600041

Roll No.

Candidate should write his/her Roll No. here.

Total No. of Questions : **7**

No. of Printed Pages : **7**

SEM–2017(02)–II

ELECTRICAL ENGINEERING

Paper—II

Time : **3** Hours]

[*Total Marks* : **300**

Instructions to the candidates :

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

*Candidates should attempt **FIVE** questions in all. Question No. **1** is compulsory. Out of remaining **SIX** questions, attempt any **FOUR**.*

***All** questions carry equal marks. The number of marks carried by a part of a question is indicated against it.*

*Answers must be written in **ENGLISH** only.*

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches should be drawn wherever required.

All parts and sub-parts of a question are to be attempted together in the answer book.

Any pages left blank in the answer book must be clearly struck out.

1. Answer the following questions : 6×10=60

(a) What do you mean by information capacity, bits and bit rate? Write the expression for Shannon limit for information capacity.

(b) Explain briefly the various methods of arc extinction in a circuit breaker.

(c) Explain the process of building up of voltage in a d.c. shunt generator and give the conditions of self-buildup voltage.

(d) Discuss the properties of Gaussian process.

(e) A 12500 kVA load is supplied at a power factor of 0·8 lagging by a 3-phase transmission line whose voltage is to be maintained at 33 kV at both ends. Determine the capacity of the synchronous condenser to be installed for voltage regulation. Given that the line resistance and reactance per phase are 4 Ω and 12 Ω respectively.

(f) What is the effect of the curvature of the earth on direct and reflected radio waves?

(g) Explain why field control is employed for getting speeds higher than rated and armature voltage control is employed for getting speeds less than rated.

(h) Determine the transfer matrix for the system given below :

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 3\\ -2 & -5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}1 & 1\\ 1 & 1\end{bmatrix}u(t) \quad \text{and} \quad y=\begin{bmatrix}2 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

(i) Explain why a single-phase induction motor is not self-starting.

(j) Differentiate between peripheral-mapped I/O and memory-mapped I/O.

2. *(a)* *(i)* Derive the expression for moment of inertia of the flywheel required for load equalization. 10

(ii) A motor equipped with a flywheel is to supply a load torque of 1000 N-m for 10 sec followed by a light load period of 200 N-m long enough for the flywheel to regain its steady-state speed. It is desired to limit the motor torque to 700 N-m. What should be the moment of inertia of the flywheel? The motor has an inertia of 10 kg-m^2. Its no-load speed is 500 r.p.m. and the slip at a torque of 500 N-m is 5%. Assume speed-torque characteristic of motor to be a straight line in the region of interest. 10

(b) An electric train weighing 500 tonnes climbs up gradient with $G = 8$ and following speed-time curve :

(i) Uniform acceleration of 2·5 km/hr/sec for 60 sec

(ii) Constant speed for 5 min

(iii) Coasting for 3 min

(iv) Dynamic braking at 3 km/hr/sec to rest

The train resistance is 25 N/tonne, rotational inertia effect 10% and combined efficiency of transmission and motor is 80%. Calculate the specific energy consumption. 20

(c) Explain the principle of dielectric heating. What are the problems associated with it? Also give the applications of dielectric heating. 20

3. *(a)* Draw the architecture diagram of 8085 microprocessor and explain the functions of each block in detail. 20

(b) *(i)* Explain all the steps required to perform an interrupt process in 8085 microprocessor. 10

(ii) What are the different modes of data transfer in microprocessor? Explain different conditions under which microprocessor controlled data transfer can take place. 10

(c) (i) Explain the different addressing modes supported by 8085 instruction set and explain each one with the help of suitable example. 10

(ii) Explain the operation of the following instructions in 8085 microprocessor : 3+3+4=10

(1) RRC

(2) CMP R

(3) LDAX Rp

4. (a) (i) Explain the various parameters that influence the design of a satellite communication link. 10

(ii) With the help of a block diagram, briefly describe the functions of the important constituent parts of a typical large size earth station. 10

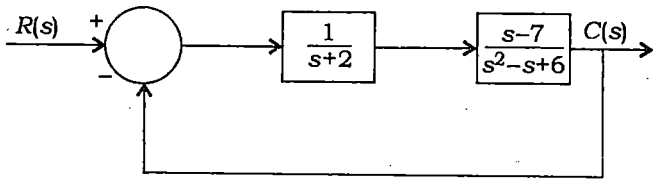
(b) (i) Briefly describe different digital modulation techniques. Which is the most commonly used one and why is that so? 10

(ii) What is the use of multiplexing techniques? Explain briefly the various multiplexing techniques. 10

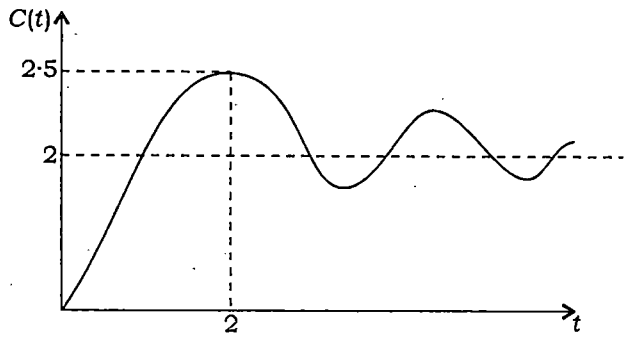
(c) (i) Draw the schematic diagram of an IMPATT diode and fully explain the two effects that combine to produce a 180° phase difference between the applied voltage and the resulting current. 10

(ii) Sketch and explain the block diagram of pulse code modulation. Also give its applications. 10

5. (a) (i) Use the Routh-Hurwitz array to determine the location (right-half plane, left-half plane or on imaginary axis) of the closed-loop poles of the following control system : 10



(ii) The step response of a second-order system is shown in the figure below for an input of $2u(t)$. Determine the open-loop and closed-loop transfer functions. Assume unity feedback : 10



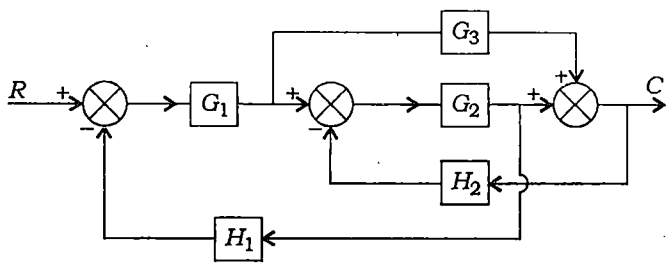
(b) The overall transfer function of a control system is given by

$$\frac{C(s)}{R(s)} = \frac{16}{s^2 + 1{\cdot}6s + 16}$$

It is desired that the damping ratio be 0·8. Determine the derivative rate feedback constant k_t and compare rise time, peak time, maximum overshoot and steady-state error for unit ramp input without and with derivative feedback control. 20

(c) *(i)* Explain the stepwise procedure for plotting root locus. 10

(ii) Determine the overall transfer function relating C and R for the system whose block diagram is shown below : 10



6. *(a)* A 15 kVA, 2300/230 V, 50 Hz, single-phase transformer gave the following test data :

Open-circuit test : $V_o = 2300$ V, $I_o = 0 \cdot 21$ A, $W_o = 50$ W
Short-circuit test : $V_s = 47$ V, $I_s = 6 \cdot 0$ A, $W_s = 160$ W

(i) Find the equivalent circuit referred to high-voltage side. 5

(ii) Calculate the full-load voltage regulation at 0·8 p.f. lagging when the load voltage is held at 220 V. 5

(iii) What is the efficiency at half the rated load at unity power factor? 5

(iv) Find the maximum efficiency and corresponding output power. 5

(b) *(i)* Derive the torque equation of a d.c. machine. 10

(ii) A 230 V d.c. shunt motor with constant field drives a load whose torque is proportional to the speed. When running at 750 r.p.m. it takes 30 A. Find the speed at which it will run if a 10 Ω resistance is connected in series with its armature. The resistance of armature may be neglected. 10

(c) A 25 hp, 400 V, 50 Hz, 4-pole, star-connected induction motor has the following impedances per phase in ohms referred to the stator side :

$R_s = 0 \cdot 641$, $R_y = 0 \cdot 332$, $X_s = 1 \cdot 106$, $X_y = 0 \cdot 464$ and $X_{mag} = 26 \cdot 30$

Rotational losses are assumed constant and are 1·1 kW and the core losses are assumed negligible. If the slip is 2·2% at rated voltage and frequency, find *(i)* speed, *(ii)* stator current, *(iii)* power factor and *(iv)* output and input power. 20

7. *(a)* *(i)* Why is load flow study essential for a power system? Starting from the fundamentals, derive static load flow equations in polar coordinates for n bus system. Also write the nature of these equations. 10

(ii) What are the various types of HVDC link? Explain each of them with the help of diagram and also mention the advantages and disadvantages of each. 10

(b) (i) Discuss the advantages of digital relays. Describe the basic functional blocks of a digital relay. 10

(ii) Explain the principle of working of distance relays. 10

(c) (i) Explain the construction, principle and working of an oil circuit breaker with a neat sketch. 10

(ii) Describe the trip circuit diagram of 3-zone distance relay used for the protection of a transmission line. Why are 3 zones necessary? How their reach setting and time setting is done? 10

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