L-1/T-2/NAME Date: 20/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

B. Sc. Engineering Examinations January 2020

Sub: **PHY 161** (Waves & Oscillation, Geometrical Optics and Wave Mechanics)

Full Marks: 180 Time: 2 Hours

The figures in the margin indicate full marks. Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION-A

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

1. (a) A person swinging in a swing and someone pushes the swing periodically. The differential equation of motion of the person executing forced vibrations in an air medium is given by,

$$m\frac{d^2x}{dt^2} + ax + b\frac{dx}{dt} = F_0 e^{ipt}.$$

Solve it to obtain the condition for maximum amplitude resonance. Draw a graph showing clearly the factors on which the sharpness of resonance depends. **(25)**

(b) How much energy must the shock absorbers of a 1200 kg car dissipate in order to damp a bounce that initially has a velocity of 0.9 m/s at its equilibrium position. Assume the car returns to its original vertical position. **(05)**

2. (a) Two blocks of masses m_1 and m_2 are connected by a spring of length l and force constant k. The combination is placed on a horizontal frictionless surface and allowed to be compressed by a small distance from rest and released. How the time period of the resultant oscillation of the two body system can be obtained using the concept of reduced mass? **(20)**

(b) A block of 600 g mass is suspended from a spring whose spring constant is 60 N/m. The block is pulled a distance of 10 cm from its equilibrium position at $x = 0$ on a frictionless surface and released from rest at $t = 0$.

(i) What are the time period and frequency of the resulting motion?

(ii) What is the amplitude of oscillation? **(10)**

3. (a) In a plane progressive wave, energy is transferred continuously in the direction of propagation of the wave. Find the expression for the energy transferred per second and intensity of a plane progressive wave. **(20)**

(b) A sinusoidal wave travelling in the positive x-direction on a stretched string has amplitude 2.0 cm, wavelength 1.0 m and velocity 5.0 m/s. The initial conditions are: $y = 0$ and $\frac{dy}{dt} <$ 0 at $x = 0$ and $t = 0$. Find the displacement using the equation, $y = f(x, t)$. **(10)**

4. (a) How can you distinguish between wave function and probability density function? **(10)**

(b) Explain, why Schrödinger equation cannot be derived from other basic principles of Physics? **(20)**

SECTION-B

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

5. (a) How infinite square well energy quantization law can be obtained from the de Broglie hypothesis by fitting an integral number of half de Broglie wavelength $\lambda/2$ into the width 'a' of the potential well? **(15)**

(b) Explain 'Quantum Mechanical Tunneling Effect'. Why it is important in Solid State Physics? **(15)**

6. (a) Draw schematically the three statistical distribution functions for the same value of α. What comments can be drawn on their probability of occupancy of a state of energy at absolute temperature T? **(15)**

(b) Find the rms speed of oxygen molecules at 0 °C. How v_{rms} for H_2 molecules can be compared with v_{rms} for O_2 molecules under standard conditions? **(15)**

7. (a) Draw a ray diagram and identify all cardinal points of a thick lens. Let us consider a convex lens of thickness, t and refractive index, n placed in air. If R_1 and R_2 be the radii of curvature of the faces of the lens, show that the focal length, f of the lens varies with its thickness as,

$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2} + \frac{(n-1)t}{nR_1R_2}\right)$. **(18)**

(b) A convergent thick lens has radii of curvature 30.0 cm and −45.0 cm, refractive index n = .5, and thickness t = 1.0 cm. For an object 40.0 cm distance from this lens, calculate first principal point, second principal point and finally image distance from the lens. **(12)**

8. (a) Mention the importance of chromatic aberration in optical systems. For a separated doublet, made of same material, show that chromatic aberration will be minimum if the distance between the lenses is equal to the mean of the focal lengths. **(18)**

(b) Two thin lenses of focal lengths f_1 and f_2 separated by a distance t have an equivalent focal length of 30 cm. The combination satisfies the conditions for no chromatic aberration and minimum spherical aberration. Find the values of f_1, f_2 and t. Assume that both the lenses are made from the same material. **(12)**

L-1/T-2/NAME Date: 13/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **MATH 183** (Coordinate Geometry and Ordinary Differential Equations)

Full Marks: 180 Time: 2 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Symbols used have their usual meaning.

SECTION-A

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

1. (a) Find the coordinates of the point on transferring the origin to which the equation $x^2+3xy+4y^2-4x-6y+5=0$ does not contain linear terms in x and y. Also find the new equation. (15)

   (b) Remove the product term from the equation $19x^2+5xy+7y^2=13$, by suitable rotation of axes. (15)

2. (a) Find the values of h and f so that the equation $9x^2+2hxy+4y^2+6x+2fy-3=0$ may represents a pair of parallel lines and find the distance between them. (15)

   (b) Prove that the pair of lines joining the origin to the points of intersection of the curve $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ by the line $lx+my+n=0$ are coincident if $a^2l^2+b^2m^2=n^2$. (15)

3. (a) Find the equation to the circle whose diameter is the common chord of the circles $x^2+y^2+2x+3y+1=0$ and $x^2+y^2+4x+3y+2=0$ (15)

   (b) Find the equation of the circle which passes through the point (1, 1) and cuts orthogonally each of the circles $x^2+y^2-8x-2y+16=0$ and $x^2+y^2-4x-4y-1=0$. (15)

4. (a) An ellipse is described by using an endless string which is passed over two pins. If the axes are to be 6 cm and 4 cm, find the necessary length of the string and the distance between the pins. (15)

   (b) The cable of a suspension bridge is a parabola. The roadway is 5m below the lowest point of cable. The span of the bridge is 50 m. and the tops of the piers are 15 m. above the road way. Find the semi-latus rectum of the parabola. If the load is supported by vertical chains at intervals of 5 m:, find the length of the chain which is 5 m. away from either of the piers. (15)

SECTION-B

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

5. (a) Find the differential equation by eliminating arbitrary constants a and b from the equation $y = ae^{3x} + be^{-2x}$. (12)

(b) Solve $(2x - y + 1)dx - (6x - 5y + 4)dy = 0$. (18)

6. (a) Define linear differential equation. (15)

Solve: $x(x-1)\frac{dy}{dx} - (x-2)y = \frac{x^4}{\sqrt{x^2-1}}$ when $y(2) = 4$.

(b) The number of bacteria in a yeast culture grows at a rate which is proportional to the number present. If the population of a colony of yeast bacteria triples in 1 hour, find the number of bacteria which will be present at the end of 6 hours. (15)

7. (a) Find the general solution of the following higher order differential equation: (15)

$$\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 13y = e^x x^2$$

(b) Solve: $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = \sin 2x$, given that $y = 1/8$ and $\frac{dy}{dx} = 4$ when $x = 0$. (15)

8. (a) Solve: $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 5y = x^2\sin(\log x)$ (15)

(b) Solve: $y\frac{d^2y}{dx^2} - \left(\frac{dy}{dx}\right)^2 = y^2 \log y$ (15)

L-1/T-2/NAME Date: 10/01/2021

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-2 B.Sc. Engineering Examination 2018-19

Sub: **EEE 161** (Electrical Engineering Principles)

Full Marks: 180 Time 2 Hours

The Figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

There are 6 page(s) in this question paper.

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE.**
All the symbols have their usual meanings.
Assume reasonable values for missing data.

1. (a) Find the equivalent resistance R_{ab} in the circuit given in Fig. 1(a). (15)

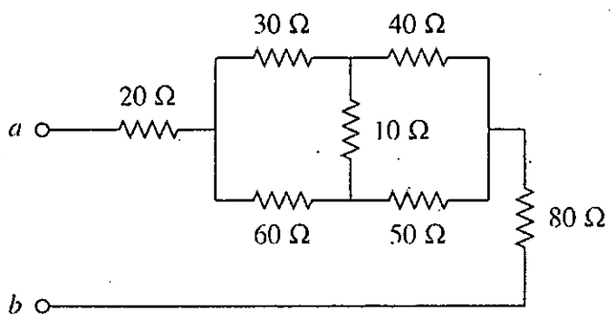

Fig. 1(a)

(b) Using nodal analysis, find v_0 in the circuit shown in Fig. 1 (b) (15)

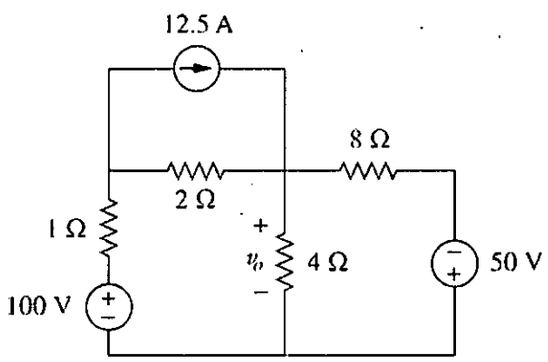

Fig. 1(b)

2. (a) For the circuit shown in Fig. 2(a), use source transformation to find i (10)

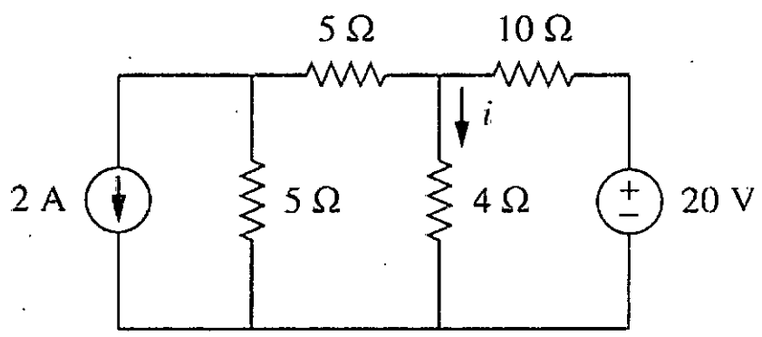

Fig. 2(a)

(b) Use the superposition principle to find v_x in the circuit shown in Fig. 2(b). (20)

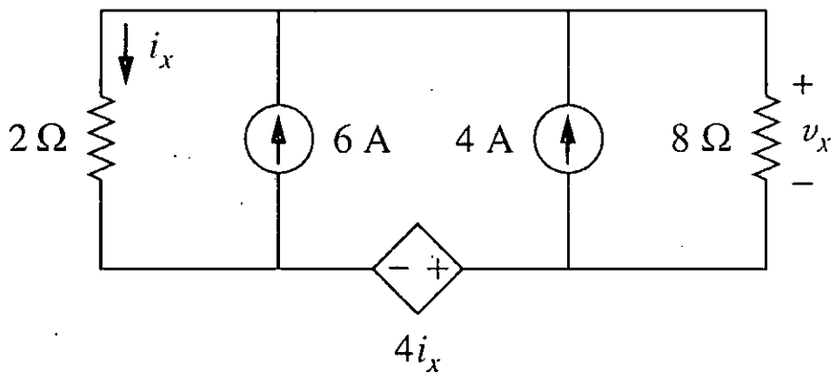

Fig. 2(b)

3. (a) Use Norton's theorem to find V_0 in the circuit shown in Fig. 3(a). (20)

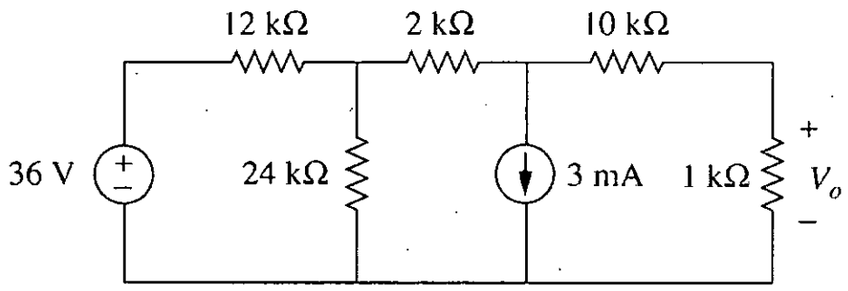

Fig. 3(a)

(b) Compute the value of R that results in maximum power transfer to the 10 Ω resistor in the circuit shown in Fig.3(b). Find the maximum power. (10)

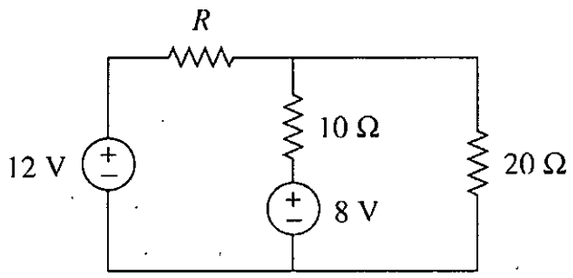

Fig. 3(b)

4 (a) Briefly explain the speed control in DC motor by varying field resistance and armature voltage (12)

(b) The parameters of a shunt connected DC motor are given below: (18)

$P_{rated} = 15\ hp,$ $I_{L,rated} = 55\ A,$ $V_T = 240\ V,$ $N_{rated} = 1200\ rpm$

$R_A = 0.4\ \Omega,$ $R_F = 100\ \Omega,$ $R_{adj} = 100\ to\ 400\ \Omega$

Rotational losses are 1800 W at full load. The magnetization curve is shown in Fig. 4(b). Assume no armature reaction.

(i) If the resistor R_{adj} is adjusted to 175 Ω, what is the rotational speed of the motor at no load condition?
(ii) What is the full load speed of the motor at this condition?
(iii) What is the speed regulation?
(iv) What are the maximum and minimum no-load speeds of the motor?

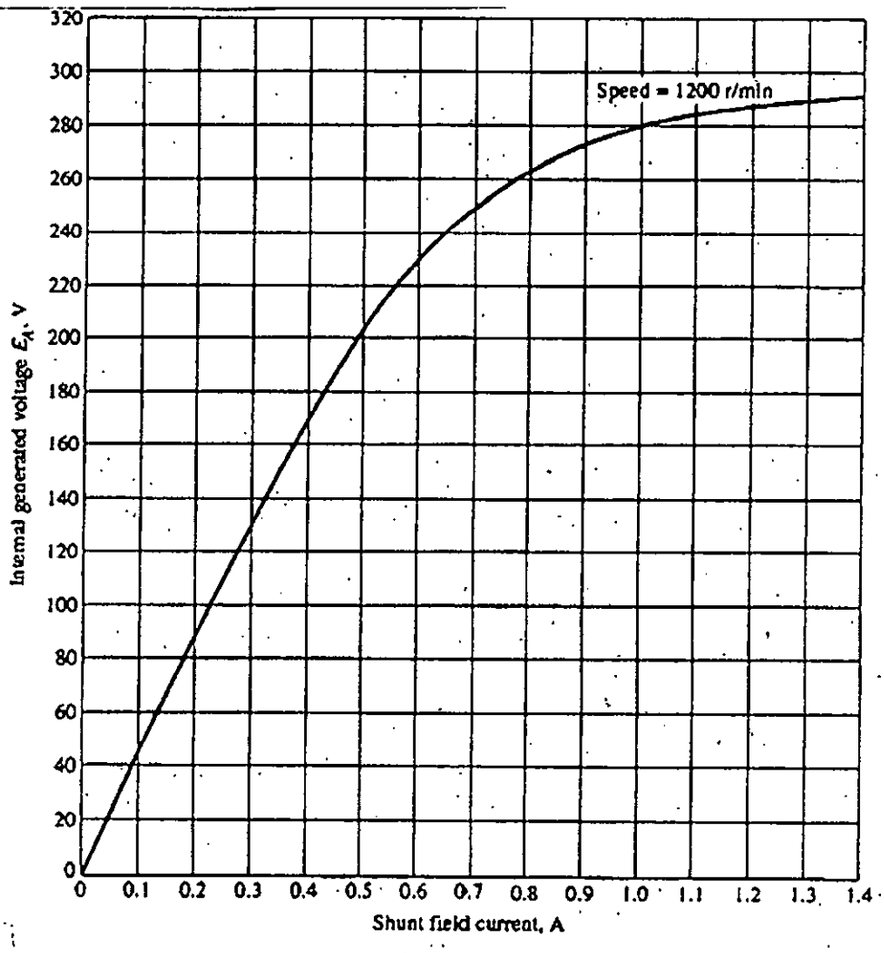

Fig. 4(b)

SECTION – B

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

All the symbols have their usual meanings.

Assume reasonable values for missing data.

5. (a) Compute $v_0(t)$ in the circuit of Fig. 5(a) (15)

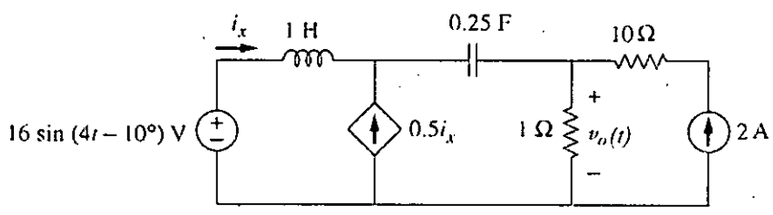

Fig. 5(a)

(b) Use node analysis to find $i_0(t)$ in the circuit of Fig. 5(b). (15)

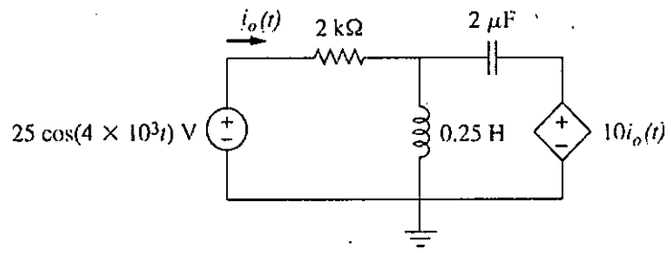

Fig. 5(b)

6. (a) Find the unknown reactive circuit component 'Z' in Fig. 6(a) which makes the power factor of the load unity. (10)

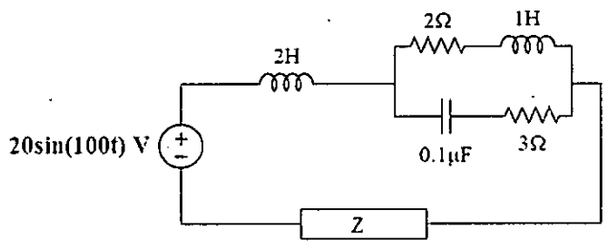

Fig. 6(a)

(b) For the circuit in Fig. 6(b), (i) find the value of $\mathbf{Z}_L$ that will receive the maximum power from the circuit. Then calculate the power delivered to the load $\mathbf{Z}_L$. (ii) Solve the problem of (i), assuming only resistive load is allowed. (20)

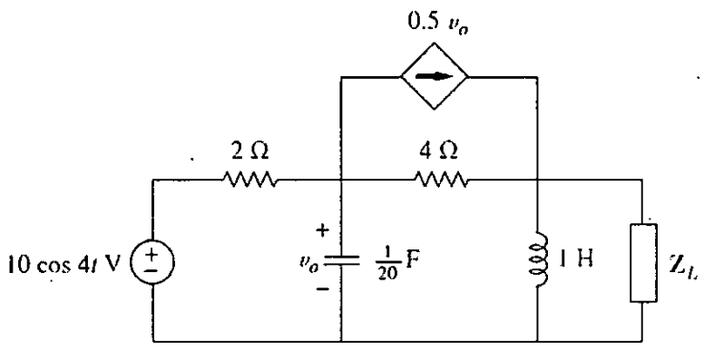

Fig. 6(b)

7. (a) Two loads connected in parallel draw a total of 2.4 kW at 0.8 pf lagging from a 120-V rms, 60-Hz line. One load absorbs 1.5 kW at a 0.707 pf lagging. Determine: (i) the pf of the second load, (ii) the parallel element required to correct the pf to 0.9 lagging for the two loads. (10)

(b) The following two parallel-connected three-phase loads are fed by a generator through a balanced transmission line with an impedance of 0.5+2j Ω per phase: (20)

Load 1: Y connected, rated at 450 kW, 0.708 pf (lagging), 440-V line voltage

Load 2: Δ connected, with 0.3+0.4j Ω impedance per phase

If the line voltage at the load is 450 V, find out –

i) The line voltage at the generator

ii) Loss at the transmission line

iii) Complex power supplied by the generator

8. (a) Discuss the differences in testing procedure for an open circuit test and a short-circuit test of a transformer and their underlying assumptions. Draw the connection diagram and develop the equivalent circuit(s) for both tests. (15)

(b) The following test data are obtained from short-circuit and open-circuit tests of a 50kVA, 2500-600 V, 60 Hz transformer: (15)

Voc = 600 V	Vsc = 76.4 V
Ioc = 3.34 A	Isc = 20.8 A
Poc= 484 W	Psc = 756 W

Determine the efficiency of the transformer when it operates at rated load and 0.8 power factor leading.