End Semester Examination – April, 2017

Program/course: **B.Tech EE**	Semester – **VIII**
Subject: **Radar Systems**	Max. Marks : **100**
Code : **ELEG435**	Duration : **3 Hrs**
No. of page/s: **02**	

Sec(A)

All questions are compulsory and each carry 5 marks.

1. What are the desirable pulse characteristics and the factors that govern them in a Radar system?
2. Draw the functional block diagram of simple pulse radar and explain the purpose and functioning of each block in it.
3. Derive the maximum range for a radar system from first principles.
4. What is meant by maximum unambiguous range & range to a target?

Sec(B)

All questions are compulsory and each carry 10 marks.

5. Derive an expression for maximum detectable signal to noise ratio.
6. What are the differences between MTI radar and pulse Doppler radar? What are the limitations to MTI performance?
7. Why does a parabolic surface make a good reflector antenna? Explain feeds for paraboloids.
8. A typical waveform used in radar is shown below in Fig. 1, calculate: (i) average power (ii) duty cycle (iii) maximum range of radar
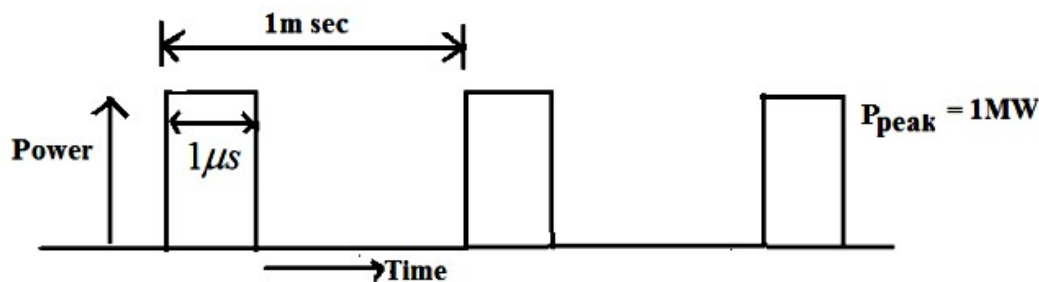

Fig.1

Sec(C)

All questions are compulsory and each carry 20 marks.

9. A radar operating at 1.5 GHz uses a peak pulse power of 2.5 MW and have a range of 100 nmi for objects whose radar cross-section is $1m^2$. if the minimum receivable power of the receiver is 2×10^{-13} W. what is the smallest diameter antenna reflector could have, assuming it to be a full paraboloid with $\eta=0.65$.

10. A pulse Doppler radar has a carrier frequency of 9 GHz and PRF of 400 GHz. Find its blind Doppler frequencies and the radial velocity of target which would be undetected by the radar.

    or

    How does a SAR differ from a physical linear array? Show that finer resolution is achievable using smaller physical apertures in SAR.

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Sec(A)

All questions are compulsory and each carry 5 marks.

1. A CW radar transmits frequency of 10 GHz and Doppler is 1000 Hz. Calculate the radial velocity of the target.
2. What do you understand by the term clutter? Explain the different types of clutter.
3. A pulse radar has peak power 5 kW and uses PRF of 10 KHz. Find the required duty cycle, peak repetition intervals, pulse width to make constant average transmitted power of 1 kW and pulse energy.
4. List the functions of a radar antenna.

Sec(B)

All questions are compulsory and each carry 10 marks.

5. Explain the basic principle of a radar system. Give limitations and applications of radars.
6. Derive an equation to show the relationship between maximum radar range and antenna gain.
7. Draw the block diagram of delay line canceller and explain how it works.
8. Derive expressions for: (i) Blind speeds (ii) Doppler frequency shift

Sec(C)

All questions are compulsory and each carry 20 marks.

9. What is the peak power of a radar whose average power is 200W, pulse width of 1μsec and has PRF of 1000Hz? Also calculate the range of this ground based air surveillance radar if it has to detect a target with a RCS of 2m2 when it operates at a frequency of 2.9 GHz with a rectangular shaped antenna which is 5m wide, 2.7m height, antenna aperture efficiency of 0.6 and minimum detectable signal is 10^{-12}.

10. Calculate the maximum range of radar system which operates at 3.5 cms wave length, with a peak pulsed power of 500 kw. If its minimum receivable power is 10^{-13} Watts, the capture area of the antenna is 8 m² and radar cross sectional area of the target is 25 m².

or

A radar has a bandwidth B = 50 kHz and an average time between false alarms of 10 minutes. (i) What is the probability of false alarm? (ii) If the pulse repetition frequency (prf) were 1000 Hz and if the first 15 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.) (iii) Is the difference between (i) and (ii) significant? (iv) What is the pulse width that results in a minimum range of 15 nmi?