2015-16

DIGITAL COMMUNICATION

EC - 501

Time - Three Hours Full Marks - 70

Answer ***any five*** questions.

All questions carry equal marks (14 *each*).

1. (a) The quantization error for a PCM system with $\mu = 2$ is specified to be no greater than ± 5 % of the peak-peak range of $x(t)$, where $x(t)$ is normalized. Find the minimum number of digits per code word.

(b) State the advantages and disadvantages of digital communication systems.

(c) Explain with a neat block diagram the function of a PCM Transmitter and Receiver using Non Uniform quantization. Derive an expression for $(S/N)_{DNUQPCM}$, stating the assumptions made in the derivation. When non-uniform quantization is used in PCM ? How non-uniform quantization is implemented using uniform quantization ? State μ-law compression and A-law compression equations.

2. (a) Explain with a neat block diagram the function of ADM transmitter and receiver and state the advantages of ADM over DM. State also the improvement of ADM over DM for voice and image transmission by ADM.

(b) Consider a signal with uniform power spectral density $G_x(f)$ $(S_x / 2W)$ π $(f / 2W)$. Show that the R.M.S. bandwidth is $W_{RMS} = \frac{W}{\sqrt{3}}$. Then calculate the optimum value of Δ in terms of S_x when $b = 16$.

(c) State and explain the different types of synchronization techniques used in digital communication systems. What do you mean by symbol synchronization ? State different symbol synchronization methods. Explain with a block diagram the function of an Early Late Gate Symbol Synchronizer.

3. (a) Show the structure of a non-coherent ASK Transmitter and Receiver and hence derive an expression for probability of error for non coherent ASK receiver.

(b) A high frequency transmitter used in a binary communication system is peak power limited to 1 kW. The power loss in the channel is 60dB and the noise power at the receiver input (ηr_b) is 10^{-4} watts. Assuming maximum signalling rate and equiprobable message bits, find P_e for non-coherent ASK and coherent PSK signalling schemes.

(c) Suppose that the number of telephone calls received by an operator on a typical working day and in a particular five-minute time interval is a Poisson variate, with a mean equal to 4. Find the probability that on a working day the operator will receive in this interval of time not more than one call.

(d) Given a random variable $v(t) = x + 3t$. If $\bar{x} = 0, \bar{x}^2 = 5$, find $\bar{v}., R_v(t_1, t_2)$ and $\bar{v}^2$.

4. Write short notes on *any two* of the following : 7+7=14

(a) Automatic Equalizer (b) Regenerative Repeater (c) QPSK Transmitter and Receiver (d) Systematic Linear Block Code.

5. (a) Show that the probability of error P_e for coherent receiver is : $P_e = Q\left(\frac{v_{max}}{2}\right)$. State the assumptions made in the above derivation. Find an expression for v_{max} for coherent PSK system.

(b) What are the factors on which probability of error for a digital communication system depends ?

(c) Derive a relation between message delay time for TDM and FDM system. Distinguish between TDM and FDM system.

6. (a) State a few error detection codes. What are the requirements for a code to be used as error detection code ? State a few error correction codes. What are the requirements for a code to be used as error correction code ?

(b) What do you mean by Backward error correction (BEC) and Forward error correction (FEC) ? When they are used ?

(c) Define coding and decoding. Why coding is needed ? What are factors on which coding or encoding process depends ?

(d) Find the generator polynomial for a (8, 5) systematic cyclic code. Hence encode 5-bit message 1 1 0 1 1 into 8-bit systematic cyclic code. Also describe the procedure of decoding of this 8-bit encoded message at the receiver.

7. (a) Describe the procedure of Huffman binary encoding scheme. What do you mean by minimum and maximum variance Huffman code ? A DMLS emits five messages with probabilities 0.4, 0.3 0.1, 0.1 and 0.1 respectively. Obtain the minimum variance binary code using Huffman binary encoding technique. Find the number of reductions, entropy of the source, the average length of the code, efficiency, redundancy and variance of the code.

(b) If (S/N) >> 1, show that minimum time required to transmit K binary digits is :

$\tau_{min} \cong 3K/ [B (S/N)_{dB}]$, where all the parameters have usual meaning.

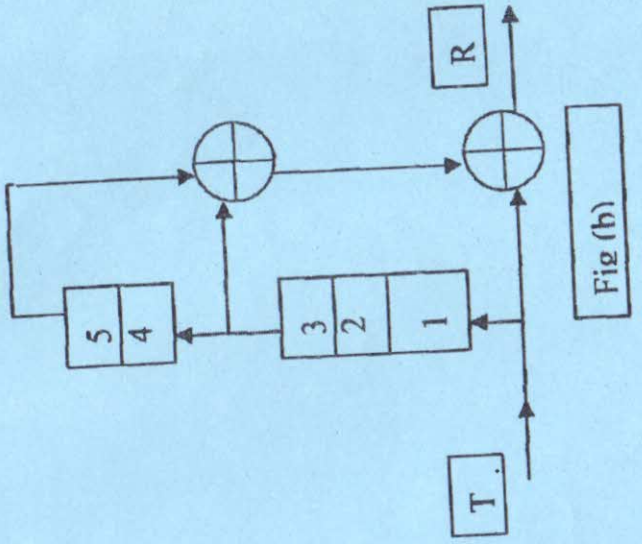
(c) Derive an expression for channel capacity of a PCM System using uniform quantization.

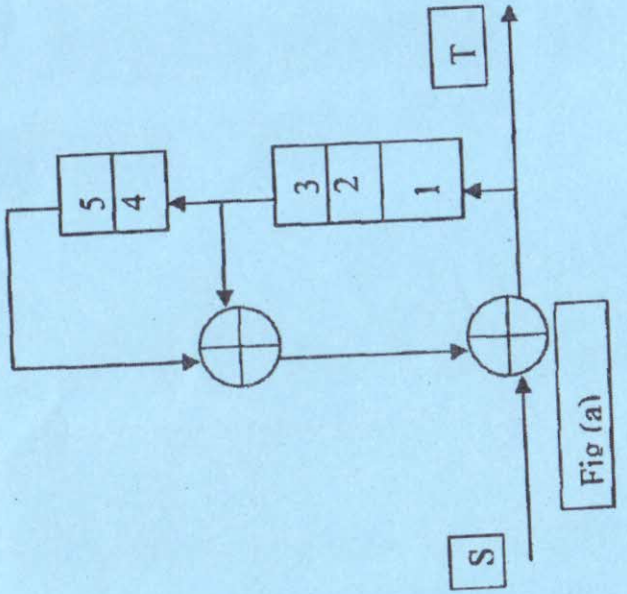
8. (a) What do you mean by stationary Random process ? Show that a randomly phased sinusoid whose analytical expression is $v(t) = A \sin(w_0 t + \varphi)$ is an outcome of a stationary random process.

(b) If $x(t) = \cos(2 \times \pi \times f_{c_1} \times t)$, find the Pre-envelope and complex envelope of $x(t)$.

Define Bandwidth efficiency ρ of a system. Derive a relation between BER and Symbol Probability of error P_e.

(b) What do you mean by scrambler and unscrambler ? For the scrambler and unscrambler shown in fig (a) and fig (b) respectively, find the transmitted sequence T at the output of the scrambler when the input sequence is S. Hence show that the same input sequence S can be obtained from the output R of the unscrambler when the unscrambler receives the output of the scrambler, which is T.





The symbol ⊕ ⇒ XOR Operation.

Fig. Q. 8 (b)

2015-16

DIGITAL SIGNAL PROCESSING

EC - 503

Time - Three Hours Full Marks - 70

Answer ***any five*** questions.

The figures in the margin indicate full marks.

1. (a) Realize de-normalized low pass, high pass, band pass and band stop filter from a normalized low pass filter.

(b) Prove that de-normalized band pass filter geometrically symmetrical with respect to the centre frequency.

(2½×4)+4=14

2. The following specifications are given for a LPF. Ω_p = 1 kHz, Ω_s = 2.33 kHz; δ_p = 0.5 dB and δ_s = 22 dB. Design the Butterworth and Chebyshev analog filter.

6+8=14

3. (a) Compare the performance of Chebyshev and Butterworth LPF.

(b) What is the motivation for analog filter design in DSP ?

(c) Derive the region of stability triangle related with second order IIR filter. 4+3+7=14

4. Design a normalized Butterworth and Chebyshev LPF, from a given de-normalized BPF specifications :

The pass band tolerance is 2dB and and the stop band tolerance is – 50 dB. The edges of the pass band are specified as 400 kHz and 1200 kHz. The edges of the stop band are specified as 100 kHz and 3000 kHz. 5+4+5=14

5. (a) Test whether

$$H(z)=\frac{1}{6+5z^{-1}+4z^{-1}+3z^{-3}+2z^{-4}+z^{-5}}$$

is stable or not.

(b) Prove that 1st order IIR low pass and high are all-pass and power complementary filter.

(c) A length of Type-1 real coefficient FIR filter has the following zeros : $z_1 = -0.5$; $z_2 = 0.3 + j\,0.5$; and $z_3=\frac{1}{2}+j\frac{\sqrt{3}}{2}$.

(i) Determine the locations of the remaining zeros.

(ii) What is the transfer function ? 5+4+5=14

6. (a) Design a simple IIR BPF having centre frequency $(\omega_0)=\frac{7}{2}$ and quality factor $(Q) = 2$.

(b) Consider a first-order stable system with system function, $H(z)=K\frac{1+az^{-1}}{1+bz^{-1}}$

Find out for what value of K, a and b does this system act as an all-pass filter.

(c) Draw the magnitude and phase response of

(i) $\frac{1}{2}(1+z^{-1})$ and (ii) $\frac{1}{2}(1+z^{-2})$. 4+5+5=14

7. (a) Draw the magnitude and phase response of M-point moving average system, where M = 5 and 14.

(b) Determine the z transform of

$$x(n)=\left(\frac{1}{2}\right)^n u(n)+2^n u(n)$$

and depict the ROC and the locations of poles and zeros in the z plane.

(c) Determine the z transform of the anticausal signal $x(n) = -a^n u(-n-1)$. 6+4+4=14

8. Write short notes on : 4+3+4+3=14

(a) Comb filters

(b) Zero phase filter

(c) Circular convolution

(d) Delay-free loops.

2015 - 16

COMPUTER ORGANISATION & ARCHITECTURE

EC - 504

Time - Three Hours Full Marks - 70

The figures in the margin indicate full marks.

Answer ***any five*** questions.

1. (a) Describe with one example each, following addressing methods and compare them with their advantages and disadvantages. $4 \times 3 = 12$

   a. Direct addressing mode
   b. Register direct addressing mode
   c. Register indirect addressing mode
   d. Immediate addressing.

   (b) A computer has 24 bits to address each word of 8 bytes in each of its memory block. What is the capacity of the memory in Mbytes ? 2

2. (a) Consider (9+7) Floating Point Notation for representing numbers. Compute $5 \times 2 = 10$

   (i) Minimum value when the number is not normalized

   (ii) Maximum value when the number is normalized.

   (b) Describe IEEE single and double precision FPN formats. 4

3. (a) Describe Fetch cycle and Execution cycle. (steps) $5 \times 2 = 10$

(b) Explain how MDR works as a central data transfer unit. 4

4. (a) In which situations interrupt occurs, in general ? 4

(b) Explain the Interrupt cycle when the interrupt has occurred during the execution cycle. (mention the registers involved). 5

(c) What happens when a CALL instruction is encountered ? 5

5. (a) Design an arithmetic unit with one selection line and two Full Adders. It needs to perform 4 operations as mentioned below 8

i. A plus B when Select = 0 and Cin = 0

ii. Increment A when Select = 0 and Cin = 1

iii. Decrement A when Select = 1 and Cin = 0

iv. A minus B when Select = 1 and Cin = 1

(b) Explain how a memory unit is interfaced with a CPU when there are 8 bits data bus and 16 bits address bus. Total memory size is 32 Kbytes. There are 8 separate memory blocks each with 4 Kbytes of memory size. 6

6. (a) Show with an example how a typical logic unit is designed that performs 4 logical operations on top of 8 arithmetic operations. 8

(b) Show how this logic unit can be added with the arthmetic unit to form a complete ALU unit. 6

7. (a) Explain with two examples, different instruction types. 6

(b) Show how $C = A - B$ gets executed with 3-Address, 2- Address, 1 - Address and 0 - Address instructions. 8

8. Write short notes on (*any two*) : $7 \times 2 = 14$

(a) Registers

(b) Flags

(c) Reverse Polish Notation.

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2015-16

SOFT COMPUTING

EC - 541

Time - Three Hours Full Marks - 70

Answer **Q. No. 1** and ***any four*** from the rest.

The figures in the margine indicate full marks.

1. Answer *any seven* of the following questions : 7×2=14

(a) Define soft computing. What are the different components of soft computing ?

(b) Perform the 'cross over and inversion" operation on the parents A and B.

B =	0	1	1	1	0	0	0	0	0	1
A =	1	1	0	0	1	1	0	1	1	1

(c) A schema is given by H = **1*00***. (i) Write the set of binary strings represented by the schema 'H'. (ii) Determine the order and defining length of H.

(d) For a GA problem, each of the three variables (x_1, x_2 and x_3) is encoded with five binary bit strings, If, chromosome (C) of the problem is C = 110100011001011, determine its associated genes and their decoded values when upper and lower limits of a variable are $X^L = 4$ and $X^U = 15$ respectively.

(e) In the population of GA, the fitness values of four individuals are obtained as 4.01, 1, 2.1 and 3.11 respectively. Find the probabilities and expected counts of each individuals.

(f) In the biological neuron write down the functions of dendrite, soma, axon and synapses.

(g) If the input to a single input neuron is 2.0, its weight is 1.3 and its bias is 3.0, what is the 'output of the neuron' if it has the following transfer functions ?

(i) Hard limit with threshold $\theta = 5.5$.

(ii) Linear with slope $m = 45°$.

(h) Explain non-uniform mutation in real coded GA.

(i) In connection with PSO define the following terms :

1. Position, 2. Fitness, 3. Pbest, 4. gbest.

Answer *any four* from the following questions : 4×14=56

2. (a) What are the main characteristics of Evolutionary Algorithm ? Discuss about them.

(b) Explain the working principle of rank based selection and tournament selection in GA.

(c) For a problem with two variables, each variable is encoded with 5 binary bits. Write MATLAB code to produce a population of 4 chromosome. 6+4+4=14

3. (a) Briefly explain the working principle of GA.

(b) Let function $f(x) = 2x - \frac{x^2}{16}$ be defined on the interval [0, 31]. Illustrate the use of genetic algorithm for determining the maximum of the function in the given interval. 4+10=14

4. (a) Discuss the theory, architecture and learning rule of perceptron networks.

(b) State the training algorithm used for the Hebb network.

(c) Realize the XOR logic function by using McCulloch-Pitts neuron. 6+2+6=14

5. (a) In the back propagation algorithm show that the correction ΔW_{ji} to the synaptic weight W_{ji} is given by $\Delta W_{ji} = \eta \delta_j y_i$, where δ_j, is the local gradient of the output neuron 'j'; y_i is the signal appearing at the output of the neuron 'i' and η is the learning rate.

(b) In connection with the back propagation algorithm discuss about the utilities of :

(i) Activation function : Logistic and hyperbolic tangent

(ii) Rate of learning and modified delta rule. 7+3+4=14

6. (a) Explain the working principle of Differential Evolution.

(b) Briefly explain the effects of different control parameters of DE. 10+4=14

7. Write short notes on *any two* of the following : 2×7=14

(a) ANN Architecture

(b) Schema Theorem

(c) Control parameters of PSO.

Q. No. EE - 501 / 080

B. Tech./Odd

2015-16/Reg

2015-16

ELECTRICAL MACHINES - II

EE - 501

Full Marks : 70 Time : Three Hours

The figures in the margin indicate full marks.

All question of a Group should be answered at one place and to the point.

Group - A

Answer *all* questions. 2×7

1. (a) How does pitch factor influence the voltage generated by an alternator?

(b) Which method yields a better estimate of voltage regulation in an alternator and why?

(c) When do circulating currents flow through the alternators connected in parallel?

(d) What is a synchronous condenser?

(e) What effect does increasing the excitation of a fully loaded synchronous motor?

(f) How does air gap length influence the maximum torque of an induction motor?

(g) What do you mean by split phasing?

P.T.O.

Group - B

Answer any *four* questions. 6×4

2. (a) Derive the expression for the power output of a three phase alternator having salient poles from fundamental principles.

(b) Explain the variation of armature reaction with load power factor in a synchronous machine.

(c) Explain clearly how a rotating magnetic field is setup around the 3-phase AC winding having 120° (electrical) phase displacement each when 3-phase balanced supply is given to it.

(d) Explain why in a synchronous motor inherently no starting torques.

(e) Using approximate equivalent circuit, derive the expressions for developed torque, maximum torque and starting torque of an induction motor.

(f) Explain how the parameters of equivalent circuit for an induction machine are determined from test results.

Group - C

Answer any *four* questions. 8×4

3. (a) The field form of a star-connected, 3-phase machine is given by 100 sin wt + 35 sin 3wt + 20 sin 5wt. If the stator has 12 slots per pole, determine in terms of the amplitude of the fundamental of the phase voltage : (i) the rms value of the line voltage, (ii) the rms value of the phase voltage. Assume coil span = pole pitch.

(b) Two three-phase, star connected synchronous generators have generated voltage of $230\angle 15°$ and $230\angle 25°$ per phase respectively under no load. The per phase reactances of the generators are 6Ω and 8Ω respectively with negligible resistances. They are connected in parallel to a load impedance of $6 + j\,8\Omega$ per phase. Determine (i) the terminal voltage per phase, the armature current of each generator, (iii) the power supplied by each generator and the total power output.

(c) A 3300 V, 3-phase star-connected synchronous motor draws a full load current of 60 A at 0.8 pf leading. The armature resistance is 1.2Ω and reactance 12Ω per phase. If the stray losses of the machine are 220 W, find : (i) emf induced, (ii) output power and (iii) efficiency of the machine.

(d) A slip-ring induction motor runs at 290 rpm on full load when connected to a 50 Hz supply. Calculate (i) the number of poles, (b) the slip, and (c) the slip for full-load torque if the total resistance of the rotor circuit is doubled.

(e) The rotor of a 4-pole, 50 Hz, slip-ring induction motor has a resistance of 0.25Ω per phase and runs at 1440 rpm at full load. Calculate the external resistance per phase which must be added to lower the speed to 1200 rpm, the torque being the same as before.

Q. No. EE - 503 / 047

B. Tech./Odd
2015-16/Reg

2015-16

CONTROL SYSTEMS

EE - 503

Full Marks : 70 Time : Three Hours

The figures in the margin indicate full marks.

Answer should be brief and to the point.

All parts of any question should be written in one place.

Answer any *five* questions.

1. (a) Draw a schematic diagram of Ward Leonard method of speed control system for DC motor and hence find the mathematic modeling of the system. 2+4=6

   (b) Show that mechanical gear-train is analogous to electrical transformer. 3

   (c) In an automatic voltage regulator (AVR), the excitation of the DC generator is controlled by PWM controlled DC chopper amplifier. Explain the closed-loop operation of the control system to maintain constant output voltage. Assume that the speed of the prime mover is constant during the operation. 5

2. (a) A unity feedback system has open loop transfer function $G(s)=\frac{w_n^2}{s(s+2\xi w_n)}$; $\xi<1$. Derive

P.T.O.

expressions for (i) peak overshoot and (ii) rise time of the time response of the given system to unit step input. 2+2=4

(b) A servo position control system is working in stable condition and maintaining good performance. Now the gain of the system is increased to a sufficiently high value. How will the transient and steady-state performance of the system be affected? 4

(c) The steady-state error due to unit step input to a unity feedback control system with the forward transfer-function $G(s)=\frac{K(s+a)}{(s+b)^2}$ is 4%. The peak overshoot is approximately 9.5% and the natural frequency is 10 rad/sec. Locate the open-loop poles and zero for the system. 6

3. (a) Draw a hardware circuit of a PID controller where the three different gains may be controlled independently. 4

(b) Comment on the limitations of proportional, derivative and integral controller separately. 4

(c) The open loop transfer function of a unity feedback control system is

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

It is desired that all the roots of the characteristic equation must lie in the region to the left of the line

$s=-a$. Determine the region for which the closed loop system is stable. 6

4. (a) Write the merits and demerits of frequency domain analysis over time domain analysis. 4

(b) Prove that if a sine wave signal is fed to a linear time-invariant system the output will also be a sine wave with different magnitude and phase angle. 4

(c) The open loop transfer function of a unity feedback system is

$$G(s)=\frac{K}{s(s^2+2s+1)(s+1)}$$

(i) Draw Nyquist plot and (ii) determine the range of value of 'K' for which the system is stable. 4+2=6

5. (a) Compare between absolute stability and relative stability with suitable examples. 4

(b) The open-loop transfer function of a unity feedback system is given by

$$G(s)=\frac{K(s+2)}{s(s+3)(s^2+2s+5)};$$

Sketch the root-locus for the system. 6

(c) Apply the angle condition to determine whether the point $s=-2+j2$ is on the root locus plot for the system whose characteristic equation is

P.T.O.

$s(s+2)+K(s+4)=0$.

If it is, determine the value of 'K' at this point by using magnitude criterion. 2+2=4

6. (a) Define gain margin (GM), phase margin (PM), gain crossover frequency (GCF) and phase crossover frequency (PCF) with reference to the following system whose open-loop transfer-function is given by

$$G(s)=\frac{k}{s(1+0.2s)(1+0.05s)};$$ 1+1+1+1=4

(b) The open loop transfer function of a unity feedback system is given by

$$G(s)=\frac{10}{s(1+0.2s)(1+0.02s)}$$

(i) Draw the Bode plot (ii) Find the phase margin and gain margin. (iii) Comment on the stability of the system. 6+2+2=10

7. A DC electromagnetic levitation system utilizes two loop control scheme, inner current loop and outer position loop. (i) Explain the closed loop control system with a suitable block diagram (ii) Discuss the design methodology of PI type current controller and Lead type position controller utilizing bare minimum system components of the aforesaid closed loop system. 6+8=14

8. (a) Write short notes (any *two*) : 4+4=8

(i) Lead-lag network,

(ii) Steady state error and error constants,

(iii) Output rate feedback controller.

(b) Derive the state-space representation of the network in Fig.1. 6

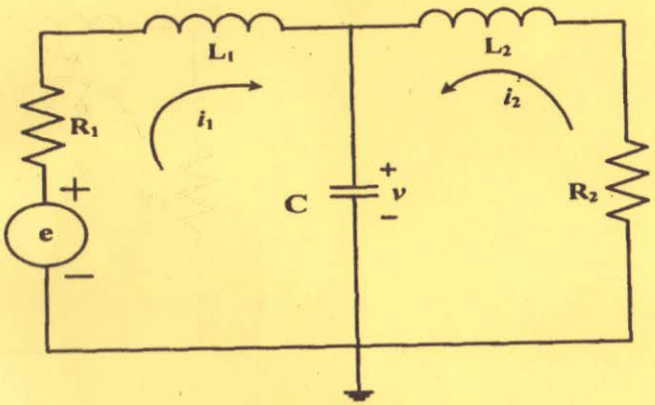


Fig.1

Q. No. EE - 504 / 028

B. Tech./Odd
2015-16/Reg

2015-16

POWER ELECTRONICS

EE - 504

Full Marks : 70 Time : Three Hours

The figures in the margin indicate full marks.

Answer question no. 1 and any *four* questions from the rest.

All parts of a question are to be answered at same place.

1. (a) Describe the change in the capacitance C_{gd} in the following MOSFET circuit model, in the ohmic region, for variation in the drain to source voltage of the device.

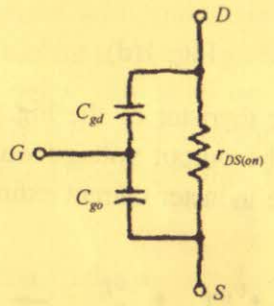


Fig. 1(a)

(b) Draw the voltage and current waveforms of a thyristor during turn off, and indicate the recovery time in the figure, before which forward voltage must not be reapplied.

P.T.O.

(c) With respective waveforms, explain how the diode current and inductor current are related, in a buck-boost converter.

(d) The unipolar switching of one Full bridge dc-dc converter results in voltage and current output as per the following Fig.1 (d). Mark the zone of operation of different devices in one sampling period for the said converter.

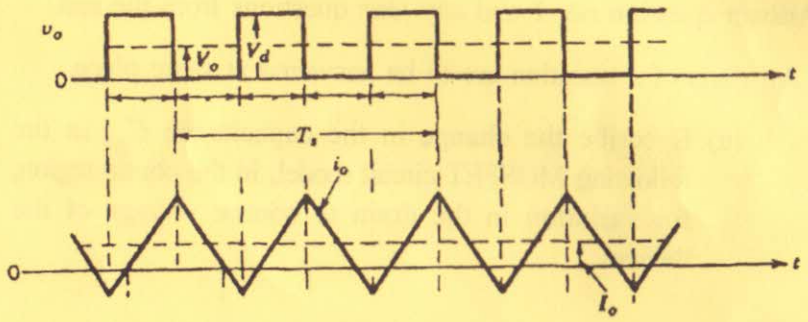


Fig. 1(d)

(e) Suppose the thyristor of the Fig. 1(e), conduct at 30°. What will be output voltage waveforms (v_d) for the circuit if the inductor current extinguishes within 15° ?

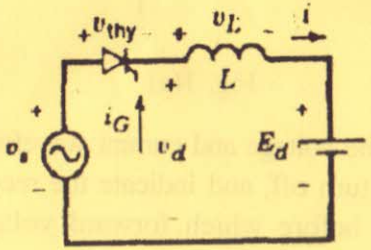


Fig. 1(e)

3+3+3+3+2=14

2. (a) What are reverse recovery current and snappiness of a power diode?

(b) For a cell charger, shown in the Fig. 2(b), input voltage is 220V, 50 Hz. The isolation transformer is having turns ratio 5 : 1. The allowable dc current is 10A. If the battery voltage is 12V, find the power dissipated at the resistance.

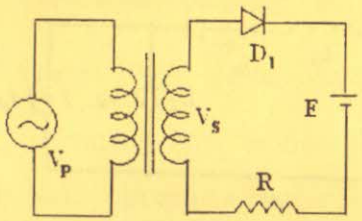


Fig. 2(b)

(c) Considering a MOSFET is used in a step down dc-dc converter with inductive load (modelled as a constant current source in parallel with a free-wheeling diode), draw the turn-on voltage and current waveforms. Also note that the free-wheeling diode is not an ideal one and has some reverse recovery current. 4+5+5=14

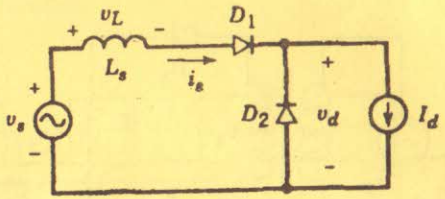
3. (a) Explain the "plasma spreading time" of the thyristor and also discuss the thermal runaway process of the device.

(b) With circuit modifications explain how the SOA in a power transistor can be increased substantially both during turn on and turn off transients.

P.T.O.

(c) Draw the AC regulator circuit with TRIAC, fired through DIAC and explain the operation in brief. 4+5+5=14

4. (a) With $I_d = 10A$ in the basic commutation circuit, given in the figure, find the output voltage, and the output power. Assume $V_s = 120$V at 50Hz and $L_s = 5$ mH.



(b) A 400V, 20A, 1500 RPM separately excited dc motor has an armature resistance of 0.75Ω and inductance of 50 mH. The motor is supplied from a three phase fully controlled converter operating from a 4000V, 50Hz, single phase supply with a firing angle of $\alpha = 90°$. What will be the speed of the motor, if it is supplying full load torque? Consider the conduction to be continuous under this condition. 7+7=14

5. (a) If the total ripple current flows through capacitor and the average current flows through the load, then derive the expression of percentage output voltage ripple in a boost converter, operating at continuous conduction mode.

(b) Considering output voltage V_0 constant the duty ration of a buck-boost converter can be expressed as

$D = \frac{V_0}{V_d}\sqrt{\frac{I_o}{I_{oB\_max}}}$ for discontinuous mode of conduction. One buck-boost converter is working at 20 kHz, input voltage $V_d = 15$V, with $L = 0.05$ mH and sufficiently large capacitor. If the load requirement is 20W at 22.5V, what should be the duty ratio of the switch? Calculate the same for the load increment of 200% at the same voltage. 7+7=14

6. (a) In full bridge PWM dc-dc converter $V_{control} = 0.5\, V_{tri(peak)}$. Explain how to find the output voltage for the said operation under bipolar switching condition.

(b) In a full bridge PWM dc-dc converter, analytically obtain the value of (V_o / V_d) which results in the maximum (peak-peak) ripple in the output voltage. Calculate the ripple in terms of dc voltage, switching frequency and duty ratio. 7+7=14

7. (a) How the fundamental wave form, is related with modulation index for a SPWM inverter?

(b) Draw the control voltage, carrier voltage, corresponding gate signal, and output voltage waveform for one switching cycle of one full bridge single phase bipolar PWM inverter.

(c) The normalized harmonic voltage of a single leg PWM inverter can be tabulated as per the following table.

P.T.O.

Now for a full bridge single phase PWM inverter $m_f = 99$, $m_a = 0.8$, dc voltage 400V, and fundamental frequency is 50 Hz. Find harmonic voltages (rms).

Generalized Harmonics of v_{A_0} for a Large m_f.

h \ m_a	0.2	0.4	0.6	0.8	1.0
1	0.2	0.4	0.6	0.8	1.0
Fundamental					
m_f	1.242	1.15	1.006	0.818	0.601
$m_f \pm 2$	0.016	0.061	0.131	0.220	0.318
$m_f \pm 4$					0.018
$2m_f \pm 1$	0.190	0.326	0.370	0.314	0.181
$2m_f \pm 3$		0.024	0.071	0.139	0.212
$2m_f \pm 5$				0.013	0.033
$3m_f$	0.335	0.123	0.083	0.171	0.113
$3m_f \pm 2$	0.044	0.139	0.203	0.176	0.062
$3m_f \pm 4$		0.012	0.047	0.104	0.157
$3m_f \pm 6$				0.016	0.044
$4m_f \pm 1$	0.163	0.157	0.008	0.105	0.068
$4m_f \pm 3$	0.012	0.070	0.132	0.115	0.009
$4m_f \pm 5$			0.034	0.084	0.119
$4m_f \pm 7$				0.017	0.050

3+4+7=14

8. (a) With gate signals discuss the mode of operation of 3-phase inverter with 180° conduction mode. Find the THD present at the supply phase voltage waveform.

   (b) In a square-wave operation of single phase full bridge dc-ac converter, explain how the voltage control is achieved. Mathematically derive the fundamental output voltage equation for this case. 7+7=14

9. (a) With the help of circuit diagram and wave forms, describe the operation of single-phase to single-phase cyclo-converter operating at 1/3rd of input frequency.

   (b) Show the output voltage wave form of 3phase AC to AC voltage regulator, made of SCR, while supplying resistive load at firing angle 60°. Also derive the rms value of the output voltage. 7+7=14

Q. No. EE - 540 / 017

B. Tech./Odd
2015-16/Reg

2015-16

MEASUREMENTS AND INSTRUMENTATION

EE - 540

Full Marks : 70 Time : Three Hours

The figures in the margin indicate full marks.

Answer any *five* questions.

(All parts of any questions should be answered at one place)

1. (a) Describe the Varley loop method for localizing of earth and short circuit faults in cables.

   (b) A capacitor having a capacitance of 2.5 μF is charged to a potential difference of 450 volts. The capacitor is disconnected from the supply and the reading on an electrostatic voltmeter in parallel with the capacitor is observed to fall to 280 volts in 15.2 minutes. The test is repeated with a resistance R in parallel with the capacitor and the voltmeter. The voltmeter's reading is now found to fall from 450 volts to 280 volts in 10.8 minutes. Calculate the value of R.

   (c) What is load cell? Where is it used? 6+5+3=14

2. (a) Define the followings with an example :

   (i) Absolute instrument

   (ii) Secondary instrument

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(iii) Static sensitivity

(iv) Accuracy

(v) Precision

(b) Draw a neat schematic diagram of the Anderson bridge. Deduce the equations when the bridge is under balance condition. Draw the phasor diagram of the voltages and currents of the bridge arms at balance.

(c) What is the difference between active and passive transducers? 5+6+3=14

3. (a) Why secondary of current transformer should not be open-circuited?

(b) Compare the merits of spring control and gravity control methods in measuring instruments.

(c) Describe the various operating forces needed for proper operation of an analog instrument.

(d) The torque of an ammeter varies as the square of the current passing through it. If a current of 10 A produces a deflection of 90°, what deflection will occur for the current of 5A when the instrument is (i) Spring controlled and (ii) Gravity controlled ? 2+3+6+3=14

4. (a) With the help of a neat sketch, describe the construction and working principle of permanent magnet moving coil instruments. What are its advantages and limitations?

(b) The inductance of a moving iron ammeter with a full scale deflection of 90° at 1.5A is given by the expression

$L = \left(200 + 40\theta - 4\theta^2 - \theta^3\right)\mu H$. Where θ is the deflection in radian from the zero position ?

Calculate : (i) Spring constant (ii) the angular deflection of the pointer for a current of 1A.

(c) Write the advantages of electrical transducers. (5+2)+3+4=14

5. (a) Write some advantages and disadvantages of Owen's bridge.

(b) What are the problems associated with the measurement of low resistances? How are they overcome through use of Kelvin's Double Bridge? Derive the expression for the unknown resistance in case of Kelvin's Double Bridge.

(c) What is Blondel's theorem? 2+7+5=14

6. (a) Explain the operating principle of LVDT.

(b) Write some advantages of magnetic flow meter and turbine flow meter.

(c) A displacement transducer with a shaft stroke of 3.0 inch. is applied to the circuit of Fig-1. The total resistance of the potentiometer is 5 KΩ. The applied voltage V_t is 5V. When the wiper is 0.9 in. from B, what is the value of the output voltage? 7+4+3=14

P.T.O.

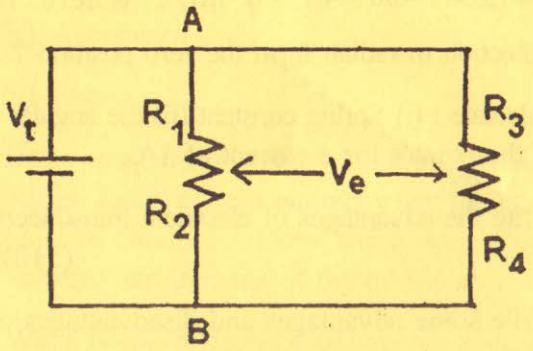

Fig.-1

7. Write short notes on (any *two*) : 7×2=14

(a) Megger

(b) Thermocouple type instrument

(c) Piezo electric transducer

(d) Heaviside Campbel bridge.
