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) Compare static relay with electromagnetic relay.
B) Explain the meaning of time grading and current grading protection system.
C) Explain making and braking capacity of circuit breaker.
D) Compare fuse with circuit breaker.

Q 2 a) Explain TRV and RRRV. Derive an expression for restriking voltage. **10**
Q 2 b) Explain concept of phasor measurement unit and its use. **10**

Q 3 a) Explain with neat diagram the construction and working of SF_6 Circuit Breaker. **10**
Q 3 b) Explain with neat diagram the working of harmonic restraint relay. **10**

Q 4 a) Explain rotor side protection for generator. **10**
Q 4 b) Explain power line carrier communication used for protection of transmission line. **10**

Q 5 a) Explain in detail the difference between impedance relay, reactance relay with the help of their characteristic. **10**
Q 5 b) Draw and explain the construction and working of pantograph isolator. Explain why isolator cannot be operated on load. **10**

Q 6 a) Explain the constructional details of HRC fuse. How arc is extinguished in HRC fuse? **10**
Q 6 b) Explain in over reach & under reach in impedance relay and state the measure to overcome it. **10**

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Time : 3 Hrs. **Marks : 80**

N. B : 1) Question No 01 is compulsory.
2) Attempt any Three questions from the remaining questions.
3) Each question carries 20 marks.
4) Figure to the right indicates full marks.

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

I] Draw and explain the status register of Pic 18 microcontroller **(05 marks)**

II] Compare the microprocessor with microcontroller **(05 marks)**

III] Write a short note on Capture Mode of CCP module in Pic18 microcontroller. **(05 marks)**

IV] Describe File Select Register (FSRx) and Stack Pointer (STKPTR) registers. **(05 marks)**

V] Explain the SPBRG register used in USART module of Pic18. **(05 marks)**

Q. 2. A] What is mean by Assembler Directives? Explain any 05 assembler directives used in Pic18 microcontroller. **(10 marks)**

B] Explain the memory organization of Data Memory along with the concept of Access Bank of Pic18 Microcontroller. **(10 marks)**

Q. 3. A] What is mean by Addressing mode? Explain the addressing modes used in Pic18 microcontroller **(10 marks)**

B] Write a C program to generate 400 Hz frequency at RB3 pin of Pic18 microcontroller using Timer0 operated in 16-bit mode. The crystal oscillator frequency is 10MHz and Timer prescaler of 128. **(10 marks)**

Q. 4. A] Draw and Explain the GIE and PEIE bits with reference to simplified vectored interrupt. **(10 marks)**

B] Explain the TxSTA and RcSTA registers used in USART module of Pic18 microcontroller. **(10 marks)**

Q. 5. A] Explain the Table Write operation along with the instructions associated with it. **(10 marks)**

B] Explain the ADCON0 and ADCON1 control registers of ADC module in Pic18 microcontroller. **(10 marks)**

Q. 6 Write **any 02** short notes.

i] LCD interfacing with Pic 18 microcontroller. **(10 marks)**

ii] DC Motor Interfacing with Pic 18 microcontroller. **(10 marks)**

iii] Stepper motor interfacing with Pic 18 microcontroller **(10 marks)**

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. Why is the phase margin increased above that desired when designing a lead compensator?

b. Define observability. Explain how it can be determined for a controller canonical representation.

c. Why is there less improvement in steady-state error if a lag controller is used instead of a PI controller?

d. The horizontal lines on the s-plane are lines of constant peak time. How these points can be mapped to z-plane? Justify with the equation.

Q2 a. Given the unity feedback system with $G(s)=\frac{K}{(s+4)(s+6)(s+12)}$ use Root locus technique to determine the value of gain K to yield a step response with a 15% overshoot. 10

b. Given the following open loop plant $G(s)=\frac{10}{s(s+2)(s+4)}$. Design a controller to yield a15% overshoot and a peak time of 0.4 sec assuming that the plant is represented in the phase variables form. Assume third pole 10 times farther from the imaginary axis than the dominant poles. 10

Q3 a. For the digital system with forward transfer function $G(z)=\frac{0.56}{(z-2)(z-3)(z-0.5)}$ find the static error constants and the steady state error if the inputs are u(t), t u(t) and $\frac{t^2}{2}u(t)$. Sampling time T=0.1. 10

b. For a unity feedback system with $G(s)=\frac{K}{(s+2)(s+6)(s+8)}$ design a lag compensator using bode plot so that the system operates with a 10% overshoot and a static error constant of 100. 10

Q4 a. Consider the plant $G(s)=\frac{20}{(s+5)(s+6)(s+9)}$ which is represented in parallel form. Design an observer with a transient response described by $\zeta=0.45$ and $w_n=100$. Place the observer third pole 10 times as far from the imaginary axis as the observer dominant poles. Transform the plant to observer canonical form for the design. Then transform the design back to parallel form. 15

b. Find G(z) for G(s)= $\frac{20}{(s+5)}$ in cascade with a sampler and a zero-order sample and hold. The sampling period is 0.25. 05

Q5 a. A unity feedback system with forward path transfer function G(s)= $\frac{K}{s(s+5)(s+8)}$ has 15% overshoot. Evaluate the current dominant poles using R.L and then design a PD controller to reduce the settling time by a factor of 2. 10

b. Given a sampler and z.o.h. in cascade with G(s)= $\frac{3}{(s+3)}$ find the range of T to make the system stable. 10

Q6 a. Given the plant 10

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

Design an integral controller to yield a 12% overshoot, 2 sec. settling time and zero steady state error for a step input.

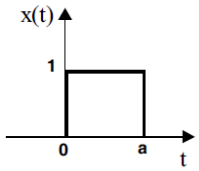
b. Compare lag and lead compensator with respect to application, pole-zero plot and circuit for implementation. Construct the transfer functions of lag and lead compensators from their respective circuits. 10

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 even and odd parts of the signal **05**



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

$$X(z) = \frac{z - 0.4}{z^2 + z + 2}$$

C) Determine the Fourier series representation of the following discrete time signals x(n)=2cos$\sqrt{3}\pi$n **05**

D) Write a note on bilinear transformation used in filter design **05**

Q 2 a) State whether the following system is linear, causal, time-invariant and stable **10**
y(n)=nx(n)+x(n+2)+y(n-2)

Q 2 b) (i) Determine the transfer function H(z) of the following system **10**

y(n)-0.5y(n-1)=x(n)

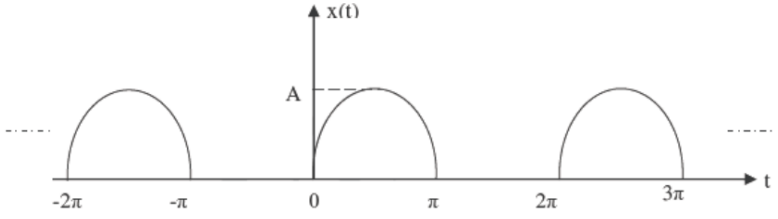
(ii) Determine whether the given signals are periodic or not, if periodic find the fundamental period.

A) $\sin(1.2\pi t)$

B) x (t) = 3 cos(4t) + 2 sin(πt)

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) An LTI system is described by the difference equation **10**

$$y(n) - \frac{9}{4}y(n-1) + \frac{1}{2}y(n-2) = x(n) - 3x(n-1)$$

Specify the ROC of H(z), and determine the h(n) for the following conditions

a)the system is stable

b)the system is causal

Q 4 b) Find the convolution of the sequences **10**

$$x_1(n) = \left(\frac{1}{3}\right)^n u(n) \text{ and } x_2(n) = \left(\frac{1}{5}\right)^n u(n)$$

Using the convolution property of Z transforms

Q 5 a) i. Perform IDFT using the matrix method to obtain x(n) of the following signal X(k) ={1,0,1,0} **10**

ii. In an LTI system i/p x(n)= {1,1,1} and the impulse response h(n)={-1,-1}. Determine Y(k) of the system by radix-2 DIT FFT

Q 5 b) An 8-point sequence is given by x(n) = { 1,2,3,4,4,3,2,}. Derive 8-point DFT of x(n) by radix-2 DIT-FFT **10**

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) Design a digital Butterworth low pass filter satisfying the following equation **10**

$0.7 \le \left|H(e^{jw})\right| \le 1 \qquad 0 \le \omega \le 0.2\pi$

$\left|H(e^{jw})\right| \le 0.3 \qquad 0.6\pi \le \omega \le \pi$

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Time: 3 Hrs **Marks: 80**

Note:- 1. Question No. 1 is compulsory
2. Attempt any three questions out of remaining five questions
3. Assume suitable data if necessary & justify the same
4. Figures to the right indicates marks

Qu.1 Attempt **any Four**.

(a) Explain Kando system of track electrification. What are the advantages and disadvantages of Kando system? **[5]**

(b) State and explain the factors affecting to schedule speed **[5]**

(c) Discuss the various protection schemes at traction substation. **[5]**

(d) Explain the working of Pantograph collector. Give its advantages **[5]**

(e) Explain block section concept. **[5]**

Qu.2 (a) Derive the equation for maximum speed in simplified trapezoidal speed-time curve. **[10]**

(b) A Speed-time curve of a train consists of:
1. Uniform acceleration of 5 Km/Hr/sec for 20 sec.
2. Free running for 20 minutes.
3. Uniform deceleration of 6 Km/Hr/sec.
4. A stoppage of 5 minutes.

Calculate (1) Distance between stations(2) Average speed (3) Schedule speeds **[10]**

Qu.3 (a) Discus the operation of DC traction using chopper control drive. **[10]**

(b) State the desirable characteristics of traction motor. How DC series motor are suitable for traction drive? Justify **[10]**

Qu.4 (a) Explain the feeding and sectioning arrangements with circuit diagram. **[10]**

(b) Describe the working of booster transform in traction system. Also state the limitation of booster transformer **[10]**

Qu.5 (a) Discuss the design consideration of catenary wire in traction system. **[10]**

(b) Explain the working of Automatic Weight Tension and Automatic Tensioning Device **[10]**

Qu.6 (a) What is Interlocking Principle? Explain various Techniques of interlocking. **[10]**

(b) Derive an expression for specific energy output on a level track using simplified time- speed curve **[10]**

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(3 Hours) **[Total Marks: 80]**

N.B. : (1) Question No.1 is compulsory
(2) Attempt any three from the remaining
(3) Figures to the right indicate full marks
(4) Assume suitable data if necessary

1.	(a)	Explain emerging trends in batteries.	20
	(b)	Explain the necessity of energy storage.	
	(c)	Explain different types of fuel cell.	
	(d)	Write a short note on: Solar Pond.	
2	(a)	Write a short note on Flywheel.	10
	(b)	Explain in detail about latent heat storage.	10
3.	(a)	Explain working principle of Rechargeable battery.	10
	(b)	Explain in detail about design considerations for sizing of different types of energy storage systems for various applications	10
4.	(a)	Write a short note on Superconducting magnetic energy storage (SMES).	10
	(b)	Explain in briefly about seasonal thermal energy storage.	10
5.	(a)	Explain in detail about Pumped hydro storage system.	10
	(b)	Write a short note on: Supercapacitors	10
6.	(a)	Explain in brief: Future technology in energy storage as Electric vehicle	10
	(b)	Explain briefly about Compressed air energy storage (CAES)	10

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