BharatiyaVidyaBhavan's

SARDAR PATEL COLLEGE OF ENGINEERING

(Government Aided Autonomous Institute)

Munshi Nagar, Andheri (W) Mumbai – 400058

End Semester - December 2022 Examinations 5/12/22

Program: T.Y. B.Tech. (Electrical) Sem V

Course Code: PC-BTE501

Course Name: Electromagnetic fields and waves

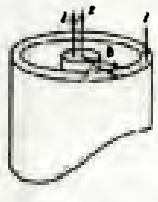
Duration: 3 hrs.

Maximum Points:100

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)	Current in the inner and outer conductors of Fig.1 are uniformly distributed. Use Ampere circuital law to derive expression of magnetic field intensity (H) for $b \leq r \leq c$  Fig.: 1	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

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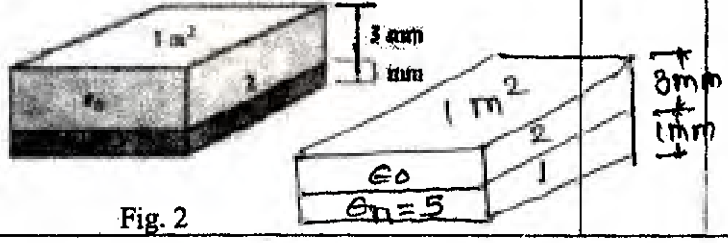
2. (a)	Starting with Ampere's circuital law, derive Maxwell's equation in integral form. Obtain the corresponding relation by applying the Stoke's theorem	**12**	1	L3	4
2.(b)	Assume that $\mu = \mu_1 = 4\,\mu H/m$ in region 1 where $Z > 0$ $\mu_2 = 7\,\mu H/m$ in region 2 where $Z < 0$, moreover let $k = -80\,\hat{a}_x\,A/m$ on the surface Z=0. Find $B_2 = ?$ *if* $B_1 = \hat{a}_x + 2\hat{a}_y + 3\hat{a}_z mT$.	**08**	3	L3	5
3. (a)	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.	**14**	3	L2	6
3.(b)	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 $\left(\frac{3.29Q^2}{4\pi\epsilon_0 l^2}\right)N$.	**06**	2	L2	2
4.(a)	Derive an expression for the energy stored in static electric field of n point charges.	**10**	2	L2	2
4.(b)	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
4.(c)	Explain in short boundary conditions in electric field and magnetic field.	**05**	1	L1	3,5
5.(a)	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.(b)	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	**05**	2	L3	3

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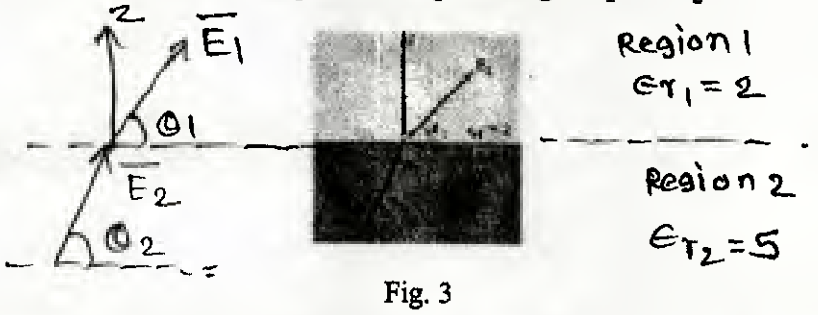
5.(c)	Derive an expression for the electric field intensity due to an infinite line charge.	**10**	2	L2	2
6.(a)	Derive Poisson's and Laplace's equations:	**05**	1	L2	3
6.(b)	Given electromagnetic wave equations are $\bar{E} = -E_m \sin(\omega t + \beta z)\hat{a}_z$ $\bar{H} = H_m \sin(\omega t + \beta z)\hat{a}_y$ Sketch E & H at t = 0.	**03**	3	L2	6
6.(c)	Given that $E_1 = 9\hat{a_x} - 2\hat{a_y} + 15\hat{a_z}\, V/m$ 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 $\bar{H} = \frac{10^4}{r}\left(\frac{1}{a^2}\sin ar - \frac{r}{a}\cos ar\right)\overline{a_\phi}(A/m)$ 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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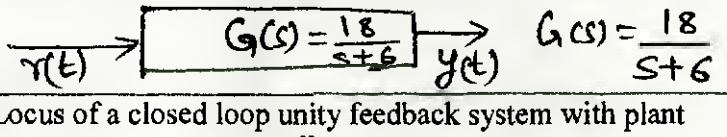
END-SEMESTER EXAMINATION DECEMBER 2022 7/12/22

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

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

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

Note : 1) Answers to all sub questions should be grouped together. 2) Figures to the right indicate full marks. 3) In the absence of any data, make suitable assumptions and justify the same. 4) Use graph paper for plotting Root Locus and semilog paper for Frequency response.

Q. No	Questions	Points	CO	BL	Module No.
1a)	Consider a second order system with transfer function $Gcl(s) = \frac{50}{(s^2+20s+50)}$. Calculate steady state value of the output, steady state error, peak time, % overshoot and settling time when unit step signal is applied as an input.	05	02	02	02
1b)	A system has transfer function $G(s) = \frac{10s^3+5s^2+10s+5}{(s+1)(s+4)(s+6)}$. Obtain state space representation of the system in controller canonical form.	05	02	02	06
1c)	Define Gain Margin and Phase Margin. Explain how these margins are measured in Bode Plot.	05	02	02	04
1d)	What will be the output of a following system when input r(t) = 5u(t).  $G(s) = \frac{18}{s+6}$	05	01	02	01
2a)	Plot Root Locus of a closed loop unity feedback system with plant transfer function $G(s) = \frac{K}{(s+1)(s+2)(s+7)}$	15	02	02	03
2b)	Consider the system in Q2a). Design the value of K to get %overshoot of 20%.	05	02	03	03
3a)	Plot frequency response (Bode plot) of a unity feedback system with $G(s) = \frac{100\,(s+20)}{(s+5)(s+10)(s+50)}$ Calculate Gain Margin and Phase Margin from the plot.	12	02	02	04
3b)	Plot polar plot of a system having loop transfer function $GH(s) = \frac{10}{s^2(s+5)}$	08	02	02	04

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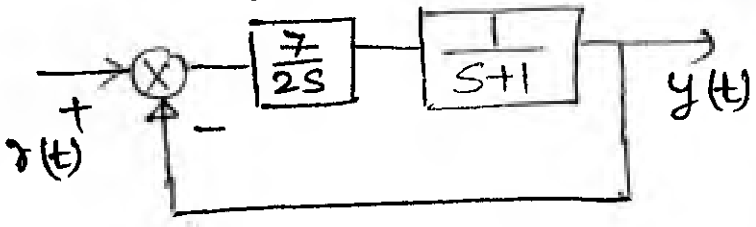
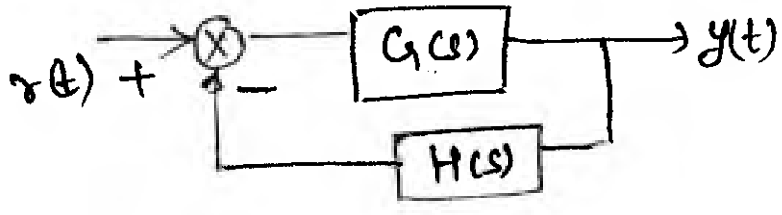
END-SEMESTER EXAMINATION DECEMBER 2022

4a)	Consider a system as given below-  Determine resultant transfer function of the system. Determine the output of the system if the input applied is r(t) = 10u(t)	10	02	02	02
4b)	Consider following system with $G(s) = \frac{10}{(s+2)}$ and $H(s) = \frac{(s+1)}{s(s+5)}$  Test if the system is stable. Add proportional controller in forward path with transfer function C(s) = Kp. Determine the range of Kp for which system is stable.	10	03	03	03
5a)	Consider a system with state equations as – $\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$ $Y = \begin{bmatrix} 1 & 3 \end{bmatrix} X$ Determine the state transition matrix, state space solution of the system (using state space analysis) when input applied is u(t) = 1 unit for t≥0. (unit step)	10	02	03	06
5b)	For the system in Q 5a), calculate eigen values of the system, eigen vectors. Comment on the stability of the system. Transform the system in Modal form.	10	02	03	06
6a)	Define Controllability and Observability. Test if a system with state space representation $\dot{X} = \begin{bmatrix} 1 & -1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$	10	02	03	06

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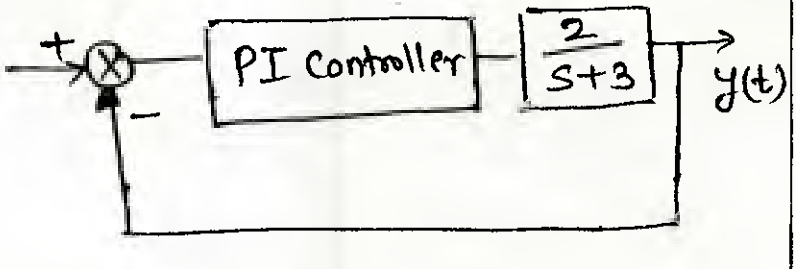
	$y = [1 \quad 0]X$ Is controllable? Also test if it is observable.				
6b)	Write transfer function of PI controller, PD controller and PID controller. Consider a first order system as shown below with PI controller.  Take Kp =1 and Ki = 2. Calculate %overshoot and steady state error of the system when input is unit step.	10	03	03	05
7a)	Calculate resonant peak and bandwidth of a system having closed loop system transfer function $Gcl(s) = \frac{5}{(s^2+s+5)}$	05	02	03	04
7b)	The equations that describe dynamics of a motor control system are $e_a(t) = R_a i_a(t) + L_a \frac{di_a(t)}{dt} + K_b \frac{d\theta_m(t)}{dt}$ $T_m(t) = K_i i_a(t)$ $T_m(t) = J \frac{d^2\theta_m}{dt^2} + B \frac{d\theta_m}{dt} + K\theta_m$ $e_a = K_a e(t)$ $e(t) = K_s [\theta_r(t) - \theta_m(t)]$ Obtain state space model of the system considering the state variables as $x_1 = \theta_m$, $x_2 = d\theta_m/dt$, $x_3 = i_a(t)$. Consider Output $y(t) = \theta_m$, input $u(t) = \theta_r(t)$.	05	01	02	01
7c)	What are the different nonlinearities present in the system? Describe any two of them.	10	04	01	07

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END SEM EXAMINATION DECEMBER 2022

Program: T. Y. B. Tech Electrical Engineering 9/12/22 **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 4.5 kW, 400 V, 50 Hz, 3-phase delta connected induction motor gave the following test results: No-load test (line values): 400 V, 4.2 A, 480 W. Blocked-rotor test (line values): 215 V, 15 A, 1080 W. Stator and rotor ohmic losses at standstill are assumed equal. Draw the induction motor circle diagram and calculate: (a) Line current, power factor, slip, torque and efficiency at full load. (b) Maximum power output and maximum power input.	15	01	BL 1,2	01
Q. 1 (b)	Describe the principle of operation of a 3-phase induction motor. Explain why the rotor is forced to rotate in the direction of rotating magnetic field. Also, explain why the rotor of induction motor can never attain synchronous speed.	05	01	BL 2	01
Q. 2 (a)	Derive the torque expression for a salient pole synchronous machine. Draw the torque-speed characteristics of the synchronous machine for generator and motoring modes.	12	02	BL 1,2	02
Q. 2 (b)	A machine has 10 slots in the stator. It is wound for forming two magnetic poles. The numbers of conductors in the slot are as follows. Assuming that IN and OUT are the direction of the current flowing through the conductors, and if all these conductors form a phase coil of 150 turns, and assuming that the phase current is 1 Amp, draw the MMF distribution in the airgap of the machine.	08	02	BL 1,2	02

END SEM EXAMINATION DECEMBER 2022

	Slot 1	10	IN	Slot 6	50	OUT			
	Slot 2	20	IN	Slot 7	40	OUT			
	Slot 3	30	IN	Slot 8	30	OUT			
	Slot 4	40	IN	Slot 9	20	OUT			
	Slot 5	50	IN	Slot 10	10	OUT			

Q. 3 (a)	Draw the phasor diagrams of the synchronous machine, a) acting as generator and supplying the lagging power factor current b) acting as motor and drawing the lagging power factor current. Comment on the nature of armature reaction in these cases.	12	03	BL 1,2	03
Q. 3 (b)	Draw the V and inverted V curves of the synchronous motor.	08	03	BL 1,2	03
Q. 4	(a) What is hunting? How can it be prevented? (b) Why the synchronous motor cannot be started with field winding excited? (c) Why single phase induction motor is not self-starting? What are the types of single phase induction machine? (d) A doubly salient machine has more torque density. Justify this.	05 05 05 05	02 03	BL 1,2	04 06
Q. 5 (a)	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:	15	02	BL 1,2	02

I_f (A)	3.2	5.00	7.50	10.00	14.00
E_f (kV)	3.10	4.90	6.60	7.50	8.24
I_{sc} (A)	500	778	1170	---	---
Z.P.F. terminal voltage (kV)	-----	1.85	4.24	5.78	7.00

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

END SEM EXAMINATION DECEMBER 2022

	the (1) e.m.f. method (2) m.m.f. method and (3) z.p.f. method.				
Q. 5 (b)	Explain the different conditions for parallel operation of alternators in detail.	05	02	BL 1,2	04
Q. 6 (a)	Explain clearly the terms direct-axis and quadrature-axis synchronous reactances. How are these determined in the laboratory? The results of slip test on a star-connected alternator are given below: $V_{max} = 100$ V, $V_{min} = 96$V $I_{max} = 10$A, $I_{min} = 7$A All are line values. Neglecting resistance, Calculate X_d and Xq in ohms.	12	02	BL 1,2	05
Q. 6 (b)	A 400 V, 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 effective stator resistance is 0.72 Ω per phase. Calculate the equivalent circuit parameters.	08	01	BL 1,2	01
Q. 7 (a)	Write short notes on the following. (1) shaded pole motor. (2) brushless DC motor	05 05	03	BL 1,2	06 07
Q. 7 (b)	Describe the construction, principle of operation and applications of stepper motor and also state their types.	03+03 +02+02	03	BL 1,2	07

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End Semester - December 2022 Examinations

12/12/22

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

Course Code: PC-BTE 504

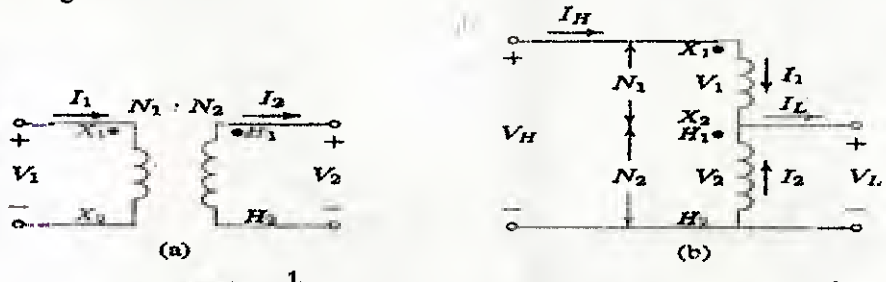
Course Name: Power System I

Notes: Attempt any 5.

Duration: 3 hours

Maximum Points: 100

Semester: V

Q. No.	Question	Points	CO	BL	Mo. No
1a	Three 6.6 kV, 12 MVA, 3-phase alternators are connected to a common bus-bar. The positive, negative and zero sequence impedances of each alternator are 15%, 12% and 4.5% respectively. A line to ground fault occurs on the bus-bar, when one of the alternator neutrals is earthed through a reactance Zn – 2 ohm. Remaining two alternators are solidly grounded. Draw the interconnection diagram of sequence networks. Determine the fault current in ampere and the voltage drop (in volts) in Zn	10	4	3, 4, 5	5
1b	A 3-phase line is supported by three disc insulators. The potentials across top unit and middle unit are 8 kV and 11 kV resp. 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.	10	5	3, 4, 5	6
2a	The line currents in a 3-phase supply to an unbalanced load are respectively $Ia = 10 + j20$, $Ib = 12 - j10$ and $Ic = -3 - j5$ amperes. Taking 'a' phase as reference, with phase sequence as *abc*, determine the sequence components of currents. Also find sequence components taking 'b' phase as reference, with sequence as bca.	10	4	3, 4, 5	5
2b	Prove that if a 2-winding transformer (fig.a) is used as auto-transformer (fig b), its power rating is increased.  i.e., $S_{auto} = (1 + \frac{1}{a}) \times S_{2winding}$ where, S_{auto} is power rating of auto-transformer, a = N1/N2 & $S_{2widing}$ is power rating of normal two winding transformer	10	3	2, 3, 4	3
3a	Find the capacitance and charging current of a single core cable for a 3-phase, 66 kV system. The cable is 1 km long having a core diameter of 10 cm and an impregnated paper insulation of thickness 7 cm. The relative permittivity of the insulation is 4 and frequency is 50 Hz.	10	2	3, 4, 5	2
3b	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

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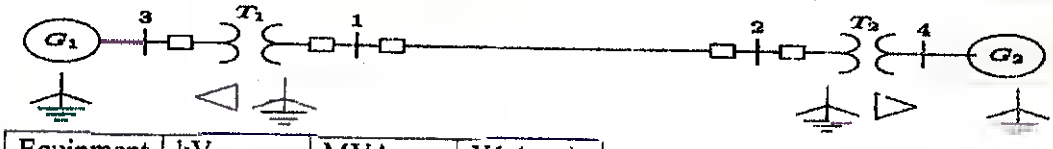
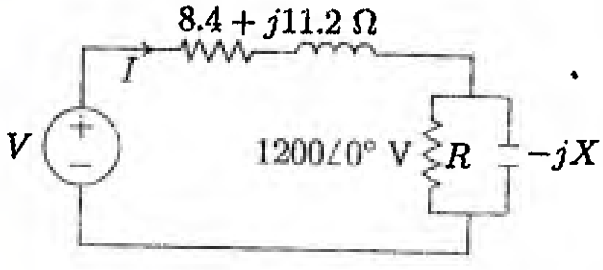
4	A power system with equipment ratings is as shown below. Select G1 as base and find p.u. values of remaining equipments. Draw impedance diagram showing these values.  Equipment | kV | MVA | X1 (p.u.) G1 | 20 | 90 | 0.16 G2 | 18 | 90 | 0.2 T1 | 20/200 | 80 | 0.09 T2 | 200/20 | 80 | 0.09 Line | | | 120 ohm	20	3, 4	2, 3, 4,	3
5a	We know for a lossless transmission, velocity of propagation of voltage or current wave is given as $v = \frac{1}{\sqrt{LC}}$ then prove that for an overhead transmission line, it becomes approximately equal to velocity of light. **Hint:** start with basic equations which are used to calculate L & C parameters of the transmission line.	6	2	2, 3, 4	2
5b	Prove that p.u. impedance of a transformer referred to primary or secondary remains same.	7	3	2 3	3
5c	The load shown in figure below consists of a resistance R in parallel with a capacitor of reactance X. The load is fed from a single phase AC supply through a line of impedance 8.4 + j11.2 ohm. The RMS voltage across load is 1200 V (rms) and the load is taking 30 kVA at 0.8 p.f. leading. A) Find the values of R and X. B) Determine the supply voltage.  	7	1	3, 4, 5	1
6a	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
6b	What is SIL loading of a transmission line? How do you calculate it? Starting from basic long line equations for voltage and current phasor at any point along the line i.e. V(x) and I(x), prove that if the line is loaded with exact SIL loading, voltage and current magnitudes remain constant over the length of the line. i.e., **prove that** $\mathbf{|V(x)| = |V_R|}$ **and** $\mathbf{|I(x)| = |I_R|}$.	10	2	2, 3, 4	2
7a	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.	10	2	1, 2	2
7b	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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ENDSEM EXAMINATION DECEMBER 2022

14/12/22

Program: Electrical Engineering B.Tech Level V

Duration: 3 hours

Course Code: PC-BTE 505

Maximum Points: 100

Course Name: Power Electronics

Semester: V

Notes:

- **Solve any five questions out of seven questions**
- **Make suitable assumptions wherever necessary**
- **Combine all the sub-questions in a given question together**
- **All Diagrams should be neat and clear**
- **Draw neat diagram if mentioned in the question**

Q.No.	Questions	Points	CO	BL	Module No.
1.	With the help of triggering signals (3 marks), draw output phase and line voltage waveforms (6 marks), output line current waveforms (3 marks), supply voltage waveforms(1 mark) for 180 degree conduction three phase voltage source inverter with star connected 'R' load (1 mark). Mathematically verify the voltage waveforms using equivalent circuit (6 marks). Draw on graph paper.	20	4	3	5
2.A)	Draw output voltage (3 marks), output current (3 marks), source current of phase B (3 marks) and supply voltage (3 marks) of three phase controlled rectifier for continuous current load when firing angle alpha is 120 degree (3 marks). Draw on graph paper.	15	2	3	3
2. B)	Derive average output voltage of single phase full wave controlled rectifier having continuous current load.	5	2	3	3
3. A)	Design a boost converter that will have an output of 30 V from a 12-V source. Design for continuous inductor current and an output ripple voltage of less than one percent. The load is a resistance of 50 ohm. Assume ideal components for this design and 25 KHz switching frequency. Select inductor ratings in design.	10	3	3	6

3. B)	Derive filter critical or minimum inductor and capacitor for DC to DC converter to work it as a boost converter. Derive output voltage in terms of supply voltage.	10	3	3	6
4. A)	A single phase full bridge diode rectifier is supplied from 230 V, 50Hz source. The load consists of R =10 ohm and a large inductance so as to render the load current constant. Determine: average value of output voltage and output current	5	2	3	3
4. B)	A DC battery 0f 150 V is charged using single phase half wave diode rectifier by using 8 ohm resistor. The ac supply is of 230 V, 50 Hz. Find the average charging current.	10	2	3	3
4. C)	Explain the effect of source side and load side inductance on single phase rectifier?	5	2	2	3
5. A)	Compare voltage source and current source Inverters. With the help of circuit diagram and explain single phase current source inverter.	8	4	3	5
5. B)	Explain Space Vector Modulation technique using example of V/F speed control of three phase induction motor.	12	4	3	5
6. A)	The single phase full-wave uncontrolled rectifier is used for a resistive load. With the help of circuit diagram explain what required to be used to connect to the rectifier to reduce voltage and current ripples in load voltage and current waveforms?	8	2	4	3,4
6. B)	Which power electronics switches are required to be used for following applications 1. three phase voltage source inverter 2. current source inverter 3. DC to DC converters 4. fan speed regulators	4	1	3	1,2
6. C)	Which characteristic of SCR makes it very much useful in controlled rectification and why SCRs are least used in voltage source inverters?	8	1	4	1,2
7.	Write short notes on following topics 1. single phase voltage controllers 2.Gating requirements of single phase voltage controllers for any of the loads	12 8	1	3	7

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END SEM Exam - December 2022 Examinations

19/12/22

Program: Electrical T.Y. B.Tech (Sem V)
Course Code: PE-BTE502
Course Name: Computer Architecture

Duration: 3 hours
Maximum Points: 100
Semester: V

- Attempt **any 5** questions from the given 7 questions.
- Make suitable assumptions wherever necessary.

Q.No.	Questions	Points	CO	BL	PI
1a.	Discuss the drawbacks of Programmed control I/O and Interrupt driven I/O. Also discuss DMA in detail to overcome them.	10	1	3	2.2.3
1b.	An application loads 200 libraries at the startup. Loading each library requires exactly 1 disk access. The seek time of the disk to a random location is given as 13ms. Rotational speed of the disk is 7500rpm. If all 200 libraries are loaded from random locations on the disk, how long does it take to load all libraries? (The time to transfer data from the disk block once the head has been positioned at the start of the block may be neglected.)	06	1	3	2.2.3
1c.	Differentiate between serial bus and parallel bus used for I/O interface w.r.t. advantages and disadvantages of each of them. (Take suitable example to explain the difference).	04	1	5	2.2.4
2a.	Solve the following $(10110)_2 * (101)_2$ using the hardware algorithm for fixed point data. Also show the necessary hardware required for the same.	10	2	3	2.1.3
2b.	Explain how the Local Descriptor Table is created with respect to 80386 processor	10	3	2	1.4.1
3.	Discuss the following architectures i. MIPS ii. DSP processor	20	3	2	1.4.1

4a.	Classify the system memory with respect to the closeness to the process with neat diagram and explain each component.	06	1	4	1.4.1
4b.	If DMA wants access to the system bus it needs to access it when processor does not need it. Justify the above statement with the concept of cycle stealing. Support the justification with diagram.	04	3	5	1.4.1
4c.	Consider a pipelined processor with the following four stages- IF : Instruction Fetch ID : Instruction Decode and Operand Fetch EX : Execute WB : Write Back The IF, ID and WB stages take one clock cycle each to complete the operation. The number of clock cycles for the EX stage depends on the instruction. The ADD and SUB instructions need 1 clock cycle and the MUL instruction need 3 clock cycles in the EX stage. Operand forwarding is used in the pipelined processor. What is the number of clock cycles taken to complete the following sequence of instructions? ADD R2, R1, R0 R2 ← R0 + R1 MUL R4, R3, R2 R4 ← R3 * R2 SUB R6, R5, R4 R6 ← R5 - R4	06	1	3	2.2.3
4d.	Decide the address bus size of that computer which can handle the main memory size of 8GB. If 24 bits are required to address the cache memory then judge the size of the cache memory required.	04	1	3	2.2.3
5a.	Solve $(0111)_2 / (10)_2$ using the restoration division algorithm.	06	2	3	2.1.3

5b.	What is dynamic branch prediction? Explain how1-bit and 2 bit predictor methods are used for dynamic branch prediction.	10	3	2	1.4.1
5c.	Differentiate between Von Neumann and Harvard Architecture	04	1	5	2.2.4
6a.	What does ISA stand for? Discuss the Software and Hardware abstraction used in ISA.	06	2	5	1.3.1
6b.	Compare RISC v/s CISC w.r.t. implementation used for designing the Control unit.	10	2	5	2.2.4
6c.	Segment Descriptor is 23AD577834B34970. Calculate the starting address and the size of the segment.	04	3	3	2.2.3
7a.	Discuss the terms 1. Micro operations 2. Micro instructions 3. Micro program	10	2	2	1.4.1
7b.	Design a cache memory and main memory system for the following requirements. 1. Main memory is of the size 64KB 2. Cache memory is of the size 4KB 3. Block size is 8B Implement the system using i. Direct Mapping. ii. 2-way set associative Mapping. Compare the two designs that have been implemented.	10	1	6	2.2.4

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END SEMESTER EXAMINATION DECEMBER 2022

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

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

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

Note: Solve any five questions.

Assume suitable data if required and justify the assumptions.

Q.No.	Questions	Points	CO	BL	Module No.
1 a	Consider the analog signal $x(t) = 2sin80\pi t$. If the sampling frequency is 60 Hz, find the sampled version of discrete time signal x[n]. Also find alias frequency corresponding to Fs=60 Hz.	03	01	03	01
b	(i) Determine if the following signal is periodic or not. If periodic find the fundamental period $x[n] = cos\frac{4\pi n}{12}$ (ii) Determine even and odd part of the signal $x[n] = 3e^{-j\frac{\pi n}{4}}$ (iii) Determine whether the following signal is energy or power signal $x[n] = (\frac{2}{7})^n u[n]$	03	01	04	01
c	Determine the range of values of a and b for stability of LTI system with impulse response $h[n] = \{(-2a)^n \quad n \geq 0 \; and \; (2b)^{-n} \quad n < 0$	03	01	03	01
d	Determine impulse response of cascaded two LTI systems having impulse response of individual $h_1[n] = (\frac{1}{5})^n u[n] \; and \; h_2[n] = \delta[n-2]$	03	01	03	01
e	Classify the following system based on linearity, time invariance and causality $y[n] = ax[2n] + x(n^2)$	03	01	04	01
f	Perform linear convolution of x[n] and h[n] using overlap and method $x[n] = \{1, -1, 2, 1, -1, 2, 1, -1, 2\}$ $h[n] = \{2, 3, -1\}$	05	01	03	01
2a	Determine the unit step response of discrete time LTI system where input x[n] and output y[n] relation is given	07	02	05	02

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END SEMESTER EXAMINATION DECEMBER 2022

	by $y[n] = x[n] - 5y[n-1]$ with initial condition y[-1]=1				
b	An LTI system has impulse response is $h[n] = x_1[n-1] * x_2[n]$. The z transform of two signals $x_1[n] and\ x_2[n]$ are given by $X_1(z) = 2 - 4z^{-1}$ and $X_2(z) = 1 + 5z^{-1}$ Determine the output of the system if input is $x[n] = \delta[n-1]$.	07	02	05	02
C	A discrete time LTI system is given by $H(z) = \frac{z(3z-4)}{(z-0.5)(z-3)}$ Specify ROC and determine h[n] if the system is (i) stable (ii) Causal	06	02	03	02
3 a	Calculate % saving in calculation of 1024 point radix 2 FFT, when compare with direct DFT	04	03	03	03,04
b	Compute DFT of x[n]={2, 2, 0, 1}. Plot magnitude and phase spectrum	04	03	03	03
c	Determine response of LTI system when input x[n]= {-2, -1, -1, 0, 2} and impulse response h[n]={1, -1, -1, 1} by FFT-IFFT.	12	03	05	03,04
4 a	Design a linear phase low pass FIR filer using Hamming window with cut off frequency $\omega_c = 0.2\pi$ rad/sample and order of the filter=8. Plot magnitude response of the designed filter. Hamming window function $w[n] = 0.54 - 0.46cos\frac{2\pi n}{M-1}$ where M is the length of the filter	10	04	06	05
b	Determine the impulse response of linear phase FIR filter of length 11 which has symmetric impulse response. The frequency response of the same satisfies the condition $H\left(\frac{2\pi k}{11}\right) = 1 \quad for\ k = 0,1,2,3\ and = 0 \quad for\ k = 4,5$	10	04	05	05
5 a	Design a low pass Butterworth filter using bilinear transformation with T=0.1sec and the following specifications $0.707 \le \lvert H(e^{jw}) \rvert \le 1 \quad for\ 0 \le w \le 0.45\pi$ $\lvert H(e^{jw}) \rvert \le 0.2 \quad for\ 0.65\pi \le w \le \pi$ Verify the design by sketching the magnitude response	12	04	06	06
b	Derive an expression to determine order of Chebyshev filter if passband, stopband attenuation, passband stopband cutoff frequencies are given	04	04	03	06

END SEMESTER EXAMINATION DECEMBER 2022

c	Compare impulse invariance method with bilinear transformation method	04	04	03	06
6 a.	Prove that FIR filter with even and odd length satisfying anti symmetry condition has linear phase	05	04	04	05
b	Explain how the window function is selected to design FIR filter. Explain the effect of window selected on frequency response of FIR filter	05	04	02	05
c	For the analog filter H(s) determine H(z) using $H(s) = \frac{s+1}{(s+2)(s+3)}$ $and\ T = 0.3\ sec$ 1. Impulse invariance method 2. Bilinear transformation method 3. Matched z transformation method In each case show if the stability is retained in z domain.	10	04	03	06
7	Explain in detail how discrete time signal processing is applied for the following system/ application 1. RADAR system to 2. Image restoration 3. Prediction of stock's future price 4. Noise cancellation in speech signal	20	05	03	07