Q 2 (a) Derive the expression for Coulomb's Law of Electrostatics.

Answer Page Number 45 & 46 of Textbook-I

Q 2 (b) What is meant by Self Induced EMF and derive an expression for the coefficient of self induction.

Answer Page Number 118 & 119 of Textbook-I

Q 3 (a) State and explain Superposition Theorem.

Answer Page Number 16 & 17 of Textbook-I

Q 3 (b) Explain the relationship between Line and Phase quantities in Delta connected circuit with the help of a phasor diagram.

Answer Page Number 283 & 284 of Textbook-I

Q 4 (a) Explain the principle of operation of DC motor with neat sketches.

Answer Page Number 505 & 506 of Textbook-I

Q 4 (b) A 230 volts dc shunt motor runs at 1000 rpm when the armature current is 35 A. The resistance of the armature circuit is 0.3Ω. Calculate the additional resistance required in the armature circuit to reduce the speed of the motor to 750 rpm, assuming that the armature current is 25 A.

Answer

Voltage applied to the motor = 230 V
Initial speed, N_1 = 1000 rpm
Armature current at 1000 rpm = 35 A
Resistance of the armature circuit, R_a = 0.3Ω
Back emf when the motor runs at 1000 rpm,

$$E_{b1} = 203 - 35 \text{ X } 0.3 = 219.5 \text{ V}$$

Let the additional resistance in the armature circuit to reduce the speed to 750 rpm be RΩ.
Then the total resistance of the armature circuit = (0.3 + R)Ω
Armature current at 750 rpm = 25 A
Thus, back emf at 750 rpm, E_{b2} = 230 - 25 (0.3 + R)
= 222.5 -25R

Shunt field current during the change of speed remains constant, as such the flux at 1000 rpm is equal to the flux at 750 rpm or $\phi_1 = \phi_2$.

Back emf for a particular motor $= K\phi N$
Where K is a constant for the motor.
Hence $E_{b1} = K\phi_1 N_1$ ------------ (i)
and $E_{b2} = K\phi_2 N_2$ ------------- (ii)
Dividing equation (ii) by equation (i), we get

$$\frac{E_{b2}}{E_{b1}} = \frac{\phi_2}{\phi_1} X \frac{N_2}{N_1}$$

$$\frac{222.5 - 25R}{219.5} = \frac{\phi_2}{\phi_1} X \frac{750}{1000}$$

Or $222500 - 25000R = 750 X 219.5$

Therefore, **the additional resistance required in the armature circuit is,** $R = 2.315\Omega$

Q 5 (a) What is Step-Up transformer? Derive an expression for the EMF equation a Transformer.

Answer Page Number 402,404 & 405 of Textbook-I

Q 5 (b) An 8-pole alternator runs at 750 rpm. It supplies power to a 6-pole, 3-phase the induction motor, which has a full load slip of 3 %. Find

(i) The speed of the induction motor and

(ii) The frequency of its rotor EMF.

Answer

Number of poles of the alternator P = 8
Speed at which alternator runs N = 750 rpm
Frequency of the alternator, $f = \frac{PN}{120} = \frac{8 X 750}{120} = 50 Hz$

Synchronous speed of the rotating magnetic field produced in the stator of 3-phase

Induction motor is $N_s = \frac{120 X f}{P}$

Where f is the frequency of the supply to the induction motor and P the number of poles

of the induction motor is $N_s = \frac{120 X 50}{6} = 1000 rpm$

Full load slip, s = 3% = 0.03

Slip of induction motor, $s = \frac{N_S - N_F}{N_S}$

Full load speed of induction motor $N_F = N_S(1 - s) = 1000(1 - 0.03)$

Therefore, $\mathbf{N_F = 970}$ **rpm**

(ii)Frequency of the rotor emf f_r = slip X supply frequency

f_r = 0.03 X 50 = 1.5 Hz

Therefore, **the frequency of rotor emf = 1.5 Hz**

Q 6 (a) What is meant by doping? Explain donor doping with neat diagram.

Answer Page Number 10 & 11 of Textbook-II

Q 6 (b) Discuss the typical forward and reverse characteristics of a germanium diode and compare it with silicon diode characteristics.

Answer Page Number 35 & 36 of Textbook-II

Q 7 (a) Draw the circuit of Full Wave Bridge Rectifier and explain its operation with input and Output waveforms.

Answer Page Number 77 & 78 of Textbook-II

Q 7 (b) What is a Clamper? Explain the operation of negative voltage clamper circuit with the help of input and output waveforms.

Answer Page Number 121 & 122 of Textbook-II

Q 8 (a) Draw and explain the Common-Base output characteristics. Label different regions on the characteristics.

Answer Page Number 162, 163 & 164 of Textbook-II

Q 8 (b) Design a collector-to-base bias circuit to have V_{CE} = 5 V and I_C = 5 mA, when the supply voltage is 15 V and the transistor h_{FE} is 100.

Answer

V_{CE} = 5 V; I_C = 5 mA; V_{CC} = 15 V and h_{FE} = 100

As we know that the relation between the Base Current (I_B), Collector Current (I_C) and current gain (h_{FE}) as

$$I_B = \frac{I_C}{h_{FE}} = \frac{5mA}{100} = 50\mu A$$

From the Collector-to-Base bias cicuit shown in Fig.1, the collector resistance R_C Is given by

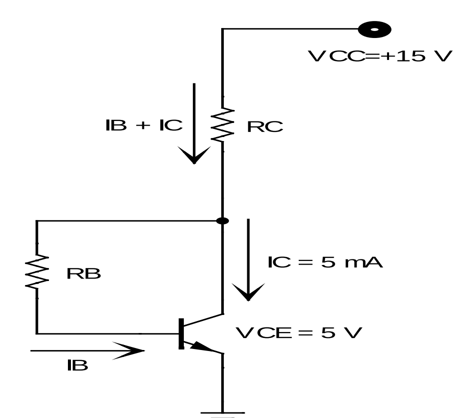

Fig.1 Collector-to-Base Bias Circuit

$$R_C = \frac{V_{CC} - V_{CE}}{I_C + I_B} = \frac{15V - 5V}{5mA + 50\mu S} = 1.98K\Omega..$$

From the figure, the base resistance (R_B) is given by

$$R_B = \frac{V_{CE} - V_{BE}}{I_B} = \frac{5V - 0.7V}{50\mu A} = 86K\Omega.$$

The designed Collector-to-Base Bias Circuit is shown in Fig.2

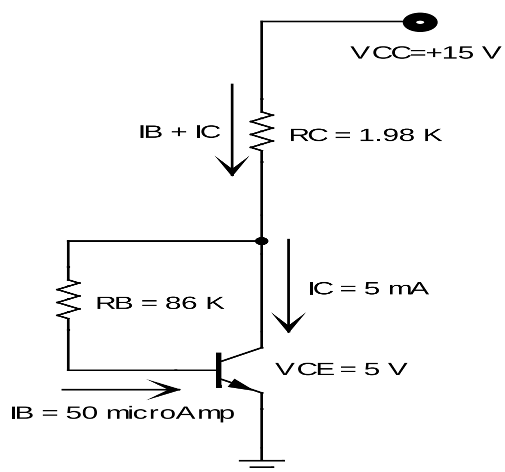

Fig.2 Collector-to-Base Bias Circuit

Q 9 (a) Draw the circuit of series voltage negative feedback and derive an expression for its voltage gain .

Answer Page Number 545 to 547 of Textbook-II

Q 9 (b) What is an Oscillator? Explain the operation of BJT Hartley oscillator.

Answer Page Number 665, 666, 675 & 676 of Textbook-II

Text Books

1. V.N. Mittle and Arvind Mittal, 'Basic Electrical Engineering', Tata McGraw-Hill Publishing Company Limited, 2nd edition, 2006.

2. Electronic Devices and Circuits, David A Bell, Fourth Edition, PHI (2006).