Telecom Technical Assistant
40% Limited Departmental Competitive Examination
Paper I
Electricals & Electronics

Time Allowed: 3 hours **Maximum Marks: 100**

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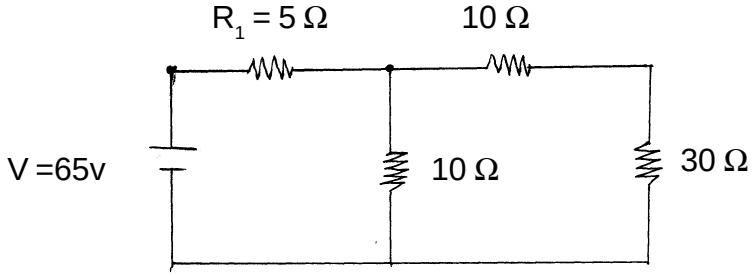
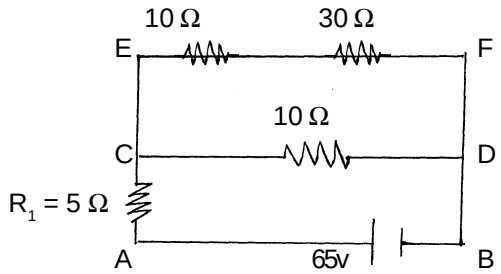
1) Determine the voltage drop across the resistor R1 in the circuit given below.



Solution

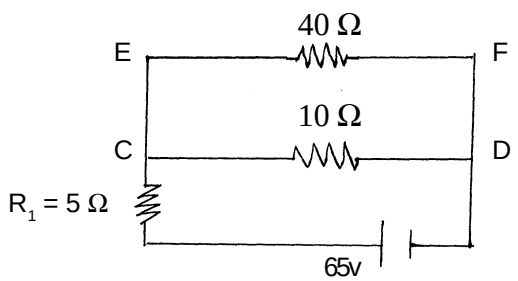
The given ciruit is redrawan as below



The Circuit can be reducecd further

R_{EF} = 10 + 30 (Since Series)

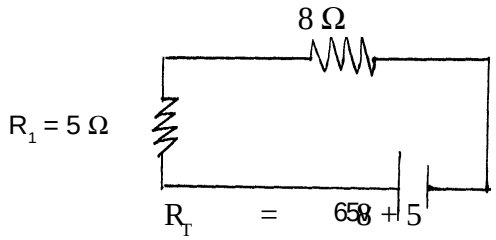
R_{EF} = 40 Ω



R_{ED} = $\frac{40 \times 10}{40 + 10}$ (Since Parallel)

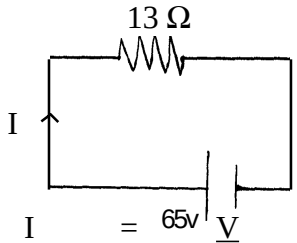
= $\frac{400}{50}$

R_{ED} = 8 Ω



$R_T = 8 + 5$

$R_T = 13\ \Omega$



$I = \frac{V}{R_T}$

$= \frac{65}{13}$

$I = 5$ Amps

Now

volt drop at R_1 = $I \times R_1$

Volt drop at R_1 = 5×5

= 25 V

Answer

Voltage drop at R_1 = 25 volt

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2. Describe the working of low pass filter with help of suitable diagram (10)

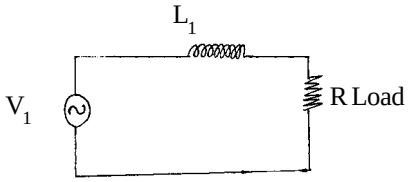
A low pass filter is a filter that passes low frequency signals but attenuates (reduces the amplitude) signals with frequencies higher than the cut off frequency. The actual amount of attenuation for each frequency varies f rom filter to filter.

It is sometimes called as high cut filter or treble cut filter when used in audio applications

There are two basic kind of circuits capable of accomplishing this objective.

1. The inductance low pass filter (RL circuit)
2. The capacitive low pass filter (RC circuit)

Inductive low pass filter:



$X_L = 2\pi f_L$

The Inductors impedence increases with increasing frequency. This high impedence in series tends to block high frequency signals from getting to the load.

The response of an inductive low pass filter falls off with increasing frequency.

Capacitive low pass filter:

The capacitor's impedence decreases with increase in frequency. This low impedence in parallel with the load resistance tends to short out high frequency signals dropping most of the voltage across series resistor.

The response of a capacitive low pass filter falls off with increasing frequency.

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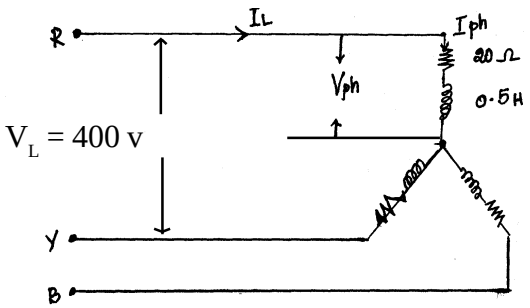
3. Three similar coils, each of resistance 20 ohms and inductance 0.5H are connected (a) in star (b) in delta to a three phase. 50 Hz 400v (between lines) supply. Calculate the total power absorbed in each case. 5 + 5

Given

Resistance	(R)	=	20 ohms
Inductance	(L)	=	0.5 Henry
Frequency	(f)	=	50 HZ
Line Voltage	(V_L)	=	400 Volt

Solution

a) In Star



In each phase

$V_{Ph} = \frac{V_2}{\sqrt{3}}$

$= \frac{400}{3}$

V_{Ph} = 231 volt

XL ph = $2\pi fL$

= 2x3.14 x 50 x 0.5

XL ph = 157 Ω

Zph = $R^2_{ph} + X^2_{LPh}$

= $20^2 + 157^2$

Z ph = 158. 3 Ω

I ph = $\frac{V_{Ph}}{Z_{Ph}}$

= $\frac{231}{}$

= 158.3

Inph = 1.5 Amps

Power in each phase (P_{Ph}) = $I^2_{Ph} R_{Ph}$

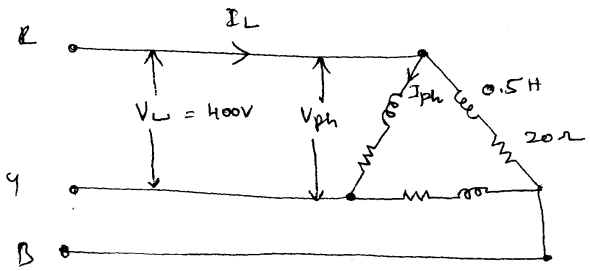
= 1.5^2 x 20

P_{Ph} = 42.6 Wats

Total for 3 phase (P_T) = 3 x P_{Ph}

In star connection P_T = 127.8 Wats

In Delta



In each phase

I_{Ph} = $\frac{V_{Ph}}{Z_{Ph}}$

$\frac{400}{158.3}$

I_{Ph} = w.53 Amps

power in each phase (P_{Ph}) = $I^2_{Ph} R_{Ph}$

= $Z.53^2$ x 20

P_{Ph} = 127.7 Wats

Power Total in 3 phase P_T = 3x127.7

= 383.1 Wats

Answer

a) Power absorbed in star = 127.8 wats

b) Power obsorbed in Delta = 383.1 wats

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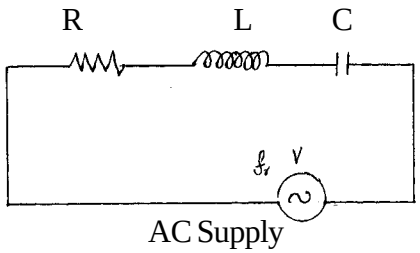
4) (a) Draw as series LCR Circuit and derive expression for its resonance frequency and current at resonance
(b) Explain the different types of losses in transmission lines.

Solution

Diagram of series 'LCR' Circuit



AC Supply

Let

R = Registance of the circuit in ohms
L = Inductance of the circuit in Henry
C = Capacitance of the circuit in Farad

In a L-C-R Series circuit when the current is in phase with the applied voltage, the circuit is said to be in resonance then phase angle is zero and zero power factor is unity. The circuit acts as registere

As $z = R^2 + (X_L - X_C)^2$ ---- (i)

where

z = Total impedence of the circuit in ohms

X_L = Inductive Reactance in ohms

X_C = Capacitive Reactance in ohms

At resurance Power factor = Cos Q = 1

ic $\frac{R}{z} = 1$

$z = R$ -------- (ii)

Frm eq (i) and (ii)

$X_L - X_C = O$

$X_L = Xc$

$2\pi f_r^L = \frac{1}{2\pi f_r^C}$

$f_r^2 = \frac{1}{(\pi 2)^2 L_C}$

$f_r^2 = \frac{1}{(\pi 2)^2 \sqrt{L_C}}$

where f_r = Resonance frequency in H_2

The Current in

resonance $I_r = \frac{V}{Z}$

$I_r = \frac{V}{R}$

(b) Loss in transmission line are of the three types

(i) Copper Loss

(ii) Dielectri Loss

(iii) Rediation or Induction loss.

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5. What is OSI Model? Explain functions of each layer down suitable diagram. (2+8)

OSI stands for OPEN SYSTEM INTECONNECTION - It is a brand model for mainframe wide area network communication. It refers to exchange of information among terminal devices, computers, people, networks and processes. The OSI model organizes the communications process into seven different categories and places these categories in a layered sequence based on their relation to the user.

7	Application Layer	Provides user application process and management functions
6	Presentation Layer	Provides for data interpretation, format and code transformation.

5	Session Layer	Provides for co-ordination of communicating processes between nodes - admin & control of sessions between two entities
4	Transport Layer	Provides for error-free delivery of data and acts as the control area for quality of service requirements
3	Network Layer	Handles the routing and switching information to establish a connection for delivery of data
2	Data Link Layer	Handles the transfer of data between the ends of a physical link
1	Physical Layer	Provides for the transparent transmission of bit streams from one physical entity to another

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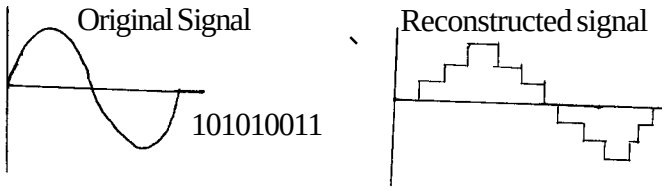
6. What is Pulse Code Modulation? Describe advantage of PCM….AM? (5+5)

Pulse Code Modulation is the most common method of encoding an analog voice signal into a digital bit stream. First, the amplitude of the voice conversation is sampled. This is called PAM (Pulse Amplitude Modulation) This PAM sample is then coded (Quantized) into a binary (digital) number. This digital number consists of zeros and ones. This voice can then be switched, transmitted and stored digitally.



Advantages of PCM:

1. It is less expensive of switch and transmit a digital signal.
2. By making a analog voice signal into a digital signal, you can interleave it with other digital signals, such as those from computers or facsimile machines
3. A voice signal which is switched and transmitted, end to end in a digital format will usually come through 'cleaner' i.e with less noise, than one transmitted and switched in analog.

   The most common method is to sample a voice conversation at 8000 times per second

   The theory is that if the sampling is at least twice the highest frequency on the channel, then the result sounds ok.

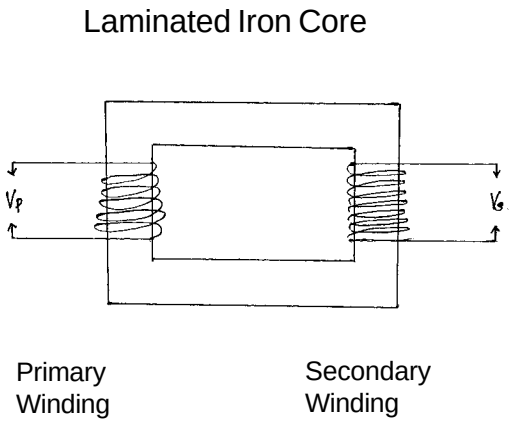
   <u>32 channel PCM</u>

   E1 =>8 bits X 32 channels X 8000 frames/second

   => 2.048 Mbps or 2 Mbps

7. a. What is Transformer. Explain its principle of work ing.(2+2+2+)

   Describe the various power losses in a transformer and the way to minimize it?



- Transformer is an electrical device used for converting low alternating voltage into high alternating voltage and vice versa.
- It transfers electric power from one circuit to another. This works on the principle of Electro mag netic induction.

<u>Working:</u>

A transformer consists of primary and secondary coils insulated from each other. The AC input is applied across the primary coil. The continuously varying current in the primary coil produces a varying magnetic flux in the primary coil, which in turn produces a varying magnetic flux in the secondary. Hence an induced e.m.f is produced across secondary.

$$\frac{E_S}{E_P} = \frac{N_S}{N_P} = \frac{I_P}{I_S} = k$$ where k is the transformer ratio

If

k > 1 It is step up transformer

k < 1 It is step down transformer

- Step up transformer increases the voltage by decreasing the current which is in accordance with the law of conservation of energy.
- Step down transformer decreases the voltage by decreasing the current

Efficiency of transformer n (etta) = output power / Input Power

$$n = \frac{E_S I_S}{E_P I_P}$$

n = 100% for an ideal transformer.

Power losses in a Transformer:

There are four types of losses

1.Hysteresis loss

2.copper loss

3.eddy current loss or iron loss

4.flux loss

Hystereis loss: The repeated magnetization and demagnetization of the iron are caused by the allowing input current produces loss in energy.

Copper Loss : The loss due to the current flow in the copper conductor both in the primary winding and second ary winding. It is also called load loss or variable loss.

Eddy current loss or Iron loss : The loss due to the laminated iron core. It is also called no load loss or constant loss.

Flux Loss : The flux produced in the primary coil is snot completely linked with the secondary coil due to leakage.

Minimizing the losses:

For minimizing the iron loss the core are laminated with insulating material.. Copper loss is dependent on current.

b. Find the secondary voltage of a transformer having primary voltage as 400 volts and number of turns in Primary as 50 and 25 in secondary winding

V_P = 400 Volt

N_P = 50

N_S = 25

V_S = ?

Solution :

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

$$V_S = \frac{N_S}{N_P} \times V_P$$

$$V_S = \frac{25 \times 400}{50}$$

$V_S = 200$ Volt

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8. What is Modulation? Name the three types of Modulation. Explain any one with wave diagram.(3+3+4)

The audio signal can not be sent directly over a long distance.

The energy of a signal directly proportional to its frequency.

Audio signal frequency ranges is 20Hz to 20 Khz. Hence audio signal is superimposed in a high frequency carrier wave..

The process of superimposing audio signal into a high frequency carriers is known a modulation .

Audio Signal (LF) —> Modulator —> amplifier—> to the medium.

Three types of modulation: (commonly used for communications)

1. Amplitude Modulation
2. Frequency Modulation
3. Phase Modulation

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9. Give the symbols of following electronic devices. Write short notes on (4 X 2.5)

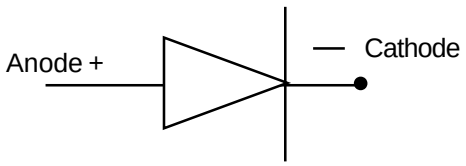
a. PN Junction Diode

b. Zener Diode

c. PNP Transistor

d. NPN Transistor

(a) PN Junction Diode

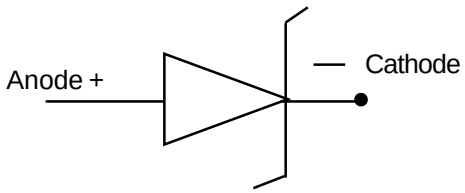


PN Junction is formed by combining N-type and P-type semi conductors together is very close contact. The term junction refers to the region where the two types of semi conductors meet.

P-N junction are commonly used as diodes. Electrical switches that allow a flow of electricity in one direction but not in the other (opposite) direction. This property is explained in term of the forward bias and reverse bias effect where the term bias refers to an application of electric voltage to the P-N junction.

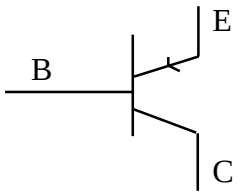
General P-N junction is used for converting AC to DC.

(B) Zener Diode



A zener diode is a type of diode that permits current to flow in the forward direction like a normal diode but also in the reverse direction if the voltage is larger than the rated break down voltage known as 'Zener Knee Voltage' or 'Zener Voltage'. The zener diode is reverse bias is called as constant voltage regulator.

© PNP Transistor

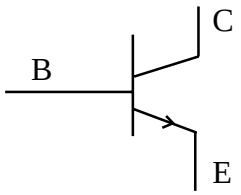


PNP transistor consists of a layer of N-doped semi conductors between the two layers of P-doped material.

PNP transistor are commonly operated with the collector at ground and the emitter connected to a positive voltage through an electric load. A small current flowing from the base allows a much greater current to flow from the emitter to the collector.

The arrow in the PNP transistor symbol is on the emitter leg and points in the direction of the conventional current flow where the device is in forward active mode.

(d) NPN transistor



NPN transistor consists of a layer of P-doped semi conductors between two N-doped layers. A small current entering the base in common emitter mode is amplified in the collector output.

The arrow in the NPN transistor symbol is on the emitter leg and points in the direction of the convention current flow when the device is in forward action mode.

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10. What is differences between Full Wave and half wave rectifier? Explain working of Full wave rectifier with the help of diagram. (5 +5)

	FULL WAVE RECTIFIER	***HALF WAVE RECTIFIER***
1	The output is smooth because the wave form is regular	The output is hard because the wave form is irregular
2	Voltage output does not drop	Voltage output tends to drop when the supply is connected to a load
3	Does not put any kind of strain in power transformers and diodes	Put dis-proportionate strain on the power transformer and the diodes
4	Cost is high	Cost is little less

Full Wave Rectifier:

A full wave rectifier converts the whole of the input wave form to one of constant polarity (positive to negative) at its output by reversing the negative (or positive) portions of the alternating current waveform. The positive (or negative) portion thus combine with the reversed negative (or positive) to produce an entirely positive (or negative) voltage / current waveform.

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11. a. Give advantages of 3-phase AC supply over single-phase supply. What is the relation between phase voltage and line voltage in 3-phase AC supply? (3+3)

Advantages of 3 phase supply over single phase:

- For large capacity generation of AC supply, the sizes of generators are comparatively lesser in size.
- Three-phase equipment's are more efficient.
- In 3 phase, both single phase and 3-phase load can be used.
- For transmission of large amount of energy 3 phase is more economical.
- For three phase - less material for a given capacity.
- Three phase apparatus costs less than single-phase apparatus.

b. If the line voltage is 440 volts AC, find out its phase voltage? (4)

Answer :

Given

Line Voltage (V_L) = 440 Votl

Phase Voltage (V_{Ph}) = ?

Solution :

$$\text{Phase Voltage } (V_{Ph}) = \frac{V_L}{\sqrt{3}}$$

$$V_{Ph} = \frac{440}{1.732}$$

$$= 2.54 \text{ Volt}$$

Answer : Phase Voltage (V_{Ph}) = 2.54 Volt

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12. What is the difference in Decibal and Neper? Write down the conversion formula for converting Decible to Neper? (10)

Neper's are an alternative logarithmic unit of relative measurement, like the decibel but based on Neperian or natural logarithms rather than common or base 10 logarithms .

(Naperian logs use e or 2.71828 as their base , rather than 10)

Conversion formula:

One Neper = 8.686 dB

Paper II

Departmental Practices

Time Allowed: 3 hours **Maximum Marks : 100**

Instruction to candidates:

1. Attempt all questions
2. Marks of each questions are indicated against it
3. Candidates should read and observe the instructions printed on the cover page of their answer books.
4. All answers should be written in English only or in Hindi only.
5. Candidates writing their answers in Hindi Medium must cross check the facts and figures and English-version of the questions. In case of any doubt, difference and discrepancy between the two versions, the English version shall be treated as correct and final.

1. What are various types of subscriber instruments used in the department? How subscribers instrument is connected with exchange equipment? Give the diagram showing different points of interconnection from subscribers premises to telephone exchange equipment. (3+3+4)
2. What is the standard configuration of 128 P CDOT RAX? Name the control cards and ordinary subscribers cards in this RAX? What are the other configurations possible in 128 P CDOT RAX? (5+3+2)

Control Cards:

RAP	RAX Administrative Processor
RSC	RAX Switch Controller CARd
SPC /ISP	Signalling Processor Card

Other cards:

CNF	Conference Card
RTC	RAX Test Terminal Card
RAT	RAX Announcement & Tone card
RMF	RAX Multi frequency card
RDS	RAX Digital Signalling
RDC	RAX Digital Controller
TC	Terminal Card (LCC , CCM , EMF , TWT)

Possible configuration:

By Providing CNF card conference facility & trunk offering facility - 8 ports

RDS &RDC is used for digital trunks (Slot 22 & 23 should be kept free in case of RDS & RDC equipped) - 32 ports

RMF is used for DTMF signalling - 8 ports

EMF - Ear & Mouth Trunk card (six wires - 2 for singalling & 4 for speech)

(to be provided only 3,4,5,&6 slots - each card occupied - 8 ports)

TWT Two way trunk for physical trunks - 8 ports

3. What is the capacity of one subscriber rack in E10B exchange? How many PCMs are required for one subscriber rack? How may subscriber may be connected to one subscriber line card of this exchange? Name the card used for ordinary subscriber and STD PCO subscribers. (3+2+3+2)

The capacity of one subscriber rack in E10B exchange = 1024

PCMs required for one subscriber rack = minimum(2) maximum (4)

Subscribers connected in one subscriber line card = XEJ8 - 8 subscribers

XEJ16 - 16 subcribers

The card used for ordinary subcriber = XEJ16 card

The card used for STD PCO subcribers = XEJ8 card

.**Give a block diagram of organizational set up of telecom circle. (10)**

CGM

PGM

GM	GM(F)
DGM	DGM (F) or DFA
DE /AGM	CAO
Senior SDE	Senior AO
SDE / AE	AO
JTO	JAO
TTA	Senior TOA
PM	GR D

RM

5. What are the different types of earthing used in the department? Describe any one of them with diagram. What is permissible limit of earth resistance for exchange equipment? (4+4+2)

Differenet types of earthing procedure:

1. Copper plate earthing
2. Coil earthing
3. Ring earthing
4. Tower earthing

Permissible limit of earth resistance for exchange equipments

Tower earth : Should not be more than 0.1 ohms (the value of towe earth should be less than the equpment earth)

Equipment Earth : Should not be more than 0.5 ohms

Power Earth : Not more than 5.0 ohms (in soft soil)

Not more than 8.0 ohms (in rocky soil)

6. Write short notes on (4 X 2.5)

a. PBX

b. IDF

c. Relays

d. MDF

7. a. Name any 5 Number of Tools used in line and cable work. Which tool is required for jumpering in Krone type CT boxes? (3+2)

   b. What types of SW board cables are used in department and where they are used? (3+2)

8. a. What is the function of Float rectifier? (5)

   b. What is the use of engine alternator in telephone exchange? What type and capacity of E/A as required for 128 P CDOT Exchange? (3+2)

9. What is lead acid battery ? Mention name of the material used for plates and solution. Give specific gravity and voltage of a charged battery. What is topping up of the cells? (3+2+2+3)

10. What is the maximum number of PCMs that can be carried by a 140mb optical fiber system. List out three type of tools used for splicing the OF cable and describe its function (4+6)