

ELECTRONICS AND TELECOMMUNICATION ENGINEERING**PAPER - I**

Time allowed: 3 hours

Maximum Marks : 200

*Candidates should attempt question No. 1 which is compulsory
and any four of the remaining questions*

1. (a) Discuss/Reason-out any five of the following:
- (i) Reasons for development from Fourier-series to Fourier- Transform to Laplace-Transform.
 - (ii) Various waveform symmetry affecting the Fourier-coefficients a_n , a_n , and b_n .
 - (iii) Necessity of shading a part of an A.C. Electromagnet in Induction Instruments. What is the direction of force or torque (i.e. from shaded pole to non-shaded pole or vice versa)?
 - (iv) In the simplest form, a mechanical Accelerometer consists of a SPRING-MASS-DASHPOT mechanism in a frame attached to a moving vehicle. Prove that the steady-state displacement of mass w.r.t. frame is a measure of constant acceleration of the frame,
 - (v) A Digital voltmeter can measure a maximum of 20 volts and employs a six-bit Analogue to Digital converter. What voltage change does each LSB represent? What voltage does [100 10] represents?
 - (vi) Synthesize the electrical LAG-LEAD network having the following transfer function:

$$G(s) = \left[\frac{s + 1/\tau_1}{s + 1/\beta\tau_1} \right] \left[\frac{s + 1/\tau_2}{s + 1/\alpha\tau_2} \right]$$

where $\beta > 1$ and $\alpha < 1$.

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- (b) Explain/Elaborate any five of the following:
- (i) Trajectory of a charged particle, shot into a uniform electric field, with initial velocity U perpendicular to electric intensity E .
 - (ii) One capacitor of 2 microfarad charged to 10 volts and, the other of 001 microfarad charged to 200 volts are parallel with similar polarity. What will be steady-state voltage across the combination?
 - (iii) Skin effect in solid round conductors: How does the conductor resistance and internal inductance change at high frequencies ? What is the remedy?
 - (iv) A simple Battery and Galvanometer method to determine polarity marks on a mutual inductance.
 - (v) In a permanent Magnet Moving Coil Galvanometer the coil former can be either of conducting or non-conducting material. Does it affect steady-state or dynamic performance or both?
 - (vi) By laminating a magnetic core, which is subjected to flux reversals, attempt is made to reduce eddy current losses or hysteresis losses or both. Explain.

2. The silicon transistor as connected in figure below has a minimum value of h_{FE} of 30.

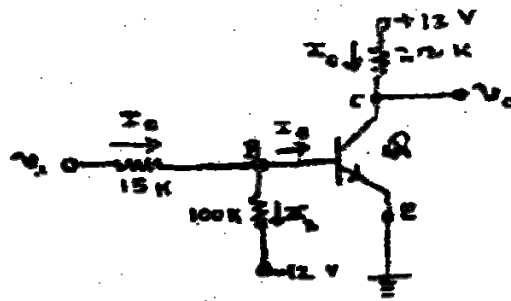


Fig. Q. 2

- (a) If input voltage $v_i = 12$ volts, show that the transistor is in Saturation.
 - (b) If input voltage $v_i = 0.4$ volt, show that the transistor is in cut-off.
 - (c) For the case (b) find the maximum temperature at which the transistor remain just cut-off. Assume I_{CBO} of 10 nano-amperes at 25 degrees Centigrade and doubles for every 10 degree Centigrade rise in temperature.

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- (a) A number of solid state devices display, in Terms of V-I characteristics, a negative incremental resistance. State the devices and draw the characteristics.

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 - (b) A transistor used in ON/OFF or switching mode drives a highly inductive attracted armature type electromagnetic relay connected in its collector circuit. Show where do you connect a free-wheel inc hole and elaborate its purpose.

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 - (c) Two waveforms are to be seen simultaneously on an oscilloscope. We may use either
 - (i) a double-beam oscilloscope, or
 - (ii) a single-beam oscilloscope in SWITCHED MODE,

OR

 - (iii) a single-beam oscilloscope in ALTERNATE MODE By suitable illustration of time-bases, explain the difference and limitations of each type.

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4. (a) A potential difference given by

$$v_0(t) = V_m \sin \omega t$$

is applied between the terminals of a LONG LOSS-LESS transmission line, the frequency “f” of the applied voltage being 3×10^8 cycles/sec. Write an equation for the voltage at a point P which is 1.5 wavelengths down the line from the voltage source.

(b) Two equal charges, q, of opposite sign, separated by a distance ‘a’ constitute an electric dipole. Derive an expression for the electric potential “V” at any point in space due to this dipole, assuming that the point is not too close to the dipole. Sketch appropriate equipotential lines.

- (c) Consider spherical symmetric distribution of charge of radius R, The charge density “ρ” in coul/metre cube be assumed to remain constant from the centre to the radius R in any direction.

Write down the Gauss’s Law and derive an expression for electric field E for points.

- (i) outside the charge distribution
(ii) inside the charge distribution

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5. (a) Define what you mean by DOT or POLARITY marks on two mutually coupled circuits. Draw two coils, with any sense of direction, on a common magnetic core and put down the polarity marks.

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- (b) Two mutually coupled coils are connected in series. Show that the equivalent inductance of the series combination tends to increase or decrease depending upon the polarity or dot marks.

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- (c) Write down the MESH equations for the following network :



Fig. Q. 5(c)

6. (a) The Fourier theorem states that a periodic function satisfying certain conditions can be represented by an infinite series of sinusoids of harmonically related frequencies. Write down the series in

- (i) conventional form, and
(ii) combined form

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- (b) Prove, analytically, that the Fourier coefficient a_n is given by equation

$$a_n = \frac{1}{\pi} \int_0^{2\pi} f(\theta) \cos(n\theta) . d\theta$$

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- (c) Find the peak value of fundamental for the following. periodic triangular waveform:

$$f(\theta) = \frac{8}{\pi} . \theta \quad 0 \leq \theta \leq \frac{\pi}{2}$$

$$f(\theta) = 8 - \frac{8}{\pi} . \theta \quad \frac{\pi}{2} \leq \theta \leq \frac{3\pi}{2}$$

$$f(\theta) = -16 + \frac{8}{\pi} . \theta \quad \frac{3\pi}{2} \leq \theta \leq 2\pi$$

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7. (a) Limiting Errors:

A resistance having a name plate resistance of 100 ohms carries a current of 4 amperes as read by an ammeter. The power dissipated comes out to be $I^2R = 1600$ watts. The guaranteed maximum errors for the resistance and ammeter are $\pm 0.2\%$ and $\pm 0.5\%$ respectively. Find the possible error in the indicated, power of 1600 watts.

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(b) Wheatstone Bridge:

There are upper and lower limits to unknown resistance that can be measured by the conventional Wheatstone Bridge. Explain the reasons.

(c) Current and Potential Transformers:

It is said that in a potential transformer (P.T.), the magnetic flux substantially remains constant irrespective of burden (load) whereas.

In a current transformer (C.T.) the magnetic flux increases as the burden is increased.

Explain why this difference. Neglect primary and secondary series resistance/leakage reactance.

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ELECTRONICS AND TELECOMMUNICATION ENGINEERING

PAPER - II

Candidates should attempt five questions, choosing not more than three questions from each Section.

SECTION A

1. (a) Why is thermal stabilization needed in transistor circuits ? Determine the values of the resistors in Figure 1 such that $I_c = 5 \text{ mA}$, $V_{ce} = 8\text{V}$, $V_e = 6\text{V}$ and $S = 10$ $h_{fe} = 20$ and $V_{ec} = 20\text{V}$.

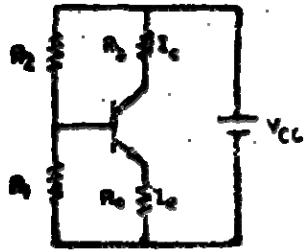


Fig. 1

- (b) What do the following mean :

(i) derating

(ii) fT.

List the factors controlling the high frequency and high power performance of transistors.

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- (c) Why is common base configuration sometimes preferred?

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2. (a) What are current controlled and voltage controlled negative resistances? Explain how such circuits may be used in bistable circuits.

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- (b) Explain the action of a transistor voltage regulator. How can its current range be increased?

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- (c) How do you express the sensitivity of a feedback network to changes in any one of its parameters ? Find the sensitivity of the voltage amplification to changes in the network given in Figure



Fig. 2

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3. (a) Discuss the relationship between ergodic process stationary process, time averages and ensemble averages. Obtain the relationship between them.

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- (b) Derive the Fourier transform of a unit step function. What is the effect of time shifting the waveform.

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- (c) With a diagram explain the principle of delta modulation. How are signals demodulated?

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4. (a) Compare the advantages of the closed loop control system. Find $C(S)/R(S)$ for the system given in Figure 3 below:

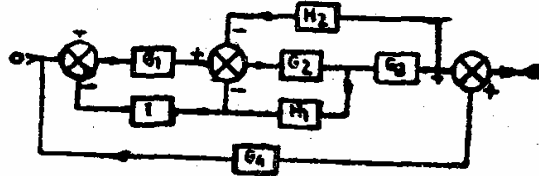


Fig. 3

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- (b) Draw the Bode Plot of

$$G(S) = \frac{64(S+2)}{S(S+0.5)(S^2+32S+64)}$$

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- (c) What are the methods of improving the stability of control system?

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5. (a) Design a lighting circuit such that the lights may be switched on or off from any one of the four switch points.

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- (b) Design a parallel counter using, only JK flip-flops, AND gates and or gates which counts in the sequence 000, 111, 101, 110, 001, 010, 000, ...

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SECTION B

6. (a) What are the advantages of PCM? How is it implemented ?
 (b) Show that the channel capacity of a noisy channel is $C = B \log_2(1 + S/N)$ where B is the bandwidth and (S/N) is the signal to noise ratio.

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- (c) Compare FSK and PSK.

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- (d) Compute the noise performance of an SSB suppressed carrier System.

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7. (a) Describe the factors which control the design of an LOS link.
 (b) What are noise temperature and equivalent noise? A resistor of value R ohms is connected across a capacitance C. What is the RMS value of the noise voltage -across the circuit?

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- (c) A radar transmitter has a maximum average peak power capability and average power capability of 10 megawatts and 5 kilowatts respectively. If P_r is 300 Hz what is the range resolution ?

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8. (a) A rectangular waveguide is propagating in the TE_{11} mode. Draw its field pattern. How do you extract energy from a wave propagating in this mode of propagation? What is the power passing through a rectangular waveguide propagating in the TE_{10} mode when the maximum of the signal strength is 100 mV/m? The dimensions of the waveguide are $3 \text{ cm} \times 1.5 \text{ cm}$ and the frequency is 10 GHz.

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- (b) A double resonator Rlystron is to give maximum power output at the fundamental frequency of 6 GHz. The accelerating voltage is 1000 V and the signal input amplitude is 3V Assuming that the beam-coupling coefficient is unity, what is the length of the drift space ?

9. (a) With suitable diagrams explain how the following are eliminated in a telephone:

- (i) side tone
- (ii) cross talk

Describe any type of transmission bridge used in telephone.

- (b) Describe the bridge duplex telegraphy. What are the causes of telegraph distortion ?

- (c) What do you understand by the following ?

- (i) additive primaries (ii) complementary primaries.

Why suppressed sub-carrier modulation is used in colour TV ? How is frequency and phase synchronisation ensured?

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10. Write notes on any four of the following:

- (a) Duplexes in radar ; (b) Sampling theorem ; (c) Gunn devices (d) Block coding (e) Fresnel zone ; (f) Tropospheric effects at microwave frequencies; (g) Facsimile ; (h) Decca navigation system.