommunication Engineering)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What are the purposes of B-ISDN? What are the methods of implementation of B-ISDN? Briefly explain the optical FTTH technology. **(12)**

   (b) Show the protocol architecture of ISDN. **(8)**

   (c) What is SONET/SDH? Mention the basic transmission rate for SONET, SDH and PDH and compare the standards. **(9)**

   (d) Why is the ATM network standard used for B-ISDN? Explain how the QoS is guaranteed in ATM networks. **(6)**

2. (a) Define the methods of handling of lost calls or blocked calls. **(9)**

   (b) What are the four factors on which the probability of a particular grade-of-service will be provided by a particular group of trunks or circuits? **(17)**

   Define the Erlang B loss formula.

   An E1 line is to be used as a high-usage trunk group between two exchanges. How much traffic can the trunk group carry if the blocking probability is to be 0.01? What is the offered traffic intensity?

   [Fig. for Q. No. 2(b) is attached]

   (c) If the busy hour traffic offered to a rank of switches is 500 Erlang, the average call duration is 5 min and 30 calls are lost in course of busy hour, what is the grade-of-service and what is the traffic carried? **(9)**

3. (a) Draw a typical VoIP network and define each component. **(8)**

   (b) Mention the VoIP functionalities and explain the following protocols: MGCP, SIP and RTCP. **(14)**

   (c) Mention the factors that could affect the audio clarity of VoIP network. Specify any technique to improve in each case if any. **(7)**

   (d) Define different VoIP gateways and show a typical example of gateway deployment. **(6)**

Contd P/2

EEE 441

4. (a) Draw the block diagram of a typical full-function fax machine and briefly describe its operation. **(12)**

   (b) Draw the block diagram of a satellite subsystem. What are the problems of geostationary satellite and how are they resolved? **(9)**

   (c) Why do we use a satellite for communication? What are the key parameters associated with an orbiting satellite from a communication point of view? **(14)**

   Deduce the expressions of coverage area, slant range and propagation delay for a satellite at a particular altitude and elevation angle.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) With necessary figures, explain the working principle of an Aluminium diaphragm speaker. **(12)**

   (b) What is sidetone? Explain how sidetone is suppressed in a telephone system. Show necessary circuit diagrams. **(13)**

   (c) What are the disadvantages of strowger switching system? How are these problems resolved in crossbar switching? **(10)**

6. (a) Draw and explain the circuit diagram of a central battery telephone system. Why the inductors and capacitors are used? What are the advantages of central battery system over a local battery system? **(14)**

   (b) Explain the working principle of a hybrid 4 wire/2 wire converter. Why are 4 wire/2 wire conversions necessary in telephone networks? **(12)**

   (c) What are the design considerations of multi-frequency signaling? **(9)**

7. (a) With necessary block diagrams, describe a common control switching system. **(15)**

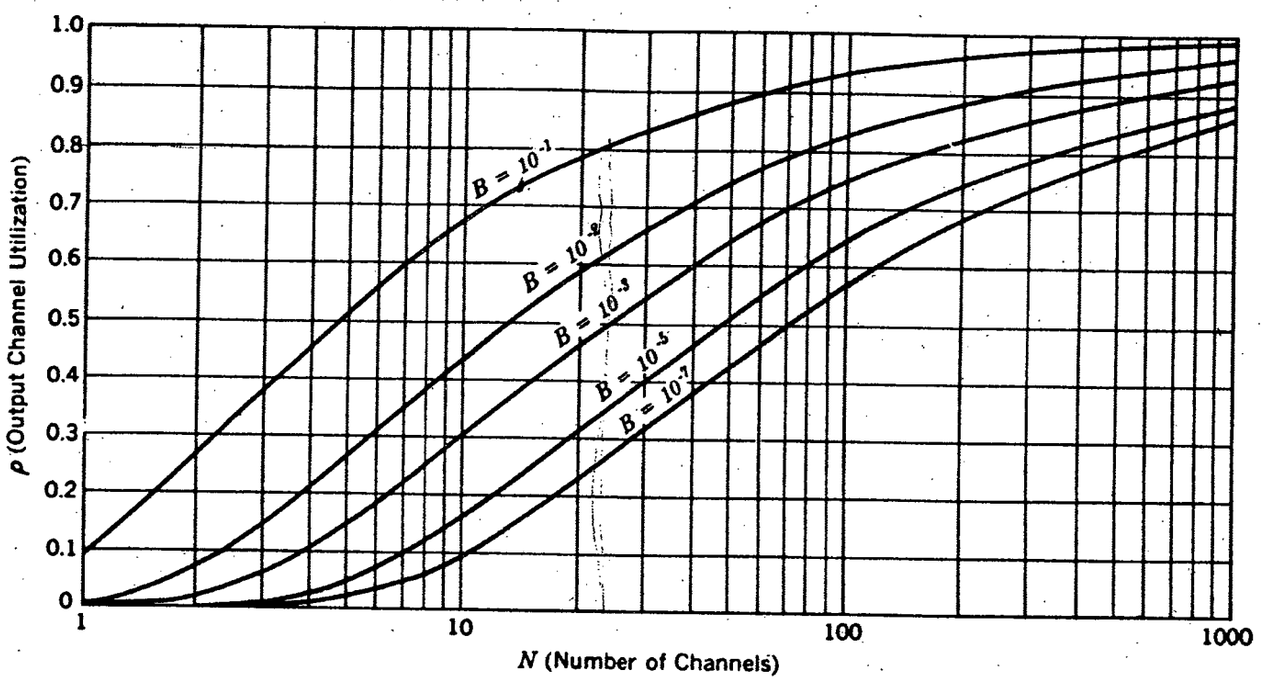
   (b) What are the differences between synchronous duplex mode and load sharing mode in a dual processor architecture? **(10)**

   (c) Briefly explain strowger trunking principle with necessary diagrams. **(10)**

8. (a) Derive the condition for non-blocking operation in a three stage space switching. **(16)**

   (b) How does a digital memory switch work? Explain time slot interchange operation with necessary diagrams. **(15)**

   (c) Why is 48 V typically selected in telephone systems? **(4)**



Output channel utilization of lost calls cleared system.

Fig. for Q. No. 2(b)

L-4/T-2/EEE Date : 17/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 461** (Semiconductor Device Theory)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Calculate the transmission and reflection flux coefficient for an electron of energy E, moving from left to right, impinging normal to the plane of a semiconductor heterojunction potential barrier of energy V_0, where the effective electron mass on the left-hand side is m_1 and the effective electron mass on the right-hand side is m_2. **(18)**

   If the potential barrier energy is $V_0 = 1.5$ eV and the ratio of effective electron mass on either side of the heterointerface is $m_1/m_2 = 3$, at what particle energy is the transmission flux coefficient unity? What is the transmission flux coefficient in the limit that particle energy $E \rightarrow \infty$?

   (b) An electron with a total energy of $E_0 = 6$ eV approaches a potential barrier with a height of $V_0 = 12$ eV. If the width of the barrier is $L = 0.18$ nm, what is the probability that the electron will tunnel through the barrier? **(12)**

   (c) If an electron has half of the potential barrier energy, what is its energy after it has successfully escaped through the barrier? **(5)**

2. (a) Explain how barrier tunneling plays role in storing and reading data in a flash memory. **(13)**

   (b) Why aluminum should not be used for electrical wiring? Explain. **(8)**

   (c) Derive the transmission coefficient of a double barrier structure. What is the condition for resonance? **(14)**

3. (a) Consider that a free electron is incident on an infinitely long potential barrier with potential V_0. Draw and briefly explain wavefunctions of the electron when its energy is (i) $0.5V_0$ (ii) $1.5V_0$, and (iii) $10V_0$. **(15)**

   (b) Why is silicon not an efficient material for using in lasers and detectors? **(8)**

   (c) Define oscillator strength of an electron transition due to photon. How the oscillator strength for electron transition due to interaction with photon in a quantum well can be increased? **(12)**

4. (a) Why is the light absorption spectrum from valence band to conduction band transitions broader than that between two subbands within the conduction band? **(13)**

   (b) Derive the Fermi's Golden rule for electron scattering due to longitudinal acoustic phonon. **(15)**

   (c) How is the electron scattering due to impurity different from scattering due to phonon? **(7)**

Contd P/2

EEE 461

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is "zero point energy" and "zero point motion"? **(6)**

   (b) Consider a 1-D monoatomic lattice. Show that for long wavelengths, it is a dispersionless medium. **(16)**

   (c) For the above 1-D monoatomic lattice derive the expression of the attenuation coefficient. Show that the waves are strongly attenuated above the cutoff frequencies. **(13)**

6. (a) Consider a linear diatomic lattice. Show that there are two branches of the dispersion relation. **(12)**

   (b) Explain why the ionic crystals exhibit reflection peaks near the resonant frequency. **(8)**

   (c) Consider the case of transverse oscillations in a linear diatomic lattice having the characteristics of NaCl ($a = 2.82 \times 10^{-10}$ m, m = 23 amu, M = 35.5 amu, long wavelength velocity 4800 m/sec). Find (i) the transverse interatomic force constant, (ii) the frequencies associated with the upper boundary of the acoustical branch and the lower and upper extremes of the optical branch of the dispersion relation. (1 amu = 1.66×10^{-27} kg). **(15)**

7. (a) Find the expression for the Einstein specific heat in the limit of very low temperatures and very high temperatures. **(18)**

   (b) Calculate the Debye temperature, Debye wavelength and the Debye frequency for diamond given the lattice constant for this material is 3.56 Å, the density of diamond is 3.52×10^{3} kg.m^{-3} and the speed of sound in diamond is 12000 m/s. **(12)**

   (c) What are the assumptions in Kronig-Penney Model? **(5)**

8. (a) If the E-k relation for a simple cubic lattice corresponding to an atomic state derived by the tight-binding approximation is given by **(12)**

   $$E(k) = E_0 - E'_0 - 2E' (\cos k_1 a + \cos k_2 a + \cos k_3 a)$$

   derive the expressions of (i) group velocity (ii) acceleration, and (iii) the effective mass tensor.

   (b) Consider a 1-D periodic potential. Using the Nearly Free Electron Model, derive the E-k relation. **(18)**

   (c) What are the differences between phonon and photons? **(5)**

L-4/T-2/EEE **Date : 17/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 481** (Power System Operation and Control)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

All the symbols have their usual significance.

1. (a) What are the objectives of power system control? How can SCADA and EMS help achieve these objectives? **(5+10)**

   (b) Explain precisely the differences between RTU (Remote Terminal Units), IED (Intelligent Electronic Devices) and PMU (Phasor Measurement Units). **(10)**

   (c) How can you transform a conventional power grid into a smart grid? **(5)**

   (d) How is electricity market operated? **(5)**

2. The on-line offers and bids submitted to the ISO for a certain hour by three GenCos and two DisCos in a spot electricity market are as follows.

Offers

	# G1			# G2			# G3		
Block:	1	2	3	1	2	3	1	2	3
MW :	5	12	13	8	8	9	10	10	5
$/MWh:	1	3	3.5	4.5	5	6	8	9	10

Bids

	# D1				# D2			
Block:	1	2	3	4	1	2	3	4
MW :	8	5	5	3	7	4	4	3
$/MWh:	20	15	7	4	18	16	11	3

Suppose there is no constraint on ramping limit and minimum power outputs of the units operated by GenCos.

(a) Calculate the total demand that can be served and the social welfare (in $) that can be achieved for each of the following market clearing prices (MCP) λ: 3, 3.5, 4.5, 5 $/MWh. **(30)**

(b) Using the results obtained in (a) conclude what is the highest total demand servable and the corresponding social welfare achievable under the given offers and bids scenario. **(5)**

Contd P/2

EEE 481

3. (a) Fast decoupled load flow analysis is used for a comprehensive analysis of the contingencies selected through a screening process. Discuss two methods for this screening. One of the methods suffers from masking problem. What is that? **(20+5)**

(b) The sensitivity matrix for a 6-line and 5 bus system is as follows. The generators are connected at buses 3, 4 and 5. The slack bus No. is 5. Base MVA = 100. **(10)**

$$[S_f] = \begin{array}{c} \\ L1 \\ L2 \\ L3 \\ L4 \\ L5 \\ L5 \end{array} \begin{array}{c} \begin{array}{cccc} (1) & (2) & (3) & (4) \end{array} \\ \begin{bmatrix} 0.4828 & -0.3448 & 0.4138 & 0.3488 \\ 0.1034 & 0.0689 & -0.4828 & -0.0689 \\ 0.4138 & 0.2759 & 0.0689 & -0.2759 \\ 0.4828 & 0.6552 & 0.4138 & 0.3448 \\ 0.1034 & 0.0689 & 0.5172 & -0.0689 \\ 0.5172 & 0.3448 & 0.5862 & 0.6552 \end{bmatrix} \end{array}$$

Determine the change in flow of line 1-2 (L1) if the line 1-3 (L2) carrying –699 MW trips.

4. (a) Write the gradient method algorithm to solve the following OPF problem. **(15)**

Minimize $f(x, u)$

subject to $g(x, u) = 0$

$h(x, u) \geq 0$

(b) In a 6-line 5 bus power system two loads D1, D2 are connected respectively at busses 1 and 2 while three generators are connected respectively at busses 3, 4, 5. In a certain hour the operating condition is as follows. **(7+13)**

D1 = 2500 MW, D2 = 300 MW, G3 = 1300 MW,

G4 = 1250 MW, G5 (at bus 5) is the slack generator to absorb any imbalance.

The sensitivity matrix $[S_f]$ for the system is as given in Q. 3(b). The nodal susceptance (p.u.) matrix [B] is as follows. Base MVA = 100.

The limits for any generation is 250 MW $\leq P_{g_i} \leq$ 1500MW.

$$[B] = \begin{bmatrix} 250 & -100 & -50 & -100 \\ -100 & 150 & 0 & 0 \\ -50 & 0 & 100 & -50 \\ -100 & 0 & -50 & 200 \end{bmatrix}$$

$x_{13} = x_{25} = x_{34} = x_{45} = 0.02$ p.u., $x_{12} = x_{14} = 0.01$ p.u.

(i) If each line can carry a maximum of 1000 MW identity which line is the most overloaded?

(ii) Show the OPF formulation to correct overloading using a linear objective function comprising generation rescheduling and load shedding. Assume a cost of $ 10 per 100 MW adjustment on all generators and $ 100 per 100 MW load shed at each bus.

Contd P/3

EEE 481

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. Five ammeters numbered A1 to A5 are used in the DC circuit of Fig. for Q. No. 5 to determine the two unknown sources I_1 and I_2. **(13+5+5+12=35)**

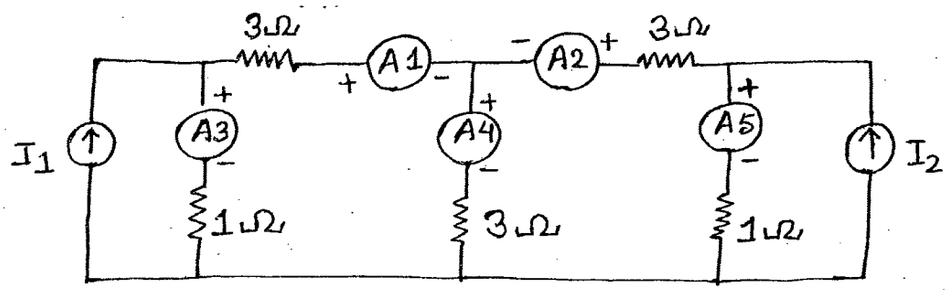


Fig. for Q. No. 5

The standard deviation of the meter errors are 0.2 A for meters A_2 and A_5 and 0.1 A for the other three meters. The readings of the five meters are 0.12, 1.18, 3.7, 0.81 and 7.1 A respectively.

(i) determine the weighted least-squares estimates of the current I_1 and I_2. Use the given [H] matrix.

(ii) Determine the estimated measurement errors $(\hat{e}_m)$.

(iii) Using the chi-square test for $\alpha = 0.01$ check for the presence of Bad data in the measurements. Use the attached chi-square table.

(iv) Identify if there are any bad data using the residuals $\left|\frac{\hat{e}_m}{\sigma_m}\right|$ for the measurements and re-estimate the source currents I_1 and I_2.

$$H = \begin{bmatrix} 0.175 & -0.075 \\ -0.075 & 0.175 \\ 0.825 & 0.075 \\ 0.1 & 0.1 \\ 0.075 & 0.825 \end{bmatrix}$$

6. (a) With neat diagrams show the two area model of generation control and derive an expression for change in the tie line power when a load change occurs in Area1 which was exporting power from Area2. **(15)**

(b) Explain "Supplementary Control Action". **(10)**

(c) Show with a diagram how you can implement the decision of unit commitment and economic dispatch in AGC logic. **(10)**

Contd P/4

EEE 481

7. In a small power system there are two stages (each 4 hours long) in a load cycle and 4 generating units. In 2nd stage load is 1100 MW and in the first stage load is 1400 MW. Only units 1 and 2 are to operate in the second stage of load cycle.

Table 1 : Possible Unit Combination

Unit No.	Combination			
	x_1	x_2	x_3	x_4
1	1	1	1	1
2	1	1	1	1
3	1	1	0	0
4	1	0	1	0

Table 2 : Unit technical and economic parameter

Generating Unit	Min (MW)	Max (MW)	a_i $\$/(MW)^2h$	b_i \$/MWh	c_i \$/h
1	100	625	0.008	8.0	500
2	100	625	0.0096	6.4	400
3	75	600	0.01	7.9	600
4	75	500	0.011	7.5	400

(i) Based on Table 1 and Table 2 calculate the power supplied by generators if x_4 combination is used and the corresponding production cost in economically loading the units when the system is in the second stage. **(10)**

(ii) Assume that the start up cost of each thermal generating unit is \$ 3000 and the shut down cost is \$ 1500, determine the optimal unit commitment policy of the four thermal units for the two stages. **(25)**

The corresponding production cost in \$ for different combinations are:

$P_1(1) = 58428$ $P_2(1) = 59356$ $P_3(1) = 58236$ $P_4(1) =$ infeasible

$P_1(2) = 45848$ $P_2(2) = 45848$ $P_3(2) = 44792$ $P_4(2) = 45868$

Where, $P_m(n)$ = Production cost of combination x_m in the stage 'n' of the load cycle.

Use the backward dynamic programming approach.

8. (a) Three generating units operating in parallel at 50 Hz have ratings of 300,500 and 600 MW and have speed-droop characteristics of 5, 4 and 3% respectively. Due to a change in load, an increase in system frequency of 0.3 Hz is experienced, before any supplementary control action occurs. Determine the amount of change in the system load and also the amount of change in generation of each unit to absorb the load change. **(18)**

Contd P/5

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Contd ... Q. No. 8

(b) A 50 Hz system consisting of the three generating units described in 8(a) is connected to a neighboring system via a tie line. Suppose that a generator in the neighboring system is forced out of service and that the tie line flow is observed to increase from scheduled value of 400 to 631 MW. Determine the amount of the increase in generation of each of the three units and find the ACE of this system whose frequency bias setting is –58 MW/0.1 Hz. **(17)**

(Use the equation for ACE = $(P_a - P_s) - 10B_f(f_a - f_s)$ MW)

Chi-square Table for Question 5

Values of area α to the right of $\chi^2 = \chi^2_{k,\alpha}$

k	$\alpha = 0.01$
1	6.64
2	9.21
.3	11.35
4	13.28
5	15.09

L-4/T-2/EEE Date : 24/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 451** (Computer Networks)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

All the symbols carry usual meanings.

1. (a) Following is the key of a transposition chipper. **(10)**

Plaintext :	2	4	3	5	1
Ciphertext :	1	2	3	4	5

Now encrypt the message "COMPUTER NETWORKS CSE 451 QUESTION 1A" using the above key. Use '0' as bogus character if necessary.

(b) You are given a network address 172.103.0.0 and asked to create subnets in the network so that the maximum number of usable hosts in any subnet is 1000. Find the followings in CIDR notation. **(10)**

(i) Subnet address of 300^{th} subnet

(ii) The 1^{st} usable address in the 300^{th} subnet

(iii) The last usable address in the 300^{th} subnet

(c) What is split horizon and poison reverse? **(5)**

(d) Why is a repeater needed? What are the differences between repeater and amplifier? **(5)**

(e) Define DHCP. What are the advantages of DHCP over BOOTP? **(5)**

2. (a) We have 5 routers labeled A-E. Suppose we have the routing tables shown below after RIP is stable. Let all links have cost 1. **(12)**

Routing Table for A

Destination	Cost	Nest Hop
A	0	---
B	1	B
C	2	B
D	1	D
E	2	D

Routing Table for B

Destination	Cost	Nest Hop
A	1	A
B	0	---
C	1	C
D	1	D
E	1	E

Routing Table for C

Destination	Cost	Nest Hop
A	2	B
B	1	B
C	0	---
D	2	E
E	1	E

Routing Table for D

Destination	Cost	Nest Hop
A	1	A
B	1	B
C	2	B
D	0	---
E	1	E

Contd P/2

CSE 451

Contd ... Q. No. 2(a)

Routing Table for E

Destination	Cost	Nest Hop
A	2	D
B	1	B
C	1	C
D	1	D
E	0	---

(i) If a message is originated from **A** and the destination is **E**. Which path does it take?

(ii) If a message is originated from **C** and a destination is **D**. Which path does it take?

(iii) Give a diagram of a possible network consistent with these tables.

(b) What is the danger in choosing 2 as the public key *e* in RSA? **(5)**

(c) What are the types of links in OSPF? **(5)**

(d) Define (any two) **(6)**

(i) Cut-through Switch

(ii) Transparent Bridge

(iii) Source Quench

(e) What are the ICMP error messages? When do we need logical to physical address mapping? What are the problems of RARP? **(7)**

3. (a) Why do we need to break up datagram packets into fragments? What flags are used on fragmentation? Let a datagram with data size of 5000 bytes is fragmented into fragments containing 1400 data bytes. The fragments will pass through a protocol/network with MTU= 1400bytes. The second fragment is itself fragmented later into more fragments which will pass through a network with MTU=600bytes. Illustrate this fragmentation with a figure showing the values of the size, offset, and more fragments (M) field. Also show which bytes of the main datagram goes to which fragment. **(15)**

(b) NAT router has only one global address. What problem this can arise? How can this problem be addressed? **(8)**

(c) What is three-node instability? What are the solutions to this problem? **(8)**

(e) How loop is prevented in path vector routing protocol? **(4)**

4. (a) An ISP is granted a block addresses starting with 150.80.0.0/16. The ISP wants to distribute these block to 2600 customers as follows. **(16)**

(i) The first group has 200 medium size businesses, each needs 16 addresses.

(ii) The second group has 300 medium size businesses, each needs 8 usable addresses.

(iii) The third group has 2100 households; each needs 4 addresses.

Design the subblocks and give the CIDR notation for each subblock. Find out how many addresses are still available after these allocations.

Contd P/3

CSE 451

Contd ... Q. No. 4

(b) Assume a router has the following CIDR entities in its routing table. **(10)**

Address/mask	Next hop
192.23.40.0/23	Router 1
135.46.56.0/22	Interface 0
135.46.60.0/22	Interface 1
Default	Router 2

What does the router do if a packet with the following destination address arrives?

(i) 135.46.57.32

(ii) 135.46.52.10

(iii) 192.23.40.7

(iv) 192.23.56.4

(c) What do you understand by best effort delivery in network layer? If reliability is important what should be done? **(4)**

(d) A *P-box* uses the following table for encryption. Show the box and connect the input to the output. Is the P-box straight, compression, or expression? **(5)**

1	**3**	**6**	**5**	**4**	**2**
		2	**6**	**1**	

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Draw a hybrid topology with a ring backbone and three star networks each containing four stations. In this topology what will happen if one of the stations is unplugged? **(8)**

(b) Prove that to guarantee correction upto t errors in all cases, the minimum hamming distance (d_{min}) in a block code must be $d_{min} = 2t + 1$. **(8)**

(c) What are the different addresses in TCP/IP protocol suit? Why are they needed? **(10)**

(d) Find the 8 bit data stream from the following signal using the differential Manchester scheme. Assume that the first bit is 0. **(5)**

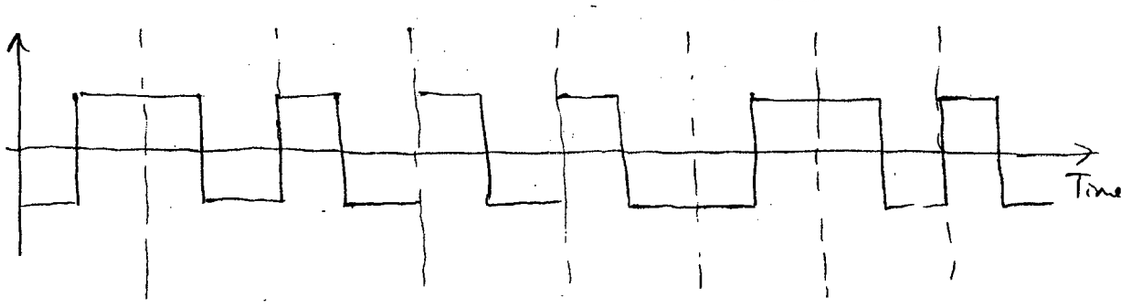

Fig for Q. 5(d)

(e) Why burst error is more likely to happen than single bit error? **(4)**

Contd P/4

CSE 451

6. (a) What are baseline wondering and synchronization problems? Discuss these problems on NRZ-L and NRZ-I schemes. **(8)**

   (b) How does a station detect collision in a channel? What happens if successive collisions are detected by a station for a single frame transmission? **(8)**

   (c) Find whether the following CRC generators detect a single bit error. **(10)**

   (i) $x^4 + x^2$ (ii) $x^3 + x + 1$ (iii) $x^2 + 1$ (iv) 1

   (d) Why is collision avoidance necessary in a wireless network? **(5)**

   (e) for n devices in a network, what is the number of cable links required for a mesh, ring, bus and star topology? **(4)**

7. (a) A sender needs to send the string "CSE 45108". Now answer the following: **(15)**

   (i) Find the checksum at the sender site.

   (ii) Find the checksum of the receiver site if 'S' is changed to 'C' and '8' is changed to '6'.

   (iii) What kind of error is undetected by the checksum?

   The space characters are discarded in calculating checksum.

   ASCII code for 'A' = 65 and 'O' = 48.

   (b) If a piconet has multiple secondary how does the communications take place? **(7)**

   (c) Give example of unicast, multicast and broadcast Ethernet addresses. How does the Ethernet address 31:20:3B:50:07:FE appear on the line in binary. **(8)**

   (d) What is the purpose of NAV in wireless LAN protocol? **(5)**

8. (a) What is PCF? Between PCF and DCF which one has the greater priority? How is it ensured? **(7)**

   (b) What is DNS and what is it used for? If all DNS servers could be crashed, what would happen to the Internet? **(8)**

   (c) How error control is done in Transport layer of OSI model? **(7)**

   (d) Show recursive and iterative DNS resolution protocol with example. **(7)**

   (e) What is the purpose of address and CNAME field in DNS records? **(6)**

L-4/T-2/EEE **Date : 24/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 437** (Digital Communication)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Consider the transmitting-side block diagram as shown in Fig. for Q. No. 1(a). **(10)**

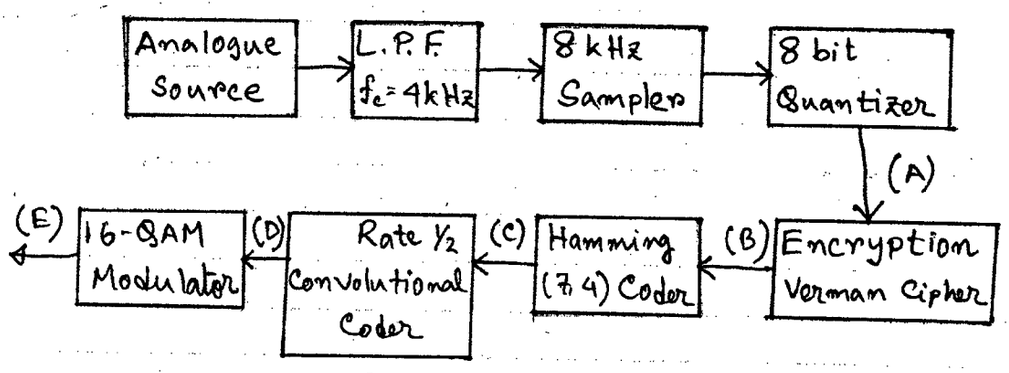

Fig. for Q. No. 1(a)

Here L.P.F. means low pass filter and f_c is its cut-off frequency. Determine the symbol rates at points denoted by (A), (B), (C), (D) and (E).

(b) State Kraft's inequality for prefix codes. Prove that, it is possible to construct a prefix code that satisfies the relation $H(x) \le \bar{l} \le H(x)+1$. **(15)**

(c) For the elements of the set X = {a, b, c, d, e}, probabilities of the elements to occur are given by – **(10)**

P(a) = 0.45	P(c) = 0.2
P(b) = 0.25	P(d) = P(e) = 0.05

Obtain the Huffman codes for these symbols and compare the average code length with H(X).

2. (a) Consider the binary communication channel shown in Fig. for Q. No. 2(a). **(10)**

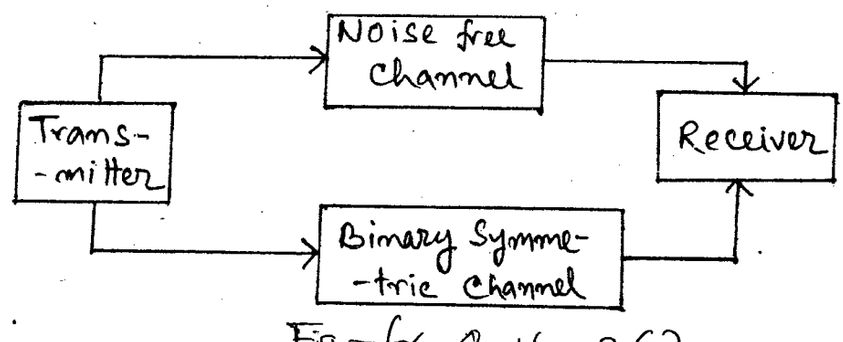

Fig. for Q. No. 2(a)

Contd P/2

EEE 437

Contd ... Q. NO. 2(a)

Bandwidth of the noise free channel is less than that of the binary symmetric channel (B.S.C.) and inappropriate for communication at the desired speed. Assume that transmitter transmits N >> 1 bits over the B.S.C. and somehow knows which bits are flipped. Prove that, at least NH(q) bits are needed to be transmitted over the noise free channel so that the receiver can perfectly recover the original message. q = crossover probability for the B.S.C.

(b) To successfully recover N message bits transmitted over a B.S.C. with crossover probability q, the transmitter must send at least $\frac{N}{1-H(q)}$ bits. Suppose, an engineer proposes a linear (n, k) block code that satisfies this limit. Prove that $d_{min} \geq \frac{2kq}{1-H(q)} + 1$. **(10)**

(c) Prove that, for a continuous random variable y with mean μ and variance σ_y^2, its differential entropy is maximized for a Gaussian pdf. **(15)**

Hint: Use the Kullback-Leibler divergence identity

$$D(f \| g) = \int_{-\infty}^{\infty} f_y(y)\left[\log_e f_y(y) - \log_e g_y(y)\right] dy \geq 0$$

3. (a) Using the Shannon-Hartley Law for AWGN channels, **(7.5+7.5=15)**

$R_{max} = B \log\left(1 + \frac{S}{N}\right)$, prove that

(i) maximum rate of symbol transfer for infinite bandwidth is given by $\frac{P_{av}}{N_0 \ln 2}$.

(ii) reliable communication is not possible for a signal with $E_b/N_0 < -1.6$ dB.

(b) In a line coding scheme, bit '0' is mapped to voltage level V_0 and bit '1' is mapped to voltage level V_1, where $V_1 > V_0$. The signal is passed through an AWGN channel with variance σ^2. At the receiving end, N samples are taken at each bit interval and their average is compared with the threshold $\frac{V_0 + V_1}{2}$ to take the decision accordingly. Show that, the bit error rate is given by $P_e = \frac{1}{2}\text{erfc}\left(\frac{\sqrt{N}\Delta V}{2\sqrt{2}\sigma}\right)$ where $\Delta V = V_1 - V_0$. **(20)**

4. (a) Derive the odd symmetry condition for the magnitude spectrum of an ISI-free signal. **(15)**

(b) Consider a pulse sequence 1100110100 represented by the modified duo-binary pulses. Obtain – **(6+6=12)**

(i) the sample values with and without precoding

(ii) the decision criteria for retrieving the bit sequence from the sample values when pre-coding is applied.

Contd P/3

EEE 437

Contd ... Q. NO. 4

(c) A baseband transmission channel has a raised cosine frequency response with a roll-off factor of 0.4. Absolute bandwidth of the channel is 1200 kHz. An analogue signal is converted to binary PCM with 64 level quantization before being transmitted over the channel. What is the maximum possible bandwidth allowed for the analogue signal? **(8)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
Q-function table is attached.

5. (a) Consider a digital modulation scheme designed as a combination of FSK and QPSK. The first two bits are QPSK modulated using a carrier of frequency f_1 and the third and fourth bits are QPSK modulated using a carrier frequency f_2. Derive the expression for minimum separation between the carrier frequencies in terms of bit interval T_b for coherent detection. **(10)**

(b) Consider an 8-QAM, where $a_I \in \{-1, 1\}$ and $a_Q \in \{-3, -1, 1, 3\}$. Sketch the constellation with a Gray mapping and determine all possible values for A and θ, where transmitted signal can be expressed as **(10)**

$$s(t) = A \cos(2\pi f_c t + \theta)$$

(c) Why half-wave sinusoids are used in MSK modulation instead of rectangular pulses? Draw the modulation block diagram for MSK and show that MSK can be interpreted as a frequency shift keying with carrier frequencies separated by a value of $\frac{1}{2T_b}$. **(15)**

6. (a) In a GMSK modulation, the Gaussian filter h(t) is convoluted with a rectangular pulse r(t) to obtain the elementary frequency pulse s(t). Prove that, to ensure GMSK remains an FM technique with modulation index of 0.5, s(t) must satisfy the condition **(15)**

$$\int_{-\infty}^{\infty} s(t)\,dt = \tfrac{1}{2}$$

(b) Consider a 4-ary modulation scheme, where **(20)**

$$s_1(t) = A \sin\left(\frac{\pi t}{2T_b}\right) \quad \text{when } m_1 = 00$$

$$s_2(t) = A \sin\left(\frac{\pi t}{T_b}\right) \quad \text{when } m_2 = 01$$

$$s_3(t) = -A \sin\left(\frac{\pi t}{2T_b}\right) \quad \text{when } m_3 = 11$$

$$s_4(t) = -A \sin\left(\frac{\pi t}{T_b}\right) \quad \text{when } m_4 = 10$$

Contd P/4

EEE 437

Contd ... Q. NO. 6(b)

(i) Identify the set of ortho-normal basis functions $\{\phi_i(t)\}$ and draw the constellation diagram.

(ii) Draw the waveshape of the transmitted signal for the bit stream 1011000001.

(iii) Design a modulator and demodulator for the modulation scheme.

7. (a) Prove that, for Verman ciphers, H(P:C) = 0 where P represents the plain text and C is the code word. **(13)**

(b) Consider the TCM structure in Fig. for Q. No. 7(b). Perform the set partitioning over the 16-QAM constellation. Draw the trellis diagram for the coded bits and property assign appropriate subsets to each branch following Ungerboeck's rules. In the complete trellis diagram, show all paths emerging from the state 01 and clearly identify the constellation point associated with every branch. **(22)**

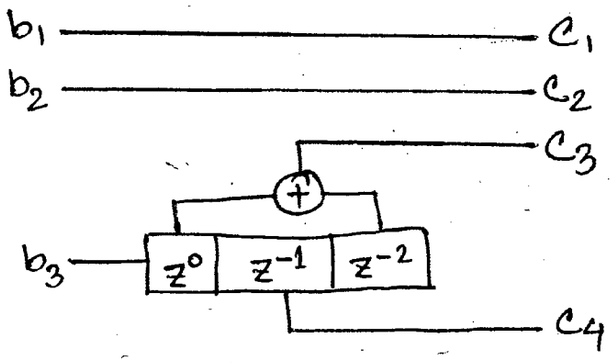

Fig. for Q. No. 7 (b)

8. (a) Derive the appropriate upper and lower limits for bit error rate in M-PSK modulation scheme. **(15)**

(b) Gaussian random variables have the interesting property that probability of such a variable (with mean μ and variance σ^2) taking value in the range $(\mu - 3\sigma)$, $\mu + 3\sigma)$ is almost 99.8%. For practical purposes, we might assume that a Gaussian random variable definitely lies in the interval $(\mu - 3\sigma, \mu + 3\sigma)$. **(12)**

An M-PSK signal with symbol energy E_s passes through an AWGN channel with a variance of $\frac{N_0}{2}$. Using the above mentioned approximation of Gaussian RVs and the idea of constellation diagram, find the expression for the minimum value of E_b/N_0 for zero bit error rate. Calculate this value in dB for M = 4. [Necessary Q-function table is attached].

(c) Prove that, for a (n, k) block code, the maximum number of correctable errors is given by **(8)**

$$\left[\frac{d_{min} - 1}{2}\right]$$

where the symbols bear their usual meanings.

Q-Function Table

z	$Q(z)$	z	$Q(z)$
0.0	0.50000	2.0	0.02275
0.1	0.46017	2.1	0.01786
0.2	0.42074	2.2	0.01390
0.3	0.38209	2.3	0.01072
0.4	0.34458	2.4	0.00820
0.5	0.30854	2.5	0.00621
0.6	0.27425	2.6	0.00466
0.7	0.24196	2.7	0.00347
0.8	0.21186	2.8	0.00256
0.9	0.18406	2.9	0.00187
1.0	0.15866	3.0	0.00135
1.1	0.13567	3.1	0.00097
1.2	0.11507	3.2	0.00069
1.3	0.09680	3.3	0.00048
1.4	0.08076	3.4	0.00034
1.5	0.06681	3.5	0.00023
1.6	0.05480	3.6	0.00016
1.7	0.04457	3.7	0.00011
1.8	0.03593	3.8	0.00007
1.9	0.02872	3.9	0.00005

The definition of Q function is:

$$Q(z) = \int_z^\infty \frac{1}{\sqrt{2\pi}} e^{-y^2/2} dy$$

Table for Q. No. 8(b)

Shahzad
24.5.14

L-4/T-2/EEE **Date : 24/05/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 457** (VLSI II)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) A 16 bit adder has to be designed in the fastest possible way using ripple carry, carry select or carry skip adder. The delay through one adder cell is 1 nsec, delay of the multiplexer to select actual carry output is 1 nsec. For the carry skip adder assume that the first and the last block will propagate the carry and all other blocks can skip the carry. (i) Calculate the delay of the ripple carry adder (ii) Calculate the optimum number of blocks, and the propagation delay of the carry select adder. Also show the circuit diagram of the complete carry select adder (iii) Calculate the optimum number of blocks and the propagation delay of the carry skip adder. Also show the circuit diagram of the complete carry skip adder. **(17)**

   (b) Sketch the partial products used by a radix-4 Booth-encoded multiplier to compute $(-14)_{10} \times (6)_{10}$ and show the generation of the corresponding final product. Design a Booth encoder using X_i, X_{2i} and M_i where X_i is true for $\pm Y$, X_{2i} is true for $\pm 2Y$ and M_i is true for negative partial products. Also design a selector circuit using this encoding where X is the multiplier and Y is the multiplicand. **(18)**

2. (a) If a combinational circuit is sequenced by flip-flop, show that the maximum allowable propagation delay of the combinational circuit is $(t_{pd})_{max} = T_c - (t_{pcq} + t_{setup} + t_{skew})$, where the symbols have their usual meanings. **(10)**

   (b) Design a low noise asynchronous resettable flip-flop and explain the operation of the circuit. **(7)**

   (c) Design a Mealy type FSM to implement a synchronous level-to-pulse converter which produces a single cycle pulse each time its input goes high. The system will be used as a push button for pedestrian crossing and the functionality is graphically shown in Fig. for Q. No. 2(c). **(18)**

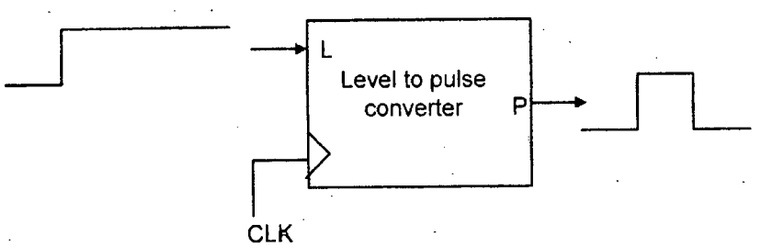

Fig. for Q. No. 2(c)

Draw the state diagram, state table, state assigned table and the RTL diagram of the system. Explain the operation of the system.

Contd P/2

EEE 457

3. (a) Show the design flow of an Application Specific Integrated Circuit Design. Write the meaning of the following file format and explain where in the design flow the files are used. DEF, ESPF and CIF. **(10)**

(b) Draw the schematic and layout diagram of a typical input pad including ESD protection circuit. Explain how the ESD protection will work. **(10)**

(c) Consider an NMOS input-pair and PMOS current mirror active load type differential amplifier. Consider for all transistors W/L = 5 μm/0.5 μm. Let $\mu_n C_{ox}$ = 260 μA/V^2 and $\mu_p C_{ox}$ = 110 μA/V^2, the bias current is 300 μA and the bias current source has an output resistance of 25 kΩ. If V'_{AN} = 5 V/μm and $|V'_{AP}|$ = 6 V/μm, determine the low frequency value of differential gain (Ad), common mode gain (Acm) and the common mode rejection ratio. All the symbols have their usual meanings. **(15)**

4. (a) Consider a two stage CMOS operational amplifier (op-amp). G_{m1}, R_1, C_1 and G_{m2}, R_2, C_2 are the transconductance, output resistance and output capacitance of 1st and 2nd stage, respectively, C_C is the compensating capacitor connecting the output of the 1st and the 2nd stage. Find the dc gain, the poles and the zeros of the circuir. **(18)**

(b) In a 2-stage CMOS op-amp, the transconductance of both the stages is 40 mA/V, output capacitance of the first and second stages are C_1 = 100 pF and C_2 = 5 pF, respectively and the output resistance are R_1 = 10 kΩ and R_2 = 15 kΩ, respectively. Calculate the location of the first pole and the second pole. If the first pole is to be moved by ten times its present location, calculate the value of the compensating capacitor required in the feedback path between the output of the first and second stage. **(17)**

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) (i) "The interconnect capacitance initially decreases with feature size but then increases again". – Explain the statement by showing various components of the interconnect capacitance as a function of feature size. **(8)**

(ii) In a 180 nm CMOS process the following parameters are given: ω_n/L_n = 2 μm/0.2 μm, ω_p/L_p = 4 μm/0.2 μm, gate oxide thickness, t_{ox} = 40 Å and interconnect capacitance C_{int} = 2 pF/cm, ϵ_{ox} = 0.35 pF/cm. Calculate the interconnect length at which interconnect capacitance becomes comparable to gate capacitance. **(10)**

(b)(i) In the year 2014, company A builds a microprocessor in 90 nm technology which operates at 1 GHz. If a new process is introduced in every 2 years with a scaling factor of s = $\sqrt{2}$, predict microprocessor clock frequency and feature size (technology size) in the year 2018. Assume all improvements come from ideal constant field scaling and the intrinsic gate delay sets clock rate. **(9)**

Contd P/3

EEE 457

Contd ... Q. No. 5(b)

(ii) A non-inverting buffer was designed as shown in Fig. for Q. No. 5(b)(ii). Explain why this design should not be accepted. **(8)**

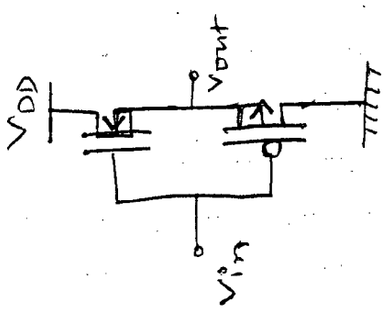

Fig. for Q. No. 5(b)(ii)

6. (a) A long interconnect line has a total distributed interconnect resistance and capacitance of R_{int} and C_{int}, respectively. Let R_0 and C_0 be the output resistance and input capacitance of the minimum sized buffer. Show that by using optimum number and size of repeater, the minimum value of 50% delay becomes $2.5\sqrt{(R_o\, C_o\, R_{int}\, C_{int})}$. **(17)**

   (b) A 3-input NOR gate is designed for equal rise and fall resistance. Consider the rising output transition occurring with two inputs held at '0' and the other input falling from '1' to '0'. Using Elmore delay model find the corresponding delay in terms of on resistance (R) and capacitance (C) of a minimum size NMOS transistor when the falling signal is connected (i) closest to the output (ii) most far from the output. Assume the gate capacitance and the drain/source capacitance of the transistor are equal and also assume $\mu_n = 2\,\mu_p$. **(18)**

7. (a) "For dynamic gate sharing the same clock cannot be cascaded" – Explain. **(15)**

   (b) A 4-bit adder with carry look-ahead is to be designed. Design the carry look ahead in multiple output domino logic with a conventional keeper. What considerations will you take to choose the optimum size of the keeper transistor? **(20)**

8. (a) Show the possible process flow of the circuit shown in Fig. for Q. No. 8(a) in a submicron TWIN-WELL CMOS process. You are free to choose to fabricate the resistance from any of the available layers. Show the process steps sequentially and for each process step show the cross sectional diagram of the two devices up to that step and the mask diagram if any. Also explain why you have chosen the particular layer for the resistance. **(20)**

Contd P/4

EEE 457

Contd ... Q. No. 8(a)

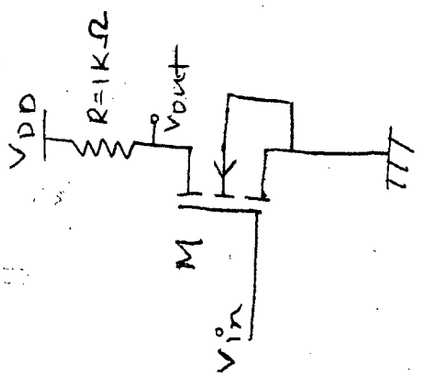

Fig for Q. No. 8(a)

(b) Explain the terms logical efforts, electrical effort, and effort delay. Using linear delay model find the delay of a 3 input NAND gate when fan out is zero and one, respectively. **(15)**

L-4/T-2/EEE Date : 24/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 477** (Power System Protection)

Full Marks : 210 Time : 3 Hours

The questions are of equal value.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Describe how actuating force is produced in an electromagnetic induction type relay.
   (b) What are the different types of actuating structure commonly used in an induction type relay? Describe the shaded pole structure.

2. (a) What is a directional relay? Describe the operating characteristics and its application.
   (b) Explain with R-X diagram the characteristics of an impedance relay and a mho relay.

3. (a) Explain the differential relay with necessary characteristics.
   (b) The connection diagram of a percentage differential relay to protect one phase of a generator is shown in Fig. 3(b). A resistance fault occurs near the neutral end with current distribution as $I_1 = 435 + j75$ amp and $I_2 = 400 + j75$ amp.

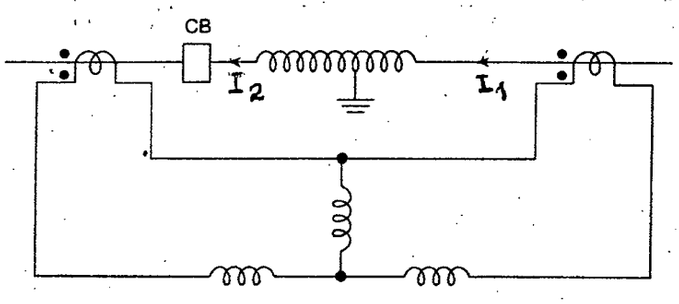

Fig. for Q. No. 3(b)

4. (a) Describe the setting of impedance relay for three zone protection of high voltage line. Show the R-X diagram of mho relay for this protection scheme.
   (b) Draw the circuit diagram of a static definite time overcurrent relay.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Define the terms: Rated Breaking Capacity, Symmetrical and Asymmetrical Breaking Currents and Rated short time current of a circuit breaker.
   (b) With a neat diagram describe the principle of operation of high pressure puffer interrupter for SF_6 circuit breaker.

Contd P/2

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6. (a) Explain with diagrams the Transient Recovery Voltage and hence deduce the expression for $e_{TRV}(max.)$ and $RRRV_{max}$.

   (b) A 50 Hz, three-phase synchronous generator has an inductance per phase of 1.75 mH and its neutral is grounded. It feeds a line through a circuit breaker. The total stray capacitance to ground of the generator and circuit breaker is 0.0025 μF. A fault occurs just beyond the circuit breaker. Ignoring the first pole to clear factor, determine (i) Natural Frequency of Oscillations, (ii) Peak Value of TRV, (iii) Time at which peak value of TRV occurs, (iv) Maximum rate of rise of TRV and (v) Time at which the maximum in part (i) occurs.

7. (a) What is arc in a circuit breaker? What are the different methods of arc extinction? Explain any one method.

   (b) Explain the arc extinction operation in a minimum oil circuit breaker.

8. (a) With neat sketches, describe the principle of operation of air-breaker circuit breaker.

   (b) Draw the equivalent circuit of a current transformer (CT).

   A CT has rated current of 250 : 5 A, $X_2 = 0.6\ \Omega$. Its magnetizing curve is shown in Fig. for Q. No. 8(b). Compute $|I_2|$ and CT errors for the following cases:

   (i) Load current of 250 A; $X_L = 4\ \Omega$ and $X_L = 8\ \Omega$

   (ii) Fault current of 750 A; $X_L = 4\ \Omega$ and $X_L = 8\ \Omega$

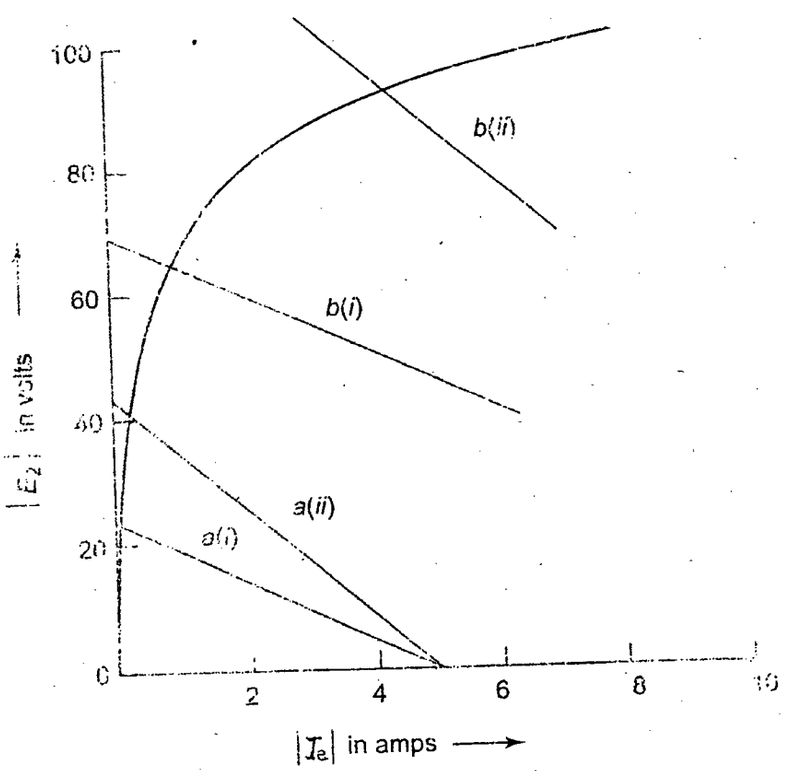

Fig. for Q. No. 8(b)

11-05-14

L-4/T-2/EEE Date : 10/05/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **CSE 453** (Computer Architecture)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Give the block and flow chart diagram of the division hardware. Explain how it operates. **(20)**

   (b) Add $2.85_{ten} \times 10^3$ to $9.48_{ten} \times 10^4$ assuming that you have only three significant digits, first with guard and round digits and then without them. Show all the steps. **(10)**

   (c) What is the difference between single bus and multiple bus structures? **(5)**

2. (a) What are the different types of caches? Discuss them. **(15)**

   (b) Draw the interrupt hardware and discuss how it works. **(10)**

   (c) Define clock cycles per instruction and MIPS (million instructions per second). **(5)**

   (d) What are the task of guard and round digits with respect to floating point arithmetic? **(5)**

3. (a) What are the different techniques of handling multiple interrupts? **(15)**

   (b) The table below shows the number of floating-point operations executed in three different programs and the runtime for those programs on three different computers: **(12)**

Program	Floating-point Operations	Execution time in seconds		
		Computer A	Computer B	Computer C
Program 1	5×10^9	2	5	10
Program 2	20×10^9	20	20	20
Program 3	40×10^9	200	50	15

   Which computer is fasted according to total execution time? How many times as fast is it compared to the other two computers?

   (c) Define the following terms in terms of Cache: **(8)**

   Hit rate, miss rate and miss penalty

4. (a) What are the different DMA configurations? Give brief descriptions. **(10)**

   (b) Here is a series of address references given as word addresses: 2, 3, 11, 16, 21, 13, 64, 48, 19, 11, 3, 22, 4, 27, 6 and 11. Assuming a direct-mapped cache with 16 one-word blocks that is initially empty, label each reference in the list as a hit or a miss and show the final contents of the table. **(12)**

   (c) Give a short code fragment in MIPS to find, if an unsigned addition causes overflow. **(8)**

   (d) What is programmed and non-programmed I/O? **(5)**

Contd P/2

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SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the registers and instructions specifically designated to handle producers in the MIPS Assembly Language? Discuss their functionalities. **(8)**

   (b) How can you pass more than 4 parameters to a procedure in MIPS Assembly Language? Discuss what could be the role of $fp in the procedure frame. **(12)**

   (c) Write MIPS code for the following recursive function: **(15)**

```
int fact (int n){
        if (n<1) return 1;
                else return (n * fact(n-1));
}
```

6. (a) Consider the single cycle datapath in Figure 2 which is constructed for *add, sub, and, or, lw, sw, beq*. Now, write the values of the control lines for each of the above instructions. **(10)**

   (b) Implement the *j* instruction on the datapath in Figure 2. Explain your implementation. **(17)**

   [You may modify Figure 2 (separate sheet) and attach the updated figure with your answer script after having it signed by the respected invigilator.]

   (c) What is the **alignment restriction** in MIPS? What changes would you think be needed in your solution of Q. 6(b), if the alignment restriction is removed? **(8)**

7. Consider the multi-cycle datapath presented in Figure 3. Now answer the following questions: **(10+7+10+8=35)**

   (a) Present the summary of the steps taken to execute the instruction classes handled in the datapath.

   (b) Considering 25% loads, 10% stores, 11% branches, 2% jumps and 52% R format instructions, calculate the CPI for the multi-cycle implementation of Figure 3. Assume that each stage requires 1 clock cycle.

   (c) Present the complete finite state machine control for the multi-cycle implementation of Figure 3.

   (d) Very briefly discuss how exceptions can be handled in the multi-cycle implementation of Figure 3.

   [You may modify Figure 3 (separate sheet) and attach the updated figure with your answer script after having it signed by the respected invigilator.]

8. (a) With the help of appropriate figures, present a simple pipelined datapath identifying the control lines and their functions. Explain how each stage is executed in this datapath. **(20)**

   (b) Explain data hazards and branch hazards with the help of appropriate examples. **(15)**

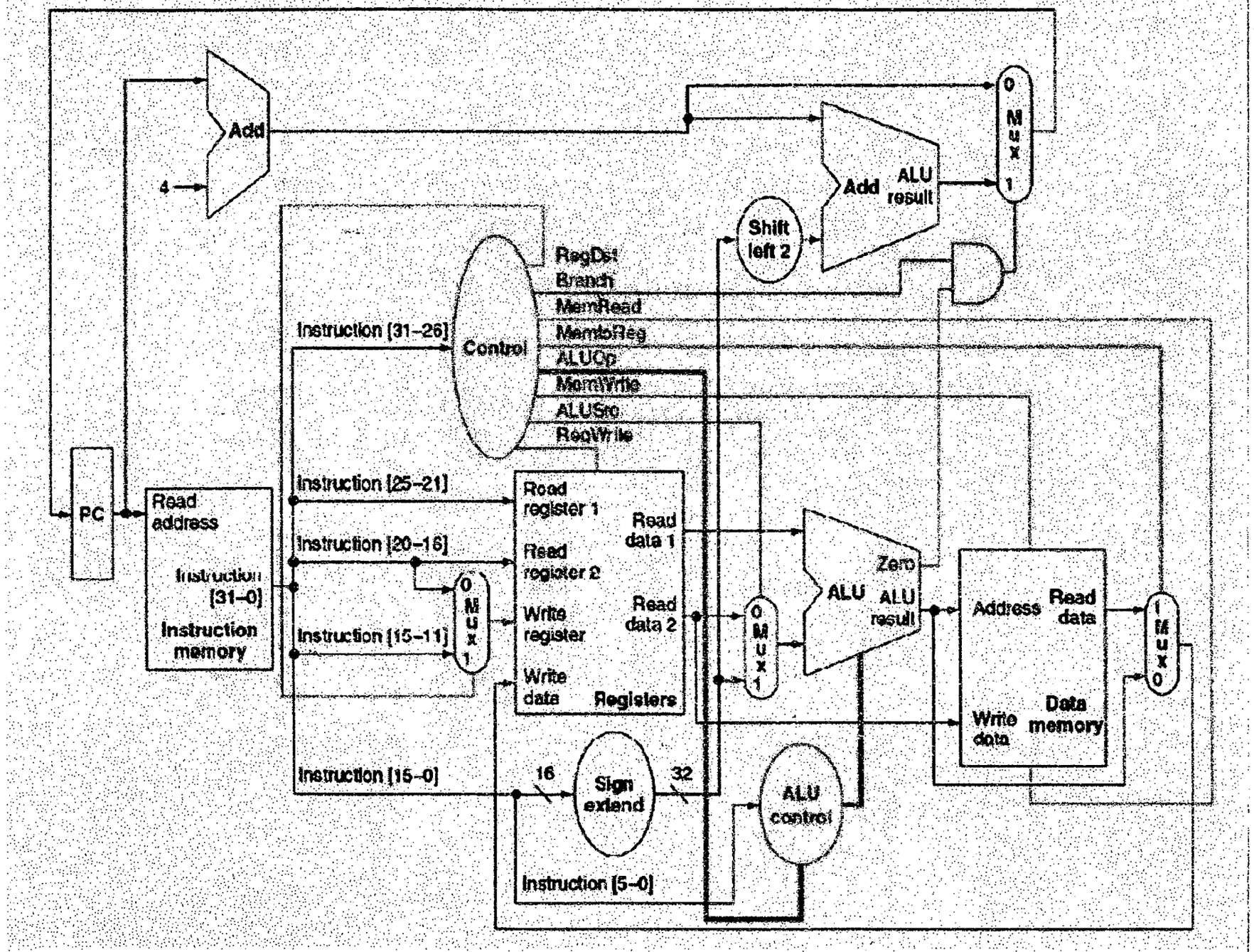
Add
4
M u x
0
1
Add
ALU result
Shift left 2
RegDst
Branch
MemRead
MemtoReg
ALUOp
MemWrite
ALUSrc
RegWrite
Control
Instruction [31–26]
PC
Read address
Instruction [31–0]
Instruction memory
Instruction [25–21]
Instruction [20–16]
Instruction [15–11]
Instruction [15–0]
Instruction [5–0]
Read register 1
Read register 2
Write register
Write data
Read data 1
Read data 2
Registers
16
Sign extend
32
ALU
Zero
ALU result
ALU control
Address
Read data
Write data
Data memory

Figure - 2

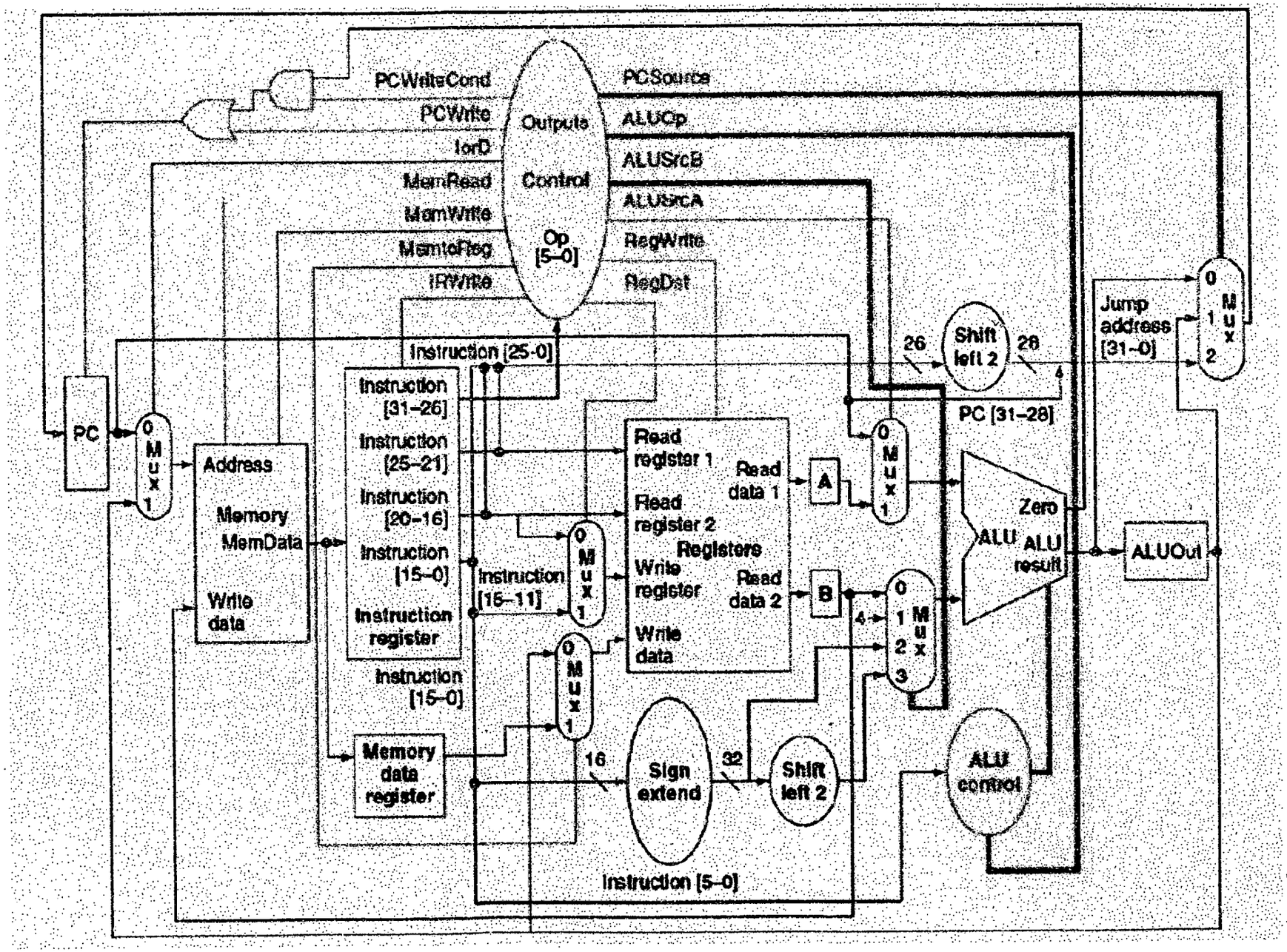
PCWriteCond
PCWrite
IorD
MemRead
MemWrite
MemtoReg
IRWrite
Outputs
Control
Op
[5–0]
PCSource
ALUOp
ALUSrcB
ALUSrcA
RegWrite
RegDst
Instruction [25-0]
26
Shift left 2
28
PC [31–28]
Jump address [31–0]
M u x
0
1
2
PC
Address
Memory
MemData
Write data
Instruction [31–26]
Instruction [25–21]
Instruction [20–16]
Instruction [15–0]
Instruction register
Instruction [15–0]
Instruction [15–11]
Memory data register
Read register 1
Read register 2
Registers
Write register
Write data
Read data 1
Read data 2
A
B
4
16
Sign extend
32
Shift left 2
Zero
ALU
ALU result
ALUOut
ALU control
Instruction [5–0]

Figure-3

L-4/T-2/EEE **Date : 07/06/2014**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2011-2012

Sub : **EEE 427** (Measurement and Instrumentation)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

The questions are of equal value.

1. (a) Write the steady state torque equation of a PMMC galvanometer and discuss the dynamic behavior of the deflection of a PMMC.

   (b) A typical panel PMMC instrument with a $3\frac{1}{2}$ in. case, a 1 mA range, and full scale deflection of 100 degrees of arc, has the following data

   $A = 1.75\ m^2$ $B = 0.2\ wb/m^2$

   $N = 84$ turns $T = 2.92 \times 10^{-6}$ N-m

   Coil resistance = 88 Ω

   Find the current and power dissipation in the coil.

2. (a) It is desired to measure the voltage across the 50 kΩ resistor in the circuit of Fig. for Q. No. 2(a). Two voltmeters are available for this measurement. Voltmeter 1 with a sensitivity of 1,000 Ω/V and voltmeter 2 with a sensitivity of 20,000 Ω/V. Both meters are used on their 50 V range. Calculate (i) reading of each meter; (ii) the error in each reading, expressed as a percentage of the true value.

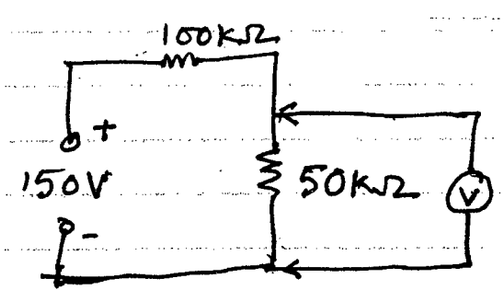

Fig. for Q. no. 2(a)

   (b) Design an Ayrton shunt as shown in Fig. for Q. NO. 2(b) to provide an ammeter with current ranges 2 A, 5 A and 10 A. A PMMC with internal resistance R_m = 30 Ω and full scale deflection of current I_{fsd} = 1 mA is used.

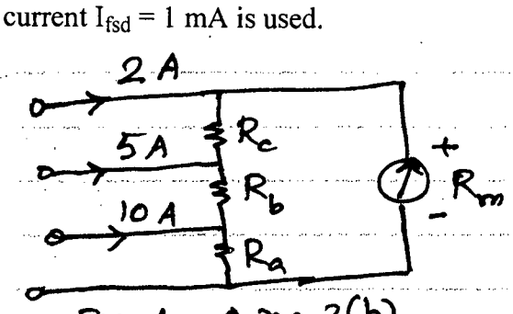

Fig. for Q. no. 2(b)

Contd P/2

EEE 427

3. (a) Define transformation ratio and nominal ratio in instrument transformers. For a current transformer find an expression of transformation ratio and phase angle error.
(b) A current transformer with a bar primary has 300 turns in its secondary winding. The resistance and reactance of the secondary circuit are 1.5 Ω and 1.0 Ω respectively including the transformer winding. With 5 A flowing in the secondary winding, the magnetizing mmf is 100 A and the iron loss is 1.2 W. Determine the ratio and phase angle errors.

4. (a) Discuss the theory and operation of a simple-phase energy meter.
(b) The current coil of a wattmeter is connected in series with an ammeter and an inductive load. A voltmeter and the voltage coil are connected across a 50 Hz supply. The ammeter reading is 5 A and the voltmeter and wattmeter reading are 240 V and 25 W respectively. The inductance of the voltage circuit is 10 mH and its resistance is 1000 Ω. If the voltage drop across the ammeter and the current coil are negligible, what is the percentage error in wattmeter reading?

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.
The figures in the margin indicate full marks.

5. (a) Differentiate, with neat sketches, between Accuracy and Precision as related to measuring instruments. **(8)**
(b) Draw the current-time characteristics of a typical thermistor element as a function of applied voltage. Deduce an application of thermistor based on this characteristics. **(4+3)**
(c) A strain gauge is bonded to a structural beam of 1 m long and 0.4×10^{-3} m^2 cross-sectional area. The gauge has an unstrained resistance of 240 Ω and a gauge factor of 2.20. With the application of a particular load to the beam, the resistance of the gauge changes by 0.013 Ω. Calculate the amount of force applied to the beam. Also calculate the change in the length of the beam. (Young's Modulus of Elasticity of the beam material is 207 GN/m^2). **(10)**
(d) Briefly explain the working principle of thermocouple-based thermal conductivity vacuum gauge. **(10)**

6. (a) For the variable reluctance type transducer shown in Fig. for Q. No. 6(a), show that the self-inductance of this transducer is inversely proportional to the length of the air-gap. **(10)**

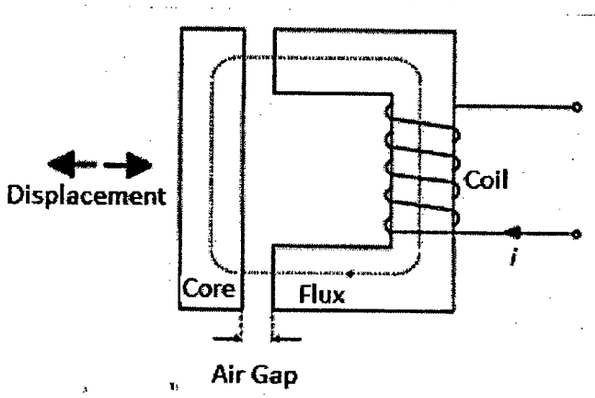

Fig. for Q. No. 6 (a)

Contd P/2

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Contd ... Q. No. 6

(b) Point out the advantages of differential output transducer arrangements over their single output counterparts. **(5+4)**

Modify the transducer arrangement shown in Fig. for Q. No. 6(a) for differential output.

(c) A linear motion (variable, x) is actuated to the solid dielectric of a parallel-plate capacitive transducer arrangement. Derive and plot the equation of capacitance between the plates as a function of x. Also, show that the sensitivity of such a transducer is constant. **(8+4+4)**

7. (a) Write a short note on 'Ultrasonic flowmeter'. **(8)**

(b) With the help of a neat sketch, briefly explain the following: photo-excitation and energy-band diagram of a p-n junction photodiode. **(8)**

(c) Show the basic circuit connection diagrams and operating quadrants of a junction photodiode operating in (i) photoconductive mode, (ii) photovoltaic mode. **(8+5)**

Which of the two operating modes, mentioned above, is suitable for high-speed optical measurements? Justify your answer.

(d) 8 measurement channels each band-limited to 5 kHz are to be transmitted by TDM/PCM telemetry. Each sample is PCM-coded into a 16-bit word. Find the minimum output rate in bits/second (bps). **(6)**

8. (a) Classify sources of noise in an instrumentation system in a neat tree structure. **(4+6)**

How does the use of twisted-pair cable compensate for the interference noise caused by inductive coupling?

(b) What is threshold digitization? Explain briefly, with diagrams. **(8)**

(c) A typical sample and hold circuit is shown in Fig. for Q. No. 8(c). If the maximum charging current of the input OP-AMP is 50 mA and the droop current is 100 pA, find the value of C and the corresponding droop rate. (Acquisition time for a 5V step should not exceed 10 μs). **(6)**

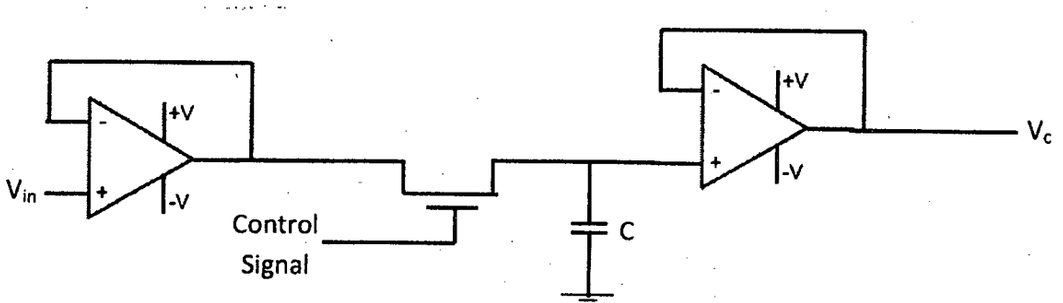

Fig. for Q. No. 8 (c)

(d) Draw the schematic diagram of an FDM system of telemetry and make appropriate sketches of signal conditions at each level, both on the transmitting and receiving sides. **(11)**
