# Paper 2018

(Conducted on 29.12.2019)

## General Engineering Paper II

### Electrical

1. (a) Determine the unknown currents through and voltages across the resistances in the circuit of figure-1. **(15)**
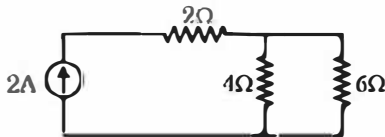


Figure-1

(b) The resistance of a transmission line is $126\Omega$ at 20°C. Determine the resistance of the line at – 35°C. The temperature coefficient of the material of transmission line is 0.00426 at 0°C. **(15)**

(c) Two heaters A and B are connected in parallel across a supply voltage. They produce 500 Kcal in 20 minutes and 1000 Kcal in 10 minutes, respectively. The resistance of heatr A is $10\Omega$.

   (i) Calculate the resistance of heater B. **(15)**

   (ii) If the two heaters are connected in series across the same supply voltage, how much heat will be produced in 5 minutes. **(15)**

The field lines make an angle of 60° with the normal to the coil. Calculate the magnitude of the counter torque that must be applied to prevent the coil from turning. **(15)**

(c) The number of turns in two coupled coils is 600 and 1700, respectively. When a current of 6 A flows in the second coil, the total magnetic flux produced in thiscoil is0.8 mWb, and the flux that links with the first coil is only 0.5 mWb. Calculate,

   (i) The self-inductances of the two coils,

   (ii) The coefficient of coupling, and

   (iii) The coefficient of mutual inductance

**(3 × 10)**

3. (a) Differentiate between absolute and secondary instruments. **(10)**

(b) What is the basic difference between indicating instruments and integrating instruments ? **(10)**

(c) A 50 μA meter movement with an internal resistance of 1 KΩ is to be used as a dc voltmeter of range 50 V. Calculate

   (i) the multiplier resistance needed, and

   (ii) the voltage multiplying factor. **(2 × 10)**

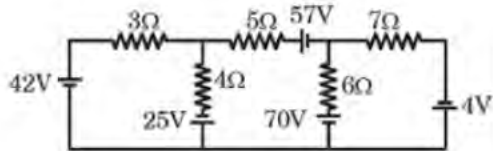**2.** (a) Determine the current through the 7Ω resistance in the network of figure-2. **(15)**



Figure-2

(b) A circular coil of 30 turns and radius 8 cm carrying a current of 6 A is suspended vertically in a uniform horizontal magnetic field of 1.0 T.

(d) In a moving coil instrument, the coil has a length of 5 cm, a width of 4 cm and 80 turns. The magnetic flux density in the air gap is 0.1 Wb/m². The hair spring provides a controlling torque of $0.5 \times 10^{-7}$ Nm/degree deflection of the coil. What current will be required to give a deflection of 60°? **(20)**

**4.** (a) A single phase 100 MVA, 132 KV/ 220 KV, 50 Hz transformer (ideal) is connected to 200 KV supply system. The secondary side of transformer is connected to a load of (300 + j 400) ohms. If the number of turns in low voltage (LV) side is 1000, find :

(i) Turn ratio

(ii) Secondary side voltage

(iii) Number of turns on the high voltage side

(iv) The maximum value of core flux

(v) Primary (source) and secondary (load) currents

(vi) Power supplied by source  **(6 × 5)**

(b) A four-pole dc machine having wave winding has 294 conductors in armature. Find the following :

(i) Flux per pole to generate 230 V when rotating at 1500 rpm

(ii) Torque at this flux when rated armature current of 120 A is flowing.  **(2 × 15)**

**5.** (a) What are the advantages of gas turbine plant over steam turbine plant?  **(15)**

(b) A single phase distributor fed at end a is loaded as shown in figure-3. The loop resistance and ractance per km are 0.3Ω and 0.15Ω respectively. Determine the voltage drop at the far end.  **(15)**
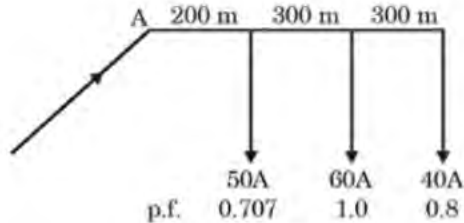


Figure-3

(c) What are the various diagnostic techniques used for monitoring the health of various equipments on the system in a power grid?  **(15)**

(d) What do you mean by plant capacity factor? Describe the plant use factor.  **(15)**

**6.** (a) Describe and differentiate the processes of direct resistance heating and indirect resistance heating.  **(15)**

(b) Determine the efficiency of a high frequency induction furnace which takes 10 minutes to melt 1.815 Kg of aluminum, the input to the furnace being 5 KW and the initial temperatures 15°C.  **(15)**

(c) If the input to an amplifier is 12 V and the output is 6 V, and the input and output impedances are equal, determine the dB gain of the amplifier.  **(15)**

(d) What is the main advantage of a comon-emitter configuration over the common-base configuration of a bipolar junction transistor?  **(15)**

# Paper 2017

## Electrical Engineering
### *(Paper II)*

**1. (a)** The resistance of copper winding of a motor at room temperature of 25°C is 3.0Ω. After an extended operation of the motor at full load, the winding resistance increases to 4.0 Ω. Find the temperature rise. Give that the temperature coefficient of copper at 0°C is 0.00426 Ω/°C/Ω. **(15)**

**(b)** A toaster rotted at 2000 W, 240 V is connected to a 230 V supply. Will the toaster be damaged? Will its rating be affected? **(15)**

**(c)** Define the following terms: **(20)**

   (i) Drift velocity

   (ii) Current density

   (iii) Power

   (iv) Electromotive force

**(d)** The domestic power load in a house comprises the following:

   (i) 10 lamps of 100 W each

   (ii) 5 fans of 80 W each

   (iii) 1 refrigerator of 0.5 hp

   (iv) 1 heater of 1 kW

Calculate the total current taken from the supply of 230 V. **(10)**

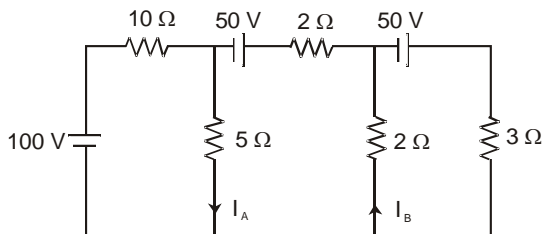**2. (a)** Using Kirchhoff's law, determine the current $I_A$ and $I_B$ in the network shown in Figure 1. **(15)**



Figure 1

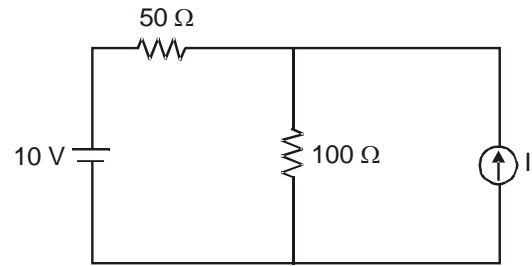**(b)** For the circuit shown in Figure 2, find I such that current in the 100 Ω resistor is zero. **(10)**



Figure 2

**(c)** A series combination of two capacitances $C_1 = 5$ F and $C_2 = 10$ F is connected across a dc supply of 300 V. Determine the

   (i) charge

   (ii) voltage

   (iii) energy stored in each capacitor **(15)**

**(d)** Define the following terms: **(15)**

   (i) Self-inductance

   (ii) Flux

   (iii) RMS value of alternating waves

**3. (a)** A circular coil of area 300 cm² and 25 turns rotates about its vertical diameter with an angular speed of 40 rad/sec in a uniform horizontal magnetic field of magnitude 0.05 T. Find the maximum voltage induced in the coil.

**(b)** Define the following terms:

   (i) Reluctance

   (ii) Permeance

   (iii) Magnetic Field Strength

**(c)** A coil has 1000 turns enclosing a magnetic circuit of 20 cm² in cross-section with 4A current in the coil, the flux density is 1.5 Wb/m², and with 8A current, it is 1.9 Wb/m². Find the mean value of inductance between these current limits and the induced emf if the current decreases from 8 A to 4 A in 0.06 sec. **(15)**

(d) A coil A of 1200 turns and another coil B of 800 turns lie near each other so that 60 percent of the flux produced in one links with the other. It is found that a current of 5 A in coil A produces a flux of 0.25 mWb, while the same current in coil B produces a flux of 0.15 mWb. Determine the mutual inductance and coefficient of coupling between the coils.
**(20)**

**4. (a)** Determine the average and rms value of the resultant current in a wire carrying simultaneously a dc current of 10 A and sinusoidal current of peak value of 1.414A.
**(10)**

(b) The resistance of a coil is 3 Ω and its time constant is 1.8 sec. At t = 0 sec, a 10 V source is connected to it. Determine the **(15)**

   (i) current at t = 1 sec

   (ii) time at which the current attains half of its final value

   (iii) initial rate of growth of current

(c) Explain in brief the following: **(20)**

   (i) Energy meter

   (ii) CRO

   (iii) 2 wattmeter method

   (iv) Multi-meter

(d) In a moving coil instrument, the coil has a length of 5 cm, a width of 4 cm and 100 turns. The magnetic flux density in the air gap is 0.2 Wb/m². The hair spring provides a controlling torque of $0.5 \times 10^{-7}$ Nm/degree deflection of the coil. What current will be required to give a deflection of 60°? **(15)**

**5. (a)** A shunt generator gives full load output of 30 kW at a terminal voltage of 200 V. The armature and shunt field resistances are 0.01 Ω and 100Ω respectively. The iron and friction losses are 1000 W. Calculate the

   (i) emf generated

   (ii) copper losses

   (iii) efficiency

(b) Explain dynamic braking of 3-phase induction motor. **(15)**

(c) Explain in brief the following:

   (i) Fractional kilowatt motors

   (ii) Auto transformers

   (iii) S. C. test of 3-phase transformer

(d) Explain parallel operation of two alternators.
**(15)**

**6. (a)** Explain in brief of the following: **(30)**

   (i) Merz-price system of protection

   (ii) Short-circuit current for symmetrical faults

   (iii) Electric welding

(b) How is the rating of a cable determined?
**(10)**

(c) What are the different configurations of BJT? Explain each with suitable circuit diagram.
**(10)**

(d) Explain electric installation of machines and relevant IE rules in brief. **(10)**

# Paper 2016

## Electrical Engineering
### *(Paper II)*

**1.** (*a*) A conducting wire has a resistance of 5Ω. What is the resistance of another wire of the same material but having half the diameter and four times the length? (15)

(*b*) Two coils connected in parallel across a 100 V dc supply, take 10 A current from the supply. Power dissipated in one coil is 600W. What is the resistance of each coil? (15)

(*c*) Determine the current through the 5Ω resistor in the circuit of Figure 1. (15)
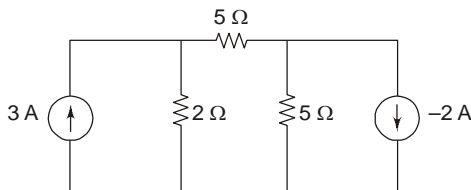


(*d*) Find the voltage across the 5Ω resistance in the network shown in Figure 2 using Thevenin's theorem. (15)
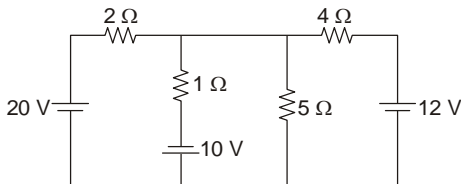


**2.** (*a*) An aeroplane with a wing span of 52 metres is flying horizontally at 1100 km/h. If the vertical component of the earth's magnetic field is $38 \times 10^{-6}$ T. Find the emf generated between the wing-tips. (10)

(*b*) A coil of 200 turns is wound uniformly over a wooden ring having a mean circumference of 60 cm and a uniform cross-sectional area of 500 mm². If the current through the coil is 4 A, calculate the (i) magnetic field strength, (ii) flux density, and (iii) total flux. (10)

(*c*) An iron choke takes 4 A current when connected to a 20 V dc supply. When connected to a 65V, 50Hz as supply, it takes 5A current. Determine the power drawn by the coil (15)

(*d*) Define the following terms

   (*i*) Mutual inductance

   (*ii*) Resonance

   (*iii*) MMF

   (*iv*) Q-factor

**3.** (*a*) Prove that the reactive power in ac circuit is equal to VI sin $\phi$.

(*b*) A 50 µA meter movement with an internal resistance of 1 kΩ is to be used as a dc voltmeter of range 50V. Calculate the

   (i) multiplier resistance required and

   (ii) voltage multiplying factor. (10)

(*c*) In a gravity controlled instrument the controlling weight is 0.005 kg and acts at a distance of 2.4 cm from the axis of the moving system. Determine the deflection in degrees corresponding to deflecting torque of $1.05 \times 10^{-5}$ kgm.

(*b*) Explain in brief (30)

   (*i*) Megger

   (*ii*) Two-wattmeter method

   (*iii*) Signal generator

   (*iv*) Earth fault detection

   (*v*) AC bridge

**4.** (*a*) Explain the braking methods of DC series motors. (20)

(*b*) Explain the parallel operation of 3-phase transformers. (10)

(*c*) Draw and explain equivalent circuit of a 1-phase transformer. Draw its phasor diagram for leading power factor load. (20)

(*d*) A 3-phase 400V, 50 Hz 6-pole star connected induction motor develops maximum torque at a speed of 940 rpm. If the rotor resistance per phase is 0.1W, determine the standstill rotor reactance. (10)

**5.** (*a*) How is the rating of circuit breakers decided? Explain in brief. (10)

(*b*) Explain Merz-Price protection of generators with appropriate circuit diagram. (10)

(*c*) Define the following terms (30)

(*i*) Demand factor

(*ii*) Tariff

(*iii*) HRC fuses

(*iv*) Diversity factor

(*v*) Derating factor of a cable

(*d*) What are the different methods of power factor improvement? (10)

**6.** (*a*) Explain earthing practices in brief. (15)

(*b*) With the help of neat and labelled circuit diagram. explain the process of electroplating. (15)

(*c*) How is the synchronous motor started? Explain the various methods of starting of a synchronous motor in brief. (15)

(*d*) What are the different configurations of an NPN transistor? Explain each in brief with neat and labelled circuit diagram. (15)