# Electrical Engineering

## Paper -II

**Time allowed : Three hours** **Maximum Marks: 300**

The figures in the right margin indicate full marks for the questions

**Note** : Attempt total 5 questions. Question nos. **1** and **5** are compulsory. Attempt any other **three,** selecting at least **one** from each Section. Assume suitable data if not provided.

### SECTION-A

1. a. i. Define absolute and relative stability. How the time response and location of roots of a characteristics equation help in prediction of stability.

   ii. Draw the transient response of a second order control system and define following parameters with its reference - rise time, maximum over shoot and settling time. 20

   b. List the registers used in 8085 microprocessor. What is stack? What is the function of stack pointer? Why PC and SP both are 16 bit registers? 20

   c. Explain the difference between high permeability materials and permanent magnet materials. 20

   OR

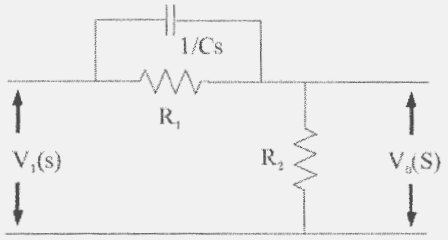
   Find the velocity of an electron in copper with Fermi-level of energy equal to 7 eV. If the relaxation time of electrons is $3 \times 10^{-14}$ seconds, find the mean free path. Assume isotropic scattering.

2 a. Draw the time response of a first order control system subjected to unit step input function. Calculate the steady state error. 20

   b. Explain the Routh's-Hurwitz Criterion of stability analysis and investigate the stability of a unity feedback control system having open-loop transfer function- 20

$$G(s) = \frac{e^{-sT}}{s(s+2)}$$

c. Derive the transfer function block diagram of a phase lead network shown below : 20




3. a. Define and list the addressing modes of microprocessor 8085? Discuss immediate and register addressing modes of Intel 8085 with suitable examples. 20

b. Discuss how to determine the control word for 8255. Make the control word for following port settings in mode 'o': Port A as an input port, Port B as an output port, Port C upper as an input port, Port C lower as an output port. 20

c. Write a program to generate delay using a register pair in microprocessor 8085. Explain with the flow chart. 20

4. a. What is a semiconductor? List some of their important properties. Discuss the effect of temperature on semiconductors with the help of energy band diagram. 20

b. i. List the commonly used photo conductive materials. What for they are used? 20

ii. Which material is popularly used in optoelectronic devices and why? Classify different types of optoelectronics Devices.

c. A magnetic material has a magnetization of 3300 Amp/meter and flux density of 0.0044 $Wb/m^2$. Calculate the magnetizing force and the relative permeability of the material. 20

## SECTION-B

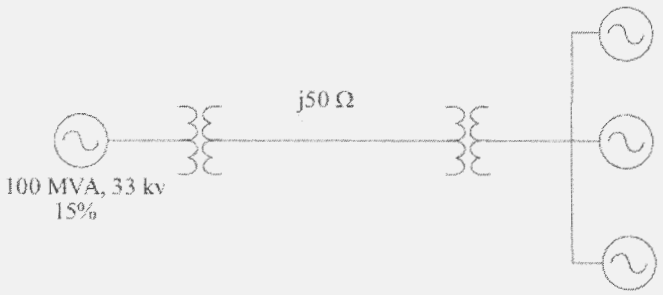
5. a. An ac voltmeter to indicate 100 V rms at full scale is to be constructed using a deflection instrument that has a full scale deflection at 500 μA. The coil resistance of the instrument is 1kΩ and the diodes used in rectifiers have a voltage drop of 0.7 V each. Draw the circuit employing a full wave rectifier and determine the required multiplier resistance. 20

b. Explain the pu system of analysing power system problems. List the advantages over absolute method of analysis. 20

c. i. List the advantages of electrical transducers in measurement of non-electrical quantities. 20

ii. Explain the terms 'Pay back period' and 'Cost benefit' related to energy conservation

6. a. A 100 MVA 33 kV 3-phase generator has a subtransient reactance of 15%. The generator is connected to the motors through a transmission line and transformers. The motors have rated inputs of 30 MVA, 20 MVA and 50 MVA at 30 kV with 20% subtransient reactance. The 3-phase transformers are rated at 110 MVA, 32 kV/110 kV (delta-star) with leakage reactance 8%. The line has a reactance of 50 ohms. Selecting the generator rating as base quantities in the generator circuit, determine the base quantities in other parts of the system and evaluate the corresponding pu value. 20




b. Classify different types of transmission lines. Draw the equivalent circuit and vector diagram for a short transmission line derive the expression for % voltage regulation. 20

c. One conductor of a 3-phase line is open. The current flowing to the delta connected load through line a is 10 A. With the current in line a as reference and assuming that line c is open, find the symmetrical components of the line currents. 20

7. a. How reactive power can be measured in a balanced 3-phase circuit using a single wattmeter? Explain. 20

b. List various methods of measurement of self inductance. Explain Maxwell's Inductance-Capacitance Bridge and list its advantages and disadvantages. 20

c. On a 250 V supply a fault having a resistance of 20 Ω develops between the unearthed end of the winding of electric heater and the frame. The resistance of the substation earth electrode is 4 Ω, that of human body 2000 Ω and the safe maximum current through the body is 25 mA. What is the safe maximum resistance of consumer's earth electrode? 20

8. a. In a satellite communication link the uplink carrier to noise ratio $(C/N)_u$ is 20 dB where as the downlink carrier to noise ratio $(C/N)_D$ is 25 dB. Find the link carrier to Noise ratio. 20

b. Explain analog FM/FDM television transmission through satellite. Write down the expression for S/N ratio calculation for satellite TV links. 20

c. i. What is the basic difference between uniform and non uniform quantization? 20

ii. Explain the operation and sketch the receiver of a differential PCM.

# Electrical Engineering

## Paper -I

**Time allowed : Three hours** **Maximum Marks: 300**

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**Note** : Attempt total 5 questions. Question no **1** and **5** are compulsory. Attempt any other **three,** selecting at least **one** from each Section. Assume suitable data if not provided.

### SECTION-A

1. a. Answer Why (any *four) ?*

   (i) Low voltage winding is placed near the core in transformers? 20

   (ii) Transformer rating is expressed in VA or kVA?

   (iii) Magnetising current of induction motor is much higher than transformer?

   (iv) Short circuit test in a transformer is performed on HV side?

   (v) A 3-phase induction motor operates at very low power factor at no load?

   b. Draw and explain the power distribution in a 3-phase induction motor with the help of equivalent circuit. 20

   c. The open circuit and short circuit test result of a 200 kVA, 11 kV/400V, delta-star distribution transformer are as follows - 20

   O.C. Test-400 V, 9 A, 1.5 kW

   S.C. Test - 350 V, rated current, 2.1 kW

   Calculate the equivalent circuit parameters referred to h.v. side and its efficiency at half-full load of unity power factor.

2 a. Derive an expression for the emf induced in a transformer winding. Show that emf per turn in primary is equal to the emf per turn in secondary. 20

   b. Classify and list various methods of speed control of an induction motor. Explain and compare star-delta and auto-transformer stater. 20

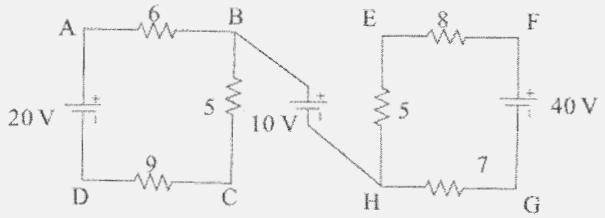
   c. An industrial unit has a total load of 1800 kW at a p.f. of 0.6 lagging. If is desired to improve the p.f. to 0.9 lagging with the installation of a synchronous condenser, then calculate- 20

   a. The kVA rating of the synchronous condenser, and

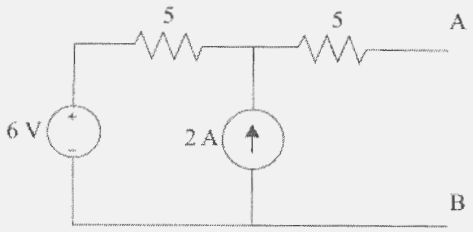
   b. Total kVA of the unit.

3. a. Compare the working of an induction motor with a synchronous motor (preferably in tabular form 20

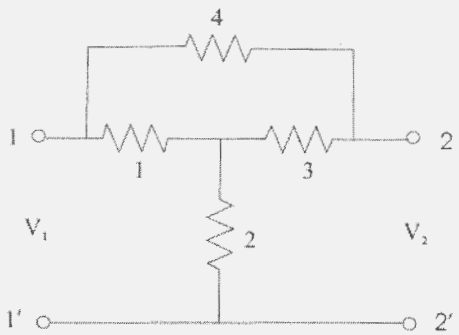
b. For the circuit shown below find $V_{CE}$ and $V_{AG}$. 20




c. Find the Thevenin and Norton equivalent circuits for the active network shown below: 20

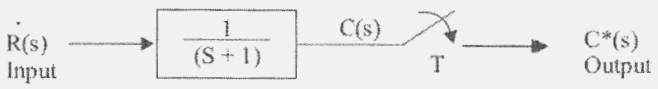



4. a. Determine the open circuit and short circuit impedances of the network shown below: 20




b. A 3-phase source is feeding a delta connected balanced load. Establish the phase relation ship of phase and line quantities (both voltages and currents) using phase sequence RYB. 20

c. Determine the z-transform of the output for the sampled-data system shown below, considering unit step input function. 20



## SECTION-B

5. a. Answer briefly (any four) 20

i. Two discrete diodes connected back to back can not be used as a transistor. Why?

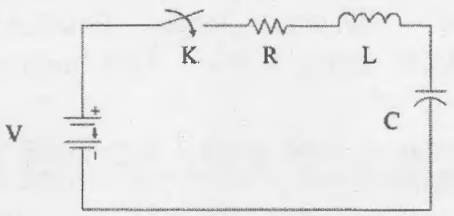
ii. Which configuration of transistor is preferred for voltage matching and why?

iii. The base of a transistor is lightly doped and very thin, why?

iv. CE configuration is widely used in all the transistor applications. Why?

v. Input impedance of FET is more than BJT. Why?

b. In the given network V =10 V, R =10 ohms, L = 1 H and C = 10 uF and $v_c(0)= 0$. Find i(0+), di/dt(0+), and $d^2i/dt^2(0+)$. 20




c. i. Find the minimized form of the logical expression 20

$$(\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}BC + AB\bar{C})$$

ii. Realise the Boolean function Y = AB + CD using maximum three 2-input NAND gates.

6 a. Write the requirements of the transistor biasing circuit. Explain base register biasing of a BJT and write its advantages and disadvantages. 20

b. Differentiate natural and forced commutation with an example. 20

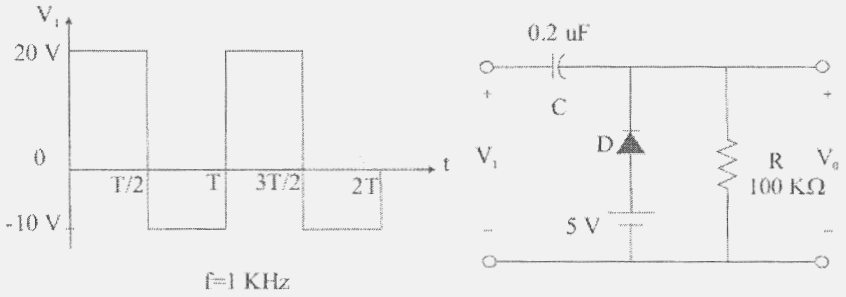
c. A thyristor is connected in series with an L-C series circuit and a source voltage of 200 V. If the thyristor is switched on at t =0, determine the conduction time of the thyristor and capacitor voltage after it is switched off. 20

The circuit parameters are L = 10 μH and C = 50 μF. The inductor carries an initial current of 250 mA.

7 a. Draw the schematic diagram of half-bridge and full-bridge dc-ac inverter, list their comparative advantages and disadvantages. Draw the output voltage and current waveform for (i) RL load, and (ii) Purely inductive load for half-bridge inverter. What is the conduction angle in each case? 20

b. List the advantages and disadvantages of FET. Explain the working principle of FET as an amplifier. 20

c. Determine the output voltage for the clamper circuit shown below. Determine the time constant and check whether this circuit will satisfy the condition of effective clamping or not. Identify the circuit as positive/ negative clamper. 20




8. a. Simplify the four variable logic function f(A, B, C, D) = Σ(0,1,2,4,5,6,8,9,12,13,14) using K-map. Also implement the simplified expression with AND-OR logic. 20

b. State Maxwell's equations in their general differential form and derive their form for harmonically varying fields. 20

c. Find the velocity of a plane wave in a loss-less medium having a relative permittivity of 5 and relative permeability of unity. 20