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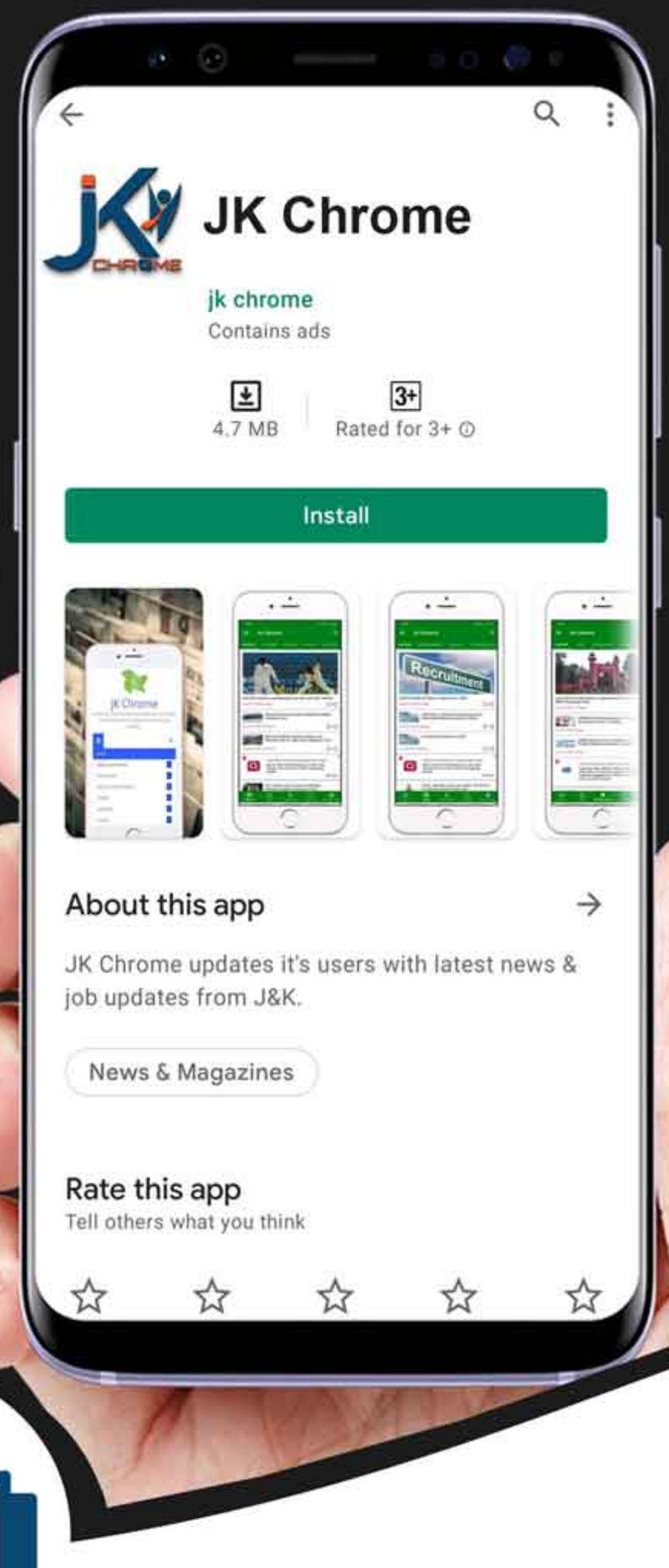

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Solved Paper 2018

(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)**

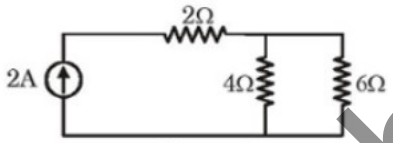


Figure-1

(*b*) The resistance of a transmission line is 126Ω 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 10Ω.

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

(ii) If the two heaters are connected in series across the 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 this coil is 0.8 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)**

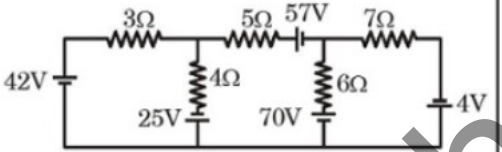


Figure-2

(*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/m^2. The hair spring provides a controlling torque of 0.5×10^{-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)**

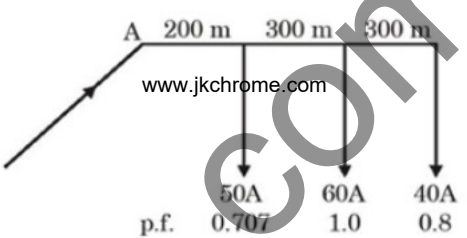


Figure-3

(*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)**

Solved 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)**

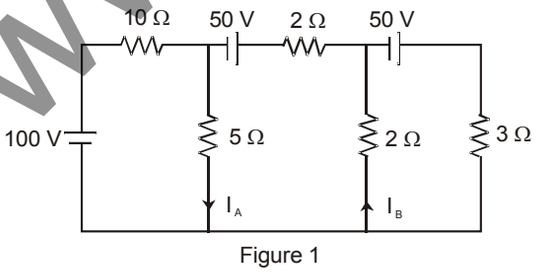


Figure 1

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

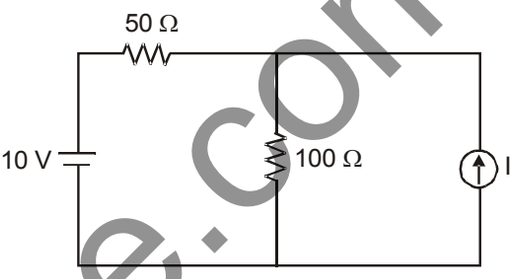


Figure 2

(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 cm^2 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 cm^2 in cross-section with 4A current in the coil, the flux density is 1.5 Wb/m^2, and with 8A current, it is 1.9 Wb/m^2. 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/m^2. The hair spring provides a controlling torque of 0.5×10^{-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)**

Solved Paper 2016

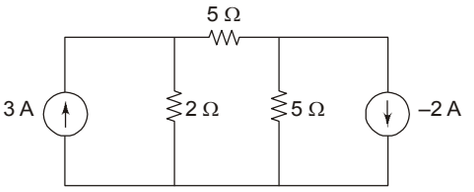
Electrical Engineering

(Paper II)

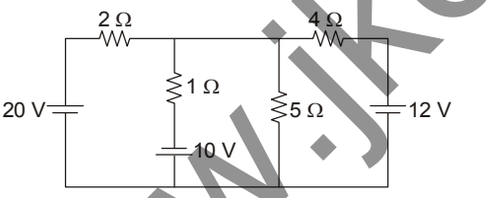
1. (*a*) A conducting wire has a resistance of 5Ω. What is the resistance of another wire of the same material but having half the diameter and four times the length? (15)

(*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 38×10^{-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 mm^2. 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 ϕ.

(*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 1.05×10^{-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)

Solved Paper 2015

Electrical Engineering

(Paper II)

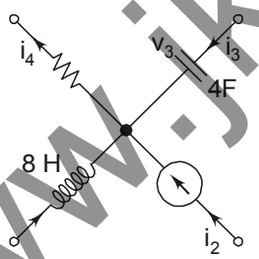
1. (*a*) Two conductors, one of copper and the other of iron, are connected in parallel and carry equal currents at 30°C. What proportion of current will pass through each, if the temperature is raised to 90°C? The temperature coefficients of resistance at 0°C are 0.0043/°C and 0.0063/°C for copper and iron respectively. (10)

(*b*) Determine the resistance and the power dissipation of a resistor that must be placed in series with a 50 ohm resistor across a 220 V source in order to limit the power dissipation in the 50 ohm resistor to 200 watts. (10)

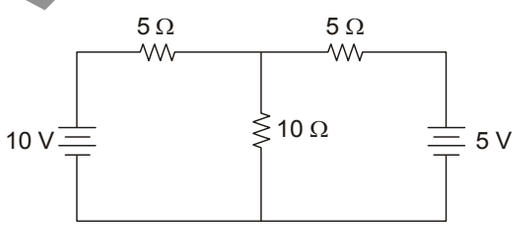
(*c*) In the network shown in Figure 1, the different currents and voltages are as under:

$i_2 = 10\ e^{-4t}$; $i_4 = 6 \sin t$; $v_3 = 8e^{-4t}$

Using Kirchhoff's Current Law, find the voltage v_1. (10)



(*d*) In figure, find the current in the 10 ohm resistor using Thevenin's theorem. (20)



(*e*) A variable air capacitor has 10 movable plates and 11 stationary plates. The area of each plate is 0.002 m^2 and separation between opposite plates is 0.001m. Determine the maximum capacitance of this variable capacitor. (10)

2. (*a*) An iron ring has a cross-sectional area of 200 mm^2 and a mean diameter of 20 cm. It is wound with 1000 turns. If the value of relative permeability is 250. Find the total flux set up in the ring. The coil resistance is 500Ω and the supply voltage is 220 V. (10)

(*b*) Define the following terms: (5+5+5+5)

(*i*) Coefficient of magnetic coupling

(*ii*) Self-inductance

(*iii*) Electromagnetic induction

(*iv*) Time constant

(*c*) A capacitor of 10μF takes a current of 2 A when alternating voltage applied across it is 220V. Calculate:

(*i*) the frequency of the applied voltage

(*ii*) the resistance to be connected in series with the capacitor to reduce the current in the circuit to 1 A at the same frequency. (5+10)

(*d*) An RLC series circuit has R = 5Ω, C = 50 μF and a variable inductance. The applied voltage is 220 V at 100 rad/sec. The inductance is varied till the voltage across resistance is maximum. Under this condition, find the

(*i*) value of inductance

(*ii*) Q-factor

(*iii*) voltages across resistance, capacitance and inductance (5+5+5)

3. (*a*) Two voltmeters have the same range 0 – 400 V. The internal impedances are 32kΩ and 18 kΩ respectively. If they are connected in series and 500 V be applied across them, what will be their readings? (10)

(*b*) Define the following terms: (5+5+5+5)

(*i*) Deflecting torque

(*ii*) Voltmeter sensitivity

(*iii*) Shading rings

(*iv*) Power factor

(*c*) Three 3-phase balanced loads are connected in parallel across a 440 V, 3-phase 3-wire balanced supply.

Load 1 : 12,000 W, delta connected, power factor = 1.0

Load 2 : 10,000 VA, star connected, power factor = 0.9 lag

Load 3 : 10,000 VAR, delta connected, power factor = 0.0 lead

Calculate:

(*i*) the total power

(*ii*) the combined power factor

(*iii*) the current drawn from the line (10+7+8)

(*d*) What is phantom loading? With a neat diagram, explain how it is carried out. (5)

4. (*a*) A 160 Ω source is to be matched to a 40Ω, 2Ω load by means of a transformer. What is the turns ratio? Determine the primary and secondary voltages and current. (20)

(*b*) Explain the various losses in a transformer. Derive the condition for maximum efficiency of a transformer. (20)

(*c*) A direct current shunt motor develops 10 HP at 8000 rpm when drawing a line current of 40 A at 220V. Find the efficiency at this load and the useful torque. (10)

(*d*) Explain the effect of frequency variation on torque-speed characteristics of a 3-phase induction motor. (10)

5. (*a*) Explain the causes of low power factor in a power system. (10)

(*b*) Explain why a three-phase induction motor is self-starting and a single-phase induction motor is not. (15)

(*c*) Explain why a synchronous motor develops torque at synchronous speed, whereas an induction motor develops torque at all speeds except the synchronous speed. (15)

(*d*) Which fault in a power system is more severe as compared to other faults and why? (10)

(*e*) What are the necessary conditions to operate two alternators in parallel to supply a common load? (10)

6. (*a*) What are the advantages and disadvantages of BJT over JFET? (10)

(*b*) Explain clearly how a fuse rating is selected for the following: (20)

(*i*) Lighting circuit

(*ii*) Power circuit

(*c*) Name the different types of domestic wiring and compare their performance briefly. (15)

(*d*) What are the advantages and disadvantages of electric drives over conventional drives? (15)

Solved Paper 2014

Electrical Engineering

(Paper II)

1. (*a*) A copper wire has a resistance of 0.85 Ω at 20°C. What will be its resistance at 40°C? Temperature coefficient of resistance of copper at 0°C is 0.004°C. (10)

(*b*) In the circuit shown in Figure, what is the value of V? (10)

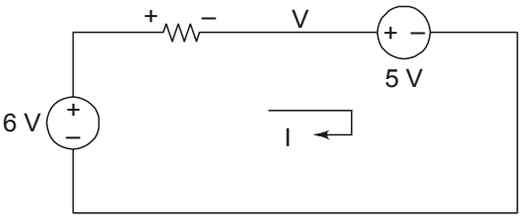


Figure 1

(*c*) What is the value of Thevenin voltage E_{Th} in the given circuit of Figure? (10)

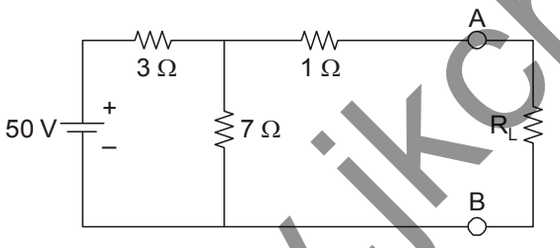


Figure 2

(*d*) In Figure, find the value of resistance R. (30)

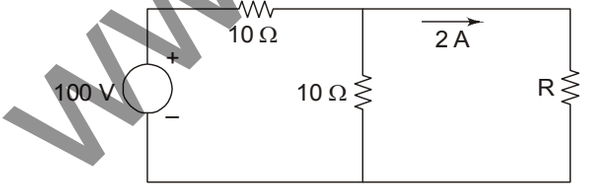


Figure 3

2. (*a*) Define the following terms: (20)

(*i*) Magnetic field intensity

(*ii*) Magnetic flux density

(*iii*) Magnetomotive force

(*iv*) Reluctance

(*b*) In a pair of coupled coils, coil 1 has a continuous current of 2A and the corresponding fluxes φ_{11} and φ_{21} are 0.3 and 0.6 mWb respectively. If the turns are $N_1 = 500$ and $N_2 = 500$, find L_1, L_2, M and K. (10)

(*c*) An AC voltage of 50 Hz has a maximum value of 50V. What will be its voltage after 1/600 second? (10)

(*d*) A circuit with a resistor, inductor, and capacitor in series is resonant of f_0 Hz. If all the component values are now doubled. Find the new resonant frequency. (20)

3. (*a*) A 100 μA ammeter has internal resistance of 100Ω. For extending its range to measure 500μA, calculate the value of shunt resistance (in Ω). (10)

(*b*) A wattmeter is connected as shown in Figure. What will be the wattmeter reading of power consumed either by Z_1 or Z_2? (10)

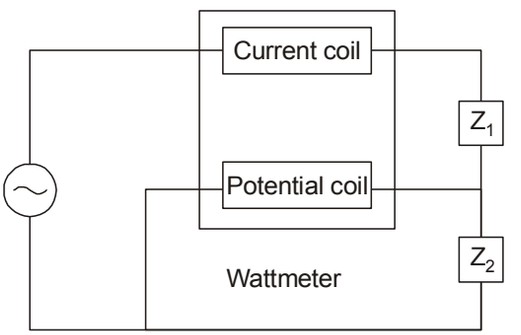


Figure 4

(*c*) A CRO screen has ten divisions on the horizontal scale. If a voltage signal 5 sin (314 t + 45°) is examined with a line base setting of 5 msec/div, find the number of cycles of signal displayed on the screen.(20)

(*d*) Prove that the power in AC circuit is equal to VI cos φ. (20)

4. (*a*) Explain the various losses in DC machines. (20)

(*b*) A DC machine induces an EMF of 240 V at 1500 rpm. Find the developed torque for an armature current of 25 A. (10)

(*c*) A 3300/300 V single phase transformer gives 0.6 A and 60 W as ammeter and wattmeter reading when supply is given to the low voltage winding and high voltage winding is kept open. What is the power factor of no load current? (15)

(*d*) A 3 hp, 3-phase 4-pole, 400V 50Hz induction motor runs at 1440 rpm. What will be the frequency of the rotor-induced EMF? (15)

5. (*a*) Explain the need for connecting a capacitor in the auxiliary winding of a single phase induction motor. (15)

(*b*) Why are two alternators connected in parallel to supply a common load? What are the necessary conditions for parallel connection? (15)

(*c*) What are the advantages and disadvantages of AC over DC? (15)

(*d*) Overhead power transmission lines are preferred over underground power cables. Discuss. (8)

(*e*) What are the main advantages of SF6 circuit breakers? (7)

6. (*a*) A residential flat has the following average electrical consumptions per day:

(*i*) 4 tube lights of 40 watts working for 5 hours per day;

(*ii*) 2 filaments of 60 watts working for 8 hours per day;

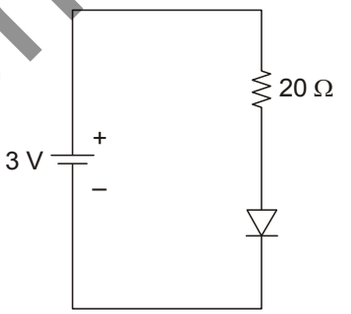
(*iii*) 1 water heater rated 2 kW working for 1 hour per day;

(*iv*) 1 water pump of 0.5 kW rating working for 3 hours per day.

Calculate the cost of energy per month if 1 kWh of energy (i.e., 1 unit of energy) costs ₹3.50. (20)

(*b*) Cite the advantages and disadvantages of electric drives. (20)

(*c*) A silicon diode is connected across a 3V supply with a series resistance of 20Ω as shown in Figure. Neglecting diode resistance, find the diode current. (20)



Solved Paper 2013

Electrical Engineering

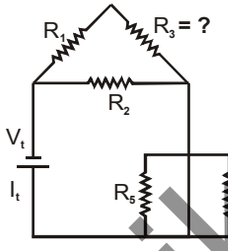
(Paper II)

1. (*a*) (*i*) An oven operates on a 15.0 A current from a 120 V source. How much energy will it consume in 3.0 h of operation? (10)

(*ii*) How many 100 W light bulbs connected to a 120 V supply can be turned on at the same time without blowing a 15.0 A fuse? (10)

(*iii*) 3.0 A, 125 V circuit contains a 10.0 W resistor. What resistance must be added in series for the circuit to have a current of 5.0 A? (10)

(*b*) In the following circuit, find the total resistance, R_3, V_2 and I_4. (30)



$R_1 = 9\ \Omega$

$R_2 = 4\ \Omega$

$R_4 = 12\ \Omega$

$R_5 = 36\ \Omega$

$R_t = 12$ V

$I_t = 1.0$ A

2. (*a*) What do you understand by magnetic hysteresis? Differentiate between hard and soft magnetic materials. (30)

(*b*) Deduce an expression for the average power in a single phase RL circuit and hence explain the term power factor. (30)

3. (*a*) Describe the working principle and construction of an induction type wattmeter. What are the errors in induction type wattmeter, and how are they compensated? (30)

(*b*) The four arms of a Maxwell A.C. bridge are as follows:

AB and BC are non-inductive resistors of 100 Ω each, DA is a standard variable inductor L of resistance 32.7 Ω and CD comprises a standard variable resistor R in series with a coil of unknown impedance. Balance is obtained when L = 47.8 mH and R = 1.36 Ω. Find the resistance and inductance of the coil. (30)

4. (*a*) (*i*) What are factors that control the speed of a DC motor? (10)

(*ii*) A 500 V shunt motor runs at its normal speed of 250 rpm when the armature current is 200 A. The resistance of armature is 0.12 Ω. Calculate the speed when a resistance is inserted in the field reducing the shunt field to 80% of normal value and the armature current is 100 A. (20)

(*b*) A three phase induction motor having a 6-pole, star connected stator winding runs on 240 V, 50 Hz supply. The rotor resistance and standstill reactance are 0.12 Ω and 0.85 ohm per phase. The ratio of stator to rotor turns is 1.8. Full load slip is 4%. Calculate the developed torque at full load. (30)

5. (*a*) What is loss load factor? Explain in detail how the loss load factor can be determined. (30)

(*b*) Discuss various bus bar systems for distribution networks. (30)

6. (*a*) Discuss the laws of illumination and their limitations in actual practice. (30)

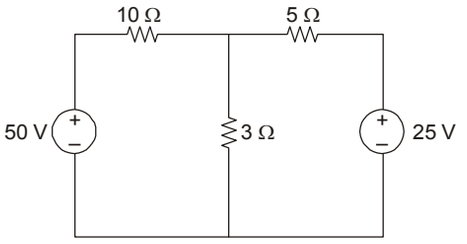
(*b*) Draw the output characteristics of a common-emitter transistor. Show various regions of operation of the BJT on this characteristic. Describe the applications of operating the BJT into different regions. (30)

Solved Paper 2012

Electrical Engineering

(Paper II)

1. (*a*) For the network shown in figure find the current in each resistor using super position principle. (30)



Figure

(*b*) Three impedances (6 + 15)Ω, (8 – 16)Ω and (8 + J10)Ω are connected in parallel. Calculate the current in each branch when the total current is 20 A. (30)

2. (*a*) What are the various methods for the measurement of three phase power? Explain two-wattmeter method for star-connected three phase balanced circuits. Also derive the expression for power factor. (30)

(*b*) Derive the e.m.f and torque equation of d.c. machines. Also discuss the significance of back emf in d.c. machines. (30)

3. (*a*) A 400 KV A, 5000/320 V, 1 phase transformer has a primary winding resistance of 0.5Ω and secondary winding resistance of 0.001Ω. The iron loss is 2.5 KW. Determine the efficiency of transformer at full load and half load at 0.85 p.f. lagging. (30)

(*b*) Explain the open circuit and short circuit tests on single phase transformer. (30)

4. (*a*) Explain the principle of operation of three phase synchronous motor. Discuss the various applications of three phase synchronous motor. (20)

(*b*) A 415 V, three phase, 50Hz, 4 pole star connected induction motor runs ar 24 rps on full load. The rotor resistance and reactance per phase are 0.35Ω and 3.5Ω respectively and the effective rotor - stator turns ratio is 0.85:1. Calculate

(i) synchronous speed

(ii) the slip

(iii) the full load torque

(iv) the power output if mechanical losses amount to 770 W

(v) the maximum torque. (40)

5. (*a*) Discuss the various types of transmission lines. Derive the expression for voltage regulation of single phase short transmission line. (30)

(*b*) Write short notes on any two of the following: (30)

(i) Power factor improvement

(ii) Buchholz Relay

(iii) Advantages of Inter connection of power stations

6. (*a*) Explain the various starting methods for three phase induction motors in detail. (20)

(*b*) A lamp having a Candle power of 300 in all directions is provided with a reflector that directs 70% of total light uniformly on a circular area 40 m diameter. The lamp is hung at 15 m above the area. Calculate: (40)

(*i*) The illumination

(*ii*) The illumination at the center

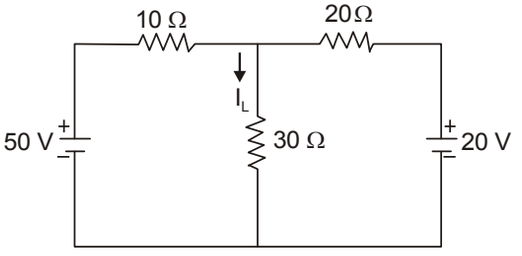
(*iii*) The illumination at the edge of the surface without reflector.

Solved Paper 2011

Electrical Engineering

(Paper II)

1. Find I_L for the circuit shown in figure, using Superposition theorem. (30)



Figure

2. Two impedances $Z_1 = (8 + j6)\Omega$ and $Z_2 = (3 - j4)\Omega$ are in parallel and this combination takes 25 A. Determine the current and power taken by each branch. (30)

3. Derive and explain the two Wattmeter method of measurement of three phase power for a balanced star connected load. Discuss the variations in readings for different power factors of loads from unity to zero. (30)

4. A short shunt compound d.c. generator delivers 100 A to a load at 250 V. The generator has shunt field, series field and armature resistance, 130 Ω, 0.1 Ω and 0.1 Ω respectively. Calculate the voltage generated in armature winding. Assume 1 V drop per brush. (30)

5. Explain the working principle of three phase synchronous motor. (30)

6. Show that maximum stress in a single-core cable is $\frac{2V}{d \log_e D/d}$

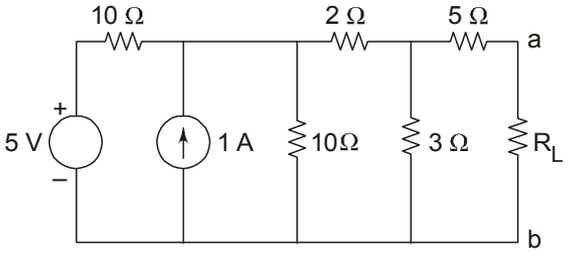
Where V is the operating voltage, d and D are the conductor and sheath diameter. (30)

Solved Paper 2010

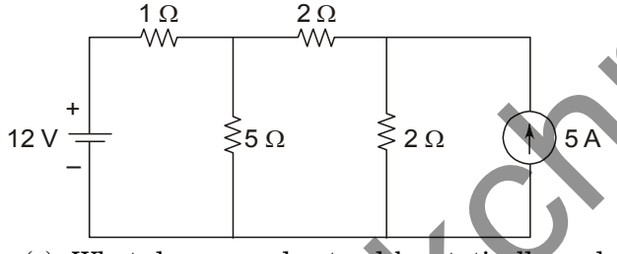
Electrical Engineering

(Paper II)

1. (*a*) In the network shown in fig. Find resistance R_L so that maximum power is developed across R_L. (10)



(*b*) Find current through 5Ω resistor in the circuit shown in Fig., using Thevenin's theorem. (10)



(*c*) What do you understand by statically and dynamically induced emf? Write down difference between them with example. (10)

2. (*a*) A coil of power factor 0.6 is in series with a 100 μF capacitor. When connected to a 50Hz supply the voltage across the capacitor is equal to the voltage across the coil. Find the resistance and inductance of the coil. (15)

(*b*) Explain with neat sketch the working principle of repulsion type moving iron instrument. Prove that the deflection of the moving iron ammeter is proportional to the square of rms value of the current. (15)

3. (*a*) Describe the construction and principle of working of a capacitor-start capacitor-run single-phase induction motor. (10)

(*b*) A 11000/400 V, distribution transformer takes a no load primary current of 1 A at a power factor of 0.24 lagging. Find (10)

(*i*) core loss current and magnetising current

(ii) core loss in the transformer.

(*c*) Explain different types of distribution systems with the help of neat sketches.(10)

4. (*a*) Describe the working of vacuum tube voltmeter VTVM. State the disadvantages of VTVM. (15)

(*b*) Describe the operation of PN junction diode under forward bias condition. (5)

(*c*) What is meant by doping in a semiconductor? How does the energy band structure of a semiconductor differ from that of a conductor and an insulator? (10)

5. (*a*) What are different turn-on methods of SCR? Explain gate triggering process to turn on the SCR. Draw the gate characteristics of SCR. (15)

(*b*) Define the following terms: (6)

(*i*) Pinch-off voltage

(*ii*) Peak inverse voltage

(*iii*) Avalanche breakdown

(*c*) In a certain transistor, collector current is 0.98 mA and base current is 20 μA. Determine the values of (9)

(*i*) emitter current

(*ii*) current amplification factor

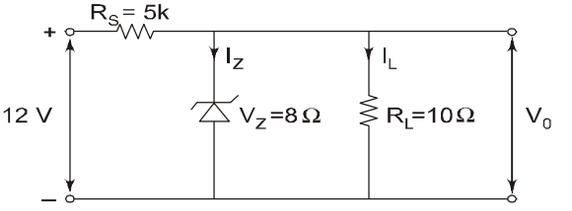
(*iii*) current gain factor.

6. (*a*) For the circuit given in Fig. below find

(*i*) output voltage V_o

(*ii*) voltage across R_S

(*iii*) current through Zener diode.



(*b*) With the help of neat diagram explain the V – I characteristics of UJT.

(*c*) Explain the following:

(*i*) Intrinsic and Extrinsic semiconductor

(*ii*) N-type and P-type semiconductor

Solved Paper 2009

Electrical Engineering

(Paper II)

1. (*a*) State Norton's theorem. (5)

(*b*) A coil of insulated wire of 500 turns and resistance of 4 Ω is closely wound on an iron ring. The ring has a mean diameter of 0.25 m and a uniform cross-sectional area of 700 mm^2. Calculate the total flux in the ring when a DC supply of 6V is applied to the ends of the winding. Assume relative permeability of iron is 500. (15)

(*c*) Determine the current I in the network shown in fig. by Thevenin's theorem. (10)

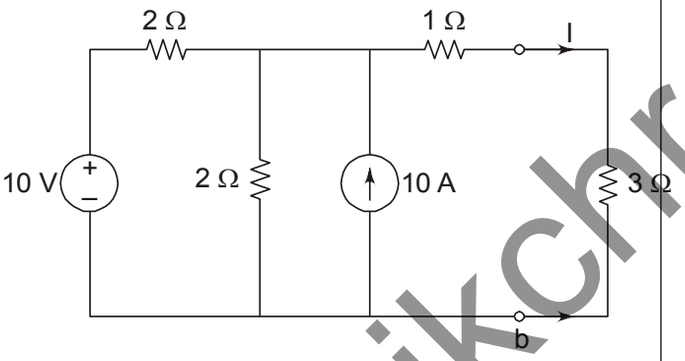


Fig.

2. (*a*) A coil of resistance 10 Ω and inductance 0.02 H is connected in series with another coil of resistance 6 Ω and inductance 15 mH across a 230 V, 50Hz supply. Calculate

(i) Impedance of circuit

(*ii*) Voltage drop across each coil

(*iii*) Total power consumed by the circuit (15)

(*b*) Describe with the aid of a carefully labelled diagram, the construction and working of electrodynamic type wattmeter. (10)

(*c*) Explain the working of single phase bridge rectifier. (5)

3. (*a*) Explain the tests to be performed on a transformer to determine the equivalent circuit parameters of transformer. (15)

(*b*) A 250 V DC shunt motor having an armature resistance of 0.25Ω carries an armature current of 50A and runs at 750 rpm. If the flux is reduced by 10%, find the speed. Assume that the load torque remains same. (15)

4. (*a*) A 3-phase star connected alternator is rated at 1600 KVA, 13500 V. The effective armature resistance and synchronous reactance are 1.5Ω and 30Ω respectively per phase. Calculate the percentage regulation for a load of 1280 kW at power factor of

(*i*) 0.8 leading

(*ii*) unity. (15)

(*b*) Describe with diagrams the working of the following induction motor starters: (15)

(*i*) Direct on-line starter

(*ii*) Autotransformer starter

(*iii*) Star-delta starter

5. (*a*) Define power factor and explain why in general, it should be kept as high as possible in power supply systems. Show with phasor diagram. How the power factor of load can be improved by connecting a capacitor in parallel with it. (15)

(*b*) With the help of labelled diagram explain the working of thermal power plant (15)

6. (*a*) Describe distance protection scheme for the protection of feeders. (10)

(*b*) Discuss the advantages of high voltage transmission. (10)

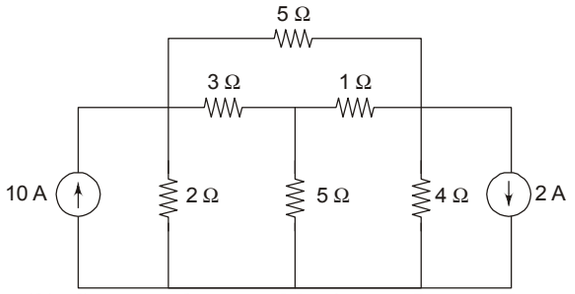
(*c*) Discuss the advantages of electric heating. Explain the principle of dielectric heating. (10)

Solved Paper 2008

Electrical Engineering

(Paper II)

1. (*a*) Use Nodal analysis to find the currents in various resistors of the circuit shown in fig.1. (10)



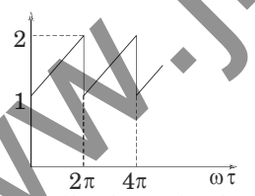
(*b*) State and prove Maximum Power Transfer Theorem for dc circuits. (10)

(*c*) The self-inductance of a coil of 500 turns is 0.25 H. If 60% of the flux is linked with second coil of 10,000 turns then calculate

(*i*) the mutual inductance of the two coils.

(*ii*) the emf induced in the second coil when the current in the first coil changes at the rate of 100 A/s. (10)

2. (*a*) Calculate the rms and average values of current i represented by the waveform shown in figure 2. (10)



(*b*) An iron choke coil takes 4A when connected to a 20V dc supply and takes 5A when connected to 65V, 50Hz ac supply. Determine.

(*i*) resistance and inductance of the coil

(*ii*) power drawn by the coil

(*iii*) the power factor (10)

(*c*) With neat diagram explain the construction of moving coil instruments and derive the expression for deflecting torque of moving coil instrument. (10)

3. (*a*) Derive an expression for the emf induced in a transformer winding. Show that emf per turn in primary is equal to emf per turn in secondary. (10)

(*b*) Give the equivalent circuit of a transformer and define its various parameters. (10)

(*c*) Explain with neat diagram the differential protection scheme used to protect Δ – Y transformer. (10)

4. (*a*) Draw the external characteristics of various types of dc generators in one figure assuming the same no load terminal voltage. Compare these characteristics. (10)

(*b*) Describe and compare various methods of speed control of dc shunt motors. (10)

(*c*) A 230 V dc series motor has an armature resistance of 0.2 Ω and field resistance of 0.1 Ω at rated voltage. The motor draws a line current of 40 amperes and runs at a speed of 1000 rpm. Find speed of the motor for line current of 20 A at 230 V. Assume that flux at 20 A line current is 60% of the flux at 40 A line current. (10)

5. (*a*) Explain various methods of starting of synchronous motor. (10)

(*b*) A 3-phase 50Hz induction motor has a full load speed of 1440 rpm. For this motor calculate the following: (10)

(*i*) Number of poles (*ii*) Full load slip

(*iii*) Rotor frequency

(*iv*) Speed of stator field w.r.t. rotor field

(*v*) Speed of stator field w.r.t. rotor structure

(*c*) Draw and explain the torque-slip characteristics of a 3-phase induction motor. Also explain the effect of rotor resistance on torque-slip characteristics. (10)

6. (*a*) Define and explain the significance of the following terms: (10)

(*i*) Load factor

(*ii*) Diversity factor

(*iii*) Demand factor

(*b*) Daily load of an industry is 200 kW for first one hour 150 kW for next 7 hours, 50 kW for next 8 hours and 1 kW for the remaining time. If the tariff in force is Rs. 1000/ per kW of maximum demand per annum plus Rs. 2.25 per kWh. Find the electricity expenditure for one year (365 days). (10)

(*c*) Explain different types of distribution systems with neat sketch. (10)

Solved Paper 2007

Electrical Engineering

(Paper II)

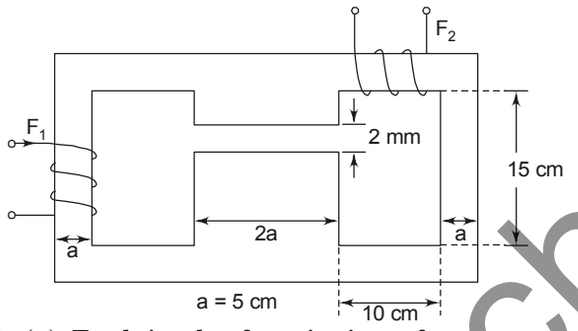
1. (*a*) Draw-electrical analogue of the given magnetic circuit (15)

(*b*) In the magnetic circuit shown coil F_1 is supplying 4000 AT in the direction indicated. Find the AT of coil F_2 to produce air gap flux of 4 mWb from top to bottom and also current direction. (15)

Core thickness = 8 cm

μ for Iron = 2500

$\mu_0 = 4\pi \times 10^{-7}$



2. (*a*) Explain the functioning of a permanent magnet type moving-coil instrument with suitable diagram

(*b*) A 25KVA, 230/115V, 50 Hz transformer has the following data:

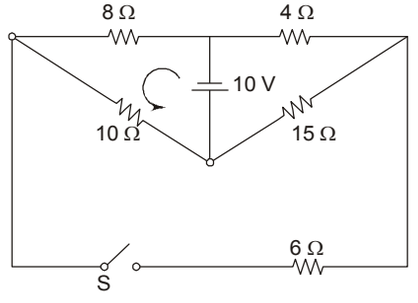
$r_1 = 0.12\ \Omega$, $r_2 = 0.04\ \Omega$

$X_1 = 0.2\ \Omega$, $X_2 = 0.05\ \Omega$

Find the transformer loading which will make the primary induced e.m.f. equal in magnitude to the primary terminal voltage when the carrying full load to the magnetising current. (15)

3. (*a*) State and explain Norton's theorem. (15)

(*b*) Use Thevenin's theorem to find the current through the switch S when it is closed.(15)



4. (*a*) Explain in detail about the Ward-Leonard system of speed control of DC motors. (15)

(*b*) A DC shunt motor is operated from 300 V mains. Its no-load speed is 1200 r.p.m. When fully loaded its speed drops to 1100 r.p.m., while it delivers a torque of 400 N.m. Find its speed and power when operated with an armature voltage of 600V, when delivering the same torque. Excitation is assumed unchanged, i.e., the motor field is still excited at 300 V, State any assumption you are required to make. (15)

5. (*a*) Explain the Double-field Revolving theory in connection with single-phase induction motor. (15)

(*b*) A 6-pole, 440V, 3-phase 50Hz induction motor has the following parameters of its circuit model (referred to the stator on equivalent star basis):

r_1 = 0.0 (stator copper loss negligible), $x_1 = 0.7\Omega$, $r'_2 = 0.3\Omega$,

$x'_2 = 0.7\Omega$, $X_m = 35\Omega$, rotational loss is 350W

Calculate net mechanical power output stator current and power factor when the motor runs at a speed of 950 r.p.m. (15)

6. (*a*) Explain in detail armature reaction is synchronous generators. (15)

(*b*) A 600V, 3-phase, 50Hz, star-connected synchronous motor has a resistance and synchronous reactance of 0.4Ω and 7Ω, respectively. It takes a current of 15 A at unity p.f. when operating with a certain field current. With the field current remaining constant, the load torque is increased until the motor draws a current of 50A. Find the torque (gross) developed and the new power factor. (15)

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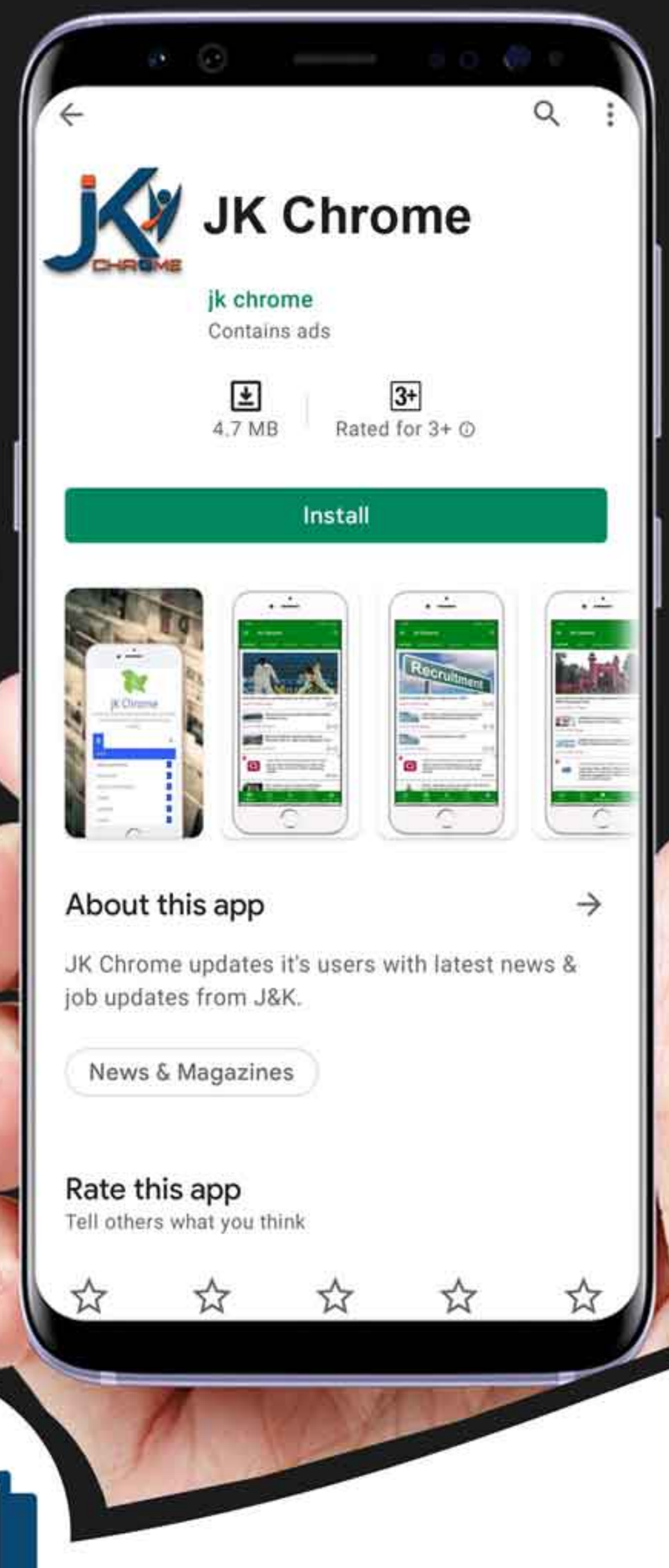

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