PAPER-II (Subjective)

1.(A)   Choose and write the correct answer from among the four options given in each case for (a) to (j) below:

(a)   Improved commutation in d.c machines cannot be achieved by

(i) Use of interpoles

(ii) Using brushes of higher resistivity

(iii) Increasing reactance voltage

(iv) Decreasing reactance voltage

(b)   A two winding single phase transformer when connected either as a step down or step up autotransformer, under the assumptions of ignoring core loss, copper loss, magnetizing current and leakage reactance, will have the maximum VA rating for the autotransformed for a given VA rating of the two winding transformer having N_1 and N_2 primary and secondary turns respectively for

(i) $\left(N_1 / N_2\right) << 1.0$

(ii) $\left(N_1 / N_2\right) = 1.0$

(iii) $\left(N_1 / N_2\right) \simeq 1.0 \text{ but} > 1.0$

(iv) $\left(N_1 / N_2\right) >> 1.0$

(c)   A surge of 10kV travels along a cable towards its junction with an overhead line. The surge impedances of the cable and the line are 50Ω and 450Ω, respectively. The surge voltage transmitted into the line is

(i) 18.0 kV   (ii) 4.0 kV   (iii) 20.0 kV   (iv) 2.0 kV

(d)
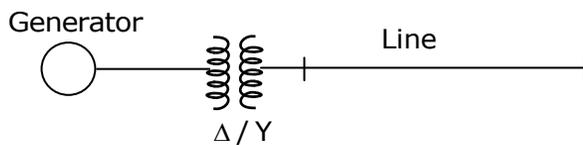
The one line diagram of a simple power system is given above. The transformation ratio of the step-up transformer is 11/220 kV. The base MVA = 100 and base kV = 11 on the generator side. The base kV on the transmission side is

(i) 11 kV   (ii) 220 kV   (iii) $\dfrac{220}{\sqrt{3}} \, kV$ (iv) $\sqrt{3} \times 220 kV$

(e)   An ideal current-controlled voltage source has the input resistance and the output resistance, respectively.

(i) ∞, ∞ (ii) $0, \infty$ (iii) $0, 0$ (iv) $\infty, 0$

(f)   Consider the following assembly language program for the 8085 microprocessor:

LXI H, 2000 H

MOV A, M

CMA

MOV A, M

After the execution of this program,

(i) Content of 2000 H is complemented and is moved to 2001 H.

(ii) Content of 2000 H is complemented and is stored in the accumulator.

(iii) Content of 2000H is moved to the accumulator

(iv) Content of 2000 H is compared with the accumulator

(g)   For data-transfer between microprocessor and I/O device, the term hand-shake refers to

(i) The conversion of parallel data to serial format for the I/O device

(ii) The conversion of serial data to parallel format for the microprocessor

(iii) The exchange of control-signals between the microprocessor and I/O device

(iv) The I/O device, gaining control of the microprocessor buses

(h)   Companding is used in PCM to

(i) Increase the signal to noise ratio

(ii) Reduce the bandwidth

(iii) Reduce the power

(iv) Get almost uniform signal to noise ratio

(i)   A freewheeling diode in a phase controlled converter

(i)   Decreases the possibility of discontinuous conduction in the load

(ii) Increases the possibility of discontinuous conduction

(iii) Impairs the power factor

(iv) Causes additional reactive power requirement

(j)   The quality of output ac voltage of a cycloconverter is improved with

(i) Increase in output voltage at reduced frequency

(ii) Increase in output voltage at increased frequency

(iii) Decrease in output voltage at reduced frequency

(iv) Decrease in output voltage at increased frequency

[B]   Answer the following questions:

(a)   What are the various conditions which have to be fulfilled before a shunt excited d.c. generator will generate rated voltage across the armature terminals?

(b)   Determine the positive-sequence component of the three currents $I_a = 10 \angle 0^O \, A$, $I_b = 10 \angle 230^o$ and $I_c = 10 \angle 130^O \, A$.

(c)   The open circuit voltage and the resistance of a microphone are 15mV and $100 \text{k}\Omega$, respectively. An amplifier with an input resistance of $50 \text{k}\Omega$ is used for amplifying the microphone output so as to deliver 2.0W power into a load of 8Ω. Find the voltage gain of the amplifier.

(d)   How does the CPU come to know about the number of bytes to be fetched from memory to execute an instruction? During which clock cycles of an instruction cycle does ALE appear? What is its function?

(e)   For a single phase ac voltage controller, which type of gating signal is more suitable, when the load is inductive? Give reasons for your answer.

Section 'A'

2.   (a)   Explain the various methods of speed control of d.c. series motor including the case when two identical d.c series motors are available.

A 4 pole d.c. series wound motor takes 20 A from 250 V d.c. supply to run at 600 rpm when all the four field coils are in series. If the load torque increases as the square of speed, find the speed and the input current when the field coils are connected in two parallel groups of two coils in series each. Assume that the flux is proportional to the current and ignore losses.

(b)   Classify 1-phase induction motors by the methods of starting and compare their performance and mention typical application areas.

A 230V, 6 pole 50Hz 375 Watt single phase induction motor has the following parameters at standstill

$r_1 = 11.4$ ohm $x_1 = 14.3$ ohm $x_0 = 275$ ohm

$r_2^{'} = 13.8$ ohm $x_2^{'} = 14.3$ ohm ignore R_0

Find the input current, power and power factor when the motor is operating at $s = 0.06$.

(c)   What is 'Hunting' in synchronous machines and what are its effects? Does it occur in synchronous generators only or in synchronous motors also? How is it reduced in salient pole synchronous generators and in turbo alternators? Formulate analytically the dynamics of hunting in case of round rotor synchronous generators and identify when hunting may lead to operational instability.

3.   (a)   Explain the different methods of electrical braking of d.c. motors and compare their advantages and disadvantages.

(b)   Explain the various methods of starting large induction motors with wound rotors and compare their values of starting torques.

(c)   A 3 – phase synchronous generator is excited by d.c field to give rated voltage at its terminals on no load when a sudden short (symmetric) circuit occur at the terminals.

Show the typical plots of the three armature phase and field current and also show the typical plot of the ac component of short circuit current in both actual and semi logarithmic plot identifying different operational conditions.

Draw the approximate equivalent circuits of the synchronous generators for $x_d^{''}$, $x_d^{'}$ and x_d in terms of leakage, demagnetising field and damper winding reactances.

Define direct axis transient open circuit time constant T'_{do}

Section 'B'

4. (a) A 220kV, three-phase transmission line is 40 km long. The resistance per phase is
        0.15Ω per km and the inductance per phase is 1.5923 mH per km. The line is
        supplying a 3-phase load of 381 MVA at 0.8 power factor lagging. Find

    (i)   The voltage and power at the sending end of the line.

    (ii) The voltage regulation and efficiency of the line

    (b)
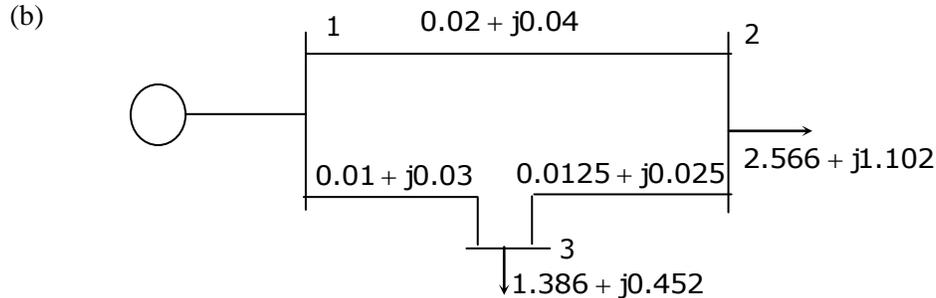
The one-line diagram of a simple three-bus power system with generator at bus 1 is given
above. The line impedances are marked in per unit of 100 MVA base. The voltages obtained
by performing load flow are:

$V_1 = 1.05 \angle 0^o$ pu

$V_2 = 0.98183 \underline{|-3.5035^o}$

$V_3 = 1.00125 \underline{|-2.8624^o}$

Determine:

   (i)   Slack-bus power

    (ii) Complex power flow on line 1-2.

    (c) The bus impedance matrix of a four-bus network with values in per unit is

$$Z_{bus} = j \begin{bmatrix} 0.15 & 0.08 & 0.04 & 0.07 \\ 0.08 & 0.15 & 0.06 & 0.09 \\ 0.04 & 0.06 & 0.13 & 0.05 \\ 0.07 & 0.09 & 0.05 & 0.12 \end{bmatrix}$$

Generators are connected to buses 1 and 2, and their sub-transient reactances were included
when finding Z_{bus}. Find the sub-transient current in the fault for a three-phase fault on bus 4
neglecting prefault current. Assume the voltage at the fault is 1.0 per unit before the fault
occurs. Find also the per-unit current from generator 2 whose subtransient reactance is 0.2 per
unit.

5. (a) A power system has a total load of 1260 MW at 50Hz. The load varies 1.5% for every
        1% change in frequency. Find the steady state frequency deviation when a 60 MW load
        is suddenly tripped. The speed regulation parameter R = 0.0025 Hz per MW.


(b)
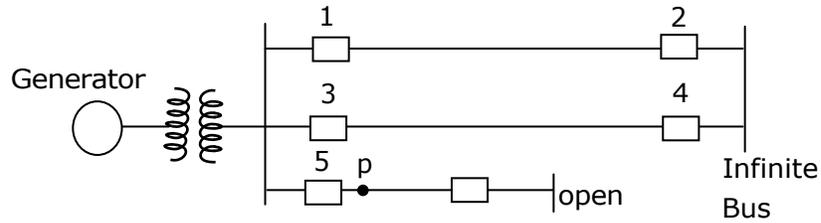
The single-line diagram of a three-phase power system is given above. The generator is delivering 1.0 per unit power to the infinite bus. The pre-fault power angle equation is

$P_e = 2.10\sin\delta$

Calculate the critical clearing angle and critical clearing time when the system is subjected to a 3-phase fault at point P (i.e. sending end of the short line). The fault is cleared by opening the circuit breaker 5. The inertia constant H = 5.0 MJ/MVA.

(c)   What are the types of HVDC transmission system applications?

(d)   Draw a neat circuit diagram of Merz-Price per cent differential protection scheme for a $3-\text{phase}$ $\Delta-Y$ connected transformer.
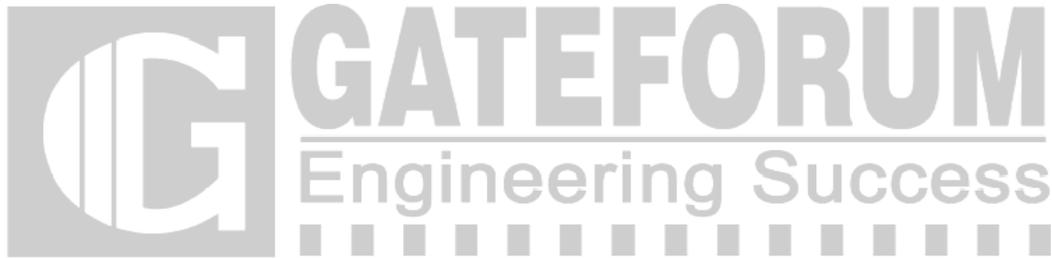
Section 'C'

6. (a) (i)   State four most important characteristics of an ideal Op Amp. Explain with the help of a suitable circuit diagram its use as

    (ii)   A weighted resistor

    (iii) An inverting amplifier

    (iv)   A non-inverting integrator

    (v)   An instrumentation amplifier

    (b) (i)   Why is a synchronous counter faster than a ripple counter?

    (ii)   Draw the circuit of a 4-bit synchronous up-counter using JK flip-flops

    (iii) Explain its operation.

    (c) (i)   Draw the circuit of an inverting Schmitt trigger using an Op Amp.

    (ii)   Draw its voltage transfer characteristic.

    (iii) If the upper and lower threshold voltages are 3V and -2V, respectively.

         and the saturation voltages of the Op Amp $= \pm 10$ V, draw the waveforms of the output voltage when

    (A)   The input is a sinusoidal voltage of peak value 5 V,

    (B)   The sane sinusoidal voltage is applied through a half-wave rectifier.

7. (a) (i)   The squares of data (0 to 9) are stored in 10 consecutive memory locations (e.g. 2600 to 2609) in the tabular form, which is called a look-up table. Values of square are in decimal. Using look-up table, write an assembly level program for 8085 microprocessor to find a square of a given decimal number (0 to 9). Write comments in each of the instruction in the program.

    (ii)   Write two varieties of single instruction (in assembly language) to perform the following individual operations:

         (p)   Clear the accumulator

         (q)   Clear the carry flag

         (r)   Assume that register pair HL has 0010H. Make it 0020 H.

    (b) Write a time efficient subroutine that arranges in increasing order a block of twenty numbers each of single byte. The starting address of the block is stored in the memory location START. Program is to be written in 8085 assembly language. Write comments in selected instructions.

    (c) (i)   In the 8085 microprocessor, a special kind of JUMP instruction is the CALL instruction. How does the CALL/RETURN instruction executed in the microprocessor?

    (ii)   The hardware interrupts can be classified into three types, depending on their maskability and the way they can be masked. Explain all these interrupts.

Section 'D'

8. (a) A radio receiver has three main blocks: R.F Amplifier, Mixer and I.F Amplifier. The noise figure of R.F.A. is 9dB and has the available power gain of 15dB. The mixer stage has a nose figure of 20dB and power gain of 10dB. This is followed by an I.F.A. having the noise figure of 10dB and power gain of 120. Calculate the overall noise figure of the receiver referred to its input.

    (b) Draw the circuit diagram of a balanced modulator using FETs and explain the generation of SSB.

    (c) What is quantizing? What for it is done? Choose an arbitrary waveform and show the quantizing operation. Also indicate the quantizing error on this sketch.

    (d) Draw the block diagrams of FM transmitters using direct the indirect methods of FM generation. Give their brief explanation indicating the advantages of indirect method.

9. (a)
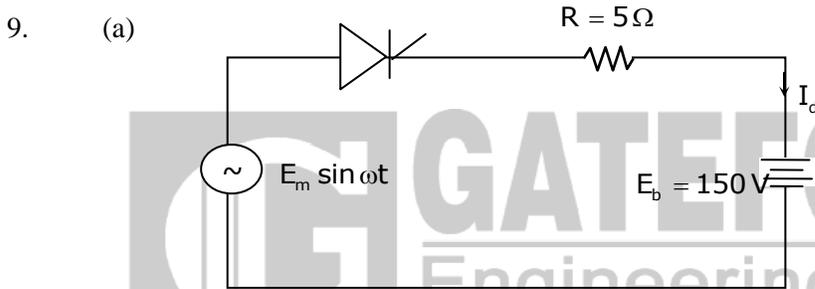
A dc battery is charged through a resistor R as shown in the above figure. Derive an expression for the average value of charging current in terms of E_m, E_b, R. Assume that the SCR is fired in every cycle.

   (i)   For an ac supply voltage of 230V, 50Hz, find the value of average charging current.
   (ii) Find average power supplied to the battery and that dissipated in the resistance.
   (iii) Calculate the power factor at the supply. (Neglect SCR drop)

    (b) A single phase semi converter using two SCRs and two diodes is supplying dc voltage to RLE (Resistance, Inductance, Battery) load. A free wheeling diode is connected across the load. Draw the circuit diagram of the semi converter and show the region of converter operation. Draw waveforms for the input voltage, output voltage, input current and current through the SCRs and diodes. Derive expressions for average output voltage and rms output voltage. (Assume highly inductive load)

    (c) Adding an inductance L in series and a free wheeling diode (FWD) in parallel to the load circuit of an SCR-converter has several advantages. Enumerate the advantages of the load inductance and freewheeling diode.