
M23BBIOK401

MaharajaEducationTrust(R), Mysuru
MAHARAJAINSTITUTE OFTECHNOLOGY MYSORE
AnAutonomousInstitute,affiliatedVisvesvarayaTechnologicalUniversity,BelagaviBelawadi,
Srirangapatna Taluk, Mandya – 571 477
ApprovedbyAICTE,NewDelhi|RecognizedbyGovt.of Karnataka|

IV Semester B.E Semester End Examinations
MODEL QUESTION PAPER

Duration: 1 hr. **Max. Marks: 50**

Subject: BIOLOGY FOR ENGINEERS

SERIES A

Note: Answer all the questions, each question carries one mark.

SI No.	Questions	CO's
1	What is the basic structural and functional unit of life? a) Organ b) Tissue c) Cell d) Molecule	1
2	Proteins are synthesized in: a) Golgi apparatus b) Ribosomes c) Mitochondria d) Lysosomes	1
3	Carbohydrates are stored in the liver as: a) Starch b) Glycogen c) Glucose d) Sucrose	1
4	The cell membrane is primarily composed of: a) Proteins and carbohydrates b) Lipids and proteins c) DNA and RNA d) Enzymes and vitamins	1
5	The smallest unit of protein structure is: a) Amino acid b) Nucleotide c) Polysaccharide d) Lipid	1
6	Which molecule is responsible for carrying genetic information in cells? a) Proteins b) Carbohydrates c) DNA d) Lipids	1
7	What type of bond joins amino acids in proteins? a) Glycosidic bond b) Peptide bond c) Hydrogen bond d) Ionic bond	1
8	DNA is composed of units called: a) Amino acids b) Nucleotides c) Monosaccharides d) Lipids	1
9	Which molecule is produced during glycolysis? a) Oxygen b) Carbon dioxide c) Glucose d) Pyruvate	1
10	What is the primary function of enzymes in biological systems? a) Transport oxygen b) Regulate cell growth c) Catalyze chemical reactions d) Store genetic information	1
11	The function of the cytoskeleton is to: a) Store genetic material b) Provide structural support to the cell c) Regulate cell division d) Produce proteins	1
12	Which organelle is involved in cellular digestion? a) Lysosome b) Mitochondria c) Chloroplast d) Peroxisome	1
13	Enzymes act as: a) Hormones b) Structural components c) Catalysts d) Energy molecules	1
14	Lipids primarily function as: a) Enzymes b) Energy reserves c) Hormones d) Genetic material	1
15	Nucleic acids are responsible for: a) Storing genetic information b) Providing energy c) Catalyzing reactions d) Forming cell membranes	1
16	Which organelle is known as the "control center" of the cell? a) Nucleus b) Golgi apparatus c) Endoplasmic reticulum d) Lysosomes	1
17	Which organelle is responsible for energy production in cells? a) Nucleus b) Mitochondria c) Golgi apparatus d) Lysosomes	1
18	Which vitamin is essential for blood clotting? a) Vitamin A b) Vitamin D c) Vitamin K d) Vitamin E	1
19	Which organelle modifies and packages proteins? a) Ribosome b) Lysosome c) Golgi apparatus d) Endoplasmic reticulum	1
20	Which type of cell would most likely contain large amounts of smooth endoplasmic reticulum (ER)? a) Muscle cell b) Liver cell c) Nerve cell d) Red blood cell	1
21	Which biomolecule is used as a primary fuel source during cellular respiration? a) Nucleic acids b) Carbohydrates c) Lipids d) Proteins	2
22	What is the primary function of enzymes in food processing? a) Enhance flavor b) Aid in digestion c) Speed up biochemical reactions d) Store nutrients	2

23	Which vitamin is fat-soluble and important for vision? a) Vitamin A b) Vitamin B c) Vitamin C d) Vitamin K	**2**
24	Polyhydroxyalkanoates (PHA) are primarily used for: a) Biodegradable plastics b) Protein synthesis c) Hormone production d) Drug delivery	**2**
25	Which of the following biomolecules is primarily responsible for providing energy to the body? a) Proteins b) Lipids c) Carbohydrates d) Nucleic acids	**2**
26	Which lipid is commonly used as biodiesel? a) Cholesterol b) Saturated fat c) Unsaturated fat d) Vegetable oil	**2**
27	Which biomolecule is used in the formation of hair and nails? a) Carbohydrates b) Proteins c) Lipids d) Nucleic acids	**2**
28	The use of nucleic acids in vaccines is primarily to: a) Provide energy b) Act as a catalyst c) Store genetic information d) Aid in digestion	**2**
29	What is the role of lipids in insulating neurons? a) Transport messages b) Store energy c) Form the myelin sheath d) Synthesize proteins	**2**
30	Which natural polymer is a primary source of bioplastics: a) Cellulose b) Proteins c) Lipids d) Starch	**2**
31	The study of plant burrs has inspired which type of bioengineering product? a) Adhesives b) Water filters c) Bioplastics d) Solar panels	**3**
32	Biodegradable plastics are often inspired by which natural polymer? a) Cellulose b) Spider silk c) Chitin d) Keratin	**3**
33	The echolocation ability of bats inspired the development of: a) Sonar systems b) MRI scanners c) Drug delivery devices d) Artificial photosynthesis	**3**
34	The structure of bird wings has influenced: a) Aircraft aerodynamics b) Insulation materials c) Water purification systems d) Drug development	**3**
35	Spider silk inspires bioengineering materials for: a) High-strength composites b) Solar panels c) Waterproof fabrics d) Prosthetics	**3**
36	Which bioinspired material mimics the water-repellent surface of lotus leaves? a) Self-cleaning fabrics b) Antibacterial coatings c) Biodegradable plastics d) Adhesives	**3**
37	What principle inspired the development of self-healing materials? a) Blood clotting b) Cell division c) Photosynthesis d) Animal regeneration	**3**
38	The structure of honeycombs is applied in bioengineering for: a) Aircraft design b) Biodegradable plastics c) Artificial organs d) Drug delivery systems	**3**
39	Sharkskin's antibacterial surface property is mimicked for: a) Self-cleaning materials b) Lightweight fabrics c) Protective coatings d) Medical implants	**3**
40	Which animal's beak inspired the design of high-speed trains? a) Hummingbird b) Kingfisher c) Penguin d) Falcon	**3**
41	What is one key benefit of scaffolds in tissue engineering? a) Supporting tissue regeneration and growth b) Enhancing oxygen delivery c) Stabilizing artificial organs d) Synthesizing biofuels	**4**
42	Artificial photosynthesis is designed to: a) Convert sunlight into energy b) Replace damaged DNA c) Generate bioelectricity from bacteria d) Improve drug delivery mechanisms	**4**
43	Bioremediation refers to: a) Using microorganisms to clean environmental pollutants b) Developing sustainable plastics c) Enhancing photosynthesis for energy production d) Printing organs for transplantation	**4**
44	Which bioengineering technology is used to create artificial tissues for drug testing? a) Bioprinting b) Bioimaging c) Electrical tongue d) Bioremediation	**4**
45	AI-assisted imaging software in bioengineering improves: a) Accuracy of medical imaging b) Biodegradable plastic production c) Regeneration of damaged tissues d) Protein synthesis in cells	**4**
46	Bioimaging is primarily used for: a) Capturing images of the body's internal structures b) Monitoring environmental changes c) Printing tissues and organs d) Developing prosthetic devices	**4**
47	DNA origami is used for: a) Designing nanoscale structures for drug delivery b) Synthesis of artificial tissues c) Regulating immune responses d) Recycling biological waste	**4**
48	What is the role of bioconcrete in construction? a) Self-repairing cracks b) Reducing building costs c) Improving thermal resistance d) Generating electricity	**4**
49	Bioprinting technologies allow for: a) Manufacturing living tissues and organs b) Synthesizing proteins for medical use c) Producing energy-efficient materials d) Filtering water with microorganisms	**4**
50	Artificial intelligence in bioengineering is applied to: a) Diagnose diseases b) Design energy-efficient buildings c) Perform DNA sequencing d) Generate biofuels	**4**

ANSWER - A

1. c) Cell
2. b) Ribosomes
3. b) Glycogen
4. b) Lipids and proteins
5. a) Amino acid
6. c) DNA
7. b) Peptide bond
8. b) Nucleotides
9. d) Pyruvate
10. c) Catalyze chemical reactions
11. b) Provide structural support to the cell
12. a) Lysosome
13. c) Catalysts
14. b) Energy reserves
15. a) Storing genetic information
16. a) Nucleus
17. b) Mitochondria
18. c) Vitamin K
19. c) Golgi apparatus
20. b) Liver cell
21. b) Carbohydrates
22. c) Speed up biochemical reactions
23. a) Vitamin A
24. a) Biodegradable plastics
25. c) Carbohydrates
26. d) Vegetable oil
27. b) Proteins
28. c) Store genetic information to stimulate immune response
29. c) Form the myelin sheath
30. a) Cellulose
31. c) Bioplastics
32. a) Cellulose
33. a) Sonar systems
34. a) Aircraft aerodynamics
35. a) High-strength composites
36. a) Self-cleaning fabrics
37. a) Blood clotting
38. a) Aircraft design
39. c) Protective coatings
40. b) Kingfisher
41. a) Supporting tissue regeneration and growth
42. a) Convert sunlight into energy
43. a) Using microorganisms to clean environmental pollutants
44. a) Bioprinting
45. a) Accuracy of medical imaging
46. a) Capturing images of the body’s internal structures
47. a) Designing nanoscale structures for drug delivery
48. a) Self-repairing cracks
49. a) Manufacturing living tissues and organs
50. c) Perform DNA sequencing

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IV Semester B.E Semester End Examinations

ELECTROMAGNETIC WAVES

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Derive the expression for electric filed intensity at a point due to an infinite line of charge.	**10**	**CO2**	**L2**
b)	A point charge q=90 μC located at origin and there are two uniform surface charge distribution -8 μC/m^2 at r=1 and 4.5 μC/m^2 at r=2m. find divergence $\vec{D}$ everywhere.	**10**	**CO1,2**	**L3**
	OR			
2 a)	Prove Gauss law in point form with relevant diagram.	**10**	**CO2**	**L2**
b)	Three negative charges Q1= -1μC , Q2= -2μC , Q3= -3μC are placed at the corners of an equilateral triangle. If length of each side is 1m. Find the magnitude and direction of Electric filed at i) At a point bisecting line between the charge Q2 and Q3 ii) At the center.	**10**	**CO1,2**	**L3**
	Module 2			
3 a)	Derive the expression of potential field due to many charges.	**10**	**CO3**	**L2**
b)	Determine whether or not the potential equations (i) V= ($2x^2$-$4y^2$-z^2) volt (ii) V=(ρcosφ+Z) volt (iii) V=(ρ^2cosφ+θ) volt. Satisfy the Laplace's equation.	**10**	**CO3**	**L3**
	OR			
4 a)	State and prove uniqueness theorem.	**10**	**CO3**	**L1,2**
b)	A potential field in free space is expressed as V= $\frac{60Sin\theta}{r2}$ **volts**. Find the electric flux density and volume charge density at a point r=3m, θ=60^0 and Φ=25^0 in SCS.	**10**	**CO3**	**L3**
	Module 3			
5 a)	State and Prove stokes Theorem	**10**	**CO3**	**L1,2**
b)	Calculate the value of the vector current density at point P(2,3,4) if $\vec{H}$=(x^{2}z $\hat{a}$y -yx) $\hat{a}x$	**10**	**CO3**	**L3**
	OR			
6 a)	Using Biot-Savarts law derive the expression for magnetic field intensity due to infinite long straight conductor.	**10**	**CO3**	**L2**
b)	Given the magnetic field h=2 ρ^2 (z+1)sinΦ$\widehat{a\Phi}$, verify stokes theorem for the portion of a cylindrical surface defined by r=2, π/4< Φ<π/2, 1<Z<1.5, and for its perimeter	**10**	**CO3**	**L3**
	Module 4			
7a)	Derive the integral and differential form of Faraday's law of Electromagnetic induction	**10**	**CO3**	**L2**
b)	Do the fields $\vec{E}$=E$_m$sinxsint $\hat{a}_y$ and $\vec{H}$=$\frac{Em}{\mu o}$cosxcost $\hat{a}_z$ satisfy maxwell's equations	**10**	**CO3,4**	**L3**
	OR			

8 a)	Obtain the magnetic boundary conditions at the interface between two different magnetic materials	**10**	**CO3**	**L2**
b)	For region1, $\mu_1=4\mu$ H/m and for region2, $\mu_2=6\mu$ H/m. the regions are separated by Z=0 plane. The surface current density at the boundary is K=100 $\hat{a}_x$ A/m. Find B_2 if $B_1=2\hat{a}_x-3\hat{a}_y+\hat{a}_z$ mT for Z=0	**10**	**CO3,4**	**L3**
Module 5				
9 a)	Show the non-existence of the field component along the direction of propagation for a uniform plane wave	**10**	**CO5**	**L2**
b)	Prove poyntings theorem	**10**	**CO5**	**L2**
OR				
10a)	Establish the relationship between $\vec{E}$ and $\vec{H}$ for a uniform plane wave	**10**	**CO5**	**L2**
b)	Prove that the velocity of an electromagnetic wave in free space is equal to the speed of light, C.	**10**	**CO5**	**L2**

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ELECTROMAGNETIC WAVES

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Define electric field intensity and derive an expression for electric field intensity due to infinite line charge.	**10**	**CO2**	**L1,L2**
b)	A charge Q1=-20μC is located at P(-6,4,6) and a charge Q2=50 μC is located at R(5,8,-2) in a free space. Find the forces exerted on Q2 by Q1 in vector form. The distance given are in meters.	**10**	**CO1,CO2**	**L2**
	OR			
2 a)	Define electric flux density and Derive an expression by applying gauss's law for infinite sheet of charge.	**10**	**CO2**	**L1,L2**
b)	Find the divergence i) Given $A=2xy\,a_x+z\,a_y+yz2a_z$ at P(2,-1,3) ii) Given $B=rz\sin\phi\,a_r+3rz2\cos\phi a_\phi$ at Q(5,π/2,1)	**10**	**CO1,CO2**	**L2**
	Module 2			
3 a)	State and prove uniqueness theorem.	**10**	**CO3**	**L2**
b)	A total charge of 40/3 nC is uniformly distributed over a circular ring of radius 2m placed in z=0 plane, with center as origin. Find the electric potential at A(0,0,5)	**10**	**CO3**	**L2**
	OR			
4 a)	State and prove Laplace and poission's equation.	**10**	**CO3**	**L2**
b)	Find whether or not the following potentials fields satisfy the Laplace's equation. i) $V=x^2-y^2+z^2$ ii) $V=r\cos\phi+z$	**10**	**CO3**	**L2**
	Module 3			
5 a)	Define magnetic field intensity and derive an expression for magnetic field intensity due to infinite long straight conductor.	**10**	**CO3**	**L1,L2**
b)	Given that the general vector A is, $H=2.5a_\theta+5a_\phi$ in spherical coordinates. Find the curl of H at (2, π/6,0)		**CO3**	**L2**
	OR			
6 a)	Define magnetic flux density and derive an expression for force between differential current elements.	**10**	**CO3**	**L1, L2**
b)	A current filament carries a current of 10A in the a_z direction on the z axis. Find the magnetic field intensity H at point P(1,2,3) due to this filament if it extends from i) Z=-∞ to ∞ ii) Z=0 to 5m iii) Z=5 to ∞	**10**	**CO3**	**L2**
	Module 4			
7a)	With the suitable diagrams, derive the boundary conditions between the two magnetic materials having different permeabilities.	**10**	**CO3,CO4**	**L2**
b)	A point charge of Q=-1.2C has velocity $v=(5a_x+2a_y-3a_z)$m/s. Determine the magnitude of the force exerted on the charge if, i) $E=-18a_x+4a_y-10a_z$ V/m ii) $B=-4a_x+4a_y+3a_z$ T iii) Both are present simultaneously.	**10**	**CO3**	**L2**

	OR			
8 a)	With the relevant equations, derive concept of displacement current.	**10**	**CO3,CO4**	**L2**
b)	A circular loop conductor lies in plane z=0 and has a radius of 0.1m and resistance of 5Ω. Given B=0.2 sin 10^3 a_z J, determine the current in the loop.	**10**	**CO3**	**L2**
	Module 5			
9 a)	Derive the wave equation staring from Maxwell equations for free space.	**10**	**CO5**	**L2**
b)	The uniform plane waves travelling in free space is given in the phasor form. The electric field is given by $E_y=10.4e^{j(2\pi\times10\text{^}9t-\beta x)}\mu$ V/m. Find i) Phase velocity ii) Phase constant iii) Propagation constant iv) Direction of propagation of uniform plan wave v) Expression for the magnetic field in phasor form.	**10**	**CO5**	**L2**
	OR			
10a)	Derive relationship between E and H in free space.	**10**	**CO5**	**L2**
b)	A 9375 MHz uniform plane wave is propagating in polystyrene. If the amplitude of the electric field intensity is 20 V/m and the material is assumed to be lossless, Find i) Attenuation constant ii) Phase constant iii) Velocity of propagation iv) Intrinsic impedance v) Amplitude of the magnetic field intensity. vi) Wavelength in List the Maxwell's equation in point form and integral form and explain physical significance of the equations. For polysterene, $\mu_r=1,\varepsilon_r=2.56$	**10**	**CO5**	**L2**

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IV Semester B.E Semester End Examinations

Analog Communication systems

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Define Amplitude Modulation. Illustrate the process of AM with relevant equations and represent the waveforms for three conditions : i) m>1, ii) m=1 iii) m<1	**10**	**L3**	**CO2**
b)	Illustrate the working of envelope detector with relevant circuit and waveforms. An AM wave with 70% modulated signal and 250W carrier power is transmitted in a channel. Calculate the total power required to transmit the signal and power on each sideband.	**10**	**L3**	**CO2**
	OR			
2 a)	Illustrate the working of high-level linear AM (Collector Modulator) with relevant circuit and waveforms.	**10**	**L3**	**CO2**
b)	Illustrate the working of a frequency division multiplexing process with relevant block diagram.	**10**	**L3**	**CO2**
	Module 2			
3 a)	Compare and contrast between PM and FM with the help of waveforms assuming a trapezoidal modulating signal (Clipped triangular signal). For a triangular carrier wave of 100KHz deviation of 10KHz and 1KHz modulating signal, calculate its modulation index.	**10**	**L3**	**CO1**
b)	Represent ASK, FSK and PSK digital modulated wave form for the given digital data 101000111 and mention its differences.	**10**	**L3**	**CO1**
	OR			
4 a)	Interpret capture, lock ranges in PLL along with its working with suitable block diagram..	**10**	**L3**	**CO1**
b)	Interpret the operation of a VCO which operates at 2.4GHz with a circuit diagram.	**10**	**L3**	**CO1**
	Module 3			
5 a)	Interpret the concept of a mixer and explain the operation of a JFET mixer with a neat circuit diagram.	**10**	**L3**	**CO3**
b)	Examine the generation and detection of PPM wave with a relevant block diagram?	**10**	**L3**	**CO3**
	OR			
6 a)	What is multiplexing and why it is required in Communication? Explain the working of Time Division multiplexing with a neat block diagram?	**10**	**L3**	**CO3**
b)	Examine the generation and recovery of PAM (Flat-Top) signal with necessary equations and waveforms?	**10**	**L3**	**CO3**
	Module 4			
7a)	Define a Probability system and illustrate the relationship between sample space, events, and Probability with its axioms.	**10**	**L3**	**CO3**
b)	Illustrate the Operation of an active 2nd order High Pass filter with relevant circuit diagram, equations, and frequency responses.	**10**	**L3**	**CO4**
	OR			
8 a)	Derive the properties of Probability measure P from its axioms with help of a Vent diagram.	**10**	**L3**	**CO3**
b)	Illustrate the operation of 1st order Passive and active Low pass filter with relevant circuit diagram and frequency response.	**10**	**L3**	**CO4**

Module 5				
9 a)	Illustrate Electromagnetic spectrum along with the wavelength range and corresponding applications.	**10**	**L3**	**CO1**
b)	What is noise in communication systems? Examine various internal noise factors.	**10**	**L3**	**CO4**
OR				
10a)	A receiver with 75 Ω input resistance operates at 31 degree. The received signal is 89MHz with a bandwidth of 6MHz. The received signal is 8.3 microvolt and is applied to an amplifier having noise figure of 2.8dB. Find a) Input noise power b) Input signal power c) S/N in decibels. d) Noise factor and S/N of the amplifier e) Noise temperature of the amplifier.	**10**	**L3**	**CO1**
b)	Define Noise Ratio and Noise Figure? Find the average noise power of a device operating at a temperature of 90 F with a bandwidth of 30KHz.	**10**	**L3**	**CO4**

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IV Semester B.E Semester End Examinations

Analog Communication System

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Illustrate the working of transistor amplitude modulator with relevant circuit and waveforms.	10	CO2	L3
b)	Illustrate the difference between AM, DSBSC, SSB and VSB with relevant frequency spectrum and their applications.	10	CO2	L3
	OR			
2 a)	Illustrate the working of diode modulator with relevant circuit and waveforms.	10	CO2	L3
b)	Illustrate the scheme of generating DSBSC modulated wave using Ring modulator with relevant circuit.	10	CO2	L3
	Module 2			
3 a)	Interpret the operation of a Varactor diode with relevant diagrams and explain why it is used for FM generation.	10	CO1	L3
b)	Interpret the operation of a VCO which operates at 10GHz with a circuit diagram.	10	CO1	L3
	OR			
4 a)	Illustrate the operation of IC NE566 for FM modulation with relevant block diagrams.	10	CO1	L3
b)	Illustrate the advantage of using Pre-emphasis and De-emphasis circuits in FM transmission with relevant sketches.	10	CO1	L3
	Module 3			
5 a)	Examine the generation and recovery of PAM (Flat-Top) signal with necessary equations and spectrum diagram?	10	CO3	L2
b)	Define Multiplexing and emphasize on its requirement in Communication system? Explain the working of Time Division multiplexing with a neat block diagram?	10	CO3	L2
	OR			
6 a)	Examine the generation and detection of PPM wave with a relevant block diagram?	10	CO3	L2
b)	Draw the block diagram of a Super heterodyne receiver and illustrate the function of each block?	10	CO3	L2
	Module 4			
7a)	Illustrate the operation of 1st order Passive and active Low pass filter with relevant circuit diagram and frequency response.	10	CO3	L3
b)	Define Auto correlation function and Cross Correlation function. State and Prove the Properties of the Autocorrelation function.	10	CO4	L3
	OR			
8 a)	Illustrate the operation of 1st order Passive and active Band pass filter and Notch filter with relevant circuit diagram	10	CO3	L3
b)	What is Conditional Probability? Prove that P(B/A)=P(A/B).P(B)/P(A)	10	CO4	L3

Module 5				
9 a)	Discuss Figure of merit of a receiver? Also analyze FoM in AM and FM systems? The bandwidth of a receiver with a 75 input resistance is 6MHz.The temperature is 29°C. Find the input thermal noise voltage?	10	CO1	L3
b)	Define Noise Ratio, Noise Figure and Noise temperature. Analyze how noises in cascaded stages are calculated with an example?	10	CO4	L4
OR				
10a)	Illustrate Electromagnetic spectrum along with the wavelength range and corresponding applications.	10	CO1	L3
b)	What is noise in communication systems? Examine various external noise factors.	10	CO4	L4

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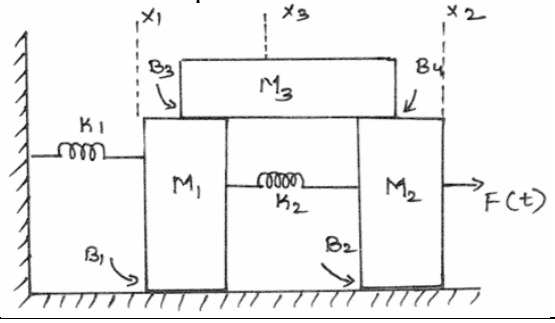
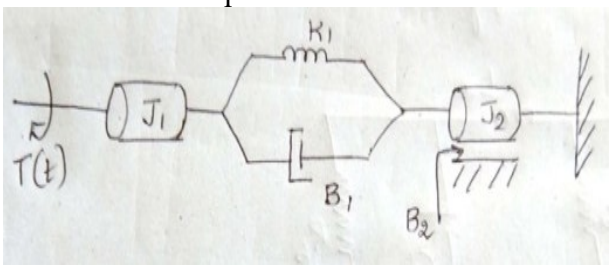
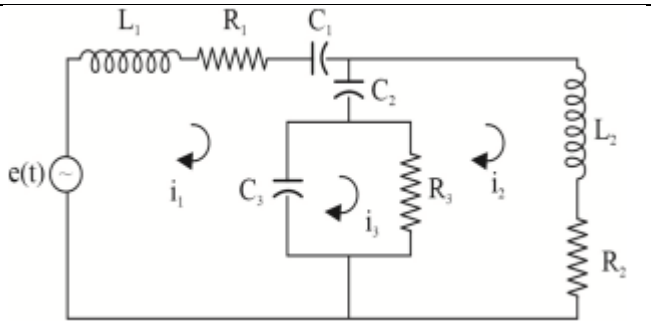
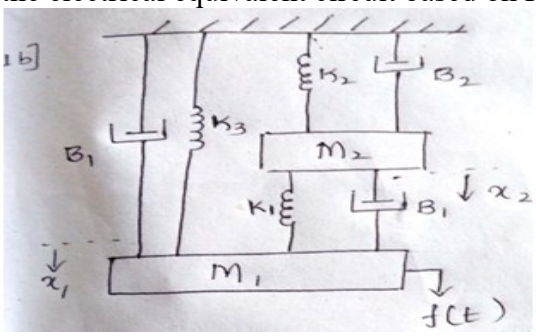
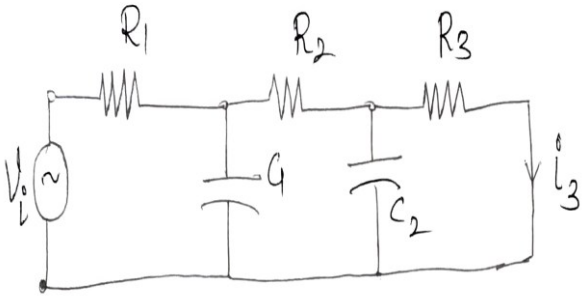
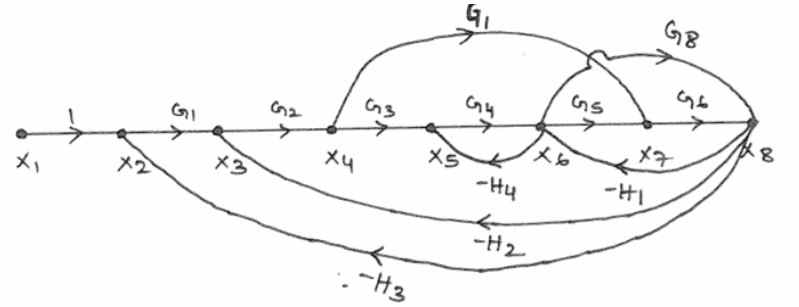
IV Semester B.E Semester End Examinations

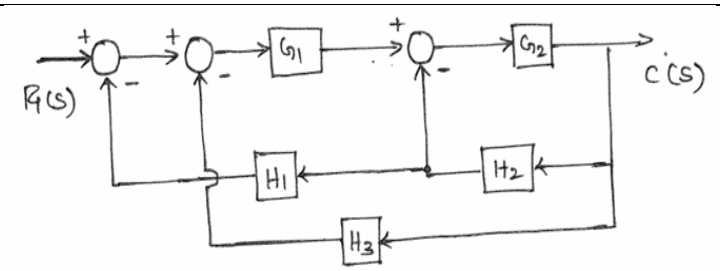
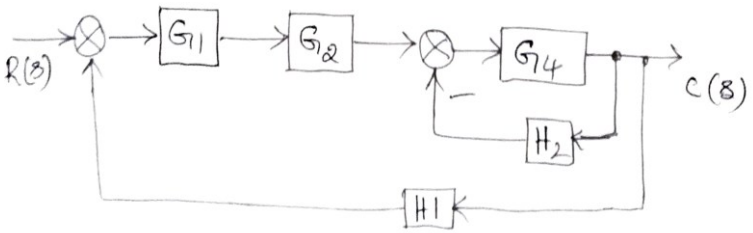
Control Systems

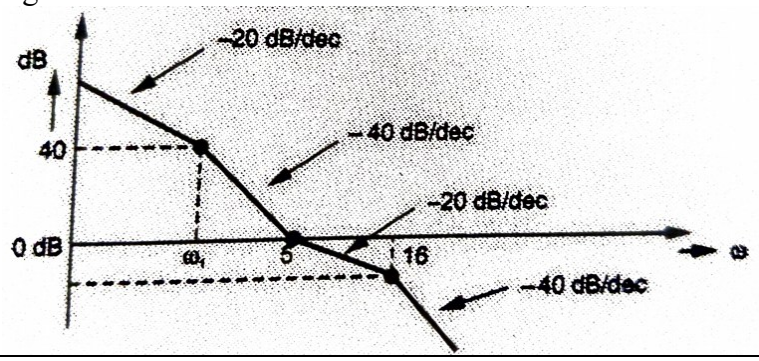
Duration: **3 hrs** Max. Marks: **100**

Answer five full questions choosing one complete question from each module.

Sl. No.		Questions	Marks	CO	RBT Level
		Module 1			
1.	a	Define Control System and explain the requirements of a good Control System.	5	CO1	L1
	b	For the translational mechanical system shown in Fig. (i) Sketch a mechanical network and obtain equations of motion. (ii) Sketch an electrical equivalent circuit based on the FV analogy. 	8	CO2	L3
	c	For the rotational mechanical system shown in Figure. (i) Sketch the mechanical network and obtain equations of motion (ii) Sketch an electrical equivalent circuit based on the TI analogy. 	7	CO2	L3
		OR			
2.	a	Give the differences between open-loop and closed-loop control systems.	5	CO1	L1
	b	Develop a translational mechanical system for the force-to-voltage analogous circuit shown in Fig.	8	CO2	L3

				
c	For the translational mechanical system shown in Fig. (i) Sketch mechanical network and obtain equations of motion. (ii) Sketch the electrical equivalent circuit based on FI analogy 	7	CO2	L3
	Module 2			
3. a	Compute the transfer function for the electrical circuit shown in Fig. using block diagram reduction techniques. 	8	CO2	L2
b	Determine the transfer function of the given signal flow graph. 	8	CO2	L3
c	Explain any four block diagram reduction rules.	4	CO1	L2
	OR			
4. a	Determine the transfer function of the given block diagram.	8	CO2	L2

				
b	Compute the Transfer function for the block diagram shown in fig using Mason gain's formula. 	**8**	CO2	L3
c	Derive the expression for the transfer function of closed-loop control systems.	4	CO1	L2
	Module 3			
5. a	Illustrate the effect of zeta on a second-order system.	8	CO3	L3
b	A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{S^2+6S+25}$. Find its rise time, Peak time, Peak overshoot, and settling time if subjected to a unit step input. Also, calculate the expression for its output response	8	CO3	L3
c	Derive the expression for delay time.	4	CO3	L3
	OR			
6. a	Illustrate the analysis of a second-order system for the unit step response.	8	CO3	L3
b	A unity feedback system has $G(s) = \frac{10(s+2)}{s^2(s+1)}$. Compute i) The static error coefficients. ii) Steady state error when the input applied is $r(t) = 3 + 2t + 5t^2$.	8	CO3	L3
c	Derive the expression for peak overshoot.	4	CO3	L3
	Module 4			
7. a	Determine the number of roots to left and right of s=-1 for a system with characteristic equation $s^4+2s^3+3s^2+s+1=0$	8	C04	L3
b	Sketch the complete root locus of the system having $G(s)H(s) = \frac{K}{s(s+2)(S^2+4s+13)}$	12	C04	L3
	OR			
8 .a	Determine the value of K for which system having an OLTF of $\frac{K}{s(s+2)(s+4)(s+6)}$ is provided with negative unity feedback starts to oscillate and the frequency of oscillation.	8	C04	L3
b	Analyze the stability of a control system with characteristic equation (S2+2S+2)+K(S+4) using Root locus technique.	12	C04	L3
	Module 5			
9 a	A unity feedback control system has $G(s) = \frac{50}{s(0.5s+1)(0.05s+1)}$. Draw the bode plot. Determine G.M, P.M, ω_{gc}, ω_{pc}.Comment on stability.	10	C04	L3

b	A system is given by $G(S) = (4S+1)\ S\ 2(S+1)(2S+1)$. Sketch the Nyquist plot and determine the stability of the system.	10	C04	L3
	OR			
10. a	Find the Transfer Function of the system whose Bode diagram is given in the figure below. 	10	C04	L3
b	A unity feedback control system has $G(s) = \frac{80}{s(s+2)(s+20)}$. Draw the Bode plot. Determine G.M, P.M, ω_{gc}, ω_{pc}.Comment on stability.	10	C04	L3

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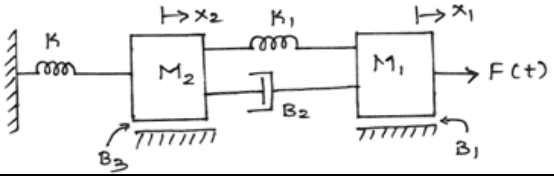
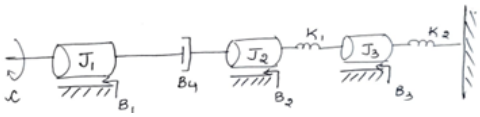
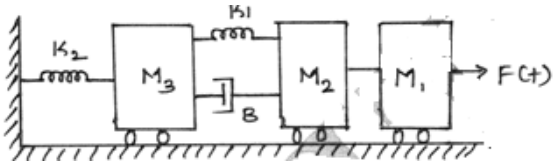
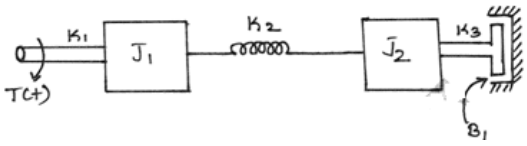
Model Question Paper

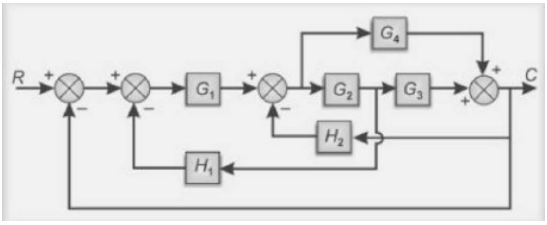
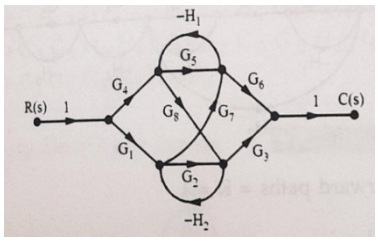
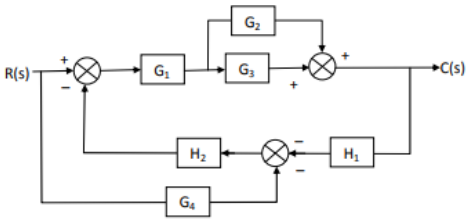
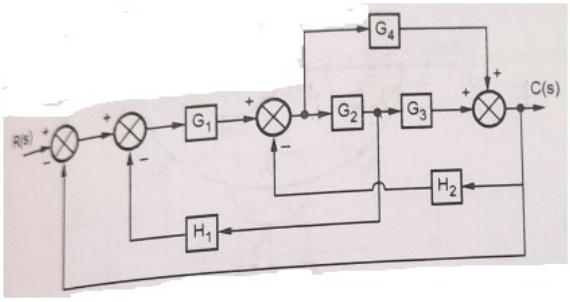
IV Semester B.E Semester End Examinations

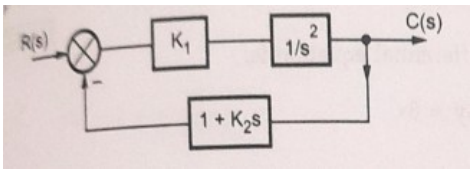
CONTROL SYSTEMS

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions, choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	For the translational mechanical system shown in Fig.1a. Sketch (i) mechanical network and obtain equations of motion. (ii) electrical equivalent circuit based on FV analogy. 	**10**	**2**	**3**
b)	For the rotational mechanical system shown in Fig. 1b. Sketch (i) The mechanical network and obtain equations of motion (ii) Electrical equivalent circuit based on TV analogy. 	**10**	**2**	**3**
	OR			
2 a)	For the translational mechanical system shown in Fig.2a. Sketch (i) mechanical network and obtain equations of motion. (ii) electrical equivalent circuit based on FI analogy 	**10**	**2**	**3**
b)	For the rotational mechanical system shown in Fig. 2b. Sketch (i) The mechanical network and obtain equations of motion (ii) Electrical equivalent circuit based on TI analogy. 	**10**	**2**	**3**
	Module 2			

3 a)	Determine the transfer function C(s)/R(s) by using the block diagram reduction technique. 	**10**	**2**	**3**
b)	Compute the Transfer function for the SFG shown in the figure using Mason's gain formula. 	**10**	**2**	**3**
	OR			
4 a)	Determine the transfer function C(s)/R(s) by using the block diagram reduction technique. 	**10**	**2**	**3**
b)	For the given block diagram, compute the transfer function using Mason's Gain formula. 	**10**	**2**	**3**
	Module 3			
5 a)	A second order system is given by $\frac{C(s)}{R(s)} = \frac{20}{S^2+5S+24}$. Find its rise time, Peak time, Peak overshoot, and settling time if subjected to a unit step input. Also, calculate the expression for its output response	**8**	**3**	**3**
b)	Explain the behavior of a first-order system for a unit step response.	**8**	**1**	**2**
c)	Define the following. i) Transient response ii) Steady state response	**4**	**1**	**2**
	OR			

6 a)	For a control system shown in the figure. Compute the values of K_1 and K_2 so that Mp = 25% and Tp = 4 s. Assume a unit step input. 	**8**	**3**	**3**
b)	Explain the behavior of Type 0 and Type 1 systems for unit step response.	**8**	**1**	**2**
c)	Define with suitable expressions i) Rise time ii) peak time	**4**	**1**	**2**
	Module 4			
7a)	Using Routh's method, find the number of roots i) in RHS ii) LHS and iii) on jω axis for the given characteristic equation. $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$	**8**	**4**	**3**
b)	Sketch the root locus for G(s) H(s)= $\frac{K}{s(s+3)(s+5)}$. Determine for damping ratio ξ = 0.6 i) damped natural frequency ii) gain K	**12**	**4**	**3**
	OR			
8 a)	Determine the ranges of K such that the characteristic equation $\frac{K(s+13)}{s(s+3)(s+7)}$ has roots more negative than s= -1	**8**	**4**	**3**
b)	A feedback control system has an open loop transfer function G(s) H(s)= $\frac{K}{s(s+2)(s^2+4s+13)}$. Draw the root locus	**12**	**4**	**3**
	Module 5			
9 a)	A unity feedback control system has G(s) H(s)= $\frac{80}{s(s+2)(s+20)}$. Draw the Bode Plot. Determine i) Gain crossover frequency ii) Phase crossover frequency iii) Gain margin iv) Phase margin. Comment on the stability.	**14**	**4**	**3**
b)	Explain the generalized Nyquist path and its mapping.	**6**	**1**	**2**
	OR			
10a)	For the given control system G(s) H(s)= $\frac{K}{s(s+2)(s+10)}$. Sketch the Nyquist plot and hence calculate the range values of K for stability	**14**	**4**	**3**
b)	Explain the terms i) Gain crossover frequency ii) Phase crossover frequency iii) Gain margin iv) Phase margin	**6**	**1**	**2**

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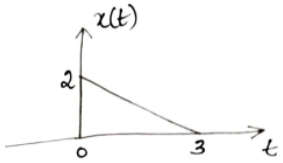
Model Question Paper

IV Semester B.E Semester End Examinations

Signals and Systems

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions, choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Determine whether the system $y(t) = cosx(t)$ is linear, time variant, Memory, causal and stable.	6	4	3
b)	Determine the even and odd components of the following. (i) $x(t) = \frac{2t^2-3t+6}{1-t}$ (ii) $x(t) = e^{-2t}\,cost$	6	1	3
c)	Consider the signal x(t) in Fig. 1(c) and sketch the following signals (i)x(t+3) (ii) x(2t-2) (iii) x(-0.5t-1) (iv) $x_e(t)$  Fig. 1(c)	8	1	3
	OR			
2 a)	Determine whether the system $y[n] = px[n] + q$ is linear, time variant, Memory, causal and stable.	6	4	3
b)	Categorize whether the following signals are periodic or not? If periodic what is the Period of it. (i) $x[n] = \cos\left(\frac{\pi n}{5}\right)\sin(\frac{\pi n}{3})$ (ii) $x(t) = 5\cos\left(\frac{4}{3}t\right) + 3\sin(t)$	6	1	3
c)	Given $x[n] = \begin{cases} 1 & n = 1,2,3 \\ -1 & n = -1,-2,-3 \\ 0 & n = 0, \lvert n\rvert > 3 \end{cases}$ .Sketch the following signals (i) x[n] (ii) x[2n+2] (iii)x[n]δ[n-1] (iv) $x_o[n]$	8	1	3
	Module 2			
3 a)	Evaluate the following continuous time convolution integral $y(t) = \{u(t+2) - u(t-1)\} * u(-t+2)$	10	2	3
b)	Consider an input $x(n)$ and a unit impulse response $h(n)$ given by $x(n) = \alpha^n u(n); 0 < \alpha < 1$ $h(n) = u(n)$	10	2	3

	Find and plot the output signal $y(n)$.			
	OR			
4 a)	Consider a LTI system with unit impulse response, $h(t) = e^{-t}u(t)$. If the input applied to this system is, $x(t) = e^{-3t}\{u(t)\text{-}u(t\text{-}2)\}$, find and plot the output y(t) of the system.	10	2	3
b)	Evaluate the discrete time convolution sum given below. $y(n) = [u(n+10) - 2u(n+5) + u(n-6)] * \beta^n u(n)$	10	2	3
	Module 3			
5 a)	Determine the system $h(t) = 3\delta(t)$ is memoryless, casual and stable	4	4	3
b)	Find the step response of the system with the impulse response (i) $h(n) = a^n u(-n)$ (ii) $h(t) = e^{-\lvert t\rvert}$	8	3	3
c)	Consider the signal, $x(n) = 2 + 2cos\frac{\pi}{4}n + cos\frac{\pi}{2}n + \frac{1}{2}cos\frac{3\pi}{4}n$. (i) Determine and sketch its power spectral density. (ii) Evaluate the power of the signal.	8	3	3
	OR			
6 a)	Determine the following system is memoryless, casual and stable $h(t) = e^{2t}u(t-1)$	4	4	3
b)	Consider a LTI system with unit impulse response, $h(t) = e^{-t}u(t)$. If the input applied to this system is $x(t) = e^{-3t}\{u(t) - u(t-2)\}$. Find the output $y(t)$ of the system.	8	3	3
c)	Plot and find the Fourier Series coefficients of the periodic signal, $x(t) = \lvert sin2\pi t\rvert$	8	3	3
	Module 4			
7a)	Using the appropriate properties, compute the CTFT of the following signal. $x(t) = \frac{d}{dt}[te^{-2t}\sin(t)\,u(t)]$	8	3	3
b)	Compute the time-domain signal corresponding to the following DTFT. $X(e^{j\Omega}) = cos^2\Omega$	7	3	3
c)	State and Prove Convolution Property of CTFT.	5	3	2
	OR			
8 a)	Using the appropriate properties, compute the DTFT of the following signal. $x(n) = \sin(\pi n/n)(1/4)^n u(n-1)$	8	3	3
b)	Compute the inverse Fourier transform of the following using the appropriate properties. $X(j\omega) = \frac{j\omega}{(2+j\omega)^2}$	7	3	3
c)	State and Prove Parseval's Theorem of DTFT.	5	3	2
	Module 5			
9 a)	Determine the Z-transform of the sequence, $x(n) = u(-n-1) + (1/2)^n u(n)$. Sketch ROC and pole-zero location of X(z) in the Z-plane.	8	3	3

b)	Determine the discrete time sequence x(n) using the partial fraction expansion method which has Z-transform, $X(z) = \frac{-1+5z^{-1}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$ with ROC: |z|>1.	7	3	3
c)	State and prove Scaling in Z-domain.	5	4	2
	OR			
10a)	Using appropriate properties, determine the Z-transform of the given sequence. $x(n) = n^2(1/2)^n u(n-3).$	8	3	3
b)	Determine inverse Z-transform using power series expansion method, $X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}$ with ROC: |z|>1.	7	3	3
c)	State and prove the Initial value theorem and the Final value theorem.	5	4	2

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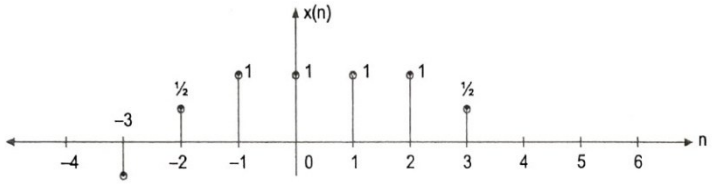
Model Question Paper

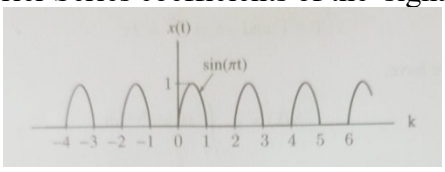
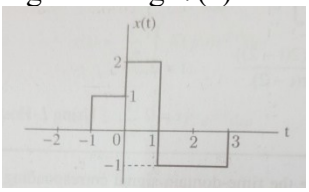
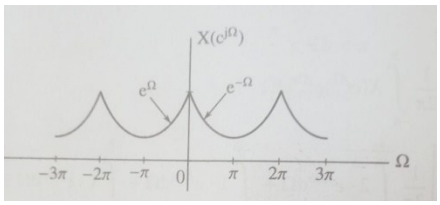
IV Semester B.E Semester End Examinations

Signals and Systems

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions, choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Determine whether the system the following signals are energy signals, power signals or neither i. $x(t) = e^{at}u(t)$ ii $x(t) = Acos(w_0t + \emptyset)$	6	4	3
b)	Determine the even and odd component of the following. (i) $x(t) = (1 + t^3)cos^{10}t$ (ii) $x(t) = t(2 - t^2)(1 + 4t^2)$	6	1	3
c)	Consider the signal $x(t) = 3u(t + 3) - u(t) + 3u(t - 3) - 5u(t - 6)$	8	1	3
	OR			
2 a)	Determine whether the system $y(n) = an^2x(n) + bnx(n - 4)$ is Linear /Nonlinear, Time variant/Invariant and Static/ Dymanic	6	4	3
b)	Categorize whether the following signals are periodic or not? If periodic what is the Period of it. (i) x[n] = $cos\ 0.01\pi n$ (ii) x(n) = $sin(\pi + 0.2n)$	6	1	3
c)	A discrete time signal is shown in figure 2c . Sketch the following  a) $y(n) = x(n - 3)$ b) $y(n) = x(3 - n)$ c) $y(n) = x(2n)$ d) $y(n) = x(n).u(3 - n)$	8	1	3
	Module 2			
3 a)	Evaluate the following continuous time convolution integral $y(t) = \{u(t + 2) - u(t - 1)\} * u(-t + 2)$	10	2	3
b)	consider the two sequences and Find y(n) and plot output signal	10	2	3

	$x(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & otherwise \end{cases}$ $h(n) = \begin{cases} \alpha^n, & 0 \le n \le 6 \\ 0, & otherwise \end{cases}$			
	OR			
4 a)	Consider a LTI system with unit impulse response, $h(t) = e^{-2t}u(t)$. If the input applied to this system is, $x(t) = e^{-t}u(t)$, find and plot the output y(t) of the system.	10	2	3
b)	Evaluate the discrete time convolution sum given below. $y(n) = [u(n-7) - 4u(n+3)] * \alpha^n u(n)$	10	2	3
	Module 3			
5 a)	Determine the system $y(t) = x(t)x(t-1)$ is linear, time variant and causal	4	4	3
b)	Find the step response of the system with the impulse response (i) $h(n) = (1/2)^n u(n)$ (ii) $h(t) = tu(t)$	8	3	3
c)	Consider the signal, $x(n) = \cos\left(\frac{6\pi n}{13} + \frac{\pi}{6}\right)$. (i) Determine and sketch its power spectral density. (ii) Sketch Magnitude and Phase spectrum.	8	3	3
	OR			
6 a)	Determine the following system is memoryless, casual and stable $h(t) = (0.99)^n u(n+3)$	4	4	3
b)	Evaluate the continuous convolution integral given below and plot it. $y(t) = \{u(t+2) - u(t-1)\} * u(-t+2)$	8	3	3
c)	Plot and find the Fourier Series coefficients of the signal, shown in Fig. 6(c)  Fig. 6(c)	8	3	3
	Module 4			
7a)	Compute the CTFT of the signal in Fig. 7(a).  Fig. 7(a)	8	3	3
b)	Compute the time-domain signal corresponding to the DTFT in Fig. 7(b).  Fig. 7(b)	7	3	3
c)	State and Prove Time differentiation property of CTFT.	5	3	2
	OR			
8 a)	Using the appropriate properties, compute the DTFT of the following signal.	8	3	3

	$x(n) = sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u(n-1)$			
b)	Compute the inverse Fourier transform of the following using the appropriate properties. $X(j\omega) = \cos\Omega + j\sin\Omega$	7	3	3
c)	State and Prove Differentiation property of DTFT.	5	3	2
	Module 5			
9 a)	Determine the Z-transform of the sequence, $x(n) = a^n u(n) - (b)^n u(-n-1)$. Sketch ROC and pole-zero location of X(z) in the Z-plane.	8	3	3
b)	Determine the discrete time sequence x(n) using partial fraction expansion method which has Z-transform, $X(z) = \frac{-4+8z^{-1}}{1-6z^{-1}+8z^{-2}}$ with ROC: |z|>1.	7	3	3
c)	State and prove Time shifting in Z-domain.	5	4	2
	OR			
10a)	Using appropriate properties, determine the Z-transform of the sequence, $x(n) = cosw_o n.$	8	3	3
b)	Determine inverse Z-transform using partial fraction expansion method, $X(z) = \frac{Z+2}{2Z^2-7Z+3}$ and with ROC: |z|>3 and . |z| <1/2	7	3	3
c)	State any five properties of ROC for the Z transform	5	4	2

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Approved by AICTE, New Delhi |Recognized by Govt. of Karnataka|

Model Question Paper

IV Semester B.E. Semester End Examinations

POWER ELECTRONICS

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions, choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Give the symbol and characteristic features of the following devices: i)SCR ii)TRIAC iii)IGBT iv)GTO v) LASCR	**10**	**1**	**2**
b)	List out any five applications of power electronics.	**5**	**1**	**2**
c)	Explain the peripheral effects of power electronics	**5**	**1**	**2**
	OR			
2 a)	Explain the steady-state V-I characteristics and switching characteristics of MOSFET.	**10**	**1**	**2**
b)	With the help of switching waveforms, explain the switching stages of a power transistor.	**5**	**1**	**2**
c)	Explain how transistors are protected against high currents.	**5**	**1**	**2**
	Module 2			
3 a)	With a neat sketch, describe the two-transistor model of a thyristor and obtain the expression for the anode current.	**10**	**1**	**2**
b)	Discuss the turn-off characteristics of SCR.	**5**	**1**	**2**
c)	An SCR has Vg-Ig characteristics given by a straight line with a gradient of 16 V/A, passing through the origin. The maximum turn-on time is 4 μs, and the maximum gate current required to obtain quick turn-on is 500 mA if the gate source voltage is 15 V. i) Calculate the value of resistance ii) Compute the gate power dissipation, given that the pulse width is equal to the turn-on time and the average gate power dissipation is 0.3 W. Also, compute the maximum triggering frequency.	**5**	**3**	**3**
	OR			
4 a)	With a neat circuit diagram and waveforms, explain the operation of the UJT firing circuit.	**10**	**1**	**2**
b)	Discuss the resistance-capacitance firing circuit.	**5**	**1**	**2**
c)	The latching current of a thyristor circuit is 50 mA, R = 20 Ω, L = 0.5 H. The duration of the firing pulse is 50 μs. Will the thyristor get fired?	**5**	**3**	**3**
	Module 3			
5 a)	With a neat diagram and relevant waveforms, explain the ϕ Bidirectional AC voltage controller. Derive an expression for RMS value of load voltage in ON–OFF AC voltage controller.	**10**	**2**	**2**
b)	Bring out the differences between ON-OFF control and PHASE control.	**6**	**2**	**2**

c)	In an ON–OFF control circuit using 1ϕ 230V, 50Hz supply, the ON time is 10 cycles and the OFF time is 4 cycles. Calculate the RMS value of the output voltage.	**6**	**2**	**2**
	OR			
6 a)	With a relevant circuit diagram and waveform, explain a single-phase full converter thyristor with R-L Load, and also derive the expression for Average and RMS output voltage.	**10**	**2**	**2**
b)	Apply the concepts of power semiconductor devices in controlled rectifier to explain Single Phase Half wave thyristor converter with resistive Load.	**6**	**2**	**2**
c)	A single-phase ac voltage controller has a resistive load R=10 Ω, and the root mean square (rms) input voltage is Vs=120V, 60Hz. The delay angle of thyristor T1 is $\alpha=\pi/2$ Determine 1. The RMS output voltage is 2. The input power factor is 3.The average input current	**6**	**2**	**2**
	Module 4			
7a)	Explain the principle of operation of a step-down chopper along with necessary waveforms, and also derive an expression for the duty cycle.	**10**	**4**	**2**
b)	Explain briefly the classification of choppers according to their quadrant operation.	**10**	**4**	**2**
	OR			
8 a)	Explain the principle of operation of a step-up chopper along with necessary waveforms, and also derive an expression for the duty cycle.	**10**	**4**	**2**
b)	Explain the principle of operation of a Buck-Boost converter along with the necessary waveforms.	**10**	**4**	**2**
	Module 5			
9 a)	Explain the classification of inverters on the basis of a number of factors.	**10**	**4**	**2**
b)	Explain the principle of operation of a single-phase full-bridge inverter for RL load along with the necessary waveforms.	**10**	**4**	**2**
	OR			
10a)	Explain the principle of operation of a single-phase half-bridge inverter for RL load along with the necessary waveforms.	**10**	**4**	**2**
b)	Explain the principle of operation of a single-phase full-bridge inverter for R load along with the necessary waveforms.	**10**	**4**	**2**

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Model Question Paper

IV Semester B.E Semester End Examinations

POWER ELECTRONICS

Duration: **3 hrs** Max. Marks: **100**

Answer five full questions, choosing one complete question from each module.

Sl. No.	Questions	Marks	CO	RBT Level
	Module 1			
1 a)	Define a power converter. Explain the different types of power converters with suitable waveforms and their applications.	**10**	**1**	**2**
b)	Analyze the control characteristics of the following power devices along with the necessary circuit and waveforms. a)SCR b)MCT c)IGBT	**10**	**3**	**2**
	OR			
2 a)	With a neat circuit diagram and waveforms, explain the necessity of di/dt and dv/dt limitations.	**10**	**1**	**2**
b)	Analyze the steady-state characteristics of a power BJT.	**10**	**3**	**2**
	Module 2			
3 a)	Analyze the static V-I characteristics of a thyristor with a suitable diagram.	**10**	**3**	**2**
b)	Analyze the different turn-on methods of a thyristor.	**10**	**3**	**2**
	OR			
4 a)	Explain the UJT Triggering circuit with a neat circuit diagram and Waveforms.	**10**	**3**	**2**
b)	Explain the Resistance-Capacitor Firing circuit for FW with a neat circuit diagram and Waveforms.	**10**	**3**	**2**
	Module 3			
5 a)	Apply the concepts of power semiconductor devices in AC voltage controllers, explain ON-OFF control, and also derive an expression for the RMS output voltage.	**10**	**2**	**2**
b)	Apply the concepts of power semiconductor devices in an AC voltage controller to explain half-phase control with a neat circuit diagram and Waveforms	**10**	**2**	**2**
	OR			
6 a)	Explain a single-phase full converter thyristor with R-L Load, and also derive the expression for Average and RMS output voltage	**10**	**2**	**2**
b)	Apply the concepts of power semiconductor devices in a controlled rectifier to explain a single-phase, half-wave thyristor converter with an R-L Load. Derive the expression for the Average and RMS output voltage	**10**	**2**	**2**
	Module 4			
7a)	Explain the principle of operation of a step-up chopper along with	**10**	**4**	**2**

	necessary waveforms, and also derive an expression for the duty cycle.			
b)	Explain the principle of operation of a buck converter along with the necessary waveforms.	**10**	**4**	**2**
OR				
8 a)	Explain the principle of operation of a step-down chopper along with necessary waveforms, and also derive an expression for the duty cycle.	**10**	**4**	**2**
b)	Explain the principle of operation of a Boost converter along with the necessary waveforms.	**10**	**4**	**2**
Module 5				
9 a)	Explain the principle of operation of a single-phase half-bridge inverter for R load along with the necessary waveforms.	**10**	**4**	**2**
b)	Explain the principle of operation of a single-phase full-bridge inverter for RL load along with the necessary waveforms.	**10**	**4**	**2**
OR				
10a)	Explain the principle of operation of a single-phase half-bridge inverter for RL load along with the necessary waveforms.	**10**	**4**	**2**
b)	Explain the classification of inverters on the basis of a number of factors.	**10**	**4**	**2**

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