

ELECTRICAL ENGINEERING (Paper II)

Time Allowed : Three Hours

Maximum Marks : 300

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.

Candidate has to attempt FIVE questions in all.

Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.

The number of marks carried by a question/part is indicated against it.

Wherever any assumptions are made for answering a question, they must be clearly indicated.

Word limit in questions, wherever specified, should be adhered to.

SECTION 'A'

1. Select any THREE of the following statements, read them carefully and identify the correct and the incorrect ones. Justify your answer using not more than 200 words in each case:-

20×3=60

- (a) At any point on the root locus with angle condition satisfied, the value of K-variable parameter (for this point to be a root) is obtained as

$$K = (\text{product of lengths of vectors from poles}) / (\text{product of lengths of vectors from zero})$$

- (b) Bridges are used to measure inductance of coils having different values of Q and capacitances are used therein to obtain the balance.

- (c) Is voltage control necessary in power systems? Various current control methods are used. Permissible voltage variations are known. Any advantage of current control?

- (d) Digital transmission has more advantages than disadvantages as compared to analog transmission.

2. (a) What do you understand by lead compensator? Draw the approximate Bode plot for a typical lead compensator. Design a suitable control system for a missile to introduce a lead of 35° and gain of 6.5 db at 2.8 rad/s. What will be the transfer function of this lead compensator that will satisfy the above requirement?

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- (b) A 25 MVA, 11 kV generator with $X''_d = 20\%$ is connected through a transformer, line and a transformer to a bus that supplies three identical motors as shown in fig. below. Each motor has $X''_d = 25\%$ and $X'_d = 30\%$ on a base of 5 MVA, 6.6 kV. The three-phase rating of the step-up transformer is 25 MVA, 11/66 kV with a leakage reactance of 10% and that of the step-down transformer is 25 MVA, 66/6.6 kV with a leakage reactance of 10%. The bus voltage at the motor is 6.6 kV when a three-phase fault occurs at the point F. For the specific fault, calculate: (a) the subtransient current in the fault (b) the subtransient current in the breaker B (c) the momentary current in breaker B. Given: Reactance of the transmission line [value illegible under the watermark] [?] on a base of 25 MVA, 66 kV. Assume that the system is operating on no load when the fault occurs.

[Figure: Single-line diagram: generator (Gen) – bus – breaker A – step-up transformer 11/66 kV – point Q on the 66 kV line – step-down transformer 66/6.6 kV – breaker – 6.6 kV motor bus (point P marked on the bus); three motors each connected to the bus through its own breaker; the lowest motor feeder has breaker B next to the bus and fault point F between breaker B and that motor.]

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- (c) What is wave energy? Explain the difficulties facing wave-power development. Give a list of devices developed for converting wave energy into electrical energy and fully describe one of these.

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3. (a) Describe the various steps involved in the fabrication of a monolithic circuit shown below:
[Figure: Terminal 1 connected to node X; a resistor from node X up to terminal 2; node X also connected to the base of an NPN transistor whose collector goes to terminal 3 and whose emitter (arrow outwards) goes to terminal 4.] 20
- (b) Draw a block diagram of Remote Terminal Unit (RTU), having different components/subsystems, communication bus etc. Write the functions it generally carries out. Briefly explain the distributed control system. Bring out the features of Data Highway. 20
- (c) State and explain the basic requirements (i.e. essential qualities) of protective relaying. 20
4. (a) Justify that the stack and subroutine offer a great deal of flexibility in writing programs. Point out the differences between stack pointer and program counter, PUSH and POP, CALL and RET. Give examples for each. Write a program to add two numbers which generate the carry over, store the carry over in memory locations XX50 and XX60 in 8085 microprocessor. 20
- (b) A CW radar operates at a frequency of 10 GHz. What is the doppler frequency produced by (i) an aeroplane flying at a speed of 250 kms per hour (ii) a man crawling at a speed of 2.5 cms per second? 20
- (c) The guided missile tracking radar operates at 5 GHz and a 1.0 MW peak power output. If the antenna diameter is 4 meters, the receiver band-width 1.6 MHz and the receiver has a 10 dB noise figure, what is its maximum detection range for 1 m² targets? 20

SECTION 'B'

5. Select any THREE of the following statements, read them carefully and identify the correct and the incorrect ones. Justify your answer using not more than 200 words in each case:-
20×3=60
- (a) Latch is used at input and tristate is used for output purposes in the microprocessor based system.
- (b) Capacitors in integrated circuits are obtained by using the transition capacitance of a reverse-biased pn junction.
- (c) An HVAC circuit breaker of a given voltage, current and MVA rating can be used as an HVDC circuit breaker of the same voltage, current and MVA rating.
- (d) Do we have a system which makes a fuller utilization of the transmission capacity of an optical fibre and needs multiplexing?
6. (a) (i) Explain the construction of single-phase induction-type energymeter. (ii) A 230 V single phase watt hour meter has a constant load of 4 A passing through it for 6 hours at unity p.f. If the meter disc makes 2208 revolutions during this period, what is the meter constant in revolutions per kWh? Calculate the power factor of the load if the number of revolutions made by the meter are 1472 when operating at 230 V, and 5 A for 4 hours. 20
- (b) How is digital data converted into analog signals for telephone lines? Compare them with respect to (i) Waveforms (ii) Bit rate (iii) Baud rate. 20
- (c) State Kepler's three laws of planetary motion. Illustrate in each case their relevance to artificial satellites orbiting the earth. 20
7. (a) Describe the band structure of an open-circuited P-N junction. 20
- (b) How I, Q and Y signals are generated in a colour TV transmitter? Explain with tube and matrix arrangement. 20
- (c) What is meant by carrier to noise ratio? How is it related to SNR? An FM system has modulation index of 10. Given that C/N is 25 dB, calculate the receiver processing gain and the S/N. 20

8. (a) Write the discrete forms of P, PI and PID controllers. What are various methods of tuning them? Discuss in brief. **20**
- (b) Explain briefly the techno-economic advantages and disadvantages of HVDC transmission system. **20**
- (c) Explain on-line real-time computer system for protection of a line. Draw a sample fault program flow diagram. **20**