Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
JANUARY/FEBRUARY 2021
SUBJECT: RADAR AND NAVIGATION (ECE - 4032)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.
- Show all the necessary steps with relevant equations and neat diagrams

1A. A pulse radar operates at 2GHz and has a per-pulse power of 1kW. If it is to be used to detect a target with RCS=20m^2 at a range of 10km, what should be the minimum isolation between transmitter and receiver so that the leakage signal from transmitter is at least 10dB below the received signal? Assume an antenna gain of 30 dB.

1B. With neat diagrams explain the working of FM-CW altimeter and compare it with radar beacons.

(5+5)

2A. With equations and neat diagrams, explain single delay line canceler and its drawbacks over double delay line canceler.

2B. A Doppler radar operating at 12GHz is intended to detect target velocities ranging from 7.2kmph to 72kmph. What is the required passband of Doppler filter?

2C. A pulsed radar has a pulse repetition rate 1700 pulses/second and transmits rectangular pulses of duration 15μs. What maximum range can a target have if no part of its delayed pulse is to overlap any part of a transmitted pulse and not be delayed more than one PRF interval?

(4+3+3)

3A. With necessary diagrams and equations explain the butterfly effect in MTI radar and discuss the limitations of MTI radar. Also, explain the MTI radar with power oscillator transmitter.

3B. A Geostationary communication satellite has an uplink frequency of 6 GHz with an antenna elevation of 5^0. Transmitter power is 1 kW. If transmitting antenna gain is 60 dB and receiving antenna gain is 0 dB, calculate the received power at the input of satellite receiver.

(6+4)

4A. A spacecraft located 1,00,000 km from the earth is sending data at a rate of R bits/s. The frequency band is centered at 2 GHz and the transmitted power is 10 W. The earth station uses a parabolic antenna, 50m in diameter and the spacecraft has an antenna with a gain of 10 dB. The noise temperature of the receiver front end is T_0 = 300K. Assume η =0.5.

i. Determine the received power level

ii. If the desired Eb/No =10 dB, determine the maximum bit rate that the spacecraft can transmit

4B. With neat diagram, explain trilateration and also explain the working of GPS.

(5+5)

5A. Compare passive and active phased array radars. Also explain the T/R module used in active phased array radar.

5B Consider a 2-D search radar having an antenna of 6.5 meters wide. If it is rotating (in azimuth) at a constant rate of 45^0 per second, how long is a potential target stays in the 3dB beam if the operating frequency is 2.8GHz?

5C Draw the block diagram of an active SONAR and explain its operation.

(4+3+3)