Register No

SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

AN AUTONOMOUS INSTITUTION

Approved by AICTE, New Delhi and Affiliated to Anna University, Chennai

.

INTERNAL ASSESSMENT EXAMINATION – I- ANSWER KEY

II Semester

Common to B.E-Computer Science and Engineering, B.E-Computer Science and Design & B.E-Computer Science and Technology

19EE101 – Basic Electrical and Electronics Engineering

Regulations 2019

Duration : 1 Hour 30 Minutes

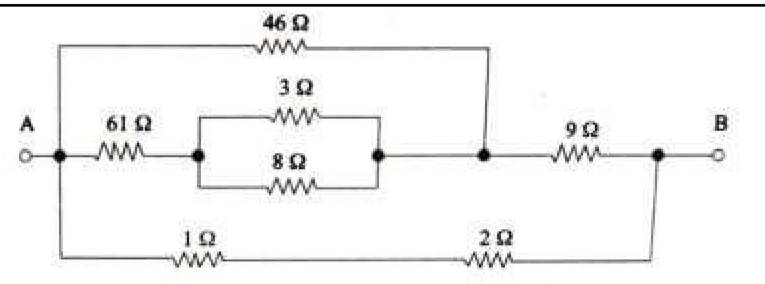
Date : 30.05.2023 Session: FN Maximum: 50 Marks

Answer ALL questions

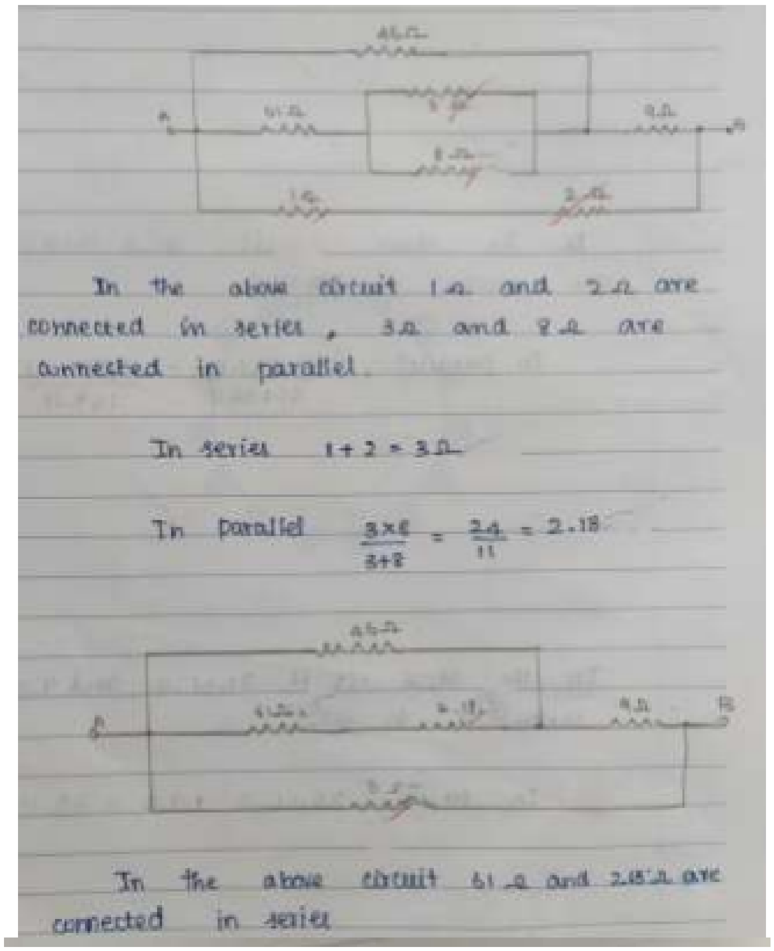
	PART A - (5 X 2 = 10 marks)			
Q.No	**Question**	**M**	**CO**	**BL**
1	State Kirchhoff's Voltage Law. The voltage around a loop equals the sum of every voltage drop in the same loop for any closed network and equals zero. Put differently, the algebraic sum of every voltage in the loop has to be equal to zero	2	CO-1	L -2
2	State the limitations of ohms' law. Ohm's law is applicable when the temperature of the conductor is constant. Resistivity changes with temperature. The relation between voltage and current depends on the sign of voltage. It does not apply to semiconductors, which do not have a direct current-voltage relationship.	2	CO-1	L -2
3	Define RMS value. The rms value of a sinusoidal voltage (or any time-varying voltage) is equivalent to the value of a dc voltage that causes an equal amount of heat (power dissipation) due to the circuit current flowing through a resistance	2	CO-1	L -2
4	Write down the EMF equation of a DC generator. $E_g = \frac{PZ \varphi N}{60 A}$ volts	2	CO-2	L -2
5	Give the application of DC Motor. Applications for DC motors are: elevators, steel mills, rolling mills, locomotives, and excavators.	2	CO-2	L -2

PART B - (2 X 13 = 26 marks)

6.	(a)	Determine the amount of total resistance between points A and B of the Circuit shown in fig.	06	13	CO-1	L-3



Answer



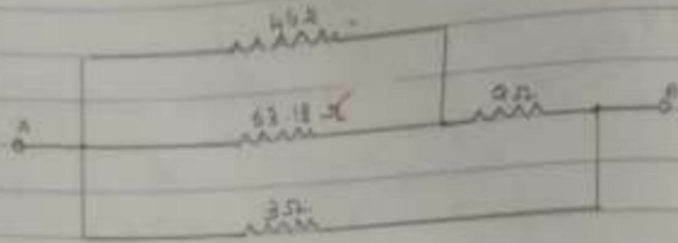
In the above circuit 1Ω and 2Ω are connected in series, 3Ω and 8Ω are connected in parallel.

In series $1 + 2 = 3\Omega$

In parallel $\frac{3\times 8}{3+8} = \frac{24}{11} = 2.18$

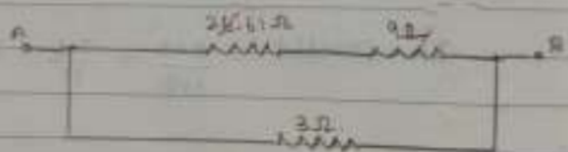
In the above circuit 61Ω and 2.18Ω are connected in series

In series 61 + 2.18 = 63.18



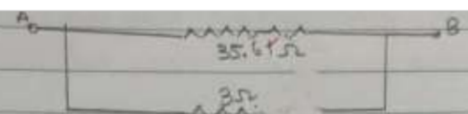
In the above circuit, 46Ω and 63.18Ω are connecter in parallel

In parallel. $\frac{46 \times 63.18}{46+63.18} = \frac{2,906.28}{109.18} = 26.61\Omega$



In the above circuit 26.61Ω and 9Ω are connected in series

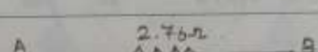
In series. 26.61Ω + 9Ω = 35.61



In the above circuit 35.61Ω and 3Ω are connected in parallel.

In parallel $\frac{35.61 \times 3}{35.61+3} = \frac{106.83}{38.61}$

$= 2.76\Omega$.



∴ The amount total resistence between points A and B of the circuit is 2.76Ω

OR

	(b)	How is the Tamil Nadu electricity board calculating the electricity cost for the domestic customer with the working principle of Energy meter? Assume your home contains two 40W fluorescent lamps and one 60W fan at usage of 12 hours per day. Calculate the electricity cost for the month. (Cost of Electricity per unit- Rs 4)	13	CO-1	L-3

Energy meter is an integrating meter. It gives the quantity of electrical energy consumed over a specified period.

Principle When a conducting metal part is placed in an alternating magnetic field, eddy currents are induced in the metal part. The magnetic flux produced by these eddy currents are made to interact with another magnetic field. Thus, the required operating torque is produced. The instrument can work on *alternating current* only.

Construction The salient parts of an induction type energy meter are schematically shown in Fig. 7.12.

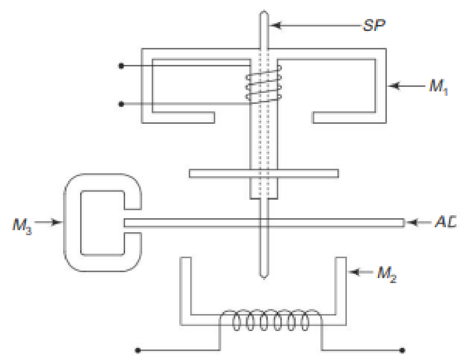


Fig. 7.12

The instrument consists of the following parts:

M_1 — Shunt magnet. The coil over this carries a current proportional to the system voltage.

M_2 — Series magnet. The coil over this carries a current proportional to the system current.

AD — Aluminium disc connected to the spindle (SP).

M_3 — Brake magnet. This is a permanent magnet. It is so arranged that the aluminium disc is in the gap between the pole pieces of it. As a result of this, when in rotation, the aluminium disc cut the permanent magnetic flux.

Assume :

1) One Fan is 80 watts

2) one flourscent lamp is 40 watts

Totally two flourscent lamp = 40 × 2 = 80 watts

3) Cost to be calculated 30 days as a month.

Calculation for flourscent lamp.

4) two flourscent lamp = 40 × 2 = 80 watts

5) Running for 12 hrs in a day
= 80 watts × 12 hrs = 960 Whr

6) For the 30 days of month
= ~~80 watts~~ 960 whr × 30 = 28,800 whr

Approximately = 28.8 Kwhr → ①

Calculation for Fan

One fan = 80 watts

Running for 12 hours = 80 × 12 = 960 whr

For 30 days of month = 960 × 30 = 28,800 whr

Approximately = 28.8 Kwhr → ②

Adding both = 28.8 + 28.8 = 57.6 Kwhr

One unit = 1 Kwhr for 57.6 Kwhr = 57.6 × 4 = Rs 230

7.	(a)	With the faraday's law, illustrate the emf building process in the working of DC generator.	13	CO-2	L-3

Faraday's law of electromagnetic induction (referred to as **Faraday's law**) is a basic law of electromagnetism predicting how a magnetic field will interact with an electric circuit to produce an electromotive force (EMF).

The generator is a dynamic machine in which mechanical energy is converted into electrical energy. It operates on the principle based on the Faraday's Law of electromagnetic induction. The emf generated is to be classified as dynamically induced emf. The basic requirements for the dynamically induced emf to exist are the following:

(i) A steady magnetic field
(ii) A conductor capable of carrying current
(iii) The conductor to move in the magnetic field

The working principle of a dc generator is illustrated in Fig. 6.1. It shows a steady magnetic field produced by the pole pieces of a magnet N and S. A single turn coil *ABCD* is placed in the field produced between the pole pieces. The coil is rotated by means of a prime mover. Thus, as per Faraday's law, an emf is induced in the coil. Such an emf is basically alternating. This bidirectional induced emf is made unidirectional using the commutator. Figure 6.2, illustrates the use of commutator.

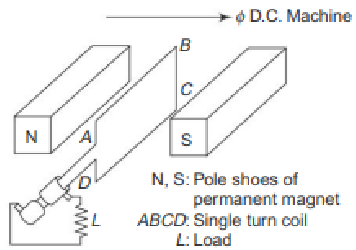


Fig. 6.1

OR

	(b)	Derive the emf equation of DC generator & determine the flux per pole for 4 pole DC machines having 260 wave connected conductors which generates an open circuit's voltage of 600V while running at 1500 rpm.	13	CO-2	L-3

Let
P – Number of poles in the generator
ϕ – flux per pole in webers
z – total number of armature conductors
A – Number of parallel paths formed by the armature winding between the armature terminals
$A = 2$, for wave wound armature winding
$A = P$, for lap wound armature winding
N – speed of rotation of armature in RPM
E_g – emf induced across the armature terminals or emf induced in any one parallel path of the armature winding.

According to Faraday's Law of electromagnetic induction, average emf induced in one conductor $= \frac{d\phi}{dt}$ [no. of turns = 1]

Here $d\phi$ – flux cut by the conductor in one revolution $= P\phi$ (wb)
and dt – time taken by the conductor for one revolution $= 60/N$ (sec.)

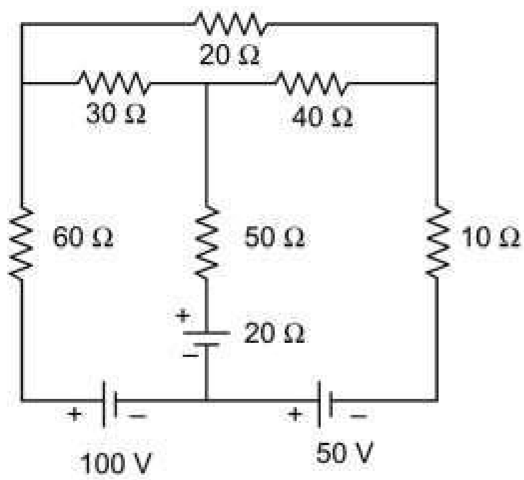
$\therefore$ Average emf generated in one conductor $= \frac{P\phi N}{60} \frac{\text{wb}}{\text{sec}}$ or volts

No. of conductors connected in series in one parallel path $= Z/A$

$\therefore$ EMF generated/path or generated EMF, $E_g = \frac{P\phi N Z}{60A}$

Note: The above is the emf is generated in the armature on open circuit. This means that no load is connected to the generator.

PART C –(1 x 14 = 14 Marks)					
8.	(a)	Calculate the current in the 50Ω resistor in the network shown in fig using mesh analysis. Also determine the voltage drop across the 20Ω resistor.	14	CO-2	L-3



Sol:

Apply KVL for Mesh 1 (ABCJHA)

$$0 = 20I_1 + 40(I_1 - I_3) + 30(I_1 - I_2)$$

$$0 = 90I_1 - 30I_2 - 40I_3 \rightarrow (1)$$

Apply KVL for Mesh 2 (HJFGH)

$$-20 + 100 = 30(I_2 - I_1) + 50(I_2 - I_3) + 60I_2$$

$$80 = -30I_1 + 140I_2 - 50I_3 \rightarrow (2)$$

Apply KVL for Mesh 3 (JCDFJ)

$$50 + 20 = 40(I_3 - I_1) + 10I_3 + 50(I_3 - I_2)$$

$$70 = -40I_1 - 50I_2 + 100I_3 \rightarrow (3)$$

By using Eq. solving method

$$(1) \Rightarrow 90I_1 - 30I_2 - 40I_3 = 0$$

$$(2) \times 3 \Rightarrow -90I_1 + 420I_2 - 150I_3 = 240$$

$$390I_2 - 190I_3 = 240 \rightarrow (4)$$

$$\div 10 \Rightarrow 39I_2 - 19I_3 = 24 \rightarrow (4)$$

		$(2)\times 4 \Rightarrow -120I_1 + 560I_2 - 200I_3 = 320$ $(3)\times 3 \Rightarrow -120I_1 - 150I_2 + 300I_3 = 210$ (+) (+) (−) (−) $710I_2 - 500I_3 = 110$ $\div 10 \quad 71I_2 - 50I_3 = 11 \rightarrow (5)$ $(4)\times 71 \Rightarrow 2769I_2 - 1349I_3 = 1704$ $(5)\times 39 \Rightarrow 2769I_2 - 1950I_3 = 429$ (−) (+) (−) $601I_3 = 1275$ $I_3 = 2.121\,A \rightarrow (6)$ sub (6) in (5) $71I_2 - 50(2.121) = 11$ $71I_2 = 117.05$ $I_2 = 1.64\,A \rightarrow (7)$ sub (6) & (7) in (1) $90I_1 - 30(1.64) - 40(2.121) = 0$ $90I_1 = 134.04$ $I_1 = 1.48\,A$ ∴ The current through 50Ω resistor is $I_{50\Omega} = I_3 - I_2 \Rightarrow 2.121 - 1.64$ $I_{50\Omega} = 0.481\,A$ ∴ The voltage drop across the 20Ω resistor $V_{20\Omega} = I_1 R \Rightarrow (1.48) \times 20$ $V_{20\Omega} = 29.6\,V$			
OR					
	(b)	Why moving iron instruments is preferred for measuring both alternating current quantities (AC) & direct current quantities (DC). Justify your answers along with the working principle of the instrument. Moving iron instruments are commonly used for measuring both AC and DC quantities due to their robustness, simplicity, and wide measuring range. These instruments rely on the principle that the magnetic field produced by the current flowing through a coil interacts with the movable iron piece, resulting in a torque that moves the pointer. In AC measurements, the iron piece oscillates back and forth due to the alternating current, enabling accurate measurement of the RMS value. For DC measurements, the iron piece aligns with the magnetic field produced by the current, providing a proportional indication of the magnitude.	14	CO-1	L-4

Thus, moving iron instruments offer versatility, durability, and accurate readings for both AC and DC quantities, making them widely used in various applications.

Moving Iron Instruments are used mainly to measure voltage or current. These are two types of moving iron instruments namely attraction type and repulsion type.

Principle It is well known that a soft iron piece gets magnetised when it is brought into a magnetic field produced by a permanent magnet. The same phenomenon happens when the soft iron piece is brought near either of the ends of a coil carrying current. The iron piece is attracted towards that portion where the magnetic flux density is more. This movement of the soft iron piece is used to measure the current or voltage which produces the magnetic field.

Construction (Refer Fig. 7.7). The instrument consists of a working coil. It carries the current to be measured or a current proportional to the voltage to be measured. A soft iron disc is attached to the spindle. To the spindle, a pointer is also attached. The pointer is made to move over a calibrated scale. The moving iron (soft iron disc) is pivoted such that it is attracted towards the centre of the coil where the magnetic field is maximum.

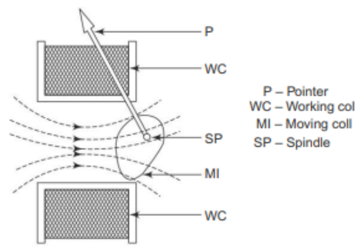


Fig. 7.7

Working The working coil carries a current which produces a magnetic field. The moving disc is attracted towards the centre of the coil where the flux density is maximum. The spindle is, therefore, moved. Thus, the pointer, attached to the spindle gives a proportional deflection.

Deflecting Torque Produced by the current or the voltage to be measured. It is proportional to the square of the current or voltage. Hence, the instrument can be used to measure d.c. or a.c scale is non-uniform.

Control torque: Spring or gravity
Damping: Air friction damping

Principle Two iron pieces kept with close proximity in a magnetic field get magnetized to the same polarity. Hence, a repulsive force is produced. If one of the two pieces is made movable, the repulsive force will act on it and move it on to one side. This movement is used to measure the current or voltage which produces the magnetic field.

Construction (Refer Fig. 7.8). The instrument consists of a working coil which carries a current proportional to voltage or the current to be measured. There are two iron pieces-fixed and moving. The moving iron is connected to the spindle to which is attached a pointer. It is made to move over a calibrated scale.

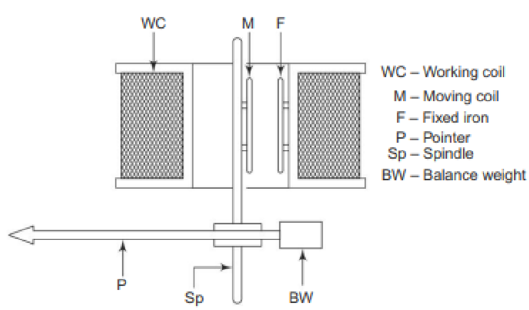


Fig. 7.8

Working When the operating coil carries current, a magnetic field is produced. This field magnetises similarly both the soft iron pieces. Thus, a repulsive force is produced which acts on the moving iron and pushes it away from its rest position. Thus, the spindle moves and hence the pointer gives a proportionate deflection. Whatever be the direction of current in the coil, the two irons are always similarly magnetised.

Deflecting Torque Produced by the current or the voltage to be measured it is proportional to the square of the current or voltage. Hence, the instrument can be used for dc and ac.

Control torque: Spring or Gravity
Damping: Pneumatic (i.e air damping)