

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Electrical and Electronic Engineering

Final Examination, 2023
 Course No: EEE 131
 Time: 03 (Three) hours

1st year 2nd semester
 Course Title: Electrical Circuit II
 Full Marks:60

N.B. : (i) Answer all questions from each PART (ii) Use separate answer scripts for each PART
 (iii) Marks allotted are indicated in the margin (iv) Using pen or pencil for drawing will not affect your marks

PART A

1. (a) Define Thevenin's theorem. Explain the importance of Thevenin's theorem. 02
- (b) Prove the relationship between the rms value of a sinusoidal voltage & its maximum value. 01
- (c) A parallel RLC circuit has the node equation: 02

$$\frac{dv}{dt} + 50v + 500 \int_{-\infty}^t v dt = 50 \cos(377t - 10^\circ)V$$
 Assuming the value of integral at $t = -\infty$ is zero, determine $v(t)$ using phasor approach.
- (d) Determine the voltage across the **33 ohm resistor** from the following circuit at steady state condition. **If you think this circuit is out of scope (syllabus of EEE 131), mention the component(s) of the circuit which makes it out of our scope.** 05

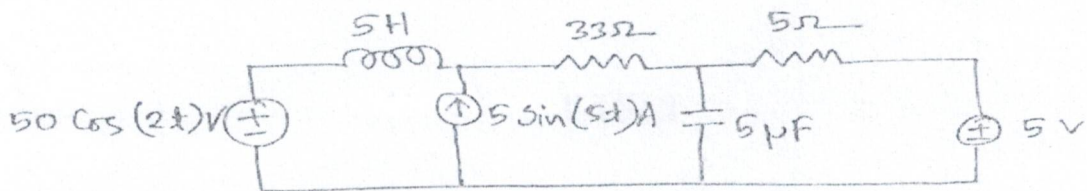


Fig. 1: Circuit for Question 1(d)

2. Three different inductive loads are connected to a 240 KV, 60Hz line (negative sequence). Load 1 draws 50KW at a power factor (p.f) of 0.7, load 2 draws 45 KVAR at a p.f of 0.8, and load 3 draws 45 KVAR at a p.f of 0.85. 03
- (a) Draw power triangles of all three loads including the power factor angle. 01
- (b) Draw the power triangle for the combined load including the power factor angle. 01
- (c) Determine all the line currents. 01
- (d) Determine three probable values of capacitance for C_1 and C_2 when four capacitors are connected (as shown in the figure) to raise the overall p.f to 0.9 lagging. 03

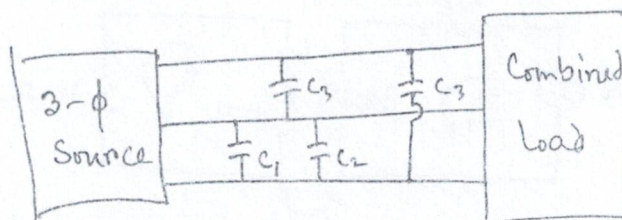


Fig. 2: Diagram for Question 2(d)

- (e) Determine the possible lowest **magnitude** of the current drawn from the supply. 01
- (f) Comparing the line currents from (c) and (d), why do engineers prefer (d)? 01

3. (a) Calculate the phase angle between $v_1 = -20\cos(\omega t + 50^\circ)$ & $v_2 = 12\sin(\omega t - 10^\circ)$ 02+03
Also, taking $v = 50\sin(\omega t)$ as reference, draw a vector diagram showing the two voltages.
- (b) Show that for a balanced wye-wye system, the neutral line is redundant. You must draw the necessary phasor diagram. 05

OR

- (a) 110 Volts are applied to a series circuit consisting of 8 ohms resistor, 0.0531 henry inductor, and 189.7 μF capacitor. When the frequency is 60 cycles per second, calculate 02+03
 i) current
 ii) reactive factor
Also, draw the phasor diagram taking current as reference, showing all the voltage drops and the resultant of these voltage drops which is 110 Volt source.
- (b) In a balanced wye-delta system, the load $(30 + j24) \Omega$ is supplied by a 220 Volt (line-neutral) source of acb sequence. The line connecting the source & the load is $(5 - j2) \Omega$ per phase.
 i) Draw the actual circuit, also draw the single-phase equivalent circuit. 0.5+1.5
 ii) Calculate all the line currents. 01
 iii) Determine the complex power absorbed by the source & the load. 02

PART B

4. (a) Establish the equation of resonant frequency and find the value of quality factor for series resonant circuit. 03
- (b) Calculate the total inductance for the following: 02

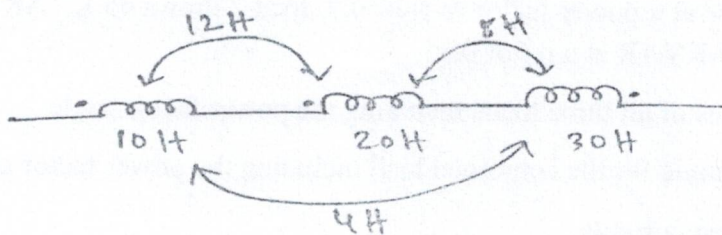


Fig. 3: For Question 4(b)

- (c) Determine V_o (voltage across 10 Ω resistor) from the following circuit 04

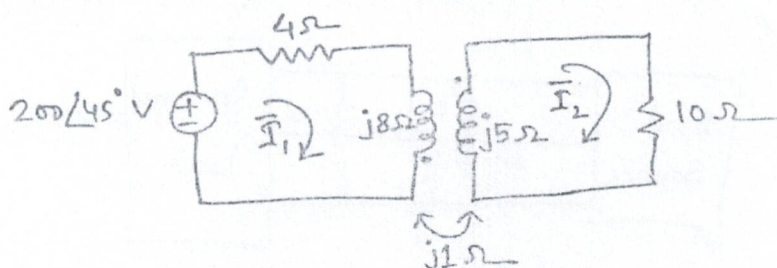


Fig. 4: Circuit for Question 4(c)

- (d) Manufacturers rate electrical machinery based on what they can control. In other words, ratings of electrical machinery are provided by manufacturers based on only what is known to them. From the perspective of power triangle, why do you think some machinery are always rated in KVA but never in KW? Answer in short. 01

5. (a) When asked to draw the frequency response of a R-L-C parallel circuit, One student drew like the shape in figure 5(i) and another drew like the shape in figure 5(ii). The teacher **accepted both** answers. Why? Show by drawing both curves completely. 02

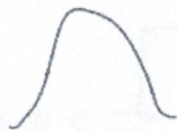


Fig. 5(i)

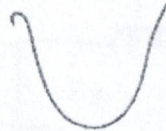


Fig. 5(ii)

- (b) Draw the phasor diagram (taking voltage as reference) for the following circuit showing the reactive component & the real component of I_L . Also, from the phasor diagram, mention the condition for resonance. 02+01

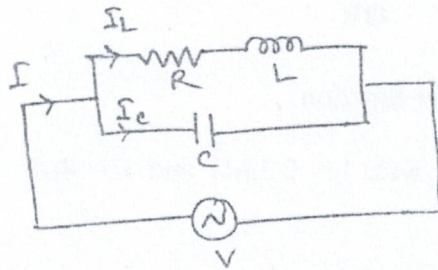


Fig 6: Circuit for Question 5(b)

- (c) Find the reflected impedance **and** the current from the voltage source for the circuit shown below. Take $Z_1 = 60 - j100 \Omega$, $Z_2 = 30 + j40 \Omega$ and $Z_L = 80 + j60 \Omega$. 02+01

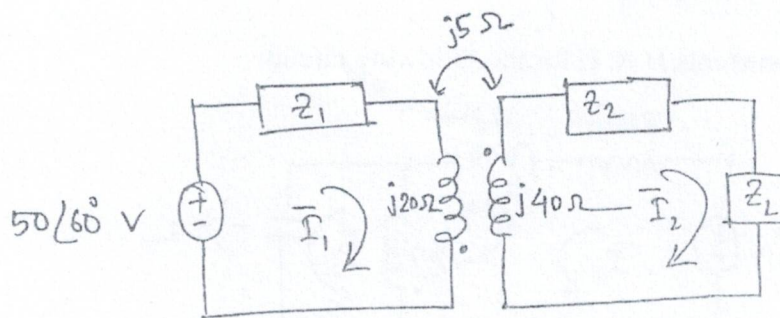


Fig 7: Circuit for Question 5(c)

- (d) Draw the **T**-equivalent and **π**-equivalent circuit for the linear transformer given below: 01+01

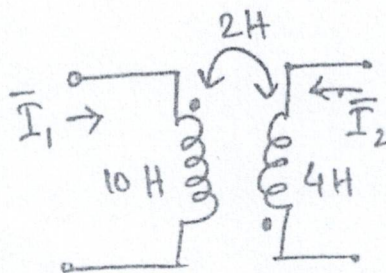


Fig 8: Circuit for Question 5(d)

6. (a) Draw the ideal & actual frequency response of lowpass, bandpass & bandstop filter. 01+01+01
- (b) Obtain the transfer function of a highpass filter using a series R-L circuit. Assume the source is $V_m \cos(\omega t)$ volt. Also, Sketch the amplitude response and phase response. 02+02
- (c) For the following circuit, find the frequency when maximum power dissipation occurs. 03

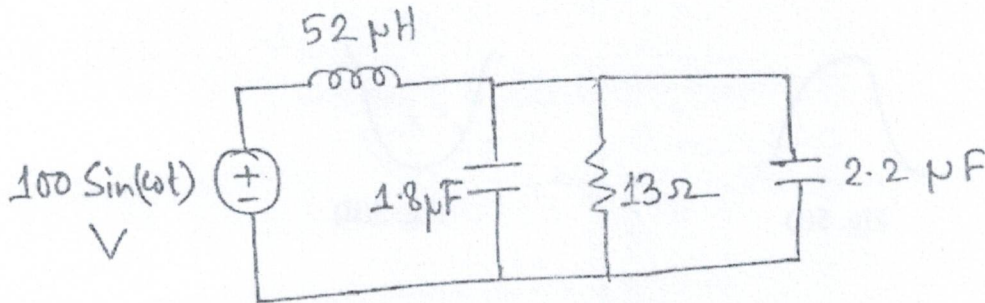


Fig 9: Circuit for Question 6(c)

OR

- (a) Define Resonance in terms of transfer function. 01
- (b) In a parallel R-L-C circuit, $R=8\text{ K}\Omega$, $L=0.2\text{mH}$ and $C=8\mu\text{F}$. Calculate the following:
- i) ω_0 , Q and B 0.5+0.5+0.5
- ii) ω_1 & ω_2 0.5+0.5
- iii) ω_1 & ω_2 0.5+0.5+0.5
- where the symbols mean the usual.

- (c) Determine the phasor currents I_1 & I_2 for the following circuit: 05

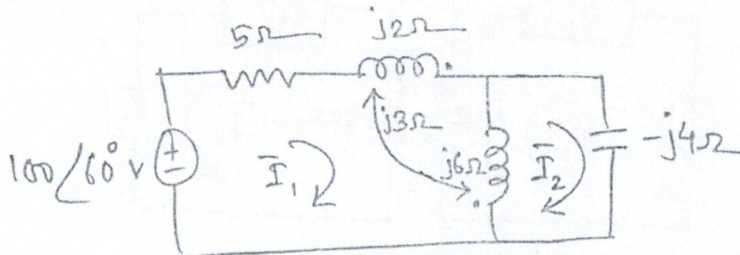


Fig 10: Circuit for Question 6-Or(c)

Sylhet Engineering College, Sylhet
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Department of Electrical and Electronic Engineering

Final Examination, 2023
Course No: PHY 103E
Time: 03 (Three) hours

1st year 2nd semester
Course Title: Physics II
Full Marks:60

N.B. : (i) Answer all questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART A

1. (a) What is the difference between inertial frame and non-inertial frame? 02
- (b) What is the Galilian transformation of velocity made by two observers in two different inertial frames. Show that the Newtonian fundamental equations are invariant under Galilian transformation. 02+03
- (c) A ball has velocity $(3i-6j+7k)$ m/s relative to a train moving with the velocity $(2i+4j)$ m/s relative to an observer on the ground. Calculate the velocity of the ball relative to the ground. 03

OR

- (a) How Galilian transformation contradict with the special theory of relativity? 02
- (b) Using Lorentz transformation, discuss time dilation and length contraction. 05
- (c) An electron is moving with a speed of $0.85c$ in a direction opposite to that of a moving photon. Calculate the relative velocity of the electron and photon. 03
2. (a) What conclusion can be drawn from Compton effect theory? 02
- (b) Show that the velocity of the centre of the mass is constant if total external force is zero. 03
- (c) A 50 kg Merry-Go round of radius 10 m is moving at a speed of 0.5 rad/s. A 40 kg child jumps on the Merry-Go round at a position 4m away from the centre of Merry-Go round. 03
- (i) Inertia of Merry-Go round.
- (ii) Inertia of the child.
- (iii) Speed of the Merry-Go round when the child jump on it.
- (d) Earth has an orbital period of 365 days and its mean distance from the sun is 1.495×10^8 km. Using Kepler's law, calculate Pluto's orbital period in earth days. 02
3. (a) Discuss binding energy curve diagram. 03
- (b) From which nuclear reaction you will get greater energy? Explain your answer. 04
- (c) How much energy will be released for the following nuclear reaction? 03



PART B

4. (a) What is wave function? Write some properties of wave function. 01+02
(b) What is uncertainty principle? Derive an expression of Uncertainty principle. 01+03
(c) Calculate the Uncertainty in the position for an electron whose speed is 0.15 m/s and for a 2 kg ball whose speed is 0.15 m/s also. Explain briefly what you understand from the result. 03

OR

- (a) Write Pauli's exclusion principle. 03
(b) Calculate the energy of a particle in zero potential. 04
(c) Calculate the permitted energy levels of an electron in a box 1A.U wide. 03
5. (a) In the statement of Gauss's law $\oint \mathbf{E} \cdot d\mathbf{s} = q_{\text{enclosed}} / \epsilon_0$. Select the correct statement from below and explain it. 04
- i) the value of $\oint \mathbf{E} \cdot d\mathbf{s}$ does not depend on the shape of $G =$ surface if it enclosed same charge.
 - ii) the E-field includes the contribution of charge outside the G-surface.
 - iii) if the charge is moved inside the G-surface, $\oint \mathbf{E} \cdot d\mathbf{s}$ on any point on the surface remain constant.
 - iv) if the charge is moved inside the G-surface, E-field at every point on surface may change but $\oint \mathbf{E} \cdot d\mathbf{s}$ remain unchanged.
- (b) Derive vector form of Gauss's law. 03
(c) How much work is required to move a $-50 \mu\text{C}$ charge from electric potential of -50 V to 250 V if the charge accelerated from rest. What is the final speed if it has a mass of 0.01 gm . 03
6. (a) Explain magnetic field with direction 02
(b) Calculate the magnetic field produced by a long infinite wire. 03
(c) Calculate magnetic flux of the figure where current flow respectively I_1, I_2, I_3 . 02

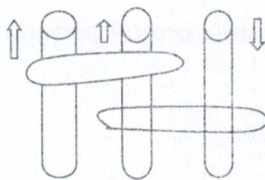


Fig. 6(c)

- (d) Derive an expression of current density. 03

Sylhet Engineering College, Sylhet
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Department of Electrical and Electronic Engineering

Final Examination, 2023
Course No: MATH 105E
Time: 03 (Three) hours

1st year 2nd semester
Course Title : Differential Equation, Laplace and Fourier Transform
Full Marks:60

N.B. : (i) Answer all questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART A

1. (a) Define ordinary and partial differential equations. 04
- (b) Form differential equations using the curves 06
 (i) $y = ax + b/x$ (ii) $r = a(1 - \cos\theta)$
2. (a) Solve the differential equation $x\sqrt{1+y^2}dx + y\sqrt{1+x^2}dy = 0$ 06
- (b) Define linear Differential Equation of order one. Create a linear differential equation and solve it. 04
3. (a) Solve the differential equation $(4x - y + 7)dx - (2x + y - 1)dy = 0$ 04
- (b) If $\frac{dy}{dx} = (4x + y + 1)^2$ then prove that $4x + y + 1 = 2 \tan(2x + c)$ 03
- (c) Solve the differential equation $\frac{d^3y}{dx^3} - \frac{d^2y}{dx^2} = 7x + 4$ 03

OR

- (a) Distinguish between regular and irregular singular points. 02
- (b) Generate the series solution of $9x(1-x)\frac{d^2y}{dx^2} - 12\frac{dy}{dx} + 4y = 0$ using Frobenius method. 05
- (c) If $L^{-1}\{f(s)\}=F(t)$ then show that $L^{-1}\{e^{-as}f(s)\} = \begin{cases} F(t-a), t > a \\ 0, t < a \end{cases}$ 03

PART B

4. (a) Find the expressions for Legendre's polynomial from Rodrigue's formula. 04
- (b) Define Bessel function. Establish the formulae for $J_{\frac{1}{2}}$ & $J_{\frac{3}{2}}$. 06
5. (a) Define Laplace transform of a function. 02
- (b) Evaluate (i) $\mathcal{L}\{e^{-t} \cos 2t\}$ (ii) $\mathcal{L}\{2e^{3t} \sin 4t\}$ (iii) $\mathcal{L}\{t^2 \cos at\}$ 08

6. (a) State convolution theorem. 03

Find (i) $\mathcal{L}^{-1}\left\{\frac{5s+4}{s^3} - \frac{2s-18}{s^2+9} + \frac{24}{s^4}\right\}$ (ii) $\mathcal{L}^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\}$

- (b) Solve the differential equations using Laplace transform 03

$$\frac{d^2Y}{dt^2} + 2\frac{dY}{dt} + 5Y = e^{-t}\sin t, Y(0) = 0, \frac{dY}{dt} = 1 \text{ for } t = 0$$

- (c) Define Fourier Series. Expand $F(x) = x^2, 0 < x < 2\pi$ in a Fourier series if the period is 2π . 04

OR

- (a) Apply Charpit's Method to solve the non-Linear partial differential equation. 06

$$px + qy = pq$$

- (b) Write about Linearity property and state Convolution theorem of Laplace transformation. 02

- (c) Obtain the differential equation of which $y = A\cos\alpha x + B\sin\alpha x$ is a solution, where A and B are arbitrary constants and α is a fixed constant. What are the degree and the order of the obtained differential equation? 02

Sylhet Engineering College, Sylhet
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Department of Electrical and Electronic Engineering

Final Examination, 2023
Course No: CHEM 201E
Time: 03 (Three) hours

1st year 2nd semester
Course Title: Chemistry (Inorganic and Quantitative Analysis)
Full Marks:60

N.B. : (i) Answer all questions from each PART
(iii) Marks allotted are indicated in the margin

(ii) Use separate answer scripts for each PART
(iv) Special Instruction (if any)-----N/A-----

PART A

1. (a) Describe Rutherford's atomic model with limitations. 05
- (b) What is (n+l) rule? Find the total number of orbitals and electrons present in 3rd energy level by calculating the values of n and l. 03
- (c) Calculate the emission wavelength (in nanometers) of the line in the Paschen series, where an electron drops down from 6th orbit. [$R_H = 1.097 \times 10^7 \text{ m}^{-1}$] 02

2. (a) What is electronegativity? How it changes in a periodic table? 04
- (b) Mention some properties and uses of Argon, Helium and Neon. 03
- (c) Ionization energy of O₂ is lower than N₂-Explain. 03

3. (a) What is Le Chatelier's principle? Write down the conditions for maximum yield of ammonia in the following reaction - 04
$$\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightarrow 2\text{NH}_3 (\text{g}) + 22.0 \text{ kcal}$$
- (b) Why chemical equilibrium is called a dynamic equilibrium? 03
- (c) At 25° C one mole of acetic acid was allowed to react with one mole of ethyl alcohol until equilibrium was established. The equilibrium mixture was found to contain 0.333 mole of unused acid. Calculate the equilibrium constant of the reaction at the same temperature. 03

OR

- (a) What is electrolysis? Explain electrolysis of molten NaCl. 04
- (b) Calculate the percent composition of each element in water. 03
- (c) Describe the classification of elements depending on their electronic configurations. 03

PART B

4. (a) What are buffer solutions? Suppose that for the analysis purpose, you need a solution of constant pH. How can you maintain the stability of pH? 01+03
- (b) Compare the Lewis theory of acids and bases with the Bronsted-Lowry concept. 03
- (c) Calculate the pH of the buffer solution containing 0.04 M NH_4Cl and 0.02 M NH_4OH . 03
 $K_b = 1.8 \times 10^{-5}$
5. (a) Deduce the rate equation of second order reaction. Show that half-life of a second order reaction depends on initial concentration. 05
- (b) Distinguish between order of a reaction and molecularity of a reaction. 02
- (c) At 444°C temperature, when 4.05 mol hydrogen and 4.65 mol iodine are heated in a flask of 1L, then 6.75 mol HI is produced. Calculate the value of K_C and K_P for the reaction: 03
- $\text{H}_2 + \text{I}_2 \leftrightarrow 2\text{HI}$.
6. (a) State Raoult's law of lowering of vapour pressure and give its derivation. 05
- (b) Write how molarity, molality and mole fraction are used to express the concentration of a solution. 03
- (c) What is the molarity of a solution prepared by dissolving 75.5g of pure KOH in 540ml of solution? 02

OR

- (a) What do you mean by S_N^1 and S_N^2 reaction? Explain stereochemistry of S_N^1 and S_N^2 reaction. 05
- (b) Write down the mechanism of the following reactions: 2.5 × 2 =
- i) Perkin Reaction 5
- ii) Aldol Condensation Reaction

Sylhet Engineering College, Sylhet
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Department of Electrical and Electronic Engineering

Final Examination, 2023

Course No: EEE 133

Time: 02 (Two) hours

1st year 2nd semester

Course Title: Energy Economics

Full Marks:60

N.B. : (i) Answer all questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART A

1. (a) What is Energy Economics? Sketch "Energy Accounting Framework"? Write 2 main factors affecting energy supply. 01+02+01
- (b) The costs of different components of wind power plant are given in Table 1.1. If, interest rate 10% and maintenance cost equal 1% of total capital cost per year. Determine the life-cycle cost of wind power plant. 05

Table 1.1: Cost Components of Wind Power Plant

Item	Cost (Rs. per kW)	Expected Life (Years)
Wind Mill	30000	20
Gearbox	3000	10
Controller	2500	10
Wind Turbine	12000	15
Electric Generator	6000	15
Accessories	2000	5

- (c) An engineer wants to travel 150 kilometers in a car which uses one liter of fuel per 12 km. Transportation of fuel from refinery to the users involves a 10% loss. The refinery operates at an efficiency level of 95% and produces 30% gasoline from the crude oil it uses. The crude oil recovery rate from the national fuels is 20% at present. Determine the crude oil required to complete the distance. 06

OR,

- (a) What is Energy Demand? Draw the block diagram of "Energy Supply Chain"? 01+03
- (b) The calorific value of a given Hydro general is 860 kcal/kWh. If 11600 GWh of this Hydro general is produced in a year, what is its energy content in ktoe and PJ? How does this compare with an equivalent amount of Geothermal? 05
- (c) A person wants to travel 10 kilometers in a vehicle which uses one liter of fuel per 10 km. transportation of fuel from refinery to the users involves a 5% loss. The refinery operates at an efficiency level of 95% and produces 30% gasoline from the crude oil it uses. The crude oil recovery rate from the national fuels is 20% at present. Determine the crude oil required to complete the distance. 06

2. (a) Write short notes on "Overview of energy demand decisions" with block diagram. 05
- (b) A diesel power plant with a capacity of 100 MW is being evaluated. The plant operates 24 hours a day, with a capacity factor of 85% (it doesn't operate at full capacity all the time). The plant has a 20-year lifespan and sells electricity at \$0.10 per kWh. The following costs are given: 10

Initial Construction Cost	\$200 million
Fuel Cost (Diesel)	\$0.15 per kWh generated
Maintenance & Operating Costs	\$10 million per year
Discount Rate	10%

Calculate Annual Energy Production, Total Annual Operating Cost and Should a company invest in the installation of a diesel power plant?

PART B

3. (a) What is the Production Possibility Frontier (PPF)? Write short notes on 'point A, B, C, X & Y' in the following figure 3(a). 02+05

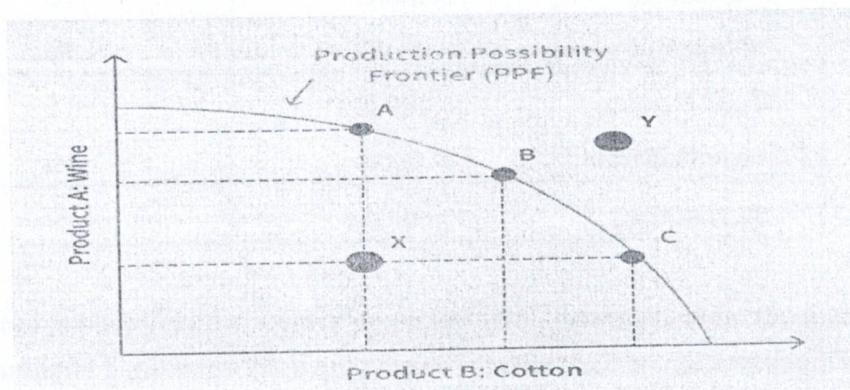


Fig. 3(a)

- (b) A power plant is evaluating three energy efficiency projects. Each with an initial investment and a series of expected cash inflows over the next few years. 08

Below are the details for each project:

- Project A:
 - Initial Investment: \$450,000
 - Cash Inflows over 3 years: \$200,000, \$250,000, and \$300,000
- Project B:
 - Initial Investment: \$400,000
 - Cash Inflows over 3 years: \$150,000, \$200,000, and \$250,000
- Project C:
 - Initial Investment: \$600,000
 - Cash Inflows over 3 years: \$250,000, \$300,000, and \$350,000

Assuming a discount rate of 10%. Which project is preferable??

4. (a) How do renewable energy sources differ from non-renewable ones? 04

- ✓
- (b) What are the key factors influencing the differences in energy distribution and consumption patterns between developing and developed countries? 05
- (c) A generating station has a maximum demand of 25MW, a load factor of 60%, a plant capacity factor of 50% and a plant use factor of 72%. Find (i) the reserve capacity of the plant (ii) the daily energy produced and (iii) maximum energy that could be produced daily if the plant while running as per schedule, were fully loaded. 06

OR,

- (a) Why solar energy is a most suitable energy source? 04
- (b) Write short notes on the energy crisis of the world. 05
- (c) A residential consumer has the following connected load: 8 bulbs of 100 W each, 2 fans of 60 W each and 2 light plug points of 100 W each. His use of electricity during a day is as under: 06

12 midnight to 5 am	one fan
5 am to 7 am	2 fans and one light point NIL
7 am to 9 am	2 fans
9 am to 6 pm	2 fans and 4 bulbs
6 pm to midnight	one fan

Find (a) connected load (b) maximum demand (c) demand factor (d) energy consumed during 24 hours (e) energy consumed in 24 hours if all devices are used all the day.