Bharatiya Vidya Bhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)
Munshi Nagar, Andheri (W) Mumbai – 400058

ENDSEM EXAMINATION DECEMBER 2023

TY
Program: Electrical Engineering sem V

Course Code: PC-BTE505

Course Name: Power Electronics

Duration: 3 hours

Maximum Points: 100

Semester: V

- **Notes:**
- **Question number 1 is compulsory**
- **Solve any four questions out of remaining 6 questions**

o.	Questions	Points	CO	BL	Module No.
	A. What are the different methods to trigger the thyristor?	4	1		1
	B. Write down the expression for average output voltage for step up chopper	6	4		6
	C. What type of gating signal is used in single phase ac voltage controller with RL load?	2	1	3	7
	D. Explain Sinusoidal PWM technique used in inverters	6	3		5
	E. Which filter is used to connect Solar PV system to the grid?	2	2		4
	Draw source voltage (2 marks), triggering pulses (3 marks), load phase voltages (3 marks), line voltages (3 marks), line load current (marks 3) of three phase 180 degree conduction voltage source inverter for R-L load. Derive load voltages (marks 6).	20	3	3	5
. A	Derive average output voltage of single phase controlled full-wave rectifier with R-L load when freewheeling diode is connected across load.	4	2	3	3
	In single phase full wave rectifier with R load, peak output voltage is 300 V and average output voltage is 100 V. Find the firing angle of the rectifier.	8			
B	Draw source voltage (1 mark), load voltage (2 marks), source current(3 marks) and load current (2 marks) waveforms for following circuit Single phase full-wave controlled rectifier with R-L load and freewheeling diode connected across the load.	8	2	3	3

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ENDSEM EXAMINATION DECEMBER 2023

	Compare current source inverter with voltage source inverter.	10	3	2	5
	Discuss the operation of single phase current source inverter with the help of neat circuit diagram.	10	3	2	5
	With the help of source voltage, load voltage, inductor voltage, capacitor voltage, inductor current, capacitor current and load current waveforms derive buck-boost DC to DC converter's output voltage relation with input voltage, critical inductor and capacitor value for continuous current mode of operation.	14	4	3	6
	The buck boost circuit has following parameters **V_s= 24 V** **D = 0.4** **R = 5 Ω** **L = 20 μH** **C = 80 μF** **f= 100 kHz** **Determine the output voltage, inductor current average, maximum and minimum values and the output voltage ripple**	6	4	3	6
	Draw the possible configurations of single phase AC voltage controllers. **For single phase AC voltage controller, feeding R-L load, draw waveforms of source voltage, gating singles output voltage and output current. Discuss the working with reference to waveforms drawn.**	6 14	1	3	7
A	**Draw following waveforms (on graph papers) of three phase controlled rectifier with continuous and ripple free load current and for α=120^0** **1. source voltage (4 marks)** **2. Load voltage (4 marks)** **3. Load current (1 mark)** **4. phase c supply current (3 marks)**	12	2	3	3
	Write short note on any of fully controlled switch by using following points **Symbol, characteristics, application**	8	1	2	2

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RE-EXAMINATION FEB 2024

T. Y

Program: Electrical Engineering Sem V
Course Code: PC-BTE505
Course Name: Power Electronics

Duration: 3 hours
Maximum Points: 100
Semester: V

9/2/24

- **Notes:**
- **Solve any five questions**

Q.No.	Questions	Points	CO	BL	Module No.
1.A	Write short note on sine-triangular PWM technique used to trigger the VSI.	12	3	3	5
1. B	Draw and explain V-I characteristics of SCR.	8	1	2	2
2.	Draw source voltage (2 marks), triggering pulses (3 marks), load phase voltages (3 marks), line voltages (3 marks), line load current (marks 3) of three phase 180 degree conduction voltage source inverter for R-L load. Derive load voltages (marks 6).	20	3	3	5
3. A	Derive average output voltage of three phase full-wave controlled rectifier with continuous current load.	8	2	3	3
3 B	Draw source voltage (1 mark), load voltage (3 marks), source current (4 marks) and load current (4 marks) waveforms for following circuit Single phase full-wave controlled rectifier with R-L-E load $\alpha=60^0, \beta=190^0$	12	2	3	3
4.A	A single-phase full bridge voltage source inverter load is R-L. Draw circuit diagram (marks 3), Draw input voltage (1 mark), output voltage (2 marks) and output current (4 marks) waveforms with appropriate naming.	10	3	3	5
B.	Discuss the operation of single-phase current source inverter with the help of neat circuit diagram.	10	3	2	5
5 A	With the help of source voltage, load voltage, inductor voltage, capacitor voltage, inductor current, capacitor current and load current waveforms derive buck DC to DC converter's output voltage relation with input voltage, critical inductor and	14	4	3	6

	capacitor value for continuous current mode of operation.				
B.	**The buck dc to dc circuit has following parameters** **Vs= 50 V** **D = 0.4** **R = 20 Ω** **L = 400 μH** **C = 100 μF** **f= 20 kHz** **Determine the output voltage, inductor current average, maximum and minimum values and the output voltage ripple**	**6**	**4**	**3**	**6**
6.	**Draw the possible configurations of single phase AC voltage controllers.**	**10**	**1**	**3**	**7**
	For single phase AC voltage controller, feeding R-L load, draw waveforms of source voltage, gating singles output voltage and output current. Discuss the working with reference to waveforms drawn.	**10**			
7 A	**Draw following waveforms (on graph papers) of three-phase controlled rectifier with continuous and ripple free load current and for $\alpha=90^0$** **1. source voltage (5 marks)** **2. Load voltage (5 marks)** **3. Load current (2 mark)** **4. phase 'a' supply current (4 marks)**	**16**	**2**	**3**	**3**
B	**Draw output voltage waveform of single-phase controlled rectifier for R-L load and suggest filter to be connected to smooth output voltage waveform.**	**4**	**1**	**2**	**2**

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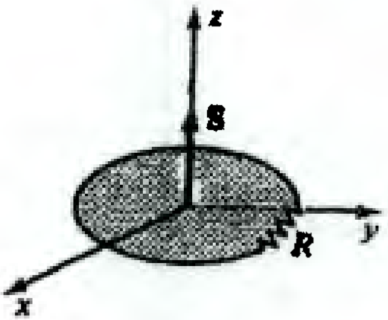
End Semester - December 2023 Examinations

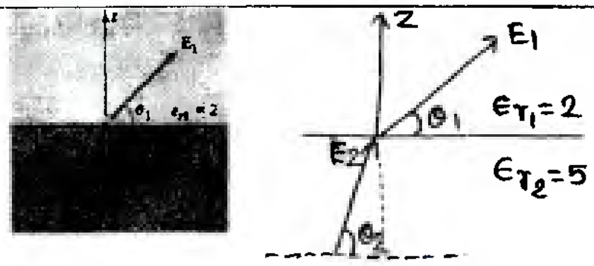
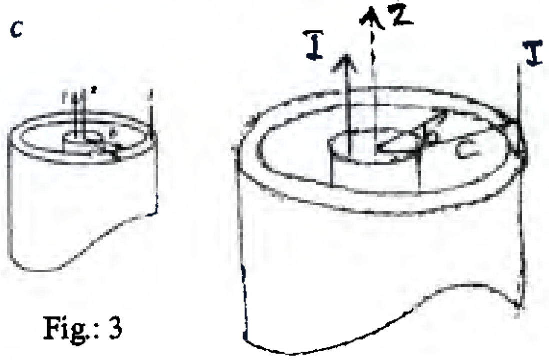
Program: T.Y. B. Tech. (Electrical) Sem V
Duration: 3 hrs.
Course Code: PC-BTE501
Maximum Points: 100
Course Name: Electromagnetic fields and waves
Semester: V

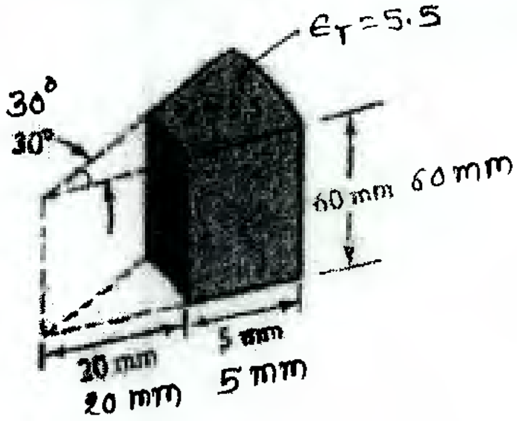
22\12\23

Notes:

1. Question number 1 compulsory
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Q. No.	**Questions**	**Pt.**	**CO**	**BL**	**Mod. No.**
1.(a)	A current filament of 10 A in the $-\hat{a}_y$ direction is parallel to y-axis at $x = 4\,m\ and\ z = 2\,m$. Find $\overline{H}$ at the origin.	05	3	L2	4
1.(b)	The circular loop conductor shown in fig. 1 lies in the $z = 0$ plane, has a radius of 0.1 m and a resistance of $5\,\Omega$. Given $\overline{B} = 0.20 \sin 10^3 t\ \hat{a}_z\ Tesla$. Determine the current.  Fig.: 1	05	3	L3	4,5
1.(c)	Given $\overline{H} = H_m e^{j(\omega t+\beta z)}\hat{a}_x$ in free space. Find $\overline{E}$.	04	2	L2	6
1.(d)	Given that $\overline{E_1} = 9\widehat{a_x} - 2\widehat{a_y} + 15\widehat{a_z}\ V/m$ at the charge free dielectric interface of Fig. 2 .Find D_2 and angle $\theta_1 and\ \theta_2$	06	2	L3	3

	 Fig. 2				
2.	Write Maxwell's equations for static and time varying fields in point form and integral form. **Derive** Maxwell's equations for time varying fields. Explain physical significance of each equation.	**20**	1	L2	4,5
3.(a)	Prove that $$\nabla \times H = J$$ Explain physical significance of above Maxwell's equation.	**10**	1	L3	4
3.(b)	Current in the inner and outer conductors of Fig.3 are uniformly distributed. Use Ampere circuital law to derive expression of magnetic field intensity (H) for $b \leq r \leq c$  Fig.: 3	**06**	2	L3	4
3.(c)	Given electromagnetic wave equations are $$\bar{E} = -E_m \sin(\omega t + \beta z)\hat{a}_z$$ $$\bar{H} = H_m \sin(\omega t + \beta z)\hat{a}_y$$ Sketch E & H at t = 0.	**04**	3	L2	6
4.(a)	For a charge $Q = 10\,nC$ moving with uniform velocity of $10^7 m/s$ and direction is specified by the unit vector $$\hat{a}_v = \hat{a}_x + \hat{a}_y + \hat{a}_z$$ Determine the force exerted on the charge if 1. $\bar{B} = \hat{a}_x + 2\hat{a}_y + 3\hat{a}_z\, mwb/m^2$ 2. $\bar{E} = 3\hat{a}_x + 2\hat{a}_y + \hat{a}_z\, KV/m$	**06**	2	L3	5

4.(b)	Determine the amplitude of the transmitted & reflected E & H at the interface, 1. If $E_0^i = 2 \times 10^{-3} V/m$ in region 1 in which $\epsilon_{r1} = 6.5, \mu_{r1} = 1\, and \sigma_1 = 0$. 2. Region 2 is free space (Assume normal incidence)	**07**	2	L3	7
4.(c)	Identical charges of $Q(C)$are located at the eight corners of a cube with side of $lmeter$ show that coulombs force on each charge has magnitude $\left(\frac{3.29Q^2}{4\pi\epsilon_0 l^2}\right) N$.	**07**	2	L2	2
5.(a)	Derive an expression for the energy stored in static electric field of n point charges.	**10**	2	L2	2
5.(b)	Given the conduction current density in lossy dielectric as $J_c = 0.02 \sin 10^9 t \ (A/m^2)$. Find the displacement current density if $\sigma = 10^2 \, S/m$ and $\epsilon_r = 8.5$.	**05**	1	L3	6
5.(c)	Calculate the flux passing the portion of the plane $\emptyset = \frac{\pi}{4}$ defined by $0.02 < \rho < 0.06 \, m$ and $0 < Z < 2 \, m$ for a current of 4 A. The flux density at a point, distance ρ from a long filamentary current **I in** $\hat{a}_z$ direction is given by $\bar{B} = \frac{\mu_0 I}{2\pi\rho} \hat{a}_\emptyset$. (Draw neat diagram)	**05**	1	L2	4
6.(a)	Explain in short boundary conditions in electric field and magnetic field.	05	1	L1	3,5
6.(b)	Find the capacitance between the inner and outer curved conductor surfaces shown in fig. 4. Neglect fringing.  Fig. 4	05	2	L3	3

6.(c)	Write short note on 1. Wave Equations 2. Reflected waves and intrinsic impedance for various materials	**10**	1	L2	7
7(a)	Derive an expression for the electric field intensity due to an infinite line charge.	**10**	2	L2	2
7.(b)	State Stoke's theorem. A circular conductor of radius $r_0 = 1cm$ has internal field $\overline{H} = \frac{10^4}{r}\left(\frac{1}{a^2}\sin ar - \frac{r}{a}\cos ar\right)\overline{a_\emptyset}(A/m)$ Where, a $= \frac{2\pi}{r_0}$. Find the total current in the conductor.	**07**	3	L3	4
7.(c)	Use spherical coordinate to express differential volume, integrate to obtain the volume defined by $1 \le r \le 2, 0 \le \theta \le \frac{\pi}{2}$ and $0 \le \emptyset \le \frac{\pi}{2}$	**03**	2	L1	1

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Re Examination - February 2024

Program: T.Y. B.Tech. (Electrical) Sem V **Duration: 3 hrs.**
Course Code: PC-BTE501 **Maximum Points: 100**
Course Name: Electromagnetic fields and waves **Semester: V**

Notes:

1. Question number 1 compulsory
2. Attempt any four questions out of remaining six.
3. Draw neat diagrams
4. Assume suitable data if necessary

Q.No.	**Questions**	**Points**	**CO**	**BL**	**Mod. No.**
1. (a)	A current filament of 20 A in the $\hat{a}_x$ direction is parallel to y-axis at $y = 4\ m\ and\ z = 2\ m$. Find $\bar{H}$ at the origin.	**07**	2	L3	4
1.(b)	For a charge $Q = 10\ nC$ moving with uniform velocity of $10^7 m/s$ and direction is specified by the unit vector $\bar{V} = -0.5\hat{a}_x + \hat{a}_y - 0.71\hat{a}_z$ Determine the force exerted on the charge if 1. $\bar{B} = \hat{a}_x + 2\hat{a}_y + 3\hat{a}_z\ mwb/m^2$ 2. $\bar{E} = 3\hat{a}_x + 2\hat{a}_y + \hat{a}_z\ KV/m$	**06**	2	L3	5
1.(c)	Determine the amplitude of the transmitted & reflected E & H at the interface, 1. If $E_0^i = 2 \times 10^{-3} V/m$ in region 1 in which $\epsilon_{r1} = 6.5, \mu_{r1} = 1\ and\sigma_1 = 0$. 2. Region 2 is free space (Assume normal incidence)	**07**	2	L3	7
2. (a)	Starting with Ampere's circuital law, derive Maxwell's equation in integral form. Obtain the corresponding relation by applying the Stoke's theorem	**12**	1	L3	4
2.(b)	Explain in short boundary conditions in electric field and magnetic field.	**08**	3	L3	5

<table>
<tr><td>3. (a)</td><td>Write Maxwell's equations for static fields in point form and integral form. Derive Maxwell equations for time varying fields. Explain physical significance of each equation.</td><td>14</td><td>3</td><td>L2</td><td>6</td></tr>
<tr><td>3.(b)</td><td>The circular loop conductor shown in fig. 1 lies in the $z = 0$ plane, has a radius of 0.1 m and a resistance of $5\ \Omega$.
Given $\bar{B} = 0.20 \sin 10^3 t\ \hat{a}_z\ Tesla$. Determine the current.
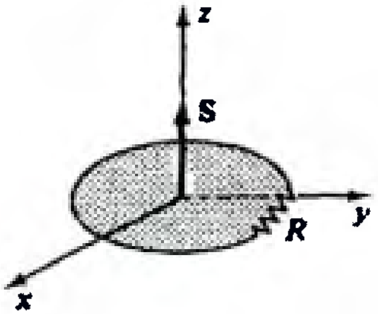
Fig.: 1</td><td>06</td><td>3</td><td>L3</td><td>4</td></tr>
<tr><td>4.(a)</td><td>Derive an expression for the energy stored in static electric field of n point charges.</td><td>10</td><td>2</td><td>L2</td><td>2</td></tr>
<tr><td>4.(b)</td><td>Prove that
$$\nabla . D = \rho_v$$</td><td>10</td><td>2</td><td>L2</td><td>2</td></tr>
<tr><td>5.(a)</td><td>Given the conduction current density in lossy dielectric as $J_c = 0.02 \sin 10^9 t\ \ (A/m^2)$. Find the displacement current density if $\sigma = 10^2\ S/m$ and $\epsilon_r = 8.5$.</td><td>05</td><td>1</td><td>L3</td><td>6</td></tr>
<tr><td>5.(b)</td><td>Find the voltage across each dielectric in the capacitor shown in Fig. 2 when the applied voltage is 500 V.
(Given: $\varepsilon_{r1} = 5$ & $\varepsilon_2 = \varepsilon_0$)
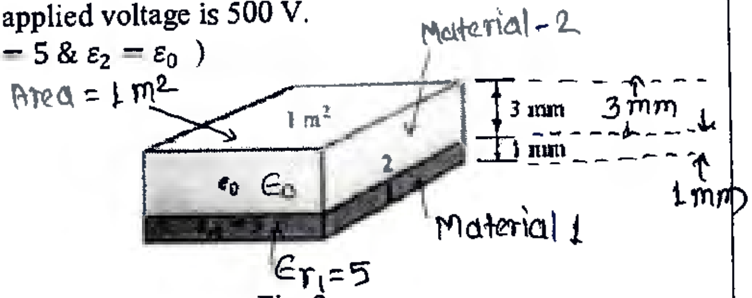
Fig. 2</td><td>05</td><td>2</td><td>L3</td><td>3</td></tr>
<tr><td>5.(c)</td><td>Derive an expression for the electric field intensity due to an infinite line charge.</td><td>10</td><td>2</td><td>L2</td><td>2</td></tr>
</table>

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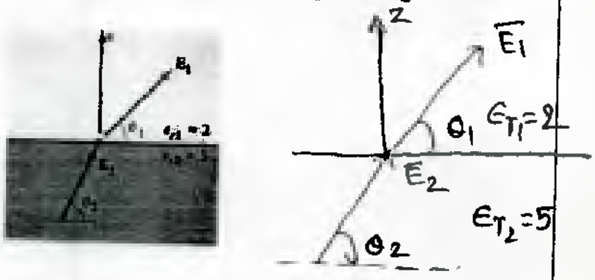
Re Examination - February 2024

6.(a)	Derive Poisson's and Laplace's equations.	**05**	1	L2	3
6.(b)	Given electromagnetic wave equations are $\bar{E} = -E_m \sin(\omega t + \beta z)\hat{a}_z$ $\bar{H} = H_m \sin(\omega t + \beta z)\hat{a}_y$ Sketch E & H at t = 0.	**03**	3	L2	6
6.(c)	Given that $\overline{E_1} = 9\widehat{a_x} - 2\widehat{a_y} + 15\widehat{a_z}\ V/m$ at the charge free dielectric interface of Fig. 3 .Find D_2 and angle $\theta_1 and\ \theta_2$  Fig. 3	**06**	2	L3	3
6.(d)	A linear, homogeneous, isotropic dielectric material has permittivity $\varepsilon_r = 3.6$ and is covering the space between z=0 and z=1. If V= - 6000 z V in material. Find- (i) $\bar{E}$ (ii) $\bar{P}$ (iii) ρ_s.	**06**	4	L3	3
7.(a)	Write short note on 1. Wave Equations 2. Reflected waves and intrinsic impedance for various materials	**10**	1	L2	7
7.(b)	State Stoke's theorem. A circular conductor of radius $r_0 = 1cm$ has internal field $H = \frac{10^4}{r}\left(\frac{1}{a^2}\sin ar - \frac{r}{a}\cos ar\right)\overline{a_\emptyset}(A/m)$ Where, a $= \frac{2\pi}{r_0}$. Find the total current in the conductor.	**07**	3	L3	4
7.(c)	Use spherical coordinate to express differential volume, integrate to obtain the volume defined by $1 \leq r \leq 2, 0 \leq \theta \leq \frac{\pi}{2}$ and $0 \leq \emptyset \leq \frac{\pi}{2}$.	**03**	2	L1	1

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26/12/23

END-SEMESTER EXAMINATION DECEMBER 2023

Program: TY BTech (Electrical) Sem V **Duration: 3Hr**

Course Code: PC-BTE-502 **Maximum Points: 100**

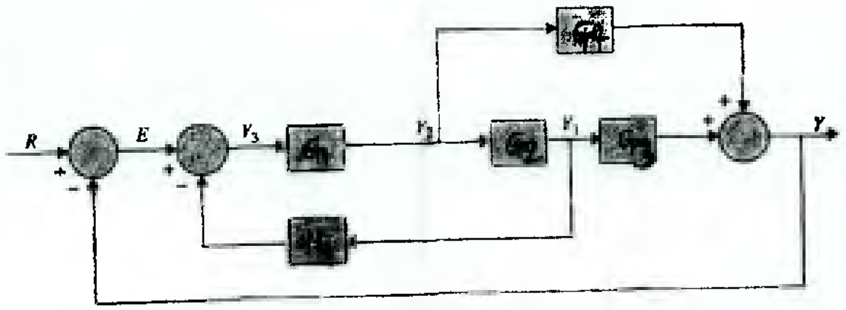
Course Name: Control System **Semester: V**

Note: 1) **Question 1 is compulsory.** Solve Any Four from remaining questions. 2) Answers to all sub questions should be grouped together. 3) Points to the right indicate full marks. 4) In the absence of any data, make suitable assumptions and justify the same. 5) Use graph paper for plotting Root Locus, Polar, Nyquist plots and semi-log paper for Bode.

Q. No.	Questions	Points	CO	BL	Module No.
1a)	Sketch Polar Plot of a system having open loop transfer function as $G(s)H(s) = \frac{16}{(s^2+10s+16)}$.	05	01 02	03	04
1b)	A system has state space representation as – $\dot{x} = \begin{bmatrix} 0 & -1.5 \\ 4 & 2 \end{bmatrix} x + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u$ and $y = [1.5 \quad 3]x$ Obtain transfer function of the system.	05	01 02	03	06
1c)	Calculate peak time, %overshoot, steady state output and settling time for a system having closed loop transfer function $Gcl(s) = \frac{25}{(s^2+s+25)}$. Plot the nature of the response for unit step input.	05	01 02	03	02
1d)	In a series RLC circuit, determine transfer function of the system if vi(t) is input applied to the circuit and voltage across indictor $v_L(t)$ is taken as the output. **OR** Justify the need of non-linear control.	05	01 04	02	01 07
2a)	Plot frequency response (Bode plot) of a unity feedback system with $G(s) = \frac{200}{s(s+1)(s+40)}$ Comment on the stability of the system.	12	02	03	04
2b)	Plot Nyquist plot of a system having loop transfer function $GH(s) = \frac{10}{S(s+5)}$ Comment on the stability of the system.	08	02	03	04

3a)	Plot Root Locus of a closed loop unity feedback system with plant transfer function $G(s) = \frac{K(s+1)}{(s^2+4s+13)}$	15	01 02	03	03
3b)	Consider the system in Q3a). Design the value of K to get time constant of 1/3 seconds.	05	01 02	04	03
4a)	Consider a system with state equations as – $\dot{x} = \begin{bmatrix}-1 & 0\\ 1 & -2\end{bmatrix}x + \begin{bmatrix}1\\ 0\end{bmatrix}u$ Determine the state transition matrix, state space solution of the system (using state space analysis) when input applied is unit step signal.	12	01 02	03	06
4b)	Test if a system with state space representation is controllable and observable $\dot{x} = \begin{bmatrix}1 & 5\\ 4 & 2\end{bmatrix}x + \begin{bmatrix}2\\ 0\end{bmatrix}u$ and $y = \begin{bmatrix}0 & 3\end{bmatrix}x$	08	01 02	03	06
5a)	Consider a closed loop system with $G(s) = \frac{10}{(s+2)}$ and $H(s) = \frac{1}{(s+5)}$. Determine steady state error and % overshoot when unit step signal is applied as an input. Add proportional plus integral controller in forward path with kp=2 and ki=1. Comment on the improvement in steady state performance of the system.	10	03	03	05
5b)	Consider a unity feedback closed loop system with $G(s) = \frac{5}{(s+2)}$. Determine steady state and transient state performance of the system when unit step signal is applied as an input and i) Proportional controller is added in forward path with kp=10. ii) PD controller is added in forward path with kp=10, kd=0.1. Compare the performance of P and PD controller in above case.	10	03	03 04	05
6a)	Determine output of a system with closed loop transfer function $Gcl(s) = \frac{(s+3)}{(s+2)(s+5)}$	10	01	02	02

END-SEMESTER EXAMINATION DECEMBER 2023

	Calculate and plot response of the system if input applied is r(t)= 20u(t). Test if it is undamped system?				
6b)	Determine resultant transfer function of the system given below- 	10	01	02	01
7a)	Calculate pole locations of the system and comment on the stability. $\dot{x} = \begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & 0 \\ -2 & -3 & -4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$ and $y = [0 \ \ 0 \ 1]x$	10	01 02	03	06
7b)	Van der Pol Oscillator dynamics are governed by following equation $\frac{d^2x}{dt^2} - \underbrace{\mu(1-x^2)}\frac{dx}{dt} + x = 0 \quad ; \quad \mu \rightarrow \text{constant}$ Where x is position. Is it a linear or non-linear system? Obtain state space model of the system in the form $\dot{X} = f(X)$. Calculate equilibrium point of the system.	10	04	03	07

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13/2/24

Re-Examination February 2024

Program: TY BTech (Electrical) Sem V **Duration: 3Hr**

Course Code: PC-BTE-502 **Maximum Points: 100**

Course Name: Control System **Semester: V**

Note: 1) Solve Any Five questions. 2) Answers to all sub questions should be grouped together. 3) Points to the right indicate full marks. 4) In the absence of any data, make suitable assumptions and justify the same. 5) Use graph paper for plotting Root Locus, Polar, Nyquist plots and semi-log paper for Bode.

Q. No	Questions	Points	CO	BL	Module No.
1a)	What is nonlinearity? Explain any one non-linearity in detail.	05	04	02	07
1b)	Consider a parallel RLC network excited by a current source i(t). Let current through inductor be $i_L(t)$. Model the system in transfer function form taking inductor current as output of the system.	05	01	02	01
1c)	A system has state space representation as – $\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ and $y = [1\ \ 1]x$ Determine if the system is stable (04)? Obtain transfer function of the system (03). Calculate output of the system for unit step input.(03)	10	01 02	03	06 04 02
2a)	Plot Root Locus of a closed loop unity feedback system with plant transfer function $G(s) = \frac{K(s+2)}{(s+1)(s+3)(s+5)}$	15	01 02	03	03
2b)	Calculate the value of gain at s= -1.5.	05	02	04	03
3a)	Plot frequency response (Bode plot) of a unity feedback system with $G(s) = \frac{50}{(s+15)(s+2)}$ Comment on the stability of the system.	10	02	03	04
3b)	Plot Nyquist plot of a system having loop transfer function $GH(s) = \frac{8}{(s+1)(s+2)}$ Comment on the stability of the system.	10	02	03	04
4a)	Consider a system having closed loop transfer function as $Gcl(s) = \frac{100}{(s^2+10s+100)}$. Determine %overshoot, peak time, settling time. Evaluate steady state error for unit step, unit ramp and unit parabolic input. Is the system stable? Justify.	10	01	02	02

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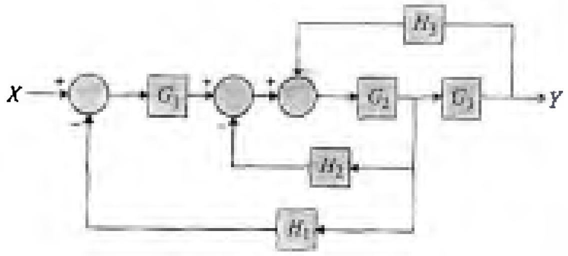
4b)	Consider a closed loop system with $G(s) = \frac{5}{(2s+7)}$ and $H(s) = \frac{(s+3)}{(s+5)}$. Determine output of the system for unit step input and calculate steady state output.	10	01	02	02
5a)	Consider a system with state equations as – $\dot{x} = \begin{bmatrix} 0 & -1 \\ -5 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$ Determine state space solution of the system (using state space analysis) when input applied is unit step signal and $x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$.	10	01 02	03	06
5b)	Consider a unity feedback closed loop system with $G(s) = \frac{1}{(s+10)}$. Determine steady state and transient state performance of the system when unit step signal is applied as an input. Add PI controller in forward path and compare the performance of system with and without controller.	10	03	03 04	[illegible]
6a)	Consider a system with characteristic equation as $3\,s^7 + 9\,s^6 + 6\,s^5 + 4\,s^4 + 7\,s^3 + 8\,s^2 + 2s + 6 = 0$. Determine stability of the system. How many poles are there on left half and on right half of s-plane?	10	02	03	03
6b)	Determine resultant transfer function of the system given below-  	10	01	02	01
7a)	Determine eigen values of the system and comment on the stability. Calculate any one eigen vector. $\dot{x} = \begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & 0 \\ -2 & -3 & -4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$ and $y = [0 \;\; 0 \;\; 1]x$	10	01 02	03	06
7b)	Derive expression for error constant, steady state error for Type 0, Type1 and Type 2 system.	10	02	02	04

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END SEM EXAMINATION DECEMBER 2023

Program: T. Y. B. Tech Electrical Engineering Sem V **Duration: 3 hr.**

Course Code: PC-BTE503 **Maximum Points: 100**

Course Name: Electrical Machines II **Semester: V**

Notes: (1) Attempt any five questions.
(2) Graph papers are required.
(3) Draw neat diagrams wherever necessary.

Q.No.	Questions	Points	CO	BL	Module No.
Q. 1 (a)	A 400V, 3-phase, 6-pole, 50 Hz, induction motor draws a power of 2kW at no load and at rated voltage and frequency. At a full-load slip of 3%, the power input to motor is 50kW and the stator ohmic loss is 1.5kW. Neglect copper loss at no load. If the stator core loss and mechanical losses are assumed equal, then at a slip of 3% calculate (a) rotor ohmic loss (b) shaft (or output) power (c) shaft torque (d) internal torque and (e) efficiency of induction motor.	10	01	BL 1,2	01
Q. 1 (b)	Draw the torque-speed characteristics of three phase induction motor and hence discuss the different methods of starting three phase induction motor in detail.	02+08	01	BL 2	01
Q. 2 (a)	A salient pole synchronous generator has the following per unit parameters. X_d=1.00, X_q=0.60 and Ra=0.02. If this generator is delivering rated KVA at rated voltage and at 0.8 p.f. leading, compute the power angle and the excitation emf.	10	02	BL 1,2	02
Q. 2 (b)	Show that for a salient pole synchronous generator, the per phase reactive power in terms of power angle δ and for a lagging power factor is given by $Q = \frac{E_f V_t}{X_d}\cos\delta - \frac{V_t^2}{X_d} - V_t^2\left(\frac{1}{X_q} - \frac{1}{X_d}\right)\sin^2\delta$ Also determine the maximum reactive power Q; the generator can deliver with fixed excitation. Neglect armature resistance.	08+02	02	BL 1,2	02
Q. 3 (a)	Discuss the effect of field current on synchronous motor power factor with the help of phasor diagram. Hence, draw and explain how V-curve and inverted V-curves are obtained	02+02 +03+03 +02	02	BL 1,2	03

END SEM EXAMINATION DECEMBER 2023

<table>
<tr><td></td><td>by varying field current of synchronous motor. Also, brief why synchronous motor is called as synchronous condenser.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Q. 3 (b)</td><td>Explain the physical concept of hunting in a synchronous machine. What are the causes of hunting? What are the bad effects of hunting? How to avoid hunting effect in machine?</td><td>02+02 +02+02</td><td>02</td><td>BL 1,2</td><td>03</td></tr>
<tr><td>Q. 4 (a)</td><td>Derive and explain the power-angle relationship and hence draw the power-angle characteristics for a salient-pole synchronous machine. Hence explain why a cylindrical rotor machine can't run as reluctance motor.</td><td>06+02 +02</td><td>02</td><td>BL 1,2</td><td>03</td></tr>
<tr><td>Q. 4 (b)</td><td>Explain the excitation circle and power circle diagram for a synchronous motor based on its voltage equation and output power equation respectively by illustrating the locus.</td><td>05+05</td><td>02</td><td>BL 1,2</td><td>03</td></tr>
<tr><td>Q. 5 (a)</td><td>A 6.6 kV, 3-phase, 50 Hz, star-connected alternator gave the following data for open circuit, short circuit and full-load zero-power factor tests:
<table>
<tr><td>I_f (A)</td><td>3.2</td><td>5.00</td><td>7.50</td><td>10.00</td><td>14.00</td></tr>
<tr><td>E_f(kV)</td><td>3.10</td><td>4.90</td><td>6.60</td><td>7.50</td><td>8.24</td></tr>
<tr><td>I_{sc} (A)</td><td>500</td><td>778</td><td>1170</td><td>---</td><td>---</td></tr>
<tr><td>Z.P.F. terminal voltage (kV)</td><td>-----</td><td>1.85</td><td>4.24</td><td>5.78</td><td>7.00</td></tr>
</table>
Per phase armature resistance is 0.2 Ω. Calculate the voltage regulation at full load current of 500 A at 0.8 p.f. lagging by the (1) e.m.f. method (2) m.m.f. method and (3) z.p.f. method.</td><td>04+
04+
04+
+04</td><td>02</td><td>BL 1,2</td><td>02</td></tr>
<tr><td>Q. 5 (b)</td><td>Explain the different conditions for parallel operation of alternators in detail.</td><td>04</td><td>02</td><td>BL 1,2</td><td>04</td></tr>
<tr><td>Q. 6 (a)</td><td>Explain clearly the terms direct-axis and quadrature-axis synchronous reactance. Draw the circuit diagram and describe how these reactances determined in the laboratory are? What is the precaution to be taken while performing test in laboratory to determine X_d and X_q?</td><td>02+02 +05+01</td><td>02</td><td>BL 1,2</td><td>05</td></tr>
</table>

Q. 6 (b)	Explain Blondel's two reaction theory as applied to salient pole synchronous machines and draw its phasor diagram for a lagging p.f. load.	06+04	02	BL 1,2	05
Q. 7 (a)	Explain the construction, principle of operation and application of stepper motor and brushless DC motor.	02+02+01+02+02+01	03	BL 1,2	07
Q. 7 (b)	Why single phase induction motor is not self-starting? Hence explain how double field revolving theory helps to make it self start. Explain the different types of single phase induction motors stating their applications.	01+04 +04+01	03	BL 1,2	06

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RE-EXAM & PREVIOUS SEM EXAM FEBRUARY 2024

Program: T. Y. B. Tech Electrical Engineering Sem V

Course Code: PC-BTE503

Course Name: Electrical Machines II

Duration: 3 hr.

Maximum Points: 100

Semester: V

Notes: (1) Attempt any five questions.
(2) Draw neat diagrams wherever necessary.

Q.No.	Questions	Points	CO	BL	Modul No.
Q. 1 (a)	A 60 kW, 400 V, 3-phase, 6-pole, 50 Hz wound rotor induction motor has a full-load slip of 0.04 when operating at rated voltage and frequency with rotor winding short circuited at slip rings. The slip at maximum torque is 0.2. Stator resistance and mechanical losses are neglected. Determine (a) the maximum torque, (b) full-load rotor ohmic losses.	10	01	BL 1,2	01
Q. 1 (b)	Explain the basic working principle of 3-phase induction motor. What are the types of 3-phase induction motor? Hence describe the construction of those types of induction motor.	04+01 +05	01	BL 2	01
Q. 2 (a)	A 400V, 50 Hz, 3-phase star connected squirrel-cage induction motor gave the following test results: No load test (line values) : 400 V, 9 A, 560 W Blocked rotor test (line values) : 210 V, 36 A, 4820 W The D.C. resistance of the stator winding per phase measured immediately after the blocked-rotor test is 0.72Ω per phase. Calculate the equivalent circuit parameters.	10	02	BL 1,2	01
Q. 2 (b)	Sketch and explain the phasor diagram of a 3-phase cylindrical pole synchronous generator at unity p.f. load, lagging p.f. load and leading p.f. load.	10	02	BL 1,2	02
Q. 3 (a)	Discuss the nature of armature reaction flux in a salient-pole synchronous machine in case armature current (a) lags the excitation e.m.f. E_f by 90° (b) leads E_f by 90° and (c) is in phase with E_f.	10	02	BL 1,2	02

Q. 3 (b)	Derive and explain the power-angle relationship and hence draw the power-angle characteristics for a salient-pole synchronous machine. Hence explain why a cylindrical rotor machine can't run as reluctance motor.	04+02 +02+02	02	BL 1,2	03
Q. 4 (a)	Describe, with physical concepts, the hunting phenomenon in synchronous machines. Explain why hunting is objectionable. What are the various causes of hunting? How can it be reduced?	04+02 +02+02	02	BL 1,2	03
Q. 4 (b)	Explain the excitation circle and power circle diagram for a synchronous motor based on its voltage equation and output power equation respectively by illustrating the locus.	05+05	02	BL 1,2	03
Q. 5 (a)	For a cylindrical-rotor altemator working at lagging p.f. show that $\tan\delta = \dfrac{I_a(X_s\cos\theta - r_a\sin\theta)}{V_t + I_a(X_s\sin\theta + r_a\cos\theta)}$ For salient-pole synchronous motor, working at lagging p.f. show that $\tan\delta = \dfrac{I_a(X_q\cos\theta - r_a\sin\theta)}{V_t - I_a(X_q\sin\theta + r_a\cos\theta)}$	05 05	02	BL 1,2	04
Q. 5 (b)	Show that a synchronous motor has no net starting torque and hence describe the methods of starting the synchronous motors against light-load torque.	02+08	02	BL 1,2	04
Q. 6 (a)	A 3-phase, 30 kW, 433 volts, 50 Hz, star-connected salient-pole synchronous motor is operating at 0.8 p.f. leading and taking 40 A from the mains. If the direct and quadrature axes reactances of the machine are 5 Ω and 3 Ω respectively, calculate the maximum power the motor can develop if its excitation is maintained constant.	10	02	BL 1,2	05
Q. 6 (b)	Explain Blondel's two reaction theory as applied to salient pole synchronous machines and draw the phasor diagram of a salient-pole synchronous generator showing also the field	05+04	02	BL 1,2	05

	component. Write whether these salient-pole synchronous generators are low-speed or high-speed synchronous machines.	+01			
Q. 7 (a)	Explain basic principle of operation, construction and applications of permanent magnet synchronous motor and brushless DC motor.	05+05	03	BL 1,2	07
Q. 7 (b)	Write short notes with suitable diagram on the following. (1) Capacitor start capacitor runs induction motor. (2) Shaded pole motor.	03+02 +03+02	03	BL 1,2	06

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END SEM EXAMINATION DECEMBER 2023

Program: Electrical Engineering T.Y. Sem V

Course Code: PE-BTE502

Course Name: Computer Architecture

Duration: 3 Hr

Maximum Points: 100

Semester: V

Notes:

- **Question 1 is compulsory.**
- **Attempt any 4 of remaining 6 questions.**
- Illustrate your answers with neat sketches wherever necessary.
- Assume appropriate data if required and state your reason.
- Preferably, write the answers in sequential order.

Q. No.	Questions	Points	CO	BL	Module No.
1.	a. Explain the main structural components of a processor.	5	1	2	1
	b. Express the following numbers in IEEE 32-bit floating-point format: a. -5, b. -6, c. -1.5, d. 384 e. 1/16, f. -1/32.	5	2	3	2
	a. Explain modes of operation of 32-bit microprocessor.	5	3	2	5
	a. Explain five stage pipelining process.	5	3	2	6
2.	a. Distinguish between Von Neumann architecture and Harvard architecture.	6	1	2	1
	a. Draw and explain a diagram to show the pipelined execution of the instructions assuming that the processor uses operand forwarding.	6	1	2	6
	a. Describe branch prediction in pipelining.	8	3	2	6
3.	a. Divide: 13/3, and 18/4 each bits are represented by 8-bits.	8	2	3	2
	b. Given x = 0101 and y – 1010 in twos complement notation (i.e., x = 5, y = -6), compute the product p = x * y with Booth's algorithm.	6	2	3	2
	c. Briefly explain what is meant by a hardwired implementation of a control unit.	6	2	2	2
4.	a. Consider a disk with an advertised average seek time of 4 ms, rotation speed of 16,000 rpm, and 512-byte sectors with 600 sectors per track and number of tracks are 6. Estimate the total number of bytes to be transfer, the total time for the transfer and the average seek time.	6	2	3	3
	a. Describe cache memory mapping techniques.	6	1	2	3
	b. Briefly explain the magnetic hard disk.	8	2	2	3

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5	a. Explain I/O module structure and the major functions of I/O module.	6	2	2	4
	a. Differentiate between parallel and serial ports.	6	1	2	4
	a. Explain Intel 8237A DMA Controller with block diagram.	8	2	2	4
6	a. Explain the programming model of 8086 microprocessor.	10	3	2	5
	b. Explain the various addressing modes of 8086 microprocessor with example.	10	3	2	5
7.	a. Describe the VLIW architecture with example.	6	3	3	7
	b. Describe the DSP architecture with example.	6	3	3	7
	c. Describe the SoC architecture with example.	8	3	3	7

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END SEM RE-EXAMINATION FEBRUARY 2024

Program: T.Y **Electrical Engineering** Sem V **Duration: 3 Hr**

Course Code: PE-BTE502 **Maximum Points: 100**

Course Name: Computer Architecture **Semester: V**

16/2/24

Notes:

- **Question 1 is compulsory.**
- **Attempt any 4 of remaining 6 questions.**
- Illustrate your answers with neat sketches wherever necessary.
- Assume appropriate data if required and state your reason.
- Preferably, write the answers in sequential order.

Q. No.	Questions	Points	CO	BL	Module No.
1.	a. Explain the main structural components of a Computer.	5	1	2	1
	b. Calculate the bias value for a). A base-2 exponent (B = 2) in a 6-bit field? b). A base-8 exponent (B = 8) in a 7-bit field?	5	2	2	2
	c. Explain modes of operation of 32-bit microprocessor.	5	3	2	5
	d. Explain five stage pipelining process.	5	3	2	6
2.	a. Distinguish between CISC and RISC.	6	1	2	1
	b. Draw and explain a diagram to show the pipelined execution of the instructions assuming that the processor uses operand forwarding.	6	1	2	6
	c. Describe branch prediction in pipelining.	8	3	2	6
3.	a. Divide: 16/4, and 12/5 each bits are represented by 8-bits.	8	2	3	2
	b. Divide -25 by 9 in binary twos complement notation, using 6-bit words.	6	2	3	2
	c. Briefly explain what is meant by a hardwired implementation of a control unit.	6	2	2	2
4.	a. Consider a disk with an advertised average seek time of 4 ms, rotation speed of 12,000 rpm, and 128-byte sectors with 300 sectors per track and number of tracks are 3. Estimate the total number of bytes to be transfer, the total time for the transfer and the average seek time.	6	2	3	3
	b. Explain single and three level cache organizations.	6	1	2	3
	c. Briefly explain the magnetic hard disk.	8	2	2	3
5	a. Explain I/O module structure and the major functions of	6	2	2	4

END SEM RE-EXAMINATION FEBRUARY 2024

		I/O module.				
	b.	Differentiate between parallel and serial ports.	6	1	2	4
	c.	Describe the blocks and working of I/O module.	8	2	2	4
6	a.	Explain the architecture of 8086 microprocessor.	10	3	2	5
	b.	Explain the various addressing modes of 8086 microprocessor with example.	10	3	2	5
7.	a.	Describe the VLIW architecture with example.	10	3	3	7
	b.	Describe the DSP architecture with example.	10	3	3	7

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End Semester - December 2023 Examinations

11/24

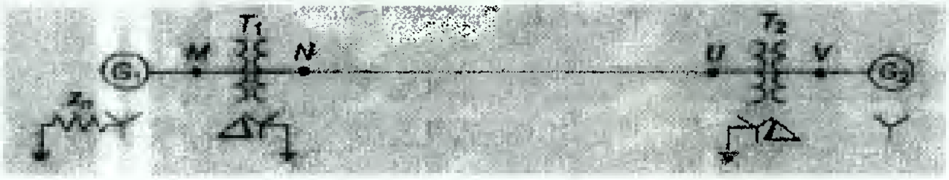
T.Y.

Program: **B. Tech. Electrical** Sem V **Duration: 3 hours**

Course Code: **PC-BTE 504** **Maximum Points: 100**

Course Name: Power System I **Semester: V**

Notes: First question is compulsory. Attempt any 4 from remaining 6.

<table>
<tr><th>Q. No.</th><th>Question</th><th>Points</th><th>CO</th><th>BL</th><th>Mo. No</th></tr>
<tr><td>1</td><td>A power system with equipment ratings is as shown below. Find fault current for a Line to ground fault to be at bus N. You can consider generator G1 or transformer T1 as a common base. The neutral grounding reactance of generator G_1 is Zn = j2.5 ohm.
<table>
<tr><th>Equipment</th><th>kV</th><th>MVA</th><th>X_1 (p.u.)</th><th>X_2 (p.u.)</th><th>X_0 (p.u.)</th></tr>
<tr><td>G1</td><td>13.8</td><td>100</td><td>0.15</td><td>0.15</td><td>0.05</td></tr>
<tr><td>G2</td><td>13.2</td><td>90</td><td>0.2</td><td>0.2</td><td>0.05</td></tr>
<tr><td>T1</td><td>12.5/115</td><td>80</td><td>0.1</td><td>0.1</td><td>0.1</td></tr>
<tr><td>T2</td><td>115/12.5</td><td>80</td><td>0.1</td><td>0.1</td><td>0.1</td></tr>
<tr><td>Line</td><td></td><td></td><td>80 ohm</td><td>80 ohm</td><td>200 ohm</td></tr>
</table>


</td><td>20</td><td>3, 4</td><td>2, 3, 4,</td><td>3</td></tr>
<tr><td>2a</td><td>The voltages across a 3-phase unbalanced load are $Va = 300 \angle 0^0$ V, $Vb = 300 \angle -90°$ V and $Vc = 800 \angle 143.1°$ V respectively. Determine the sequence components of voltages when actual phase sequence is *abc*.</td><td>10</td><td>4</td><td>3, 4, 5</td><td>5</td></tr>
<tr><td>2b</td><td>A 3-phase line is supported by three disc insulators. The potentials across top unit and middle unit are 8 kV and 10 kV respectively. Find (i) the ratio of capacitance between pin and earth to the self-capacitance of each unit (ii) the line voltage and (iii) string efficiency.</td><td>10</td><td>5</td><td>3, 4, 5</td><td>6</td></tr>
<tr><td>3a</td><td>A two winding transformer is rated at 50 KVA, 230/1200 V, 60 Hz. When operated as a conventional two winding transformer at rated load, 0.8 lagging power factor, its efficiency is 96% Now this transformer is to be used as a 1430/1200 V step down autotransformer, then find its KVA rating and efficiency for loading of 0.8 lagging power factor.</td><td>10</td><td>3</td><td>2, 3, 4</td><td>3</td></tr>
<tr><td>3b</td><td>Draw a neat diagram of construction of a 3 core cable with various layers of protection around it. Explain the purpose of each layer and material used for the same.</td><td>10</td><td>2</td><td>1, 2</td><td>2</td></tr>
</table>

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End Semester - December 2023 Examinations

a	Consider a 3-phase generator with Z_1, Z_2, & Z_0 as the positive, negative and zero sequence impedances and E_a is the generated Emf, then with sequence diagrams prove that in case of a line to line fault, the fault current will be given as $I_f = -j\sqrt{3}\, I_a^1 = -j\sqrt{3}\,\frac{E_a}{Z_1 + Z_2}$	10	4	2, 3, 4	5
b	A 50 MVA, 11 kV three-phase alternator was subjected to different types of faults. The fault currents are as under : 3-phase fault = 2000 A ; Line-to-Line fault = 2600 A ; Line-to-ground fault = 4200 A The generator neutral is solidly grounded. Find the values of the three sequence reactances of the alternator in ohm. Ignore resistances.	10	4	2, 3, 4	5
a	Find the capacitance of a 100km long 3 phase, 50Hz transmission line consisting of 3 conductors (one conductor for one phase), each of diameter 2cm and spaced 2.5 meter at each corner of an equilateral triangle. What will be the charging current if line is charged with 110kV voltage source?	6	2	2, 3, 4	2
b	Derive ABCD parameters for a medium transmission line using PI model.	7	3	2 3	3
c	Two loads connected in parallel are supplied from a single phase 240 V rms source. Both of the loads draw a total of 400 kW real power at 0.8 p.f. lagging. If one of the loads draws 120 kW at 0.96 pf leading, find the complex power of the second load.	7	1	3, 4, 5	1
a	What is Sag in transmission line? Derive expression for calculation of sag in case of tower supports are of equal heights.	10	5	1, 2	6
b	The ABCD constants of a 500 kV lossless long transmission line are as follows $A - D = 0.86 + j0$ $B = 0 + j130.2$ $C = j0.002$ Find sending end voltage and current when line delivers 1000 MVA at 0.8 power factor lagging at 500kV. What will be the SIL loading of this 500kV line if its characteristic impedance is 290 ohm?	10	2	2, 3, 4	2
a	Compare Thermal, Hydro and Nuclear power plants based on following factors- 1) Initial cost, 2) Efficiency 3) Environmental /Social Impacts How much percentage is the penetration of renewable resources at present in Indian power sector?	10	1	1, 2	1
b	Explain in detail the factors affecting the resistivity of soil. Also discuss the experimental set up used for measurement of earth resistance.	10	6	1, 2	7

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T.Y **END SEMESTER EXAMINATION JANUARY 2024**

Programme: B. Tech in Electrical Engineering Sem V **Duration:3 Hr**

Course Code: PE-BTE 501 **Maximum Points:100**

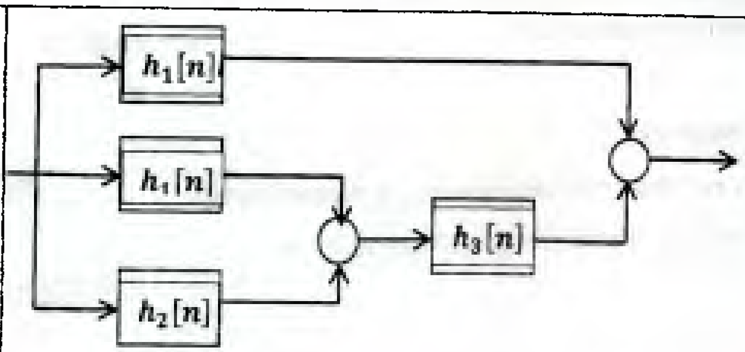
Course Name: Digital Signal Processing **Semester: V**

Note: Q1 is compulsory. Solve any four questions from the remaining six

Assume suitable data if required and justify the assumptions.

Q.No.	Questions	Points	CO	BL	Module no
1 a	Explain the effect of sampling and quantization while converting analog signal into digital signal For the signal f(t) = 3 sin8πt + 6sin12πt + sin14πt, determine the minimum sampling frequency to avoid aliasing and write an expression for the corresponding discrete time signal	04	01	2	1-6
b	Are the following systems equivalent? Justify 1. $y[n] = 0.2y[n-1] + x[n] - 0.3x[n-1] + 0.02x[n-2]$ 2. $y[n] = x[n] - 0.1x[n-1]$	04	02	3	
c	Compare the number of computations required to compute 512 points DFT using direct method and radix 2 FFT algorithms	04	03	3	
d	Prove that FIR filter satisfying symmetry/ anti symmetry condition has linear phase characteristic.	08	04	2	
2 a	If x[n] is input and y[n] is output of the system then 1. $y[n] = x[n^2]$ Check for causality 2. $y[n] = 2x[n] + \frac{1}{x[n-2]}$ Check for linearity 3. $y[n] = cos[x[n]]$ Check for stability 4. $y[n] = C^{x[n]}$ Check for time invariance	06	01	3	2
b	1. $x[n] = cos(\frac{5\pi}{9}n + 1)$, check if the signal is periodic or not. If periodic, find the period. 2. x[n]= [1,3,2,5], draw x[n], x[-n-2], x[2n], x[n/2], x[n+2].	06	01	3	2
c	If $h_1[n] = (\frac{1}{3})^n u[n], h_2 = (\frac{1}{2})^n u[n]$ *and* $h_3[n] = (\frac{1}{5})^n u[n]$, determine overall impulse response for the following system	08	01	3	2-3

END SEMESTER EXAMINATION JANUARY 2024

					
3 a	Fibonacci sequence of integer numbers is given as 1 1 2 3 5 8…Determine the closed form expression for nth term of Fibonacci sequence i.e. y[n]=1, 1, 2, 3, 5….	06	02	3	3
b	For the following difference equation and associated input and initial conditions determine the response y[n] y[n]+2y[n-1]=x[n], x[n]=$0.2^n u[n]$ and y[-1]=1	06	02	3	3
c	Determine impulse response of the system with transfer function $H(z) = \frac{1}{1-0.8z^{-1}+0.12z^{-2}}$ in each of the following case and comment about stability and causality of the system 1. ROC $\|z\| > 0.6$ 2. ROC $\|z\| < 0.2$ 3. ROC $0.2 < \|z\| < 0.6$	08	02	3	3
4 a	Draw flow graph to compute 16 point DFT using any FFT algorithm. Complete the flow graph which can be used to compute IDFT of the same	06	03	2	4
b	Determine DFT of x[n]= [2,4,6,8] using DIT FFT algorithm and using it and not otherwise determine DFT of x1[n]= [2,0,4,0,6,0,8,0] x2[n]= [2,4,6,8,2,4,6,8]	06	03	3	4
c	Determine output of LTI system with impulse response h[n]=[1, 1, 0, 2, 0, 2] and input [2, 0, 2] using DFT-IDFT only.	08	03	3	4
5 a	Show that how one to one mapping of S- and Z- plane is not possible with impulse invariance method and how is it with Bilinear Transformation method.	06	04	2,3	5

	Convert the following analog filter into digital filter using impulse invariance method only. Sampling period 0.2 sec. The filter transfer function is given by $H(s) = \frac{s+2}{s^2+7s+12}$				
b	**Convert the analog filter** $H(s) = \frac{(s+0.2)}{(s+0.2)^2+36}$ **into digital filter using Bilinear Transformation. The digital filter should have resonant frequency** $\omega_r = \pi/2$	**06**	**04**	**3**	**5**
c	**Write the steps for designing IIR filter.** **Derive an expression to determine order of a low pass Butterworth filter.** **IIR filter required to meet the following specifications** **Passband ripple<= 1dB** **Stopband attenuation >=25dB** **Passband cut off frequency: 4KHz** **Stopband cut off frequency : 6KHz** **Determine the order of Butterworth filter**	**08**	**04**	**3-4**	**5**
6 a	**Explain the principle of FIR filter design using** 1. **Window method** 2. **Frequency Sampling method**	**06**	**04**	**2**	**6**
b	**Design Linear phase FIR filter using appropriate window function. Justify the assumptions or decisions taken while designing** **Passband Edge frequency: 2KHz** **Stopband Edge frequency: 3KHz** **Sampling Frequency: 20KHz** **Stopband attenuation: 17dB** **[Rectangular** $w[n] = \left\{\begin{matrix}1 & n=0,1\ldots,M-1\\0 & Otherwise\end{matrix}\right\}$ **Maximum Stop band attenuation=21dB,** ΔF**=0.9/M Hz** **Hanning or Raised cosine** $W[n] = \frac{1}{2}(1-cos\frac{2\pi n}{M-1})$ $n = 0,1\ldots,M-1$ **Maximum Stop band attenuation = 44dB,** ΔF**=3.1/M Hz** **Hamming** $W[n] = 0.54 + 0.46cos\frac{2\pi n}{M-1}$ $n = 0,1\ldots,M-1$ **Maximum Stop band attenuation=53dB,** ΔF**=3.3/M Hz]**	**06**	**04**	**4**	**6**

c	**Determine impulse response of FIR filter of length 7 using frequency sampling method** $H_d(e^{jw})=\left\{\begin{matrix} e^{-jw(M-1)/2} & for\ 0 \leq w \leq \frac{\pi}{2} \\ 0 & otherwise \end{matrix}\right\}$	**08**	**04**	**4**	**6**
7	**Explain DSP application in detail based on the following** **1. Correlation.** **2. Linear phase filters** **3. Weiner filter** **4. Auto Regressive Moving Average model**	**20**	**01-04**	**3**	**7**