KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2019

Department of Electronics and Communication Engineering

ECE 1109

(Solid State Electronics)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is electronic band structure? Draw the energy band of conductors, semi-conductors and insulators. (08)
   b) What is Fermi level? How the Fermi level is changed with the increase in temperature? Is it the same for intrinsic and extrinsic semiconductors? (10)
   c) Write down Matthiessen's rule. Show that resistivity of conductor is changed with temperature. (09)
   d) Calculate the mean scattering time of conduction electrons in copper, where the density of Cu is 8.96 $gmcm^{-1}$, atomic mass is 63.5 $gmmol^{-1}$ and its conductivity is $5.9\times10^5\ \Omega^{-1}cm^{-1}$. (08)

2. a) What is thermally generated charge carriers? Write and explain 'Wiedemann-Franz Law'. (07)
   b) Define "Electron emission". Explain secondary and field electron emissions with necessary diagrams. (08)
   c) Explain the formation of depletion layer in p-n junction. How the width of the depletion layer changed with doping level? (10)
   d) A tungsten filament consists of a cylindrical cathode 5 cm long and 0.03 cm in diameter. If the operating temperature is 2,227^{0}C, then find the emission current. Given that A = $60.2\times10^4 A/m^2/K^2$ and $\Phi = 4.517$ eV. (10)

3. a) Write short notes on "Transition capacitance" and "Diffusion capacitance". (08)
   b) Show that the Fermi level in a n-type semiconductor is $E_F = E_c - KTln\frac{NC}{ND}$, where the symbols have usual meaning. (10)
   c) Derive the continuity equation. Also explain its physical significance. (12)
   d) A conductor has diffusion constant of 13.7 cm^2/sec, for temperature at 31^{0}C, find out the mobility of the charge carriers. (05)

4. a) Describe Hall effect with necessary diagram. Write down the importance and application of Hall effect. (08)
   b) What is leakage current? Write down the applications of liquid crystals. (07)
   c) A zener diode used in a voltage regulator remains an output voltage of $\pm 50\ V$. The load resistance is 10 KΩ and the series resistance is 7 KΩ; if the maximum and minimum values of zener diode currents are 9 mA and 1 mA, respectively, then find out the range of input voltage that can be varied. (12)
   d) What is barrier potential? How can it be overcome in p-n junction? Explain with necessary diagrams. (08)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Describe the effect of impurity on the energy of a semiconductor. (08)
   b) Prove that the current passing through a diode in forward bias condition is a summation of majority and minority carriers flow. (06)

c) Determine V_0 and I_0 for the configuration of Figure 5(c). (07)

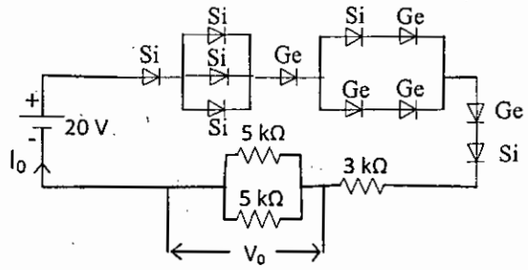

Fig. 5(c)

d) Write down the operation of a center-tap full wave rectifier. Show that for center tap rectifier, PIV = 2 V_m. (14)

6. a) For the Figure 6(a), find the (*i*) voltage at point 'a', (*ii*) voltage across resistor R_L, (*iii*) voltage drop across resistor R, (*iv*) the current through zener diode, considering all the diodes are ideal. (13)

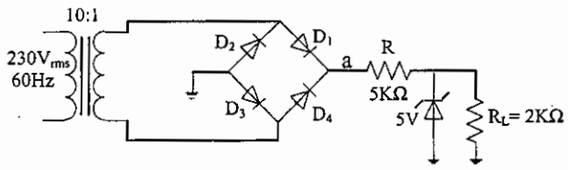

Fig. 6(a)

b) What is zener region? Explain the p-n junction for reverse bias condition. (06)

c) What is filter circuit? Explain the operation of a π filter with appropriate diagram. (10)

d) The circuit of Figure 6(d) uses two zener diodes, each rated at 15V, 200 mA, if the circuit is connected to a 45 V unregulated supply, determine (*i*) the regulated output voltage, (*ii*) maximum load current, and (*iii*) minimum load current. (06)

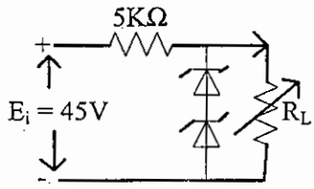

Fig. 6(d)

7. a) Write down the advantages of transistor over vacuum diode. "Emitter of a transistor is dopped heavily but base is lightly dopped" – why it is so? (09)

b) Show that the common emitter configuration, collector current is not zero, even if the base current is zero. (08)

c) In a common base configuration, α = 0.96. The voltage drop across 2 KΩ resistance which is connected to the collector is 3 V. Find (i) voltage drop across resistance 5 KΩ, (ii) base current, and (iii) base current configuration from Figure 7(c). (09)

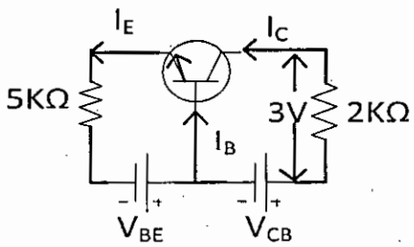

Fig. 7(c)

d) Explain the amplification action of a transistor with proper example. (09)

8. a) Write down the difference between BJT and FET with proper symbols. (08)

b) A JFET has a drain current of 5 mA. If I_{DSS} = 10 mA and V_{GS}(off) = -6V, find the value of (i) V_{GS} and (ii) V_P. (06)

c) Explain the transfer characteristics of JFET. Describe the operation of p-channel enhancement type MOSFET with appropriate figure. (13)

d) What is varactor diode? Describe the operation of a voltage controlled tuning with varactor diode. (08)

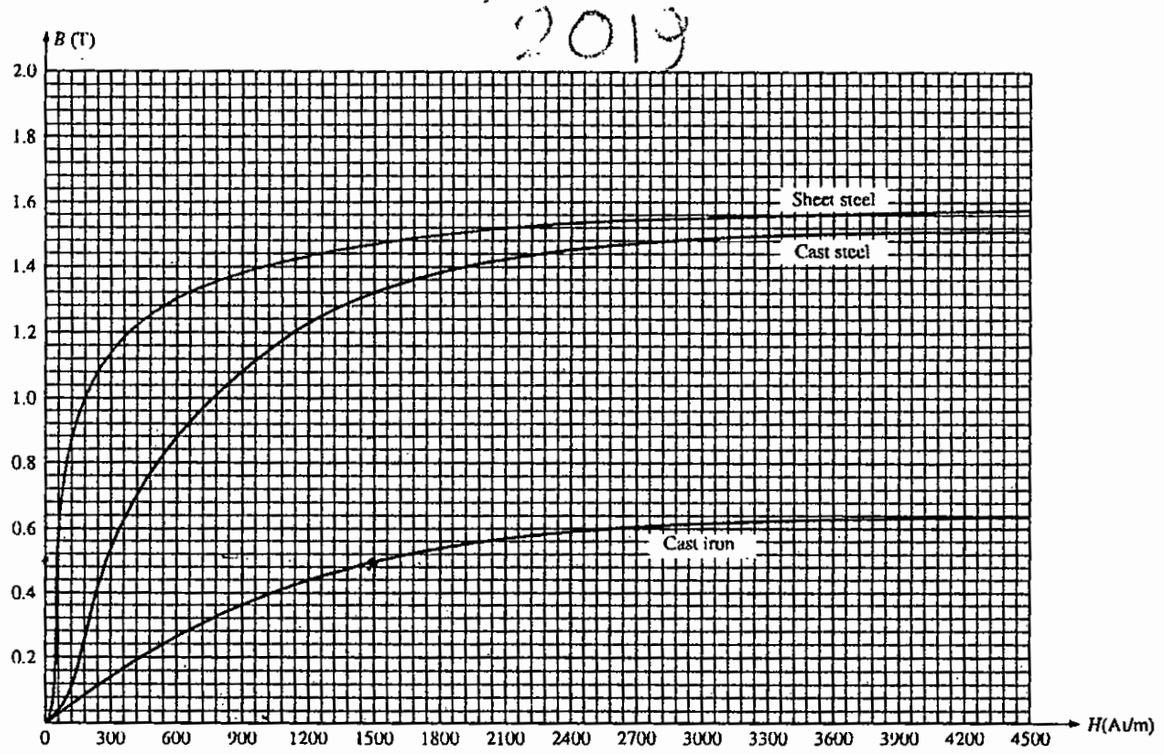

FIG. 12.7
Normal magnetization curve for three ferromagnetic materials.

Note from the various curves that for a particular value of H, say, H_x, the value of B can vary widely, as determined by the history of the core. In an effort to assign a particular value of B to each value of H, we compromise by connecting the tips of the hysteresis loops. The resulting curve, shown by the heavy, solid line in Fig. 12.6 and for various materials in Fig. 12.7, is called the *normal magnetization curve.* An expanded view of one region appears in Fig. 12.8.

A comparison of Figs. 12.3 and 12.7 shows that for the same value of H, the value of B is higher in Fig. 12.7 for the materials with the higher μ in Fig. 12.3. This is particularly obvious for low values of H. This correspondence between the two figures must exist since $B = \mu H$. In fact, if in Fig. 12.7 we find μ for each value of H using the equation $\mu = B/H$, we obtain the curves in Fig. 12.3.

It is interesting to note that the hysteresis curves in Fig. 12.6 have a *point symmetry* about the origin; that is, the inverted pattern to the left of the vertical axis is the same as that appearing to the right of the vertical axis. In addition, you will find that a further application of the same magnetizing forces to the sample results in the same plot. For a current I in $H = NI/l$ that moves between positive and negative maximums at a fixed rate, the same B-H curve results during each cycle. Such will be the case when we examine ac (sinusoidal) networks in the later chapters. The reversal of the field (Φ) due to the changing current direction results in a loss of energy that can best be described by first introducing the *domain theory of magnetism.*

Within each atom, the orbiting electrons (described in Chapter 2) are also spinning as they revolve around the nucleus. The atom, due to its

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2019

Department of Electronics and Communication Engineering

Basic Electrical Engineering

(EEE 1109)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define (i) Bilateral circuit (ii) Active element (iii) Passive network (iv) Loop and (v) Mesh with proper examples. (10)

b) What are linear and nonlinear circuits? Calculate the equivalent resistance R_{eq} and current i_o in the following circuit. (10)

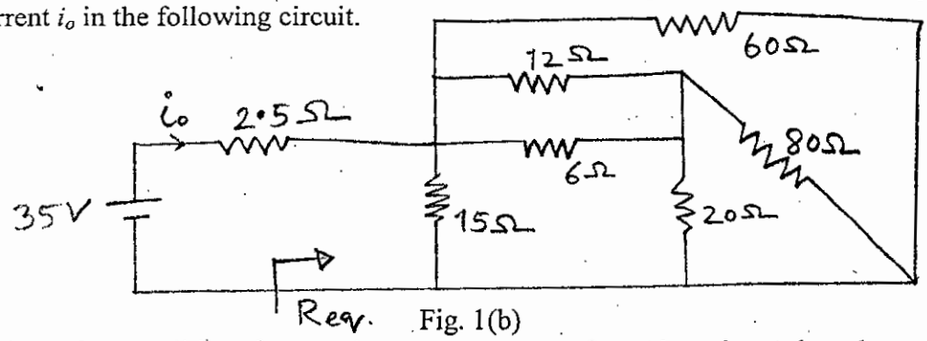

Fig. 1(b)

c) Deduce the condition for maximum power transfer. Also show that the power transfer efficiency is only 50% under this condition. Then why it is still useful in communication engineering? (15)

2. a) Define the following terms: (12)
(i) Independent source (ii) Dependent source (iii) Primary Cell and (iv) Secondary Cell.

b) Determine the nodal voltages and branch currents of the network shown in Fig. 2(b) (11)

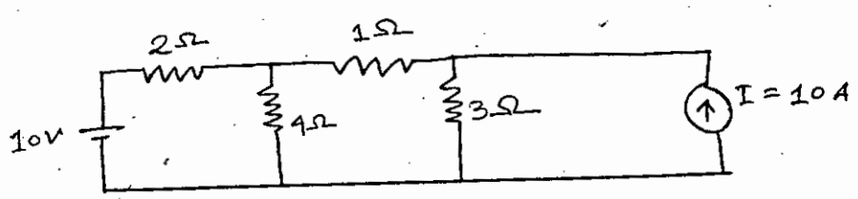

Fig. 2(b)

c) Find the loop current for the following circuit using loop current and mesh current method. (12)

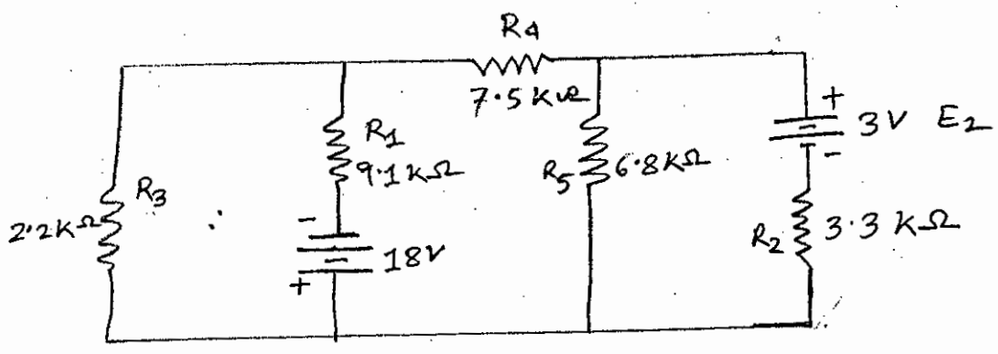

Fig. 2(c)

3. a) State superposition theorem. Determine the current (I) through the 2Ω resistor in the following circuit using the superposition theorem.

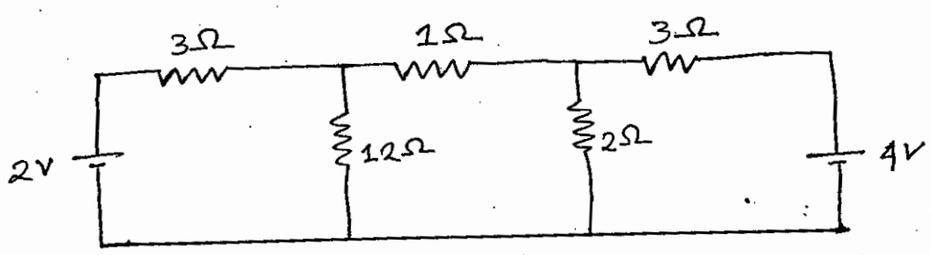

Fig. 3(a)

b) Find the Thevenin equivalent of the circuit given below at terminals *a-b*. (13)

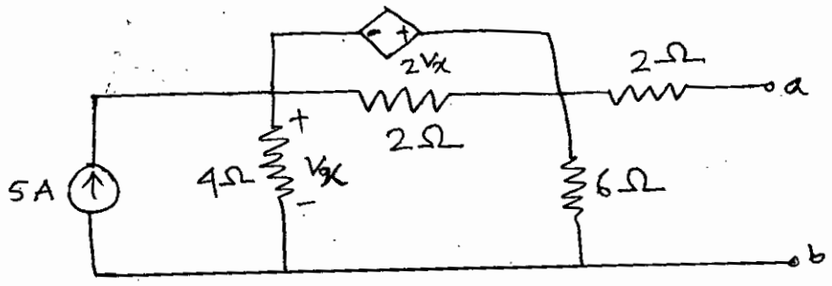

Fig. 3(b)

c) State reciprocity theorem. Use source conversion technique to find the voltage v_x for the following network. (12)

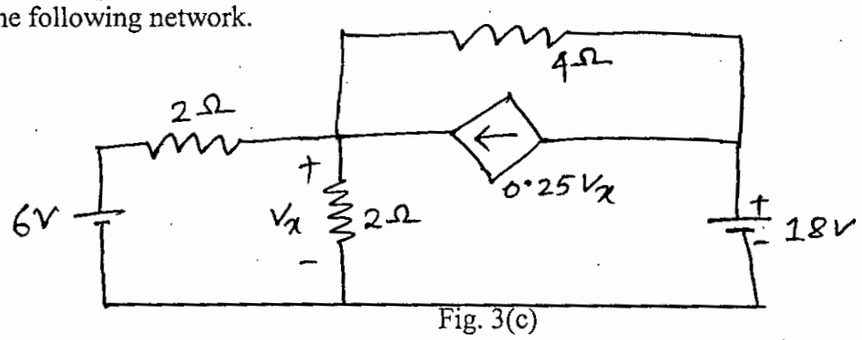

Fig. 3(c)

4. a) Define permeability and reluctance. Distinguish between electric circuit and magnetic circuit. (06)

b) State and explain Biot-Savart law for a magnetic circuit. (08)

c) Explain Ampere's circuital law. Write down some applications of magnetic circuit. (09)

d) Find the magnetic flux Φ for the series magnetic circuit in the following figure for the specified impressed *mmf*. (12)

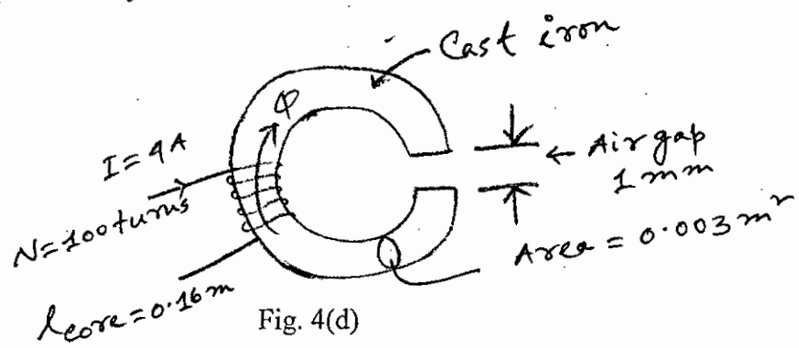

Fig. 4(d)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Define alternating current (ac). Write down the advantages of ac systems over dc systems. (07)

b) Define (i) Period (ii) Cycle and (iii) Angular velocity. Find the phase difference between the following voltage and current. Also, which wave leads? (12)
$v = 310\sin(\omega t - 60^0)$ and $i = -310\cos(\omega t - 45^0)$

c) Write the equation of instantaneous power of a *RL* branch and also show its different components and resultant power by graphically. (06)

d) A resistive element of 30 ohms is connected in series with an inductance coil, the self-inductance of which is 50 mH and the ohmic resistance of which is 4.5 ohms. a voltage $v = 100 \cos 377t$ volts is connected to the series branch. (10)
   a) Evaluate the expression for i .
   b) Evaluate the expression for p.

6. a) Define form factor. Explain the physical significance of form factor and crest factor. (07)
   b) *110V* applied to a series circuit consisting of *8Ω* resistance, *0.0531H* inductance, and *189.7μF* capacitance. When the frequency is *60* cycles, calculate current, power, power factor, vars, reactive factor and volt-amperes. Also calculate the voltage drop across each circuit element and draw the vector diagram. (15)
   c) What is meant by resonance? Prove that "In *RLC* series circuit, the maximum voltage across the capacitor occurs below the resonant frequency and the maximum voltage across the inductor occurs above the resonant frequency". (13)

7. a) Find the all possible roots of $\sqrt[3]{\frac{10\angle 45^0 5e^{j60^0}(-4.047-j2.94)}{1-j1.732}}$ (08)
   b) Derive the expression for bandwidth of a series *RLC* selector circuit. (10)
   c) What are the advantages of using 3-phase system over single-phase system? (05)
   d) For the given circuit as shown in figure below, i) find conductance and susceptance of each branch and ii) draw vector diagram. (12)

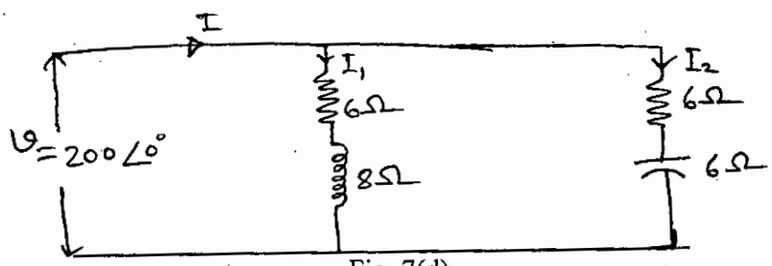

Fig. 7(d)

8. a) What is phase sequence? Why it is important? Explain the two lamp method of determining phase sequence of a 3-phase system. (12)
   b) Define balanced and unbalanced 3-phase systems. A balanced star connected load having an impedance of *15+j20Ω* in each phase is connected to a *3*-phase, *440V, 50 Hz* supply. Find the line currents and the power absorbed by the load. Assume *RYB* phase sequence. (13)
   c) Define magnetic coupling. Derive the expression of the coefficient of magnetic coupling. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2019

Department of Electronics and Communication Engineering

Hum 1109

(Economics)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Explain the concept of economics. Distinguish between micro and macro economics. (10)
   b) Explain the fundamental problems of an economic system. (10)
   c) Explain the economy's tradeoff between cloth and food on a production possibilities frontier. (15)

2. a) What is law of demand? Explain market equilibrium with the help of demand and supply curve. (15)
   b) Explain the non-price factors that affect the demand curve to shift. (10)
   c) "Technology and Government policy affect the supply of goods and services"- Explain how does it work? (10)

3. a) Define price-elasticity of demand. Explain the various types of price elasticity of demand. (10)
   b) Which one has greater elastic, "Samsung mobile or mobile in general"? Explain. (05)
   c) Solve the problem: There are 10,000 identical individuals in the market for commodity x, each with a demand equation is given by $Q_{dx} = 12 - 2P_x$ and 1,000 identical sellers each with a supply equation is given by $Q_{sx} = 20P_x$. (20)
      i) Find market demand and market supply equation for commodity x.
      ii) Obtain equilibrium price and quantity.

   Now if the government decides to collect a sales tax of $2 per unit sold, from each of 1,000 identical seller, of commodity x,
      iii) What effect does this have on the equilibrium price and quantity?
      iv) Who actually pays the tax?
      v) What is the total amount of taxes collected by the government?

4. a) Define market. Write down the forms of market. (05)
   b) What is short run? For a given price, explain how the perfect competitive firms choose the level of output that maximizes profit. (20)
   c) Identify the shut-down position of a firm in the short-run under perfect–competition. (10)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Distinguish between *GNP* and *GDP*. (10)
   b) Critically explain the income method of national income accounting. (15)
   c) National income model: (10)

   $Y=C+I+G$
   $C=100+0.75Y_d$
   $Y_d=Y-T$
   $T=10+0.05Y$
   $I=50$ and $G=40$.
   Calculate equilibrium, national income and consumption level.

6. a) Define the term "Propensity to consume". Discuss the factors which govern propensity to consume. (10)

b) Prove that – (10)

(i) $APC+APS=1$ (ii) $MPC+MPS=1$

c) A company wants to buy a machine at cost 3,000 Tk which lifetime 2 years. Expected return of the machine is Tk 1,100 and Tk 2,420. Current interest rate is 7%. i) Find out *MEC* ii) Is it profitable? (15)

7. a) What is inflation? Briefly describe the causes of inflation. (13)

b) What are the monetary tools to control inflation? Explain. (16)

c) Define demand pull and cost push inflation. (06)

8. a) Give the salient features of planned economy. (10)

b) What are the objectives of economic planning? Discuss. (10)

c) What conditions are essential for success planning? Discuss. (15)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2019

Department of Electronics and Communication Engineering

Math 1109

(Mathematics-I)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define continuity and differentiability of a function. Let (12)

$$f(x)=\begin{cases}x^2-16x, & x<9\\ 12\sqrt{x}, & x\geq 9\end{cases}$$

Is $f(x)$ continuous at $x = 9$? Determine whether $f(x)$ is differentiable at $x = 9$ or not. If possible find the value of the derivative at that point.

b) Evaluate (10)

$$Lt_{x\to 0}(1+\sin x)^{1/x}$$

c) If $y=\sin^{-1}x$, show that $(1-x^2)Y_{n+2}-(2n+1)xY_{n+1}-n^2Y_n=0$. Find also the value of $(Y_n)_0$. (13)

2. a) Find the differential coefficient of $(\sin x)^{\cos x}+(\cos x)^{\sin x}$. (10)

b) Find the relative extrema (if exist) of the following function: (12)

$$f(x)=\frac{4}{x}+\frac{36}{2-x}$$

c) If $u=f(x^2+2yz,\ y^2+2zx)$, then find the value of (13)

$$(y^2-zx)\frac{\partial u}{\partial x}+(x^2-yz)\frac{\partial u}{\partial y}+(z^2-xy)\frac{\partial u}{\partial z}.$$

3. a) Show that for the curve $by^2=(x+a)^3$ the square of the sub tangent varies as the subnormal. (11)

b) Find the Taylor finite series of $f(x)=\cos^2 x$ about $x=\frac{\pi}{4}$. (12)

c) State mean value theorem. Find the point C (if exist), where the tangent line is parallel to the secant line on [0, 3] of $f(x)=\sqrt{x+1}$. (12)

4. a) If ρ_1 and ρ_2 be the radii of curvature at the ends of a focal chord of the parabola $y^2=4ax$, then show that $\rho_1^{-2/3}+\rho_2^{-2/3}=(2a)^{-2/3}$. (13)

b) Differentiate $\tan^{-1}\frac{\sqrt{(1+x^2)}-1}{x}$ with respect to $\tan^{-1}x$. (10)

c) Find the asymptotes of the curve $x^3+y^3=3axy$. (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. Integrate ANY THREE of the followings: (35)

(a) $\int \frac{dx}{(2x+1)^2\sqrt{3x^2+2}}$, (b) $\int \frac{dx}{x^4+3x^2+1}$, (c) $\int e^x \frac{x^2+1}{(x+1)^2}dx$,

(d) $\int \frac{1-\sin x+\cos x}{1+\sin x-\cos x}dx$

6. a) Evaluate $\lim_{n\to\infty}\left[\frac{1^2}{n^3+1^3}+\frac{2^2}{n^3+2^3}+\cdots\cdots+\frac{n^2}{2n^3}\right]$. (10)

b) $\int_0^{\pi/2} \log(\tan x+\cot x)dx$ (12)

c) $\int_0^1 \frac{x^3\sin^{-1}x}{\sqrt{1-x^2}}dx$ (13)

7. a) Show that $\beta(m,n)=\int_0^\infty \frac{y^{n-1}}{(1+y)^{m+n}}dy$. (09)

b) Evaluate $\int_0^\pi x\sin^6 x\cos^4 x dx$ (11)

c) State and prove Walli's formula. (15)

8. a) Find the area of the region bounded by the parabolas $y^2=4ax$ and $x^2=4ay$. (12)

b) Find the length of the perimeter of the circle $x^2+y^2=4$. (12)

c) Find the volume of the solid produced by the revolution of the loop of the curve $a^2y^2=x^3(2a-x)$. (11)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st Year 1st Term Examination, 2019

Department of Electronics and Communication Engineering

Ph 1109

(Physics)

TIME: 3 hours FULL MARKS: 210

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

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What is simple harmonic motion? Show that the average kinetic energy and average potential energy of a simple harmonic motion are equal. (14)
   b) What is superposition principle? Show that superposition principle is valid only in case of linear homogeneous equation. (11)
   c) The force and displacement of a simple dynamic system undergoing sinusoidal excitation are given by the equations: (10)

$$F = 5 \sin\left(\frac{\pi t}{20}\right) \text{ newtons and}$$

$$y = 0.50 \sin\left(\frac{\pi t}{20} - \frac{\pi}{4}\right) \text{ meters}$$

   Calculate the work done in 30 seconds and in 5 minutes.

2. a) What is damped vibration? Derive and solve the differential equation of damped simple harmonic motion in LCR circuit. (16)
   b) Define bandwidth of resonance. Derive an expression for bandwidth of resonance. (10)
   c) Deduce the frequency and quality factor for a circuit with $L = 2$ mH, $C = 50$ μF, and $R = 2$ ohms. (09)

3. a) What is stationary wave? Discuss analytically the formation of stationary waves when reflection occurs at a free boundary. Why are they referred to as stationary waves? (17)
   b) Show that the group velocity depends on the medium through which the wave is transmitted. (08)
   c) A string vibrates forming stationary waves represented by $y = 0.8\, sin0.32xcos16t$, where x and y are expressed in meters and t in seconds. What are the amplitude and velocity of the individual waves and where superposition gives rise to this vibration? (10)

4. a) Discuss the general properties of nucleus. (10)
   b) Discuss the properties of nuclear forces. (08)
   c) Discuss secular equilibrium and transient equilibrium. (08)
   d) The half life of $_{92}U^{238}$is 4.51×10^{9} years. What percentage of $_{92}U^{238}$that existed 10^{10} years ago still survives? (09)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Discuss Michelson-Morley experiment and Show that there is no existence of ether in the universe. (15)
   b) Establish mathematically Einstein's mass energy relationship. Explain the physical significance of this relation. (10)
   c) A spaceship is 100 m long on the ground. When it is in flight, its length is 99 m to an observer on the ground. What is its speed? (10)

6. a) Discuss the drawbacks of classical physics in explaining photoelectric effect. (10)

b) What is Compton effect? Prove that the Compton redshift depends only on the angle of scattering. (15)

c) The photoelectric threshold frequency of silver is 1.086×10^{15} Hz. Calculate (i) the maximum kinetic energy of ejected electrons and (ii) the stoping potential in volts for the electrons, when the silver surface is illuminated with ultra-violet light of frequency 1.5×10^{15} Hz. (10)

7. a) Show that the distance between two consecutive dark or bright fringes are equal and is $\beta = \frac{\lambda D}{d}$. (10)

b) What is Newton's ring? How Newton's ring is formed? Derive the expressions for diameter of dark and bright rings in Newton's ring experiment. (15)

c) In an experiment with Fresnel's biprism, fringes for light of wavelength 5×10^{-5} cm are observed 0.2 mm apart at a distance of 175 cm from the prism. The prism is made of glass of refractive index 1.5 and it is at a distance of 25 cm from the illuminated slit. Calculate the angle at the vertex of the biprism. (10)

8. a) What is chromatic aberration? Show that the circle of least confusion depends on the diameter of the lens aperture and dispersive power of the material, but is independent of the focal length of the lens. (12)

b) What is specific rotation of an optically active substance? Discuss the determination of specific rotation of sugar solution by means of a polarimeter. (13)

c) Calculate the specific rotation of a given sample of sugar solution if the plane of polarization is turned through 26.4^0. The length of the tube containing 20% sugar solution is 20 cm. (10)