Himachal Pradesh Administrative Service Combined Competitive (Main / Written) Examination, 2020

ELECTRICAL ENGINEERING (PAPER-II)

Time allowed: Three Hours Maximum Marks: 100

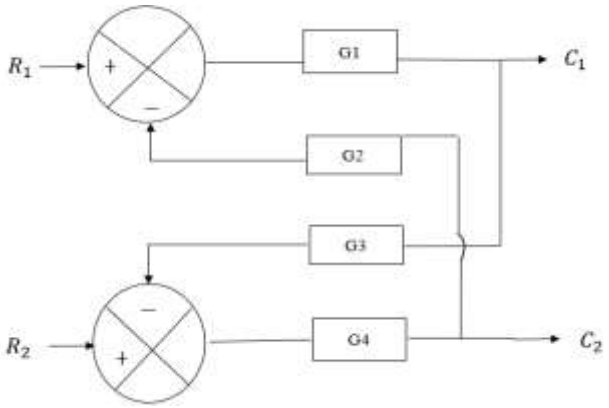
QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
2. Candidate has to attempt FIVE questions in all.
3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted choosing *at least one from each part.*
4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
5. Write answers in legible handwriting.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
9. Re-evaluation / Re-checking of answer book of the candidate is not allowed.

Part A

1. (a) Find the output c_1 and c_2 for the control system given in figure below:



(10)

(b) The characteristic equation of the feedback control system is:

$$s^4 + 20s^3 + 15s^2 + 2s + K = 0$$

(i) Determine the range of K for the system to be stable.

(ii) Can the system be marginally stable? if so find the required value of K and the frequency of sustained oscillations.

(10)

2. (a) A system is described by the following state variables equations:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}-1 & 1\\ 0 & -2\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}1\\ -1\end{bmatrix}u(t)$$

Where *u(t)* is the unit step input and output

$$y(t) = \begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}$$

Determine *y(t), t ≥ 0* when the initial values of the states at time t = 0 are $x_1(0) = x_2(0) = 1$.

(10)

(b) Describe the phenomenon of superconductivity. Draw the curve which shows the variation of electrical resistance versus temperature and also define transition temperature. Write its few applications.

(10)

Part B

3. (a) By drawing a suitable waveform, explain a typical instruction cycle of an 8085 microprocessor.

(10)

(b) An energy meter is designed to have 80 revolutions of the disc per unit of energy consumed. Calculate the number of revolutions made by the disc when measuring the energy consumed by the load carrying 30A at 230V and 0.6 power factor. Find the percentage error if the meter actually makes 330 revolutions. Also specify whether the meter runs slower or faster.

(10)

4. (a) Write various steps followed in IC fabrication technology and also explain them.

(10)

(b) Draw a neat diagram of De Sauty bridge for the measurement of capacitance and derive an expression for the unknown capacitance. What are the demerits of this ac bridge? (10)

Part C

5. (a) A 3-phase, 11 kV transmission line delivers a load of 2395 kVA at 0.8 p.f. (lag) over a distance of 25 km. The transmission line has an impedance per phase of (3.25+j7.55) ohms. Determine the sending-end voltage and sending-end power factor.

(10)

(b) Each line of 3-phase system is suspended by a string of three similar insulators. The string insulator has a self-capacitance of C farads. The shunting capacitance of the connecting metal work of each insulator is 0.2 C to earth. Calculate the voltage across each insulator as a percentage of the line voltage to earth and also string efficiency.

(10)

6. (a) State various types of stability in power system. Explain "Equal Area Criterion" with example to determine transient stability of power system

(10)

(b) Write in short different types of non-conventional energy sources and explain various difficulties associated with conventional energy sources in the context of present global scenario.

(10)

Part D

7. (a) What are different kinds of optical fibers? Discuss various kinds of dispersions produced when light propagates through optical fiber.

(10)

(b) Explain the principle of FMCW radar and differentiate with CW radars? Principle of measurement in reference of maximum range and range resolution.

(10)

8. (a) For a QPSK system with the given parameters

$C = 10^{-12}$ W $f_b = 60$ kbps $N = 1.2\text{x } 10^{-14}$ W $B = 120$ kHz

Determine

(i) Carrier power in dBm

(ii) Noise power in dBm

(iii) Noise power density in dBm

(iv) Energy per bit in dBJ

(10)

(b) Explain various digital modulation techniques.

(10)

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