

B.Sc. Engineering 1st year 1st Term Examination, 2018
Department of Electronics and Communication Engineering
KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
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)

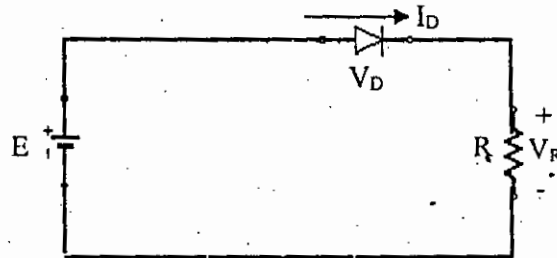
1. a) What do you mean by Electronics? Write down the applications of Electronics. (06)
b) What are the differences between solid state and non-solid state components? Why do we need to study solid state physics? (08)
c) What are the main drawbacks of classical free electron theory? Explain the assumptions made in quantum theory to overcome the drawbacks. (13)
d) For a silicon conductor, the diffusion constant is 13 cm²/sec. For room temperature (30° C), Find out the mobility of charge carriers. Also find out the mean scattering time 'τ' from that value. (08)
2. a) Define 'work function' and 'surface-barrier'. Explain 'Thermionic' and 'Photo-electric' electron emissions. (10)
b) Show that the width of the space charge region at a p-n junction is (13)
$$W = \sqrt{\frac{2\epsilon v_0}{q} \left(\frac{1}{N_a} + \frac{1}{N_d} \right)}$$
, where the symbols have their usual meanings.
c) An electric field of 2.3x10⁵ Vm⁻¹ is applied to a copper wire of diameter 1.67 mm. The density of copper is 8.96 gm cm⁻³ and its atomic mass is 63.5 gm mol⁻¹. The total resistance is 63.75 Ω and the mean scattering time is 2.5x10⁻¹¹ ms. Calculate (i) Resistivity and mobility of the conductor. (ii) The current through the conductor. (iii) What is the length of the wire? (12)
3. a) Briefly describe the process of 'Avalanche' and 'Zener' breakdowns. (06)
b) Explain the formation of depletion layer in p-n junction. How the width of the depletion layer is changed with doping level? (07)
c) State Matthiessen's rule for the resistivity of metals. Show that the temperature dependence of resistivity of metal is $\rho = \rho_0 + \alpha T$, Where ρ_0 and α are constants. (12)
d) Design a voltage regulator using a zener diode that will remain an output voltage of ±50 V across a load resistance of 10 K Ω with an input voltage, which varies from 80 V to 120 V. If there is a 5 K Ω series resistance, find the maximum and minimum values of zener diode current. (10)
4. a) Show that contact potential of p-n junction is $V_0 = KT \ln \frac{N_D N_A}{n_i^2}$, where the symbols have their usual meanings. (12)
b) What is skin effect? Write down the importance and applications of Hall effect. (07)
c) What is Electronic Band Structure? Draw the energy bands of Conductors, Semiconductors and Insulators. (08)
d) For a particular semiconductor material, $N_c = 1.5 \times 10^{18}$ cm⁻³, $N_v = 1.3 \times 10^{19}$ cm⁻³ and $E_g = 1.43$ eV. Determine (i) The intrinsic carrier concentration (n_i^2) of the semiconductor at temperature T=300 K. (ii) Find the position of intrinsic Fermi level (E_F) with respect to the center of the band gap. (08)

SECTION B

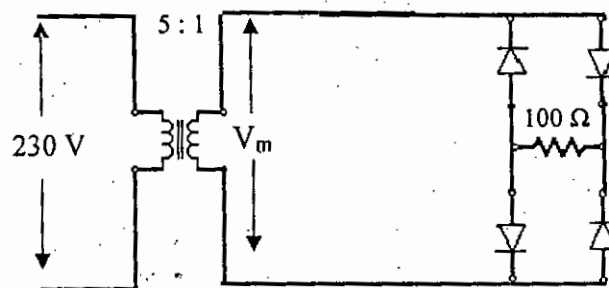
(Answer **ANY THREE** questions from this section in Script B)

5. a) Conductors have a positive temperature coefficient, whereas semiconductor materials have a negative temperature coefficient-Why? Explain briefly. (08)

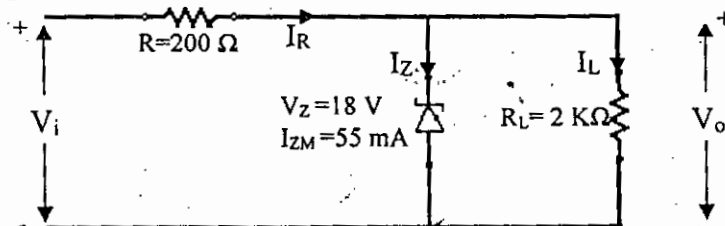
- b) Show that the PIV for each diode is double in a full wave rectifier using center-tapped transformer than that of a bridge rectifier. (10)
- c) How can a junction diode be used as a protection element for LED? (07)
- d) For the following circuit find out the operating point and calculate the voltage across the load from the figure (10)



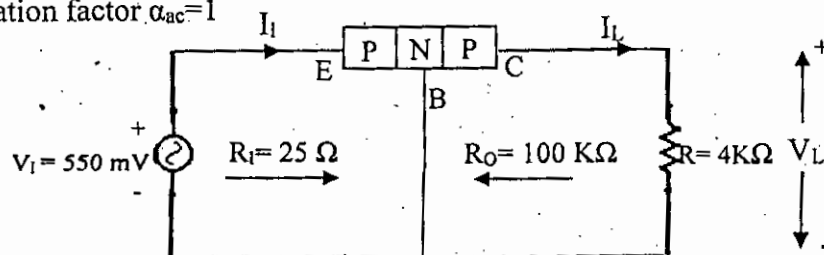
6. a) Show that in half-wave rectification, a maximum of 40.6% of ac power is converted into dc power. (12)
- b) What do you mean by filter circuits? Explain the operation of a π filter with appropriate diagram. (11)
- c) Figure (6c) shows the bridge type circuit having the load resistance 100Ω and transformer turn ratio 5:1. The primary is connected to 230 V, 50 Hz supply. Find the dc voltage and PIV for dc output. Assume the diodes to be ideal. (12)



7. a) What is meant by regulated power supply? Design a regulated power supply for your mobile phone (+5 Vdc) from 220 V ac mains. Mention the input and output wave-shapes at every stage with proper labeling. (10)
- b) What are the differences between BJT and FET? Mention the advantages of FET over BJT. (10)
- c) Determine the range values of V_i that will maintain the zener diode of the following figure. (10)



- d) Determine α_{dc} if $I_E = 2.8 \text{ mA}$ and $I_B = 20 \mu\text{A}$ (05)
8. a) Prove that the expression for collector current of common base connection is $I_c = \frac{\alpha}{1-\alpha} I_B + \frac{I_{CBO}}{1-\alpha}$, where the symbols have their usual meanings. (09)
- b) Write short notes on (i) Tunnel diode (ii) Photo Diode (05)
- c) What is the primary difference between D-MOSFET and E-MOSFET? Explain the basic operation and characteristics of D-MOSFET. (11)
- d) Calculate the voltage gain A_v of the following figure. If $V_i = 550 \text{ mV}$ and $R = 4 \text{ K}\Omega$. Assume amplification factor $\alpha_{ac} = 1$ (10)



KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 1st Year 1st Term Examination, 2018
 Department of Electronics and Communication Engineering
 EEE 1109
 (Basic Electrical Engineering)

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the right margin indicate full marks.
 iii) B-H curve may be supplied if necessary.

SECTION A

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

1. a) Distinguish between the following circuit elements: (09)
 - i) Active vs. Passive
 - ii) Bilateral vs. Unilateral
 - iii) Linear vs. Nonlinear
- b) Write short note on primary cell and secondary cell. (05)
- c) Deduce the condition for maximum power transfer in an electrical circuit. Also show that the power transfer efficiency is only 50% under this condition. Then why it is still useful in communication engineering? (15)
- d) Determine current through each resistor in the following circuit of Fig. 1(d.) (06)

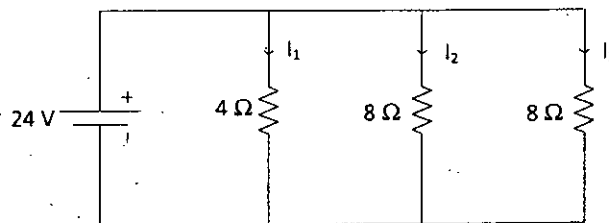


Fig. 1(d)

2. a) Calculate the mesh current I_1 , I_2 , and I_3 of the following circuit shown in Fig 2(a). (12)

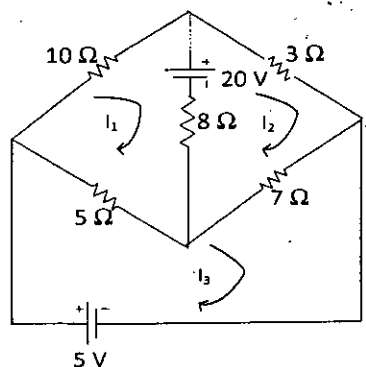


Fig. 2(a)

- b) Deduce the expression for Y- Δ and Δ -Y conversions. Using such conversion, find the current I of the following network. (13)

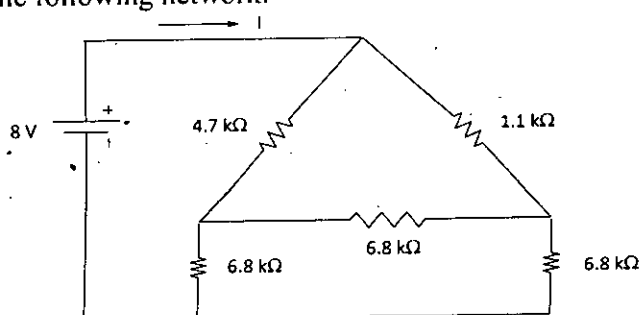


Fig. 2(b)

- c) Derive the node voltage equations and determine the current in each branch for the circuit shown in Fig. 2(c). (10)

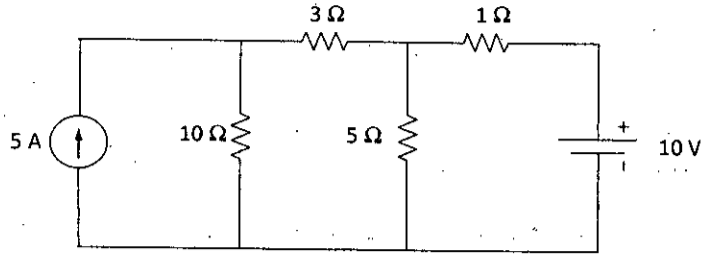


Fig. 2(c)

3. a) Find the voltage across the $2\ \Omega$ resistor (V_{AB}) in the following figure by using the superposition theorem. (12)

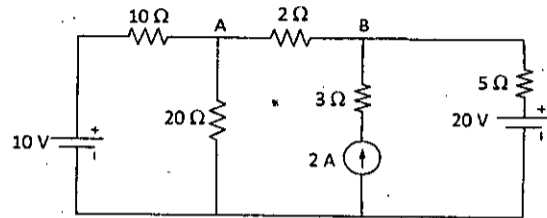


Fig. 3(a)

- b) State Norton's theorem. For the circuit as given below, find: (13)
- Thevenin equivalent circuit to the left of the terminal a-b.
 - Norton equivalent circuit.

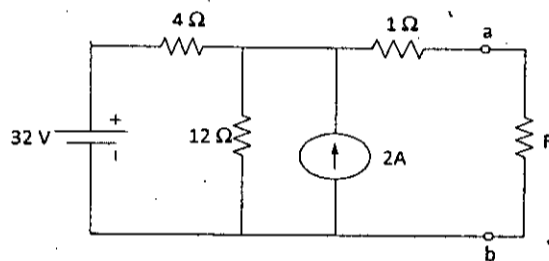


Fig. 3(b)

- c) What is supernode? Using the supernode approach, determine the nodal voltages for the following network. (10)

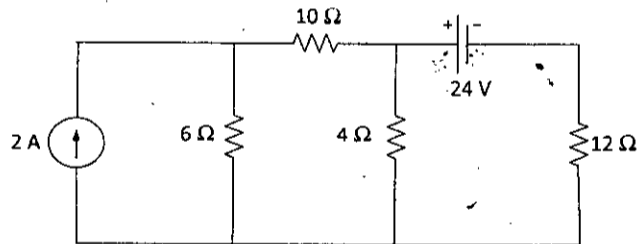


Fig. 3(c)

4. a) State the Reciprocity and Millman's theorem. Verify the Reciprocity theorem for the given circuit shown in Fig. 4(a). (15)

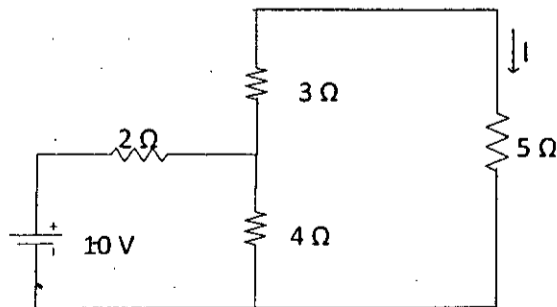


Fig. 4(a)

- b) Define permeability and reluctance. Also explain hysteresis loss and eddy current loss in a magnetic circuit. (10)

- c) Find the current I required to established a flux $\phi=2.4 \times 10^{-4}$ Wb in the magnetic circuit shown below: (10)

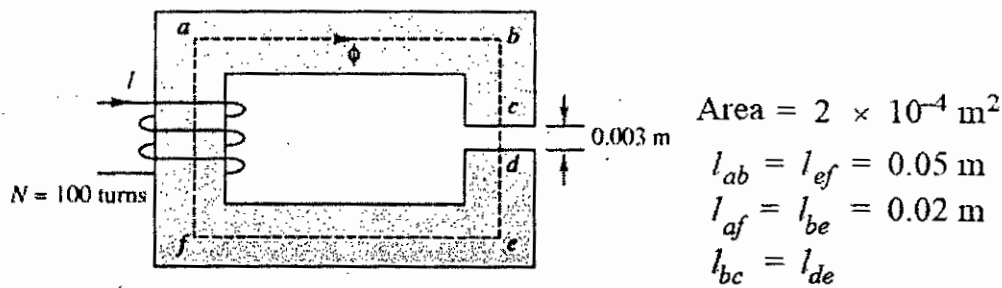


Fig. 4(d)

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. (06)
- b) What is phase? Draw the waveforms of $v=100\cos(\omega t-60^\circ)$ and $i=10\sin(\omega t-60^\circ)$ and find their phase difference. Which wave leads? (08)
- c) "The capacitor receives energy from the source during one quarter cycle and returns the same amount during next quarter cycle"-justify the statement and find the amount of energy. (11)
- d) Show that the crest factor of a sine wave is $\sqrt{2}$ and the form factor is 1.11. (10)
6. a) Define the following terms in the context of *ac* signal: (06)
 - i) Effective value, ii) Impedance, and iii) Power factor.
- b) 220 V and 50 Hz supply is applied to the following circuit. Calculate the current, power, power factor, and VARs. Also calculate the voltage drops across the elements. (12)

Fig. 6(b)

- c) "Multiplication and division operations of phasors are suitable in polar form"-justify the statement. (08)
- d) Describe the use of an RLC series circuit as a selector. Derive Q-factor, $Q_0 = \frac{f_0}{f_0 - f_1}$. (09)
7. a) Write down the condition for resonance in *ac* circuit and find the resonant frequency. (05)
- b) Derive the expression for bandwidth of a series RLC selector circuit. (10)
- c) What is phase sequence? Why is it important? Explain the two lamp method of determining phase sequence of a 3- ϕ system. (12)
- d) What is balanced 3- ϕ system? Prove that 3- ϕ system is more economical than 1- ϕ system. (08)
8. a) Explain the effects of varying capacitance on the voltages and currents on a series RLC circuit and hence find the optimum capacitance for resonance. (10)
- b) Explain how the power factor can be improved. (05)
- c) Explain the two-wattmeter method to measure the power of a 3- ϕ system. (12)
- d) A balanced star connected load having an impedance of $15+j20 \Omega$ in each phase is connected to a 3- ϕ , 440 V, 50 Hz supply. Find the line currents and the power absorbed by the load. Assume RYB phase sequence. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

B.Sc. Engineering 1st year 1st Term Examination, 2018
Department of Electronics and Communication Engineering

~~HUM ECE~~ 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) "Economics was a science of wealth: it is now a science of welfare" Discuss in brief. (10)
 - b) Define law of demand. Explain why does the demand curve shift? (10)
 - 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 1000 identical producers of commodity x, each with a supply equation is given by $Q_{sx}=20P_x$. (i) Find the 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 the 1000 identical sellers 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?

2.
 - a) What is price elasticity of demand? Explain the types price elasticity of demand with example. (10)
 - b) The R J smith corporation is a publisher of romance novel. The corporation hires an economical to determine the demand for its product. After months of hard work the analyst informed that the demand for the firm's novel is given by the following equation:
$$Q_x=12000-5000 P_x+5I+500 P_c$$
Where, P_x is the price charged for the R J Smith novel. I_1 is the income per capita. PC_1 is the price of books from competing publisher.
Assume, that the initial values of P_x , I and P_c are \$5, \$10000 and \$6 respectively. Using the information, the manager wanted to (i) determine what effect a price increased would have on total revenue. (ii) Evaluate how sale of the novels would change during a period of rising incomes. (iii) Assess the probable impact if competing publishers would raise their price.

3.
 - a) Define market. What are the forms of market? (10)
 - b) Show how, in perfectly competitive equilibrium the price of a commodity is equal to its marginal and average cost of production. (15)
 - c) "All firms do not always aim at profit maximization"- Explain (10)

4.
 - a) What do you mean by "Production"? Explain the factors of production. (25)
 - b) Is land capital? Justify your statement. (10)

SECTION B

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

5. a) Define national income and personal income. Explain "income method" of national income accounting in brief. (15)
- b) Distinguish between GNP and GDP. (05)
- c) Given a National income model: (15)
- $Y=C+I+G$ $C=100+1/3Y_d$; $Y_d=Y-T$ $I=50$, $T=20+0.05Y$ $G=30$
- Find out equilibrium National income & Consumption level.
-
6. a) Define investment. What are the determinants of investment? (10)
- b) Briefly explain how higher savings leads to a higher standard of living. (10)
- c) If cost of a project is Tk. 6, 00,000, its life time one year and expected return of it is Tk 6,50,000. (i) What is marginal efficiency of capital? (ii) Is project profitable due to market interest of 10%. (15)
-
7. a) Define project evaluation. Explain cost benefit analysis of a project. (20)
- b) Prove that $APC+APS=1$ (10)
- c) Derivate a consumption function when marginal propensity to consumption 0.75 and autonomous consumption 100. (05)
-
8. a) Define inflation, demand pull inflation and cost push inflation. (10)
- b) How do you suggest the government to control inflation through Monetary measure? (15)
- c) What conditions are essential for success of planning? Discuss (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 1st Year 1st Term Examination, 2018
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) What are necessary and sufficient conditions for existence of limit of a function? (10)
Applying (δ, ϵ) definition of limit, show that $\lim_{x \rightarrow 2} \frac{2x^2 - 8}{x - 2} = 8$. Also find δ , if $\epsilon = 0.1$.
- b) Let $f(x) = \begin{cases} x^2 - 16, & x < 9 \\ 12\sqrt{x}, & x \geq 9 \end{cases}$ (10)
Is $f(x)$ continuous at $x=9$? Determine whether $f(x)$ is differentiable at $x=9$.
- d) The adiabatic law for the expansion of air is $PV^{1.4} = k$, where k is a constant. If at a given time the volume is observed to be 20 cu.ft. and the pressure is 50 lbs per square inch, at what rate is the pressure changing if the volume is decreasing at the rate of 2 cu.ft. per sec. (13)
- d) What is the physical meaning of $\frac{dy}{dx}$. (02)
2. a) Find $\frac{dy}{dx}$ for the following cases: (10)
i) $e^{xy} - 4xy = 2$.
ii) $x = a(\cos t + t \sin t)$, $y = a(\sin t - t \cos t)$
- b) If $y = \frac{x^2 + x - 1}{x^3 + x^2 - 6x}$, find y_n . (07)
- c) Evaluate $\lim_{x \rightarrow 0} \left(\frac{\sin x}{x} \right)^{1/x}$. (10)
- d) Find the value of $\sin 31^\circ$ without using calculator correct up to two decimal places. (08)
3. a) The cost $c(x)$ of manufacturing of television is given by the formula (10)
 $c(x) = 5 + \frac{48}{x} + 3x^2$, where x is the number of television manufactured. Find the minimum cost.

B.Sc. Engineering 1st year 1st Term Examination, 2018
Department of Electronics and Communication Engineering
KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

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 simple harmonic motion is an oscillatory motion in terms of velocity, displacement and acceleration. (13)
b) What is linear equation? Show that the superposition principle is valid only in the case of linear homogenous equation. (12)
c) A SHM is presented by $y=12\sin(6t-\pi/3)$, where y is measured in meters, t in seconds and the phase angles in radians. Calculate the frequency, epoch, maximum displacement, velocity and acceleration at $t=0$ and $t=6$ seconds. (10)

2. a) What is Damped oscillation? Let a body executing SHM. If the body is placed in a damping medium, then (i) Write down the forces that are subjected to the body to generate damped oscillation and hence construct the differential equation. (ii) Solve the differential equation of damped vibration. (iii) Hence obtain the condition for critical damping. (17)
b) What is wave velocity? Derive an expression for energy of a progressive wave. (10)
c) A wave along a string is given by the relation $y=0.02\sin(30t-4x)$, where x is in meters and t is in seconds. Find the amplitude, frequency, speed and wavelength. (08)

3. a) What is Doppler's effect? Derive an expression for the apparent frequency of a note when (i) The source and observer is moving separately towards the stationary observer and source. (ii) The source and the listener are moving. (12)
b) What is Beats? If two wave trains of frequency, f_1 and f_2 are sounded together, then show that the number of beats produced per second is f_1-f_2 . (13)
c) Let two SHM of same frequency but of amplitude 'a' and 'b' are given by, (10)
$$x=asin(\omega t+\phi)$$
$$y=bsin(\omega t)$$

If they superimpose to each other then, (i) Obtain the general equation of resultant vibration. (ii) Draw the Lissajous figures for $\phi=\pi/2$ and 2π .

4. a) What is Binding energy and packing fraction of a nucleon? In case of binding energy, (10)
 (i) Draw the binding energy curve. (ii) Show that $B. E = \{A(M_n - 1) + Z(M_p - M_n)\} C^2$, where the symbols have their usual meaning.
- b) Show that, the average life period of a radioactive atom is the reciprocal of the radioactive constant. (10)
- c) A nuclear reaction is given below, (10)

$${}_{92}^{235}\text{U} + {}_0^1\text{n} \longrightarrow [{}_{92}^{236}\text{U}] \longrightarrow {}_{42}^{95}\text{Mo} + {}_{57}^{139}\text{La} + 2{}_0^1\text{n} + Q$$
 i) What type of reaction is it? Explain in brief.
 ii) Calculate the released energy (Q) from the reaction.
- d) The half-life of Radon is 3.82 day. Find the time of decay to 60% of it. (05)

SECTION B

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

5. a) What are the differences between inertial and absolute frame of references? Starting from Lorentz transformation, drive an expression for length contraction. (10)
- b) Derive an expression for Einstein's mass energy relation and hence prove that classical kinetic energy is only an approximation. (15)
- c) A rocket ship 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) What are the basic postulates of Bohr Atom Model? Calculate the limiting values of wavelengths of different spectral series of Hydrogen atom. (15)
- b) Show that the quantum physics give the same results as the classical physics in the limit of very large quantum numbers. (10)
- c) How much energy is required to remove an electron in the $n=2$ state from a Hydrogen atom? (10)
7. a) What is coherent source of light? What is the necessity of coherent sources to observe interference of light? (10)
- b) How can you obtain Newton's rings in the laboratory? Discuss the determination of the wavelength of light by Newton's ring. (15)
- c) In a Newton's ring experiment the diameter of the 15th ring was found to be 0.59 cm and that of 5th ring was 0.336 cm. If the radius of the plano-convex lens is 100 cm, calculate the wave of light used. (10)
8. a) What is polarization of light? Discuss Brewster's law and hence show that the reflected and refracted rays are 90° apart. (10)
- b) Discuss the Fraunhofer diffraction due to a single slit and discuss the intensity distribution on the screen. (15)
- c) Deduce the missing order for a double slit Fraunhofer diffraction pattern if the width of the slit and the opaque space are 0.16 and 0.8 mm respectively. (10)