SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

VIII SEMESTER

1906801 – RADAR AND NAVIGATIONAL AIDS

Department of Electronics and Communication Engineering

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UNIT I - INTRODUCTION TO RADAR EQUATION

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations.

PART – A

Q.No	Questions	COs	BT Level	Competence
1.	What is radar?	1	BTL 1	Remembering
2.	What do you mean by maximum unambiguous range?	1	BTL 1	Remembering
3.	Define Plan Position Indicator.	1	BTL 1	Remembering
4.	Name the applications of radar.	1	BTL 1	Remembering
5.	Categorize the antenna parameters.	1	BTL 1	Remembering
6.	How the weakest signal is detected?	1	BTL 1	Remembering
7.	Illustrate the factors affecting radar operation.	1	BTL 2	Understanding
8.	A radio link has a 15 W transmitter connected to an antenna of $2.5m^2$ effective aperture at 5 GHz. The receiving antenna has an effective aperture of 0.5 m^2 and is located at a 15 Km line-of-sight distance from the transmitting antenna. Assuming lossless, matched antennas, find the power delivered to the receiver.	1	BTL 2	Understanding
9.	Sketch the two dimensional radiation pattern of a directional antenna.	1	BTL 2	Understanding
10.	Give some examples of simple targets.	1	BTL 2	Understanding
11.	Mention the limitations of Basic radar	1	BTL 2	Understanding
12.	Relate the gain and directivity of an antenna through an appropriate mathematical expression.	1	BTL 1	Remembering
13.	How will you determine the minimum range and range resolution?	1	BTL 2	Understanding
14.	List out the advantages of basic radar	1	BTL 2	Understanding
15.	What is called as false alarm?	1	BTL 2	Understanding
16.	List out the main reasons for the failure of the simple form of the radar equation.	1	BTL 1	Remembering
17.	Explore the term Scan to Scan Fluctuation.	1	BTL 1	Remembering

18.	Summarize the different types of radar signals.	1	BTL 2	Understanding
19.	Write an equation for Probability density function.	1	BTL 2	Understanding
20.	Mention the importance of Resolution in Radar.	1	BTL 2	Understanding
21.	Infer the expression for the fundamental range equation.	1	BTL 1	Remembering
22.	Outline the characteristics of Rayleigh region.	1	BTL 2	Understanding
23.	Interpret the term radar duty cycle.	1	BTL 1	Remembering
24.	Why the target echoes might not exceed the threshold and would not be detected. Justify?	1	BTL 1	Remembering

PART – B

1.	How noise is detected in signals? Explain Briefly.		(13)	1	BTL 3	Applying
2.	List the antenna parameters and explain any four parameters in detail.		(13)	1	BTL 4	Analyzing
3.	Describe the major areas of Radar applications.		(13)	1	BTL 3	Applying
4.	(i)	Elaborate the block diagram and operation of conventional pulse radar with a superheterodyne receiver.	(7)	1	BTL 4	Analyzing
	(ii)	Tabulate the IEEE standard radar frequencies.	(6)			
5.	Summarize the basic principles of radar, maximum unambiguous range Run as a function of frequency, types of radar.		(13)	1	BTL 3	Applying
6.	(i)	A radar system transmits pulses of duration of 2 μs and repetition rate of 1kHz. Find the maximum and minimum range for radar.	(7)	1	BTL 4	Analyzing
	(ii)	For pulse radar with a maximum unambiguous range of 300km. what is the maximum allowable pulse repetition frequency for unambiguous reception?	(6)			
7.	(i)	A radar system operates at 6GHz and output power of 3MW. If the antenna diameter is 5m and the receiver bandwidth is 1.5MHz and has a 12 dB noise figure, what is the maximum detection range for $1m^2$ target.	(7)	1	BTL 4	Analyzing
	(ii)	Examine the minimum receivable signal in a radar receiver operating in standard ambient temperature, which has an IF bandwidth of 2 MHz and a noise figure of 12 dB.	(6)			
8.	Explain the various target models to represent the radar cross section fluctuations.		(13)	1	BTL 3	Applying
9.	Consider the three-target labeled A, B, C. Target A is within the ambiguous range interval R_{un}, target B at a distance greater than R_{un} but less than $2R_{un}$, while target C is greater than 2 R_{un} but less than $3R_{un}$. Calculate the pulse repetition frequency with appearance of the echoes.		(13)	1	BTL 4	Analyzing

10.	Demonstrate the origins of radar by the numerous methods in many countries.		(13)	1	BTL 3	Applying
11.	Describe briefly the behavior of the radar cross section of targets in the Rayleigh region, resonance region and optical region.		(13)	1	BTL 3	Applying
12.	(i)	Illustrate the concept of probabilities of detection and false alarm using simple envelope detector.	(7)	1	BTL 3	Applying
	(ii)	Write short notes about (a) antenna gain (b) Effective area and beam width (c) Revisit time (d) beam shape	(6)			
13.	(i)	Explain the typical radar antenna pattern types with suitable diagram.	(8)	1	BTL 4	Analyzing
	(ii)	What are the different ranges of frequencies that radar can operate and give their applications?	(5)			
14.	Describe the process of summing all the radar echoes by integration of pulses.		(13)	1	BTL 3	Applying
15.	Generalize the radar range equation based on the characteristics of the transmitter, receiver, antenna target and the environment.		(13)	1	BTL 3	Applying
16.	Illustrate the concept of receiver noise and the signal to noise ratio.		(13)	1	BTL 4	Analyzing
17.	Analyze the probabilistic terms in the detection of signals in the presence of noise.		(13)	1	BTL 3	Applying
	PART – C					
1.	Describe the block diagram of a simple radar set and explain the essentials of its operations.		(15)	1	BTL 4	Analyzing
2.	A marine radar operating at 10GHz has a maximum range of 50km with an antenna gain of 4000. If the transmitter has a power of 250kW and minimum detectable signal of 10^{-11} W. Determine the cross section of the target the radar can sight.		(15)	1	BTL 3	Applying
3.	Discuss the peter swerling statistical model for fluctuations of targets and compare the detection probabilities of swerling statistical model		(15)	1	BTL 4	Analyzing
4.	A radar has a bandwidth B = 50Hz and an average time between false alarms 10 min. a) What is the probability of false alarm? b) If the pulse repetition frequency (prf) were 1000Hz if the first nmi of range were gated out (receiver is turned off) because of the use of a long pulse what would be the new probability of false alarm? (Assume the false alarm time has to remain constant). c) Is the difference between (a) and (b) significant? d) What is the pulse width that results in minimum range of 15nmi?		(3) (5) (3) (4)	1	BTL 3	Applying
5.	Briefly explain the various system losses encountered in the radar system from many sources depending on the radar design.		(15)	1	BTL 4	Analyzing

UNIT II - MTI AND PULSE DOPPLER RADAR

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies – Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking – Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics -Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).

PART – A

Q.No	Questions	COs	BT Level	Competence
1.	What is meant by clutter in radar display?	2	BTL 1	Remembering
2.	What is saturation detector?	2	BTL 1	Remembering
3.	Define eclipsing loss.	2	BTL 1	Remembering
4.	Draw the block diagram of single delay line canceler.	2	BTL 2	Understanding
5.	Relate the term bipolar and unipolar video.	2	BTL 2	Understanding
6.	Mention the methods for employing multiple PRFs to avoid losing target echoes due to blind speeds.	2	BTL 1	Remembering
7.	Define Dynamic Range.	2	BTL 1	Remembering
8.	State MTI improvement factor.	2	BTL 1	Remembering
9.	Summarize the properties of single DLC that limit the utility of simple doppler filter.	2	BTL 2	Understanding
10.	Interpret the term doppler frequency shift with radial velocity.	2	BTL 1	Remembering
11.	Outline the characteristics of doppler filter.	2	BTL 1	Remembering
12.	List the disadvantages of recursive delay line filter.	2	BTL 2	Understanding
13.	Interpret how blind speed occurs in sampling.	2	BTL 2	Understanding
14.	Compare the importance of Stalo and Coho.	2	BTL 2	Understanding
15.	Analyze why VHF is not considered as a desirable frequency choice for a long range air surveillance radar.	2	BTL 2	Understanding
16.	Summarize the advantages of doppler filter banks over the single filters.	2	BTL 2	Understanding
17.	Categorize the methods used to reduce blind speeds.	2	BTL 2	Understanding
18.	Differentiate MTI with respect to pulse doppler radar.	2	BTL 1	Remembering
19.	Illustrate the expressions for doppler frequency shift from clutter scatterer.	2	BTL 2	Understanding

20.	Name the compensation techniques in MTI radar.	2	BTL 1	Remembering
21.	How blind phase is different from blind speed?	2	BTL 2	Understanding
22.	Classify the types of regions according to elevation angle.	2	BTL 2	Understanding
23.	Mention the advantages of MTI radar.	2	BTL 1	Remembering
24.	Identify the effect of multipath depending of elevation angles.	2	BTL 1	Remembering

PART – B

1.	Interpret the CW radar and simple pulse radar with neat block diagram		(13)	2	BTL 3	Applying
2.	What is doppler frequency shift? Obtain the expression for doppler frequency shift from radial velocity.		(13)	2	BTL 4	Analyzing
3.	Discuss the four methods for reducing the detrimental effects of blind speeds.		(13)	2	BTL 3	Applying
4.	(i)	Explain the frequency response of the single delay line canceler with relevant mathematical expressions.	(7)	2	BTL 3	Applying
	(ii)	List the advantages of filter bans and derive an equation for response of Doppler filter bank.	(6)			
5.	Write the Improvement factor for single DLC and double DLC. Derive the expression for clutter attenuation.		(13)	2	BTL 4	Analyzing
6.	Explain in the detail about digital MTI processing.		(13)	2	BTL 4	Analyzing
7.	With the help of three pulse canceller, explain the configuration of recursive and non-recursive filter.		(13)	2	BTL 3	Applying
8.	Elaborate the eight pulse doppler filter bank with uniform amplitude weights.		(13)	2	BTL 3	Applying
9.	(i)	Compare the mono pulse tracking and conical scan tracking.	(7)	2	BTL 3	Applying
	(ii)	Calculate the doppler shift when tracking a car moving away from radar at 100 miles/hour? The radar is operating at 1GHz.	(6)			
10.	Describe the operation of moving target detector signal processor.		(13)	2	BTL 3	Applying
11.	With necessary sketches, explain in detail the split gate tracking mechanism of a target in range.		(13)	2	BTL 4	Analyzing
12.	Demonstrate the concept of Mono pulse in one angle coordinate, and Mono pulse in two angle coordinate in radar tracking.		(13)	2	BTL 4	Analyzing
13.	Analyze the degradation in performance of MTI radar with suitable expressions		(13)	2	BTL 4	Analyzing
14.	Draw the low angle tracking illuminates the target via two paths and describe the methods for reducing multipath effects at low angles.		(13)	2	BTL 3	Applying
15.	List the compensation techniques of MTI radar on a moving platform and explain it with suitable examples.		(13)	2	BTL 3	Applying
16.	Derive the total power spectral density of clutter using gaussian model.		(13)	2	BTL 4	Analyzing

17.	Summarize the principle of staggered pulse repetition frequencies with neat sketch and formulate the maximum improvement factor analytically.	(13)	2	BTL 3	Applying

PART – C

1.	Derive the frequency response of delay line canceller with neat diagram.		(15)	2	BTL 3	Applying
2.	(i)	Compare the performance of CW radar and pulsed radar	(8)	2	BTL 4	Analyzing
	(ii)	For an MTI radar analyse the first three blind speeds at 2GHz when the PRF is 1KHz.	(7)			
3.	Determine the doppler shift caused by a vehicle moving toward a radar at 96km/h, if the radar operates at 10GHz.		(15)	2	BTL 4	Analyzing
4.	Estimate the expression for doppler frequency shift of a doppler filter.		(15)	2	BTL 4	Analyzing
5.	Explain in detail about conical scan and sequential lobing.		(15)	2	BTL 3	Applying

UNIT III - DETECTION OF SIGNALS IN NOISE

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators- Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter.- The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

PART – A

Q.No	Questions		BT Level	Competence
1.	What is CFAR loss?	3	BTL 1	Remembering
2.	Define matched filter.	3	BTL 2	Understanding
3.	Mention the functions of radar antennas.	3	BTL 2	Understanding
4.	List the advantages of cassegrain feed system.	3	BTL 1	Remembering
5.	Sketch the periodically loaded line phase filter diagram.	3	BTL 1	Remembering
6.	What are the differences between TWTA and klystron amplifier?	3	BTL 2	Understanding
7.	Interpret the meaning of array factor.	3	BTL 1	Remembering
8.	Summarize the advantages of dual offset symmetric reflector antennas.	3	BTL 1	Remembering
9.	Draw the hybrid coupled phase bit diagram using 3dB hybrid junction.	3	BTL 2	Understanding
10.	Enumerate the basic principle of Radiosonde.	3	BTL 2	Understanding
11.	Distinguish series feed array and parallel feed array.	3	BTL 2	Understanding
12.	Write the expression for normalized radiation pattern of an array of isotropic elements.	3	BTL 1	Remembering

13.	List the factors affecting the transmitted waveform by a radar.		3	BTL 1	Remembering
14.	Identify the feed networks used in a phased array antenna.		3	BTL 1	Remembering
15.	Interpret how spillover happens during the reception of signal in an antenna.		3	BTL 1	Remembering
16.	Draw the hysteresis loop of a ferrite toroid.		3	BTL 2	Understanding
17.	Mention the basic radar measurements that can be achieved from a point target.		3	BTL 2	Understanding
18.	Classify different types of propagation of radar waves.		3	BTL 2	Understanding
19.	Analyze how the aperture blockage can be prevented in reflector antenna.		3	BTL 2	Understanding
20.	Categorize the different radar cross section modulations.		3	BTL 2	Understanding
21.	Explore the need for integrator in modern radar.		3	BTL 1	Remembering
22.	Why magnetron is called as cross field device?		3	BTL 1	Remembering
23.	Mention the various types of stable oscillator.		3	BTL 2	Understanding
24.	Summarize the radar RF power sources.		3	BTL 1	Remembering
	PART – B				
1.	Justify the importance of electronically steered phased array antenna in radar signal detection with relevant mathematical expressions.	(13)	3	BTL 3	Applying
2.	Derive the expression for the frequency response of matched filter.	(13)	3	BTL 4	Analyzing
3.	(i) Estimate the expression for output signal from the matched filter.	(7)	3	BTL 3	Applying
	(ii) Write short notes on matched filter characteristics of nonwhite noise.	(6)			
4.	Show the magnitude of the matched filter frequency response function is same as the amplitude spectrum of the input signal.	(13)	3	BTL 4	Analyzing
5.	Describe in detail about the various detection criteria.	(13)	3	BTL 3	Applying
6.	Summarize the in-phase and quadrature detector operation of radio receiver. Obtain the expression for output voltage of the detector.	(13)	3	BTL 4	Analyzing
7.	(i) Write short notes on three methods of diode phase shifters with neat diagram.	(7)	3	BTL 3	Applying
	(ii) With neat diagram explain the series and parallel feed array network.	(6)			
8.	Discuss in details the concept, design principles of constant false alarm rate receiver.	(13)	3	BTL 4	Analyzing
9.	Elaborate the principle of parabolic reflector antenna with the neat diagram and explain the types of feed used.	(13)	3	BTL 4	Analyzing
10.	Explain the operation of binary integrator with neat block diagram.	(13)	3	BTL 3	Applying

11.	Calculate the diameter of dish antenna that will form a beam having 0.5° HPBW at a frequency of 8.2 GHz. Assume an efficiency constant of 0.6, calculate the antenna gain and effective aperture.	(13)	3	BTL 4	Analyzing
12.	A 3m diameter parabolic antenna operates at 6.8GHz. Determine half power beamwidth, beamwidth between first nulls and the gain of the antenna in dBs.	(13)	3	BTL 3	Applying
13.	(i) Examine the various elements of Radar signal management.	(7)	3	BTL 4	Analyzing
	(ii) Summarize the atmospheric refraction in standard propagation and nonstandard propagation of radar waves.	(6)			
14.	Discuss in detail about standard propagation in the earth's atmosphere.	(13)	3	BTL 4	Analyzing
15.	Explain the different types of mixers in super heterodyne receiver and find noise figure at front end of the mixer.	(13)	3	BTL 3	Applying
16.	Analyze the cross-sectional view of coaxial cavity magnetron tube and explain the operation of cross field amplifier.	(13)	3	BTL 3	Applying
17.	(i) Demonstrate the working of LQ radar detector in detail.	(7)	3	BTL 4	Analyzing
	(ii) With neat sketch explain the cell averaging constant false alarm rate receiver (CFAR).	(6)			
	PART – C				
1.	With neat diagram, discuss the Component parts of Radar Signal management.	(15)	3	BTL 4	Analyzing
2.	Demonstrate the working of klystron amplifier and travelling wave tube amplifier with neat diagram.	(15)	3	BTL 4	Analyzing
3.	An L-band radar operating at 1.25 GHz uses a peak pulse power of 3 MW and must have a range of 185.2 km for objects whose radar cross section is $1m^2$. If P_{min} is 2×10^{-13} Watt. Calculate the smallest diameter the antenna reflector could have, assuming it to be a full paraboloid with η=0.65.	(15)	3	BTL 3	Applying
4.	Derive the parabola geometry that makes it a suitable for antenna reflectors. Design an antenna employing a parabolic reflector that is likely to be a highly directive receiving antenna.	(15)	3	BTL 3	Applying
5.	Consider the N-port networks in cascade with different noise figures and gain but with same noise bandwidth. Determine the output noise of the network and effective noise temperature of a receiver. Also Analyze the noise figure due to loss in the transmission line.	(15)	3	BTL 4	Analyzing

UNIT IV - RADIO DIRECTION AND RANGES
Introduction - Four methods of Navigation. - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding -Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range (VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment -

Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System.				
PART – A				
Q.No	**Questions**	**COs**	**BT Level**	**Competence**
1.	Define Navigation.	4	BTL 1	Remembering
2.	What is the need of a Chronometer?	4	BTL 2	Understanding
3.	Draw the series tuned loop input circuits.	4	BTL 1	Remembering
4.	Write the expression for minimum and maximum interval between the pulses of Loran-A display.	4	BTL 1	Remembering
5.	What are the errors arising in direction finders?	4	BTL 1	Remembering
6.	Classify the four methods of navigation.	4	BTL 1	Remembering
7.	Summarize Electronic Navigational Aids.	4	BTL 1	Remembering
8.	Discuss about mountain effect.	4	BTL 2	Understanding
9.	Summarize the different hyperbolic navigational systems.	4	BTL 2	Understanding
10.	Review the principle of Navigation by Dead Reckoning.	4	BTL 2	Understanding
11.	Mention the different types of automatic direction finders.	4	BTL 1	Remembering
12.	How Celestial navigation is accomplished?	4	BTL 1	Remembering
13.	Demonstrate Hyperbolic System of Navigation.	4	BTL 1	Remembering
14.	Exhibit how antenna effect is minimized.	4	BTL 1	Remembering
15.	How does the Omega system works?	4	BTL 2	Understanding
16.	List the advantages of OMEGA system.	4	BTL 1	Remembering
17.	Draw the loran triplets and coverage of loran-A chains	4	BTL 2	Understanding
18.	Illustrate the need of Adcock direction finders.	4	BTL 1	Remembering
19.	Analyze the various sources of errors in VOR system.	4	BTL 2	Understanding
20.	Categorize the two types of radio ranges in use.	4	BTL 2	Understanding
21.	List the disadvantage of loop direction finder.	4	BTL 2	Understanding
22.	What is the operating frequency of LORAN-C?	4	BTL 2	Understanding
23.	Enumerate the basic principle of Long Range Navigational Aid.	4	BTL 2	Understanding
24.	What is the need of DECCA Navigation System?	4	BTL 2	Understanding
PART – B				

1.	With neat diagram explain the principle and operation of celestial navigation in detail.	(13)	4	BTL 4	Analyzing
2.	Discuss about the navigation by dead-reckoning with velocity triangle.	(13)	4	BTL 3	Applying
3.	With the help of phasor and polar diagram describe the operation of loop antenna.	(13)	4	BTL 3	Applying
4.	(i) Write notes on various loop input circuits.	(10)	4	BTL 3	Applying
	(ii) What is hyperbolic system of navigation and give its working principle.	(3)			
5.	From the principle of rectangular loop antenna, derive the expression for resultant voltage around the loop. Draw the cardioid pattern of vertical antenna and loop antenna.	(13)	4	BTL 4	Analyzing
6.	(i) Interpret the procedure for direction finding in loop.	(5)	4	BTL 3	Applying
	(ii) Draw the input circuit of aural-null direction finder and explain its operation.	(8)			
7.	Discuss the working principle of goniometer with necessary diagrams.	(13)	4	BTL 3	Applying
8.	Elaborate the various classes of errors in direction finding.	(13)	4	BTL 4	Analyzing
9.	Discuss the working principle of radio compass receiver with block diagram.	(13)	4	BTL 4	Analyzing
10.	Describe in detail about VHF automatic direction finder with block diagram and draw the circuit of the phase measuring part of the receiver.	(13)	4	BTL 3	Applying
11.	Demonstrate the operation of LF/MF four course range with polar diagram.	(13)	4	BTL 3	Applying
12.	Consider an antenna system consisting of two antennas A and B separated by a distance of less than $\lambda/2$ and rotated around the circumference of a circle of radius r. Calculate the phase difference between the antennas using CADF.	(13)	4	BTL 4	Analyzing
13.	(i) Discuss about the instrumentation part of VOR receiver	(8)	4	BTL 4	Analyzing
	(ii) Summarize the importance of direction finding at very high frequencies.	(5)			
14.	Explain in detail about Adcock Direction Finders and its advantages over loop antenna.	(13)	4	BTL 4	Analyzing
15.	Discuss the working principle of VOR ground equipment with neat block diagram.	(13)	4	BTL 4	Analyzing
16.	Illustrate the sequence of transmission and reception in Loran-A and Loran-C.	(13)	4	BTL 3	Applying
17.	Discuss the following:		4	BTL 3	Applying
	(i) Decca receiver configurations.	(10)			
	(ii) Range and Accuracy of Decca receiver.	(3)			
	PART – C				
1.	What is omega system? Explain the transmission format of omega stations and list the advantages of omega system.	(15)	4	BTL 3	Applying
2.	Summarize the various automatic direction finding methods with neat diagrams.	(15)	4	BTL 3	Applying
3.	With neat diagram, discuss in about DECCA navigation system.	(15)	4	BTL 4	Analyzing

4.	Analyze the four methods of navigation to determine the position of the craft and directions to reach the desired direction.	(15)	4	BTL 4	Analyzing
5.	With neat diagram elaborate the basic principles of function and operation of VOR receiver.	(15)	4	BTL 3	Applying

UNIT V - SATELLITE NAVIGATION SYSTEM

Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment - Instrument Landing System - Ground Controlled Approach System - Microwave Landing System (MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning System (GPS).

PART – A

Q.No	Questions	COs	BT Level	Competence
1.	What is meant by Localizer?	5	BTL 1	Remembering
2.	Where we locate the frequency tracker to get the output signal?	5	BTL 1	Remembering
3.	List out the basic elements of MLS system.	5	BTL 1	Remembering
4.	Mention the disadvantages of ILS.	5	BTL 1	Remembering
5.	Define - Inertial Navigation.	5	BTL 1	Remembering
6.	What is meant by Doppler navigation?	5	BTL 1	Remembering
7.	State the features of Navigation over earth.	5	BTL 1	Remembering
8.	What are the components of inertial navigation systems?	5	BTL 1	Remembering
9.	Quote about Decca tracking and ranging.	5	BTL 1	Remembering
10.	Express the field pattern of TACAN beacon.	5	BTL 1	Remembering
11.	Summarize the principle of doppler radar.	5	BTL 1	Remembering
12.	Illustrate the velocity components of the four beams of Janus-X.	5	BTL 1	Remembering
13.	Mention the Secondary Radar systems.	5	BTL 2	Understanding
14.	Outline the components of the doppler navigation system.	5	BTL 2	Understanding
15.	Define doppler shift.	5	BTL 2	Understanding
16.	Draw the block diagram of a two filter frequency tracker.	5	BTL 2	Understanding
17.	State the concept of doppler profile.	5	BTL 2	Understanding
18.	Write the doppler range equation.	5	BTL 2	Understanding
19.	Categorize the types of Radar present in the Ground controlled approach systems.	5	BTL 2	Understanding

20.	What are the errors arising from two sources in position determination?		5	BTL 2	Understanding
21.	What is meant by Drift angle?		5	BTL 2	Understanding
22.	List the L-band frequencies used in Navstar GPS.		5	BTL 2	Understanding
23.	Summarize the major components of Navstar modern receiver.		5	BTL 2	Understanding
24.	Analyze how track speed is calculated.		5	BTL 2	Understanding
	PART – B				
1.	Explain the operation of localizer antenna array with neat phasor and polar diagram.	(13)	5	BTL 3	Applying
2.	Derive the expression for field pattern of TACAN receiver and draw the radiation pattern.	(13)	5	BTL 3	Applying
3.	Discuss about the radiation diagram of the glide slope equipment in cartesian and polar coordinates.	(13)	5	BTL 4	Analyzing
4.	Elaborate in detail about the concept of airborn DME interrogator with neat block diagram.	(13)	5	BTL 4	Analyzing
5.	Generalize about the instrumentation part of ILS receiving equipment.	(13)	5	BTL 4	Analyzing
6.	Predict the various ground controlled approached system in elevation and azimuth plane.	(13)	5	BTL 4	Analyzing
7.	Summarize the beam scanning techniques in microwave landing system and basic elements of the MLS.	(13)	5	BTL 4	Analyzing
8.	(i) Interpret the steps involved in generation of response and filter pulses in the transponder receiver.	(7)	5	BTL 4	Analyzing
	(ii) Describe the importance of DME beacon.	(6)			
9.	(i) How to find the location facilities in TRSB-MLS and time sharing of various functions?	(5)	5	BTL 3	Applying
	(ii) Conclude the basic elements of the conventional double super heterodyne receiver.	(8)			
10.	(i) Discuss about the basic concepts of distance measuring equipment.	(6)	5	BTL 4	Analyzing
	(ii) Explain about the TACAN in detail with suitable diagram.	(7)			
11.	Describe the operation of DME and draw the waveforms of the tracking circuit.	(13)	5	BTL 3	Applying
12.	Elaborate about antenna systems for the microwave landing system.	(13)	5	BTL 4	Analyzing
13.	Illustrate the principle of doppler radar and beam configuration of antenna heading stabilization and antenna track stabilization.	(13)	5	BTL 3	Applying
14.	Derive the expression for doppler frequency equations in Janus-X antenna system.	(13)	5	BTL 4	Analyzing
15.	Explain in detail about components of Doppler navigation system.	(13)	5	BTL 3	Applying
16.	Analyze about earth coordinate mechanization for navigation in the latitude and longitude system of coordinates.	(13)	5	BTL 4	Analyzing
17.	(i) Deduce the expression for Signal to noise ratio from doppler range equation.	(7)	5	BTL 3	Applying
	(ii) Discuss about frequency modulated continuous wave doppler radar with neat block diagram.	(6)			

PART – C					
1.	Explain the various components of an inertial navigation system with neat sketch.	(15)	5	BTL 3	Applying
2.	Explain in detail about Navstar Global Positioning system.	(15)	5	BTL 4	Analyzing
3.	Explain the location of the components of the instrument loading system with respect to the runway.	(15)	5	BTL 3	Applying
4.	Interpret the importance of three segments of the GPS system and explain the basic principles of operation of Navstar global positioning system.	(15)	5	BTL 4	Analyzing
5.	Elaborate the beam configurations of doppler radar in an aircraft in level flight.	(15)	5	BTL 3	Applying