SUBJECT: ELECTRONICS/TELECOMMUNICATION ENGINEERING: PAPER –I
SET-A

Time: 3 hours | Full Marks: 200

Note: Answer Question No. 1 and any four from the rest. All questions carry equal marks.

Q1. Answer any ten (10) 10 x 4 = 40

(a) What is reverse saturation current in reference to a p-n junction diode?
(b) What are intrinsic and extrinsic semiconductors?
(c) What is depletion region in p-n junction?
(d) If vector $\vec{A} = 5\hat{a}_x + 6\hat{a}_y + 3\hat{a}_z$ and vector $\vec{B} = \hat{a}_x + 4\hat{a}_y$, Find a unit vector along $\vec{A} + 2\vec{B}$
(e) State maximum power transfer theorem.
(f) Define Poynting vector.
(g) What are the active and passive type instruments?
(h) A series RLC circuit with R=3KΩ, L=10H, C=200μF, has a constant voltage source, V=50V, applied at time t=0. Obtain the transient current if the capacitor has no initial charge.
(i) Define dipole and dipole moment.
(j) What are variables? How variables are declared in C language?
(k) Define the terms: span and tolerance used in instrumentation.
(l) Whit is the physical definition of curl of a vector field?
(m) Find the divergence of the vector $\vec{A} = yz\hat{a}_x + 4xy\hat{a}_y + y\hat{a}_z$ at (1, -2, 3)

Q2. Answer any eight (8) 8 x 5 = 40

(a) The reverse saturation current at 300K of a p-n junction Ge diode is 5 μA. Find the voltage to be applied across the junction to obtain a forward current of 50mA.
(b) How avalanche breakdown occurs in p-n junction diode?
(c) What is a rectifier circuit? How full wave rectification can be achieved?
(d) Define a two port network. Calculate the equivalent z-parameters of two series connected two-port networks in terms of the individual z-parameters of each network.
(e) State and explain the laws of thermocouple.
(f) What is an isolation amplifier?
(g) Find the average and *rms* value of a half wave rectified signal.
(h) Findform factor and crest factor of a voltage signal $v=200\ sin314t$:
(i) A strain gauge is bound to a short column which is then loaded in compression. The resistance of the strain gauge is 240 Ω before loading and 230 Ω while load is

applied. The Gauge Factor of the strain gauge is 2.15. The column has a cross section of 20 mm x 15 mm. Young's Modulus of the material is 70 GNm^{-2}. Determine the load carried by the column.

(j) Explain the construction and working principle of linear variable differential transducer.

Q3. Answer any five (5) 5 x 8 = 40

(a) Explain the *Volt-Ampere (V-I)* characteristics of a p-n junction in forward and reverse bias condition.

(b) Distinguish between clipping and clamping circuits.

(c) What is an instrumentation amplifier?

(d) The voltage applied to a circuit is $e = 100\,sin(\omega t + 30^o)V$ and the current flowing in the circuit is $i = 15\,sin(\omega t + 60^o)\,A$. Determine impedance, resistance, reactance and power factor of the circuit.

(e) What are frequency division and time division multiplexing?

(f) Calculate the voltage drop across and current through the load resistance (R_L) for the circuit shown in figure 1. The Silicon p-n junction diode has a cut-in voltage of 0.7V.

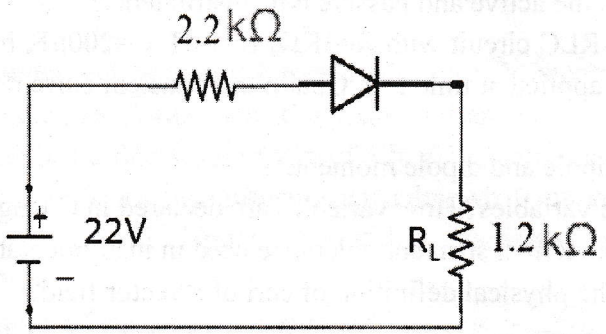

Figure 1

(g) State Norton's theorem. Write the steps used to Nortonize a circuit.

Q4. Answer any four (4) 4 x 10 =40

(a) Draw potential energy band diagram of an unbiased p-n junction diode. What changes will occur in the band diagram when it is positively and negatively biased?

(b) What is ripple factor? Explain how the ripples in a full wave rectified signal can be minimized using capacitive filters?

(c) Show that a source free series RLC circuit in under-damped condition produces oscillatory natural response.

(d) Write the four Maxwell's equations and give their physical interpretation.

(e) Design an algorithm and the corresponding flowchart for adding the test scores as given below:
26, 49, 98, 87, 62, 75

Q5. Answer any two (2) 2 x 20 = 40

(a) A half wave rectifier uses a diode with a forward resistance of 50Ω. If the input ac voltage is 20 V (rms) and the load resistance is 1.2 kΩ, determine the (i) dc load current (ii) ac load current (iii) peak inverse voltage (iv) load output voltage (v) dc output power and (vi) conversion efficiency.

(b) (i) Determine the equivalent resistance between terminal A and B in the circuit shown in figure 2. Also determine the potential drop across 2Ω resistor in the network.
(ii) State Thevenin's theorem. Obtain the Thevenin equivalent circuit for the network shown in figure 3.

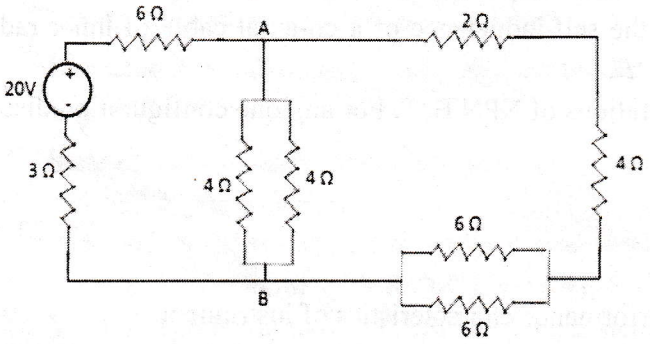

Figure 2

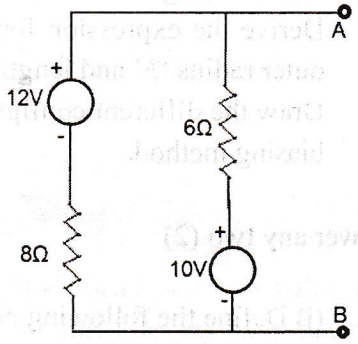

Figure 3

(c) Find the equivalent value of the input resistance of the circuit shown in figure 4 using star-delta conversion method.

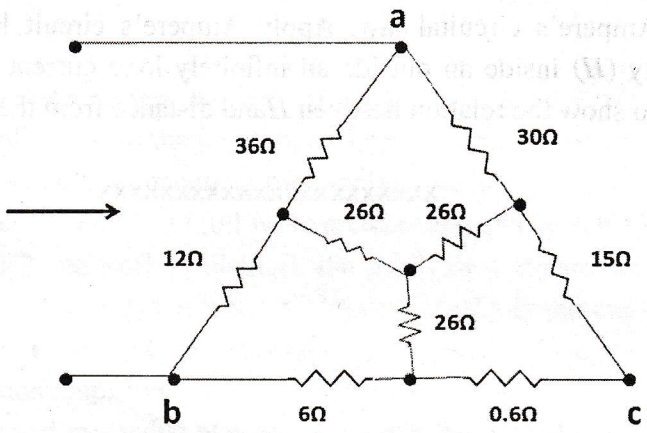

Figure 4

Q6. Answer any four (4) 4 x 10 = 40

(a) Define an algorithm. State the benefits of using and algorithm.

(b) What are the basic symbols used in a flow chart and what are their functions?

(c) State Bio Savart's law. Find the magnitude and direction of magnetic field intensity (***H***) at point (-4,4,0) due to a semi-infinite current filament carrying a current of 3A.

(d) Given the magnetic vector potential $\boldsymbol{A} = -\frac{\rho^2}{4} a_z$ wb/m, calculate the total magnetic flux crossing the surface $\phi = \pi/2$, $1 \leq \rho < 2$ m and $0 \leq z < 5$ m.

(e) Derive the expression for the self-inductance of a co-axial cable of inner radius '*a*', outer radius '*b*' and length '*l*'.

(f) Draw the different configurations of NPN BJT. For any one configuration discuss one biasing method.

Q7. Answer any two (2) 2 x 20 =40

(a)

(i) Define the following performance characteristics of instrument:
accuracy, precision, resolution, sensitivity, and hysteresis.

(ii) A thermocouple has a linear sensitivity of 30μV/°C, calibrated at a cold junction temperature of 0°C. It is used to measure an unknown temperature with the cold junction temperature of 30°C. Find the actual hot junction temperature if the emf generated is 3.0mV.

(b) Explain the operation of successive approximation type analog to digital converter. Define the conversion time and quantization error of an analog to digital converter (ADC).

(c) State Ampere's circuital law. Apply Ampere's circuit law to find magnetic field intensity (***H***) inside an outside an infinitely long current carrying conductor. Plot a graph to show the relation between ***H***and distance from the center of the conductor.

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