Duration – 3 Hours **Total Marks – 80**

N.B.:- (1) Question No.**1** is compulsory.
(2) **Attempt** any **three** questions out of remaining **five** questions.
(3) Assume suitable data if necessary and justify the same.

Q 1. Answer the following questions. **20**
a) Explain the role of protective relaying in the power system.
b) Explain the difficulties in current differential protection.
c) Explain the working of the under frequency relay.
d) Explain high resistance arc interruption method..

Q 2. a) Explain the construction, working principle and operation of Vacuum circuit breaker. **10**
b) Differentiate between static and electromagnetic relay. **10**

Q 3. a) Explain the construction and working principle of SF_6 circuit breaker with neat sketch. **10**
b) Draw and explain single line diagram of a typical substation and indicate the location of different switchgear and protecting devices. **10**

Q 4. a) Describe the differential protective scheme for star - delta connected transformer. **10**
b) Describe the protective schemes employed for the protection against overload and winding temperature of induction motor. **10**

Q 5. a) Describe the bus zone protection in detail. **10**
b) Explain the types of protective schemes employed for the protection of transmission line. **10**

Q 6. Write a note on **Any Two** **10*2**
a) Numerical Relay
b) Bus bar Protection
c) Phase comparison carrier current protection.

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Time: 3 Hours **Total Marks: 80**

Note: **Question No.1 is compulsory.**
Solve **ANY THREE** questions from the **remaining** questions.
Figure to the right indicates full marks.

		Marks
Q. 1	Solve **ANY FOUR** questions from following.	
a)	Compare AC and DC systems of traction.	**5**
b)	Discuss the factors affecting schedule speed of a train	**5**
c)	What are the important features of tractive drive?	**5**
d)	Explain railway SCADA system.	**5**
e)	What are the disadvantages of bow collector ?	**5**
Q. 2 a)	What are the advantages of composite system of traction employing 25KV AC supply and dc traction motors.	**10**
b)	Name the various method of electric braking. Give the merits and limitations of regenerative braking.	**10**
Q.3 a)	Define traction substation. What are the major equipment used in traction substation.	**10**
b)	What are the different types of pantographs used and give their merits and demerits.	**10**
Q4. a)	Explain the working principle of a DC track circuit. What are the factors affect the functioning of track circuit.	**10**
b)	Explain the various train lighting systems ?	**10**
Q5. a)	Explain the chopper method of control of DC motors. What are the merits and demerits of this method of control.	**10**
b)	A train runs with average speed of 40 kmph. Distance between stations is 2 km. Value of acceleration and retardation are 1.5 Kmphps and 2.5 Kmphps respectively. Find the maximum speed of train assuming trapezoidal speed time curve.	**10**
Q6. a)	Explain the importance of neutal section used in railway with a neat diagram.	**10**
b)	What is the function of a signal ? Explain their positions	**10**

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Correction in Q.P.Code: **10038283**
Q)2a) iv) State whether the systems is time invariant or not y(t)=**sin20πt**

Duration – 3 Hours **Total Marks - 80**

N.B.: - (1) Question No.**1** is compulsory.
(2) **Attempt** any **Three** questions out of the remaining **five** questions.
(3) Assume suitable data if necessary and justify the same.

Q 1. Answer **all questions**.

A) Sketch the signal, x(t) = 2 u(t) + t u(t) – [(t - 1) u(t - 1)] -3 u(t - 2) **05**

B) Determine the inverse Z transform of the following **05**

$$X(z) = \frac{1 + z^{-1}}{1 - z^{-1} + 0.5z^{-2}}$$

C) Define mixed phase, minimum phase and maximum phase system. **05**

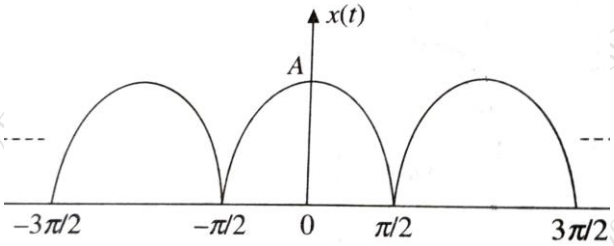
D) Perform bilinear transformation to $H(s) = \frac{2}{(s+1)(s+3)}$ with T=0.1s **05**

Q 2 a) i) Test the causality of y(t) = x(t) + 3 x(t + 4) **10**
ii) Test the linearity of $y(t) = e^{x(t)}$.
iii) Test the stability of the LTI system, whose impulse response is $h(t) = e^{-4t}$ u(t)
iv) State whether the systems is time invariant or not y(t) = x(t) sin20Πt

Q 2 b) Determine the step response of an LTI system whose impulse response h(n) is given by $h(n) = a^{-n}$ u(-n); 0 < a < 1. **10**

Q 3 a) The length of an FIR filter is 9. If the filter has a linear phase-show that the following equation is satisfied, $\sum_0^{M-1} h(n)[\sin(\omega\tau - \omega n)] = 0$ **10**

Q 3 b) Calculate the trigonometric fourier series expansion of the waveform **10**



Q 4 a) (i) An LTI system is governed by the equation, **10**
y(n) = -2 y(n- 2) - 0.5 y(n- 1) + 3 x(n- 1) + 5 x(n). Determine the transfer function of the system.
ii) Find the Z-transform of $x(n) = a^{n+1}\,u(n+1)$.

Q 4 b) Using Z-transform, perform deconvolution of the response **10**
y(n) = (1, 4, 8, 8, 3, -2, -1) and impulse response h(n) = (1, 2, 1, -1) to extract the input x(n).

Q 5 a) Determine the X(k) of the LTI system when the input sequence **10**
x(n) = {-1, 1, 2, 1, -1} by radix 2 DIT FFT.

Q 5 b) $Y(k) = \left\{ 0,\ -\sqrt{2} + j(2+\sqrt{2}),\ 0,\ \sqrt{2} - j(2-\sqrt{2}),\ 8,\ \sqrt{2} + j(2-\sqrt{2}),\ 0,\ -\sqrt{2} - j(2+\sqrt{2}) \right\}$ **10**
Find the 8 point inverse DFT of using radix-2 DIT FFT

Q 6 a) The desired response of a low-pass filter is **10**

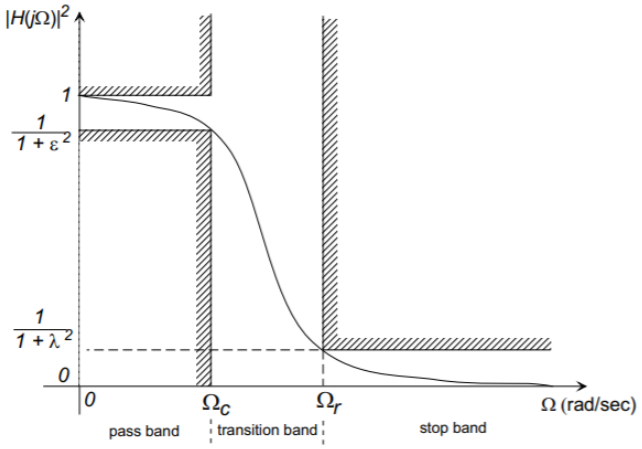
$$H_d(e^{jw}) = \begin{cases} e^{-j3\omega}, & \frac{-3\pi}{4} \le |w| \le \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < |w| \le \pi \end{cases}$$

Determine $H(e^{jw})$ for M=7 using a Hamming window.

Q 6 b) Butterworth filter has a magnitude response given by **10**

$$|H(j\Omega)| = \frac{A}{\left[1+(\Omega/\Omega_c)^{2N}\right]^{0.5}}$$

Where A is the filter gain and Ωc is the 3dB cut off frequency and N is the order of the filter. The design parameters of the buttworth filter are obtained by considering the LPF with the desired specifications as shown in fig



Derive the equation to find the order 'N' of filter in terms of filter specification

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Duration: 3 Hours **Marks:80**

Note:
1. Q.no. 1 is compulsory.
2. Answer any three questions from Q. No. 2 to Q. No. 6.
3. Write in legible handwriting.
4. Make any suitable assumptions wherever required.
5. Must make suitable supporting diagrams wherever desired.
6. Figure to the right indicates marks.

Q1 Each question carries five marks **20**

a. Explain the design of state feedback controller by transformation.

b. Why is the phase margin increased above that desired, when designing a Lag compensator using Bode-plot?

c. Draw the realization for the digital compensator defined by $G_c(z)=\frac{z+8}{z^2+z-2.5}$

d. Compare PI and PD controllers with respect to application, electrical equivalent circuits and pole-zero plots in s-plane.

Q2 a. Determine the range of sampling interval, T, to make the system stable for a unity feedback system which has a forward transfer function of $G1(s)=\frac{10}{(s+4)}$ is connected in cascade with an ideal sampler, and zero order hold. **10**

b. A unity feedback system with forward path transfer function $G(s)=\frac{K}{s(s+5)(s+8)}$ has 12% overshoot. Evaluate the current dominant poles using root locus and then design a PD controller to reduce the settling time by a factor of 1.5. **10**

Q3 a. For a unity feedback system with $G(s)=\frac{K(s+4)}{s(s+6)(s+8)}$, design a lag compensator using bode plot so that the system operates with a 50° phase margin and a static error constant of 80. **10**

b. Explain the steps in lead compensator design using frequency domain analysis. Draw the pole zero plot and write a typical transfer function for a lead compensator. **10**

Q4 a. Define observability. Check the observability of the following system. **05**

$$\dot{x} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & 0 & 2 \\ 1 & -2 & -4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u; \qquad y = [1 \quad 0 \quad 0]\, x$$

b. Design an observer for the plant with the transfer function $\frac{20}{(s+5)(s+10)(s+20)}$ if the plant is represented in cascade form. Transform the plant to observer canonical form for the design. Then transform the design back to cascade form. The characteristic polynomial for the controller is ζ=0.5 and wn=10 and the observer is 10 times faster than the controller. **15**

Q5 a. A compensator is given whose transfer function is $G(s) = \frac{(s+0.1)}{(s+0.02)}$. Identify the compensator, draw the circuit with the parameter values to realize the given compensator. **10**

b. Given the following open loop plant $G(s) = \frac{10(s+8)}{s(s+2)(s+4)}$. Design a controller to yield a15% overshoot and a settling time of 4 sec assuming that the plant is represented in the phase variables form. Draw the representation with the controller gains. **10**

Q6 a. Given unity feedback system which has a forward transfer function of $G_1(s) = \frac{20}{s(s+5)}$ is connected in cascade with an ideal sampler, and zero order hold. Find the steady state error if the inputs are 10u(t), 10t u(t) and $10t^2u(t)$. Sampling time T=0.5. **10**

b. Given the unity feedback system with $G(s) = \frac{K}{s(s+4)(s+10)(s+12)}$. Use root locus to determine the value of gain K to yield a step response with a 20% overshoot. **10**

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Time:3 hrs **Marks: 80**

Question No 01 is compulsory.

Attempt any Three questions from the remaining questions.

Each question carries 20 marks.

Figure to the right indicates full marks.

Q. 1. Attempt any 04 sub-questions out of 05 sub-questions.

I] Discuss the concept of Access Bank in Pic18 microcontroller. **(05 marks)**

II] Enlist the differences between Interrupt and polling process. **(05 marks)**

III] What is timer roll over? Specify the significance of TMR0IF. **(05 marks)**

IV] Draw and Explain status register in Pic18 microcontroller. **(05 marks)**

V] Interpret the instructions TBLRD* and TBLRW* for Pic18 microcontroller. **(05 marks)**

Q. 2. A] What is meant by addressing mode in PIC 18F microcontroller? Demonstrate any three addressing modes with examples. **(10 marks)**

B] Draw the generic block diagram of PIC 18 Microcontroller and interpret all the internal peripheral devices. **(10 marks)**

Q. 3. A] Explain the different types of instruction sets and mention two examples of each set. **(10 marks)**

B] Explain the different assembler directives modes used in Pic18 microcontroller. **(10 marks)**

Q. 4. A] Explain the registers SPBRG, TxSTA registers associated with serial communication in PIC 18F. **(10 marks)**

B] Explain the CCP (Compare, Capture, and PWM) module in PIC18F4520 microcontroller in detail. **(10 marks)**

Q. 5 A] Demonstrate the steps taken by the microcontroller when interrupt occurs. Specify the necessary steps to enable TMR0 interrupt. **(10 marks)**

B] Write a C program to generate a square wave of 10ms period, Use Timer 0 in 16 bit mode, XTAL = 10MHz and prescalar of 128. **(10 marks)**

Q. 6 Write short notes on **(20 marks**

i] ADC module and associated registers with ADC

ii] Seven Segment LED Interfacing with PIC 18 Microcontroller.

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