CC/M/EXAM.
2020

ELECTRICAL ENGINEERING

PAPER—II

Time : 3 hours] [Full Marks : 250

Note : 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.

SECTION—A

1. Answer *any* **five** of the following questions : 10×5=50

(a) Define and explain the condition for a system to be stable with due reference to zeroes and poles of a system.

(b) Derive the expression for gain of a feedback system in terms of forward gain and feedback gain.

(c) Explain how flag bits of a microprocessor 8085 are set/reset.

(d) Explain the basic differences between Microprocessor and Microcontroller.

(e) Describe the theory and working of an LVDT.

(f) Explain how frequency and phase can be measured using a CRO.

(g) Explain the function of SP (Stack Pointer), when a microprocessor 8085 executes PUSH and POP instructions.

2. Answer the following questions :

(a) The mechanical system is (shown in Fig-1) initially at rest. If a force is applied at $t=0$, determine the transfer function of the system $G(s)$, where M, K and μ are the mass, spring constant and coefficient of friction respectively. 20

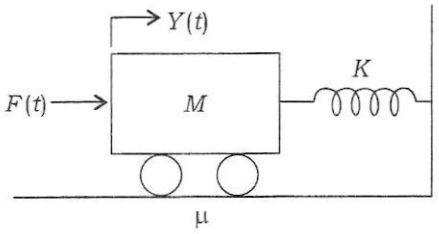

Fig-1

(b) Draw the Nyquist plot for unity feedback control system, with open loop transfer function given below. Also determine the stability of the closed loop system :

$$G(s) = \frac{K(1-s)}{(s+1)}$$ 15

(c) Examine the observability of the system. Convert the state model into observable phase variable form.

$$\dot{X} = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} - \begin{bmatrix} 11 \\ 1 \\ -14 \end{bmatrix} v \text{ and } y = [-3 \quad 5 \quad -2] \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix}$$ 15

3. Answer the following questions :

(a) Provide functional block diagram of PPI 8255. Interface a PPI 8255 to a microprocessor 8085 as IO device with address space 80 H–83 H. Develop program in assembly language to configure Port–A as output Port and Port–B as input port in mode-0 and set Port–A as FFH if PB0=1, otherwise set Port–A as 00 H. 20

(b) Provide functional block diagram of PPI 8253. Interface to a PPI 8253 to microprocessor 8085 as IO device having address space 10 H–13 H. Develop program in assembly language to set counter-in mode-1 with initial count F366 H. 15

(c) Interface an 8 K ROM and two 4 K RAM to a microprocessor as memory mapped IO devices with address spaces for the devices as given below :

8 K ROM–address space–0000–1 FFFH
4 K RAM (1)–address space–8000–8 FFFH
4 K RAM (2)–address space–A000–AFFFH

Use necessary address decoder to ensure that each memory device will have unique address space given above. 15

4. Answer the following questions :

(a) Draw and explain the use of different components used in Schering Bridge. Provide detailed analysis for measurement of capacitance using Schering Bridge. 20

(b) Readings of two wattmeters used for measurement of three-phase power of a three-phase balance and three-phase circuit are 150 W and –30 W respectively. Determine the line current and power factor of the load if line to line voltage is 440 V. 15

(c) A metallic strain gauge has resistance of 120 Ω and a gauge factor of 2. It is installed on an aluminium structure which has a yield point stress of 0·2 GN/m^2 and Young's modulus of 68·7 GN/m^2. Determine the change in resistance of the gauge that would be caused by the loading of the material to yield point. 15

SECTION—B

5. Answer *any* **five** of the following questions : 10×5=50

(a) The incidence matrix of a graph is given as

$$\begin{bmatrix} -1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 1 & 0 \\ 0 & -1 & 0 & -1 & 0 & -1 \\ 1 & 0 & 0 & 0 & -1 & 1 \end{bmatrix}$$

Draw the graph.

(b) Explain how PV bus is treated in load flow analysis.

(c) Obtain Y_{BUS} matrix for the system given in Fig-2.

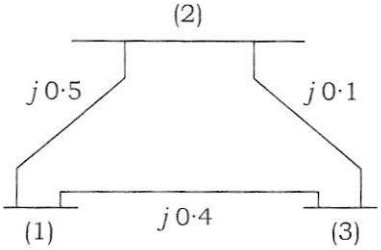

Fig-2

(d) Describe the working principle of impedance type distance relays.

(e) Explain how per unit quantities are represented in a power system in terms of base kV and MVA.

(f) Explain basic principle of formation of arc during breaking operation of circuit breaker.

(g) Explain briefly the following types of signal format for transmission of a binary data :

(i) NRZ signaling

(ii) RZ signaling

(iii) AMI-RZ signaling

6. Answer the following questions :

(a) Derive equal area criteria condition for transient stability analysis of a power system. Show the effect of three-phase fault at the generator bus on a power angle curve of lumped power system containing a generator, a transmission line and a load. Also, determine the fault clearing time for the system so that the system does not lose synchronism. 20

(b) Derive model for load flow analysis based on NR method. Provide expression for derivative terms of the elements of Jacobian matrix for NR method. 15

(c) The fuel inputs per hour for a system with unit I and unit II are given by

$$F_1 = (8P_1 + 0 \cdot 024 P_1^2 + 80)\, 10^6 \text{ Btu/hr}$$

$$F_2 = (6P_2 + 0 \cdot 04 P_2^2 + 120)\, 10^6 \text{ Btu/hr}$$

The maximum and minimum loads on the units are 100 MW and 10 MW, which are to be maintained strictly. Determine the minimum total cost of generation per day for the load curve given in Fig-3. The cost of the fuel is ₹ 2·5 per million Btu. The load during the day is shown below. Also find the operating cost per unit of energy. 15

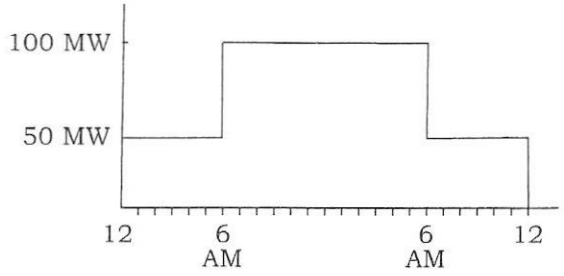

Fig-3

7. Answer the following questions :

(a) What is restricting voltage of an AC circuit breaker? Provide theoretical analysis to determine the maximum possible value of restricting voltage. Draw different components of an air blast circuit breaker and explain its operating principle. 20

(b) Derive the Universal Relay Torque Equation. Present the torque equations for over current and directional relay and their characteristics. Explain the principle of distance relays stating clearly the difference between impedance relay, reactance relay and mho relay. 15

(c) Provide and explain the differential projection used for the protection of a three-phase transformer. 15

8. Answer the following questions :

(a) Provide scheme for Pulse Code Modulation (PCM) and derive the expression for quantization error associated with PCM. Provide and explain the scheme used for transmission and receiving Differential Pulse Code Modulation (DPCM). 20

(b) What is pulse time modulation? Explain the procedure for generation of *(i)* PWM and *(ii)* PPM modulated signal. 15

(c) Derive and draw spectrum of ASK and FSK signals for band limited signal. Also highlight the basic difference between two spectrums. 15

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