L-1/T-2/IPE **Date : 20/02/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **EEE 167** (Basic Electrical & Electronic Circuit)

Full Marks: 280 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 5V peak 1kHz sinusoidal voltage signal is rectified using a full wave bridge rectifier. The output waveform of the rectifier is shown in Fig for Q. 1(a) **(20)**
Find the RMS value, average value and form factor of the voltage signal.

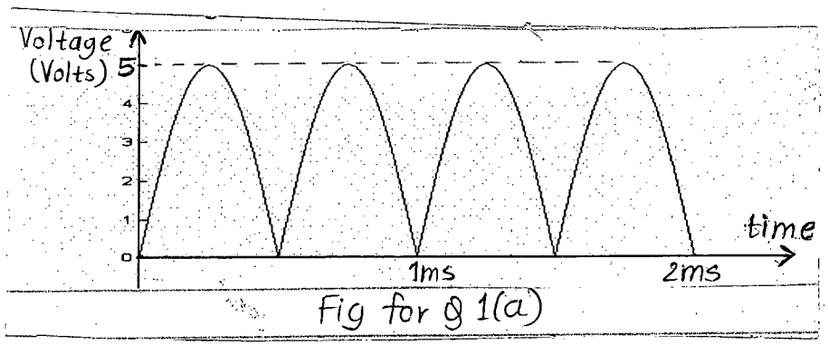

Fig for Q 1(a)

(b) Find the expression for impedance and instantaneous power for a series RC branch excited by sinusoidal voltage. **(26 $\frac{2}{3}$)**

2. (a) Draw the complete phasor diagram of the circuit shown in Fig for Q 2(a) taking i_{RL} as reference. **(23 $\frac{1}{3}$)**

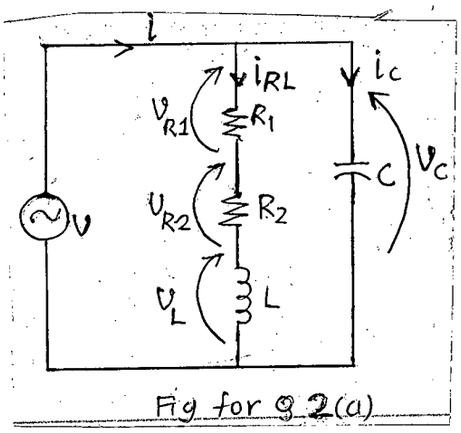

Fig for Q 2(a)

(b) The voltage v = 100 cos (ωt + 30°) v is impressed across a series RLC load. The current flowing through the series combination has a peak value of 10A and the peak occurs at time, t = 0

(i) Find the total impedance of the series RLC branch. **(10)**

(ii) If the RLC branch has inductance, L = 1mH and capacitance, C = 20 μF; find the frequency. **(13 $\frac{1}{3}$)**

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3. (a) For the circuit shown in Fig for Q. 3 (a) the current i_2 is $I_2 = 5 \angle 0°$A (rms).

(i) Find the current i_1 in phasor form. **($13\frac{1}{3}$)**

(ii) Find the real power and reactive power consumed by the impedance Z_x. **($13\frac{1}{3}$)**

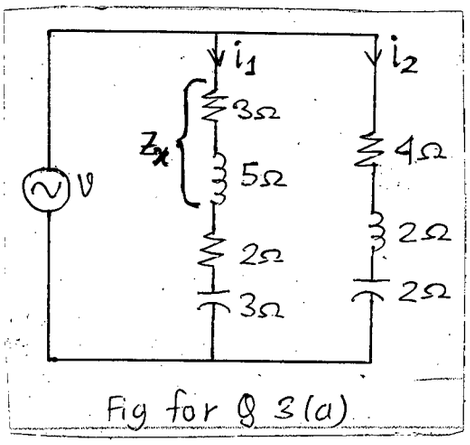

Fig for Q 3(a)

(b) A balanced 3-phase Δ- connected load draws 792 watts real power from 3-phase supply. Each phase of the load consists of 60 ohms resistance and 80 ohms inductive reactance in series. **(20)**
Find the rms values of line current & line voltage.

4. (a) Find the voltage V_0 and current I_0 for the circuit shown in Fig. for Q. 4(a). Use constant 0.7 V voltage drop model for the diodes. **($23\frac{1}{3}$)**

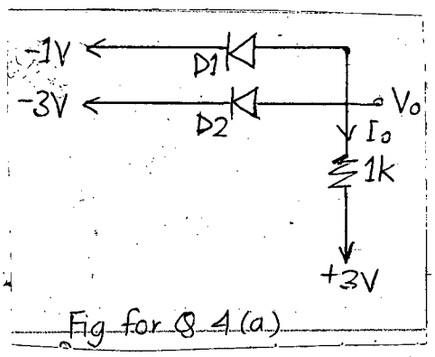

Fig for Q 4(a)

(b) Find the range of resistive load value, R_L that provides a constant DC voltage across the load for the Zener shunt regulator shown in Fig for Q. 4(b). **($23\frac{1}{3}$)**

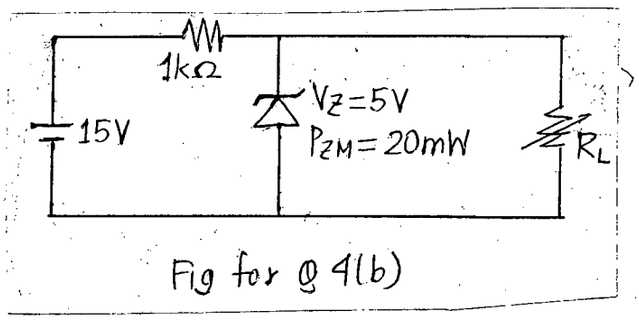

Fig for Q 4(b)

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EEE 167

SECTION – B

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

5. (a) Calculate the power absorbed by the 6 Ω resistor in the circuit shown using mesh analysis. **($23\frac{1}{3}$)**

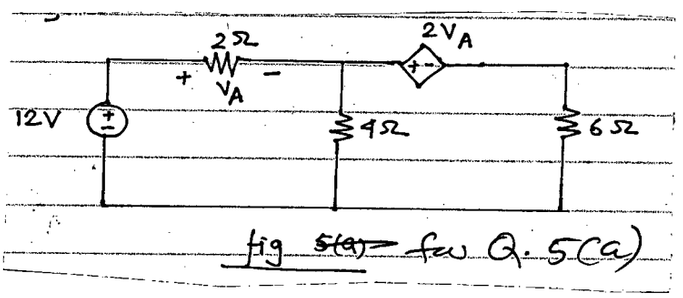

fig 5(a) for Q. 5(a)

(b) Find the equivalent resistance between terminals a & b for the circuit shown. **($23\frac{1}{3}$)**

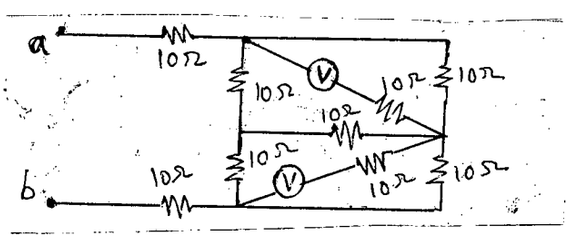

Fig. for Q. 5(b)

6. (a) Use superposition principle to find the voltage V_0 for the circuit shown. **(20)**

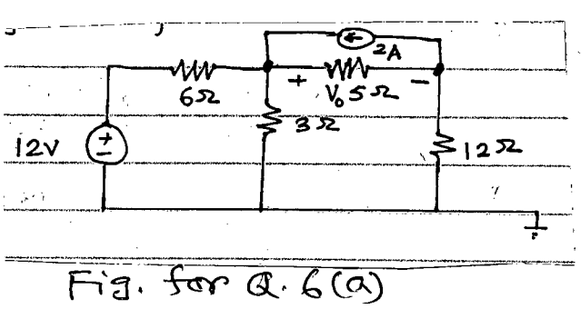

Fig. for Q. 6(a)

(b) Use source transform to express the network between terminals x and y as a series combination of a voltage source and a resistor for the circuit shown. Also, find the maximum power that can be obtained from a load connected between the terminals. **($20+6\frac{2}{3}$)**

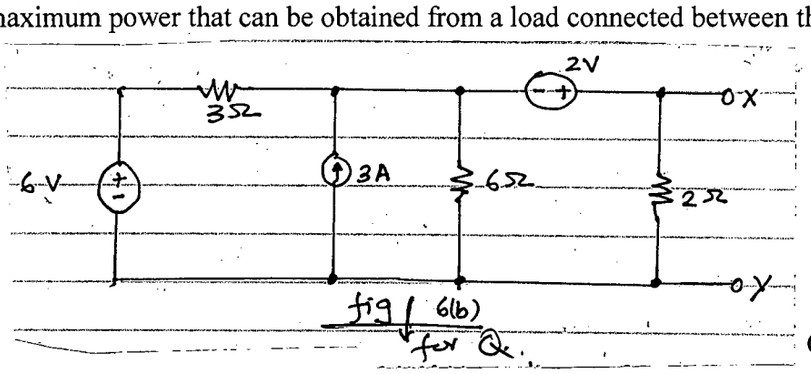

fig 6(b) for Q.

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7. (a) Find the voltage across the 2Ω resistor using nodal analysis method for the circuit shown. **($26\frac{2}{3}$)**

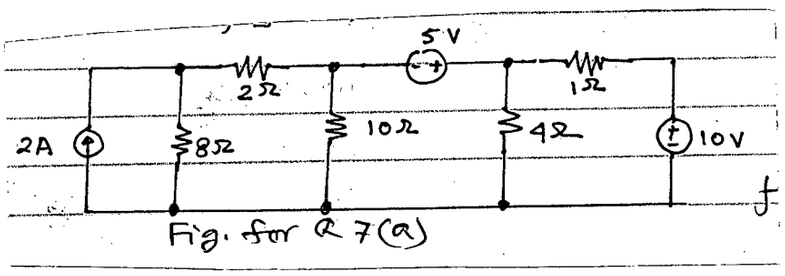

Fig. for Q 7(a)

(b) Find the Norton equivalent of the network between terminals a & b for the circuit shown. **(20)**

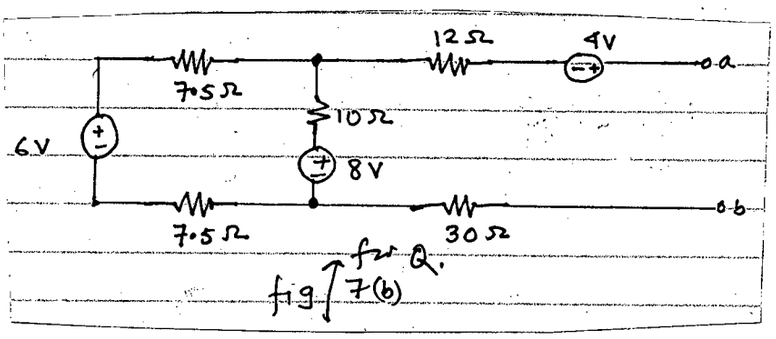

fig 7(b) for Q.

8. (a) Find the value of resistor R_C to obtain $V_{CE} = 1/3\ V_{CC}$ for the circuit shown. **($26\frac{2}{3}$)**

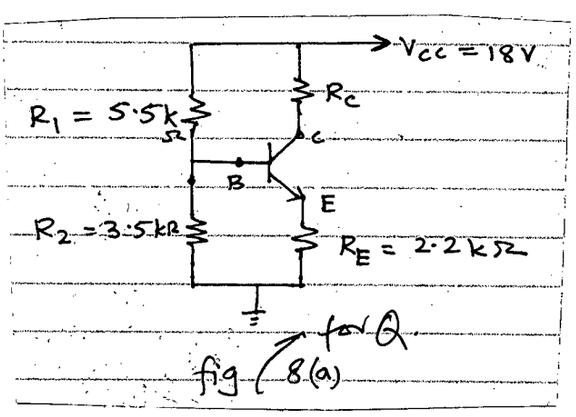

fig 8(a) for Q.

(b) Find the value of I_B, I_C and I_E for the circuit shown. **(20)**

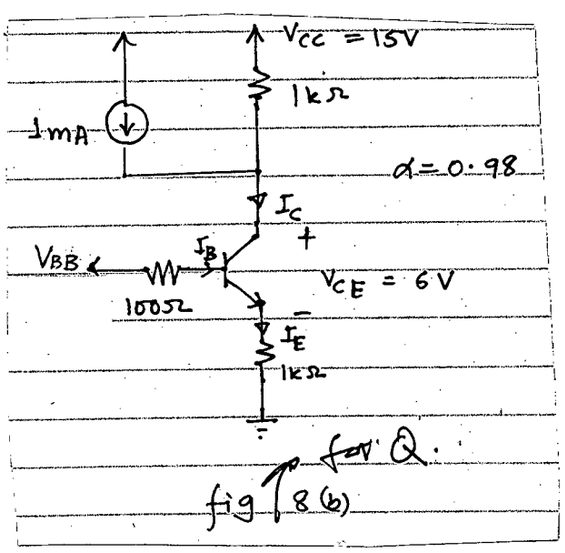

fig 8(b) for Q.

L-1/T-2/IPE **Date : 21/01/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **MATH 193** (Vector, Matrix and Solid Geometry)

Full Marks : 280 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) Prove vectorially that the diagonals of a paralleogram bisect each other. **(14)**

   (b) Ascertain the linear dependence or independence of the vectors **(16)**

   $$\underline{a} = 2\hat{\underline{i}} + \hat{\underline{j}} - 3\hat{\underline{k}}, \quad \underline{b} = \hat{\underline{i}} - 4\hat{\underline{k}} \quad \text{and} \quad \underline{c} = 4\hat{\underline{i}} + 3\hat{\underline{j}} - \hat{\underline{k}}$$

   If dependent, find a relation among them.

   (c) Prove that **(16⅔)**

   $$\underline{a} \times (\underline{b} \times \underline{c}) = (\underline{a} \cdot \underline{c})\underline{b} - (\underline{a} \cdot \underline{b})\underline{c}$$

2. (a) Find the area of a triangle whose vertices are A (1, 2, 3), B (2, 5, –1) and C (–1, 1, 2). **(12)**

   (b) If $\underline{V} = \underline{\omega} \times \underline{r}$, prove that $\underline{\omega} = \frac{1}{2} \text{ curl } \underline{V}$. **(13)**

   (c) Show that the four points whose position vectors are $3\hat{\underline{i}} - 2\hat{\underline{j}} + 4\hat{\underline{k}}$, $6\hat{\underline{i}} + 3\hat{\underline{j}} + \hat{\underline{k}}$, $5\hat{\underline{i}} + 7\hat{\underline{j}} + 3\hat{\underline{k}}$ and $2\hat{\underline{i}} + 2\hat{\underline{j}} + 6\hat{\underline{k}}$ are co-planar. **(12)**

   (d) Find the volume of a parallelopiped if $\underline{a} = -3\hat{\underline{i}} + 7\hat{\underline{j}} + 5\hat{\underline{k}}$, $\underline{b} = -3\hat{\underline{i}} + 7\hat{\underline{j}} - 3\hat{\underline{k}}$ and $\underline{c} = 7\hat{\underline{i}} - 5\hat{\underline{j}} - 3\hat{\underline{k}}$ are the three co-terminous edges of the parallelopiped. **(9⅔)**

3. (a) Show that the transpose of the product of two matrices in the product in reverse order of their transposes, i.e., (AB)′ = B′A′ **(10⅔)**

   (b) Find the inverse of $A = \begin{bmatrix} 2 & -1 & -1 \\ 1 & -2 & 1 \\ 1 & -1 & 2 \end{bmatrix}$ and hence check your answer. **(16)**

   (c) Reduce $A = \begin{bmatrix} 1 & -2 & 1 & 3 \\ 4 & -1 & 5 & 8 \\ 2 & 3 & 3 & 2 \end{bmatrix}$ to the normal form B and compute the matrices P and Q such that PAQ = B, where A and B are equivalent matrices. **(20)**

Contd P/2

MATH 193

4. (a) Examine the consistency and hence solve the equations. **(16)**

$$5x + 3y + 7z = 4$$
$$3x + 26y + 2z = 9$$
$$7x + 2y + 10z = 5$$

(b) State and prove Cayley-Hamilton theorem. **(10⅔)**

(c) Find the eigenvalues and eigenvectors for the following matrix **(20)**

$$A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -4 & -3 \end{bmatrix}$$

SECTION – B

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

5. (a) By shifting the origin and rotating the axes of coordinates the equation $x^2 + 3xy + y^2 + 2x + 3y - 1 = 0$ is transformed into one of the form $ax^2 + by^2 = c$. Find the angle of rotation and the coordinates of the new origin. **(26⅔)**

(b) Test the nature of the conic given by the equation $4y^2 + 12x - 20y + 67 = 0$. Reduce it to its standard form and find its properties. **(20)**

6. (a) Find the acute angle between the lines whose direction cosines are given by the relations: $l + m + n = 0$ and $l^2 + m^2 + n^2 = 0$. **(20)**

(b) Test if the four points (0, –1, –1), (4, 5, 1), (3, 9, 4) and (–4, 4, 4) are coplanar or not. Hence find the common plane if exists. **(26⅔)**

7. (a) Find the equation of the plane through the points (2, –1, 0), (3, –4, 5) and parallel to the line $2x = 3y = 4z$. **(20)**

(b) Find the length of the shortest distance between the lines **(26⅔)**

$$\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1};$$
$$\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$$

Find also its equation and the points where it intersects the lines.

8. (a) Find the equation of a sphere for which the circle $x^2 + y^2 + z^2 + 10y - 4z = 8$, $x - 2y + z = 3$ is a great circle. **(20)**

(b) Find the equations to the tangent planes to $2x^2 - 6y^2 + 3z^2 = 5$, which pass through the line $x + 9y - 3z = 0$, $3x - 3y + 6z - 5 = 0$. **(26⅔)**

L-1/T-2/IPE **Date : 06/03/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **MME 195** (Engineering Materials I)

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) Explain the order of elimination of impurities in Basic Bessemer Process of steelmaking with the help of a refining diagram. **(15)**

   (b) "Most high-grade alloy steels are at present manufactured in the electric furnace" — Justify. **(5)**

   (c) With the help of heat treatment cycle describe the process of malleabilizing for producing ferritic malleable cast iron. **(15)**

2. (a) Show the major microstructural changes during very slow cooling of 1.2% carbon steel, from austenite to room temperature. **(8)**

   (b) "Hardening by quenching is almost always immediately followed by tempering " – why? **(12)**

   (c) Write the important characteristics of Martensite transformation. **(5)**

   (d) What is 'Nitriding'? List the advantages and disadvantages of this process. **(10)**

3. (a) What are the effects of alloying elements on ferrite and carbide? **(10)**

   (b) Describe the power metallurgical process for producing sintered carbide cutting tools. **(10)**

   (c) Write the chemical composition, properties and uses of the following: **(3×5=15)**

   (i) Admiralty brass

   (ii) Mn – brass

   (iii) Gun metal

4. (a) Explain how porous structure is developed during the solidification of alpha-brass. **(15)**

   (b) What are the steps of age-hardening of Al- 4% Cu alloy? **(7+8=15)**

   Show the major microstructural changes occur during precipitation hardening of Al-4% Cu alloy.

   (c) What is the limitation of tin-base babbitt metal and how it can be overcomed? **(5)**

Contd P/2

MME 195

SECTION – B

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

5. (a) What changes would you expect in a typical creep curve, when the alloy under observation is subjected to changing stress and temperature. Draw the corresponding creep curves and explain briefly the reasons for such changes in curve shape. **(15)**

   (b) Draw neat sketches of typical fatigue fracture surfaces failed under (i) single stress cycle and (ii) different stress cycle. Also, discuss the characteristics features of a fracture surface failed under fatigue load. **(10)**

   (c) Explain under which conditions impact test becomes important. Also, what are the differences between fracture surfaces, obtained from impact tests, failed in brittle manner and ductile manner? **(10)**

6. (a) What is the difference between resilience and toughness? **(05)**

   (b) Consider you have tensile tested a high carbon steel and a mild steel specimens. Draw the corresponding schematic stress-strain plots. Identify and explain which material has higher toughness and which one has higher resilience. **(20)**

   (c) For a BCC (body-centred cubic) unit cell, prove that only 68.1% of the volume of the unit cell is occupied by the nuclei and inner electrons. **(10)**

7. (a) In your opinion, which non-destructive test is most suitable to detect a blow hole deep inside a casting. Justify your answer and briefly discuss the working principle of the test. **(15)**

   (b) What reducing agent would you suggest to reduce iron ore in modern blast furnaces? Write down important characteristics of that agent. **(10)**

   (c) Draw [110] and [111] directions within a cubic unit cell. **(10)**

8. (a) In a plain graph paper draw a phase diagram of a system, containing two metals: A and B, which are completely insoluble in the solid state, and having a eutectic point at 60B. Also, for an alloy of composition 40B, schematically show the changes in microstructure occurred during slow cooling from liquid state to room temperature. **(20)**

   (b) For the alloy mentioned in question 8(a), calculate the phase fractions at (i) just above liquidus line, (ii) just below liquidus line, (iii) just above eutectic temperature and (iv) at room temperature. **(15)**

L-1/T-2/IPE **Date : 26/01/2012**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2010-2011

Sub : **PHY 117** (Waves and Oscillations, Physical Optics and Wave Mechanics)

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) Write down three most probable distribution laws mentioning each term. **(9)**

   (b) Using Fermi-Dirac probability distribution function find out the probability of finding an electron at T = 0 K with energy (i) less than and (ii) greater than the Fermi energy. Find out also the probability of finding an electron at any finite temperature at Fermi level. **(16)**

   (c) Distinguish between Fermions and Bosons with appropriate examples. **(10)**

2. (a) Briefly describe the phenomena that can not be explained using classical physics but can be explained in terms of quantum physics. **(10)**

   (b) What are the postulates of wave mechanics? Deduce the Schrödinger wave equation for a free particle moving in a field of constant potential V_0. **(15)**

   (c) State Heisenberg's uncertainty principle. Find the uncertainty in the momentum of a particle when its position is determined within 0.01 cm. **(10)**

3. (a) Write down one application of the wave nature of moving electrons. Briefly describe the consequence of the wave nature of moving electrons in that application. **(8)**

   (b) Write down the requirements that are imposed on a physically acceptable wave functions. What do you understand by the terms 'eigen value' and eigen function'? **(12)**

   (c) Solve the Schrödinger equation for a linear harmonic oscillator to obtain its energy eigen values and eigen functions. **(15)**

4. (a) What is interference of light? Do you think that the formation of interference fringes is in accordance with the law of conservation of energy? Justify your answer. **(10)**

   (b) What is meant by fringe width? Derive an expression for the width of a fringe in terms of the wavelength of light used, distance between the two coherent sources and the distance of the screen from the sources. **(18)**

   (c) Two coherent sources are 0.18 mm apart and the fringes are observed on a screen 80 cm away. It is found that with a certain monochromatic source of light, the fourth bright fringe is situated at a distance of 10.8 mm from the central fringe. Calculate the wavelength of light. **(7)**

Contd P/2

PHY 117

SECTION – B

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

5. (a) Distinguish between Fraunhofer and Fresnel diffraction. **(10)**

   (b) Find the following expression for Fraunhofer diffraction through a circular aperture. **(25)**

$$I(\theta) = I(0)\left[\frac{2\,J_1\,(ka\sin\theta)}{ka\sin\theta}\right]^2$$

   where the symbols have their usual meaning.

6. (a) Distinguish between ordinary light and polarized light. **(6)**

   (b) Explain Brewster's law. Show from this law that when light is incident on a transparent substance at the polarizing angle, the reflected and refracted rays are at right angle. **(10)**

   (c) Define optical axis. Explain the phenomenon of double refraction. **(10)**

   (d) What is specific rotation? Calculate the specific rotation of sugar if the plane of vibration is turned through 26.4°, traversing 20 cm length of 20% sugar solution. **(2+7)**

7. (a) Define simple harmonic motion and discuss its characteristics. **(5)**

   (b) Obtain expressions for the displacement and total mechanical energy of a body executing simple harmonic motion. **(20)**

   (c) An oscillating spring block system has a mechanical energy of 1.0 joul, amplitude of 10 cm and maximum speed of 1 m/sec. Find spring constant and mass of the block. **(10)**

8. (a) Write down the characteristics of a mechanical wave. Define energy density and intensity of a plane progressive wave. Obtain expressions for both. **(6+5+15)**

   (b) A transverse sinusoidal wave is travelling along a string in the positive x-direction. The vertical distance between a crest and a trough is 1.3 cm. The motion is repeated regularly 125 times/sec. The distance between adjacent wave crests is 15.6 cm. Find the amplitude and speed of the wave. Also write down the displacement equation of the wave. **(9)**
