M.Tech (R&M), Two Year (Four Semesters)

Scheme to be valid with effect from the admitted batch of 2019 – 2020

MODEL QUESTION PAPERS

DIGITAL SIGNAL PROCESSING

Subject Code: MTRM-1.1 **Max Marks : 70**

Note : Answer any FIVE questions

1. A digital low-pass filter is required to meet the following specifications.
   (i) Pass band ripple ≤ 1 dB (ii) Pass band edge : 4 KHz (iii) Stop band attenuation ≥ 40 dB (iv) Stop band edge : 6 GHz (v) Sampling rate : 24 KHz
   The filter is to be designed by performing a bilinear transformation on an analog system function satisfying above specifications. Determine the order of butterworth, chebyshev and elliptic analog designs to be used to meet the specifications in the digital implementation. Determine the transfer function of the digital filter in each case.
   [14M]
2. (a) Explain about optimization methods for designing IIR filters and delay equalized elliptic filters.
   [7M]
   (b) Compare optimum FIR filters and delay equalized elliptic filters. [7M]
3. (a) Define (i) decimation (ii) interpolation and explain the process of decimation by factor 'D' [7M]
   (b) Decimating x(n) by a factor of D = 2 produces the signal $x_d(n)=x(2n)$ for all n shows that $x_d(n)$ and its transform $x_d(w)$. Do we lose any information when we decimate the sampled signal $x_s(n)$?
   [7M]
4. (a) Show that the linear interpolation is a second order approximation.
   [7M]
   (b) Explain the implementation of digital filter banks. [7M]
5. (a) Consider the ARMA process generated by the difference equation x(n) = 1.6x(n-1) - 0.6x (n-2) + w(n) + 0.9w(n-1)
   [7M]
   (i) Determine the system function of the whitening filter and its poles and zeros (ii) Determine the power density spectrum of {x(n)} [7M]
   (b) Illustrate how the whitening property of a prediction area filter and the AR modeling of a discrete time stochastic process are complementary.
   [7M]
6. (a) What is the role of wiener filters for filtering and prediction of signals.
   [6M]
   (b) Consider a signal x(n) = s(n) + w(n) where s(n) is an AR (1) Process that satisfies the difference equation. S(n) = 0.8 s(n-1) + v(n) where {v(n)} is a white noise sequence with variance σ^2_v = 0.49 and {w(n)} is a white noise sequence with variance $\sigma^2_w=1$. The process {v(n)} and {w(n)} are uncorrelated (i) Determine the autocorrelation sequence { $r_{ss}(m)$} and { $r_{xx}(m)$}. (ii) Design a wiener filter of length M = 2 to estimate {s(n)} (iii) Determine the MMSE for r = 2 [8M]
7. (a) Determine the reflection coefficient k_3 in terms of the autocorrelations { $\psi_{xx}(m)$} from the scheme algorithm and compare your result with the expression for k_3 obtained from the Levinson Duebin algorithm.
   (b) Explain the Goertzel algorithm. If this algorithm fails which algorithm do you suggest ?

8. Describe the following [14M]

(i) Convolves

(ii) Channel vocoder TDM to FEM translate

Modal Question Paper
M.Tech (Radar & Microwave Engineering)
1st Semester
MICROWAVE COMPONENTS AND NETWORKS

Subject Code : MTRM-1.2 **Max Marks : 70**

Note : Answer any **FIVE** questions

1.a)Specifythereasonswithexampleswhyconventionaltransistor,ICandwirewon'tworkat microwavefrequencies.(5)
b)WritetheapplicationsoftheE.M.spectrum(300MHz-300GHz)(3)
c)Aradartransmitteroutputpowermeasuredis1000w.Expressthepowerintermsofd Bw anddBm.(6)

2.a)writetheprincipleofoperationoftwocavityklystronamplifierwithneatdiagram.(5)
b)Explainthevelocitymodulationinreflexklystronusing Applegatediagramfor13/4cycle.(6)
c)ReflexKlystronoperatesat9GHzwithbeamvoltageof300V,repellerspaceis20mmfor 13/4mode.Findthemaximumpowerwhen I_B =20mA.(3)

3.a)DifferentiatebetweenlinearbeamtubesandMtypetubewithreferencetotheElectricand Magneticfields.(5)
b)Explaintheprincipleofoperationof Magnetronandwritethe Hullcutoffcondition(9)

4.a)writetheprincipleofoperationoftunneldiodeandPINdiode(6)
b)whataredifferencebetweenfixedstepandvariableattenuators(6)
c)InputVSWRofanattenuatorwhichisshortedattheotherendisobservedtobe2.5.whatis theattenuationintroducedbytheattenuator?(2)

5.a)whatarethepropertiesofscatteringMatrix?(5)
b)Obtainthe'**S**'Matrixfor'4-port'directionalcoupler?(9)

6.a)Differentiatebetweenthe'E'and'H'planesofTeejunction?(6)
b)writethe'S'matrixforMagicTeeorHybridjunction.(8)

7.a)whataretheadvantagesofMMICs?(3)
b)Whatarethebasicmaterialsusedinfabrications ofMMICs.Explainthesubstrateand conductormaterialcharacterizedwithexamples.(6)
c)Explainthediffusion,Ionimplementationandepitaxialgrowthmethosof MMICfabrications(5)

8.a)Drawtheexperimentalsetupandexplaintheprocedureformeasuringthe VSWRoflessthan 10.
(7)
b)Explainthefollowingwithrespecttodirectionalcoupler.(7)

i.Couplingfactor
ii.Directivity
iii.Isolation.

OPTICAL FIBERS AND APPLICATIONS

Subject Code: MTRM-1.3(Elective-1) **Max Marks : 70**

Note : Answer any FIVE questions

1. a) Discuss the properties and characteristics of Optical fibers 7
   b) Explain the difference between a step-index fiber and a graded index fiber. 7 What are the advantages of using graded index core in a fiber?

2. a) Explain the principle of operation of LED. Enumerate the characteristics of LED 7
   b) Discuss the operation of an Avalanche Photodiode. Explain the factors that limit the time response of Avalanche photodiode. 7

3. a) Explain the operation of a LASER. 6
   b) Explain the following properties of LASER : 8
   i) Line Width ii) Beam Divergence angle

4. a) With neat diagrams explain the various types of splicing and source couplings used in optical fibers. 7
   b) Explain the principle of operation of i) Optical fiber isolator ii) Optical attenuator 7

5. a) What is system risk time?. Explain how does it limit an optical fiber communication link. 7
   b) Explain quantum limit.A certain optical fiber link at 850 nm requires maximum bit error rate(BER) = 10^{-9} . Find the quantum current at a data rate of 10 Mb/Sec. (Assume h= 6.626 X 10^{-34} J-Sec) 7

6 a) Draw the block diagram of an optical receiver and give the noise equivalent circuit of the voltage amplifier. 6
   b) Explain the principle of operations of Photo detectors and photo multipliers. 8

7 a) What is multiplexing?. Explain in detail the Wavelength division multiplexing. 7
   b) Explain various network topologies in multiplexing fiber optic sensors. 7

8 Write short notes on: 14
   a) PIN photo diodes
   b) Fiber Bragg Gratings
   c) Digital System design.

MODERN RADAR SYSTEMS

Subject Code : MTRM-1.3(Elective-I) **Max Marks : 70**

Note : Answer any **FIVE** questions

1(a) What is meant by Radar cross-section and how does it influence detectability? 7M
(b) State Radar range equation and discuss the influence of radar cross section on the range realizable. 7M

2(a) What is meant by "frequency agility" and how does it influence the radarPerformance. 7M
(b) Describe the importance and functioning of a monopulse radar. 7M

3(a) What are the main components of a "Tracking Radar". 7M
(b) Two aircrafts are at the same elevation from a radar system but travelling on different glide paths .Explain how the two targets can be resolved and tracked. 7M

4 (a) How is a target "acquired". 7M
(b) Explain whether modulation is required for implementing surveillance radar .7M

5 (a) What factors determine accuracy in a Doppler radar? 7M
(b) A Doppler radar works at 12GHz and uses a pulse modulator. If the pulse width 1 sec, what is the range and velocity detectable if peak power is 500watts?Assume Suitable parameters for antenna and target cross section and discriminator Sensitivity. 7M

6 (a) Describe the performance of a radar system which is useful in measuring velocity of a target accurately. 7M
(b) What is the need for pulse compression in radar receiver. 7M

7 (a) Briefly describe how a Stealth aircraft avoids detection by radar. 7M
(b) What steps are to be taken in a defence radar system if it is known that the frequency used information is available to the enemy. 7M

8. Write short notes on the following: 14M
(a) Range Resolution
(b) Pencil Beam
(c) Electronic Counter Measure(ECM)

EMI/EMC

Subject Code : MTRM– 1.4(Elective-II) **Max. Marks :**70

Note : Answer any **FIVE** questions.

1 (a). List out the mechanisms in which EMI propagates from source to receiver and briefly explain the Electromagnetic spectrum and it's utilization. [7]

(b). List out sources of EMI in detail. [7]

2 (a). What is meant by ESD. Explain effects of lightening discharge on transmission lines. [7]

(b). Draw an ESD equivalent circuit and explain Electromagnetic pulse and it's impact. [7]

3 (a). Draw an equivalent circuit of relay / switching circuit and explain the characteristics of Electromagnetic noise produced by switches. [7]

(b). How do you explain phenomenon of crosstalk in transmission lines and list out materials to be used and materials to be avoided for reducing passive intermodulation. [7]

4 (a). Compare radiated interference test facilities in detail. [7]

(b) Explain the precautions to be taken in open area test site measurements. [7]

5 (a). Explain the conducted EM noise on power supply lines and conducted EMI from equipment and how do you eliminate them. [7]

(b). Describe different types of grounding techniques with suitable examples. [7]

6 (a). Define shielding effectiveness and explain different methods of shielding and design methodologies. [7]

(b). Describe characteristics of EMI filters [7]

7 (a). Describe the characteristics of cables, connectors and compensators in EMCdesign. [7]

(b). Briefly discuss isolation transformers and optoisolators. [7]

8 . Write short notes on.

(a) EMC Standards (b) Electrical bonding [14]

(c) Electrical surges (d) Statistical EMI / EMC modules

MICROPROCESSOR SYSTEMS

Subject Code: MTRM-1.4(Elective-II)Max. Marks : 70

1. Draw the architectural block diagram of Intel 8051 microcontroller and explain the function of each block. [14]

2. (a) Draw the programming model of Intel 8086 and explain the function of registers and flags. [10]

   (b) Which instruction places the E-flags on the stock in the Pentium-IV microprocessor. [4]

3. (a) Explain the programming addressing modes and two stack memory addressing modes. [10]

   (b) Explain how LOOPE instruction operates [4]

4. (a) Explain how do you interface a 8259 A programmable intercept controller to 8086 microprocessor. [10]

   (b) Describe the differences between a protected mode and real mode intercept [4]

5. Describe how a direct memory access controller device an be connected to a 80686 system and describe how a DMA data transfer takes place [14]

6. (a) Explain with a block diagram how a co-processor can be connected to an 8086 operating in a maximum mode [10]

   (b) What ways are a standard microprocessor and a co-processor different from each other. [4]

7. Draw a 8-bit LED display interfaced to the 8086 microprocessor through an 82C55 PIA and explain the operation with the help of programming modes[14].

8. Write notes on any two of the following

   (a) RISC processor [7]
   (b) 8251 [7]
   (c) Interrupts used in 8086 [7]
   (d) differences between 8086 and 8088 [7]

RF AND MICROWAVE ENGINEERING

Subject Code : MTRM-2.1 **Max Marks : 70**

Answer any **FIVE** questions

1. a) Explain merits and demerits of RF and Microwaves in detail. (7)
   b) Describe in detail RF and Microwave circuits design methodologies. (7)
2. a) Compare RF / Microwave and DC/low frequency signal in detail. (5)
   b) Analyze the following circuit (fig. 1) in phasor domain. (4)

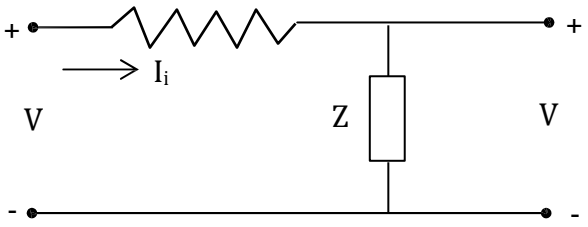

Fig. 1

   c) Calculate and plot the voltage gain magnitude and phase, if (i) the shunt element in Fig. 1 is a perfect capacitor, (ii) the shunt element in Fig. 1 is a perfect inductor. (5)

3. a) Define and explain (7)
   (i) Reflection Coefficient
   (ii) Power Reflection Coefficient
   (iii) Return Loss
   (iv) Reflection Loss or Mismatch Loss
   b) A lossless transmission line of Z_0= 100 is connected to a load Z_L= 100 + j 100 . Using a Smith Chart, (7)
   (i) Determine the Reflection Coefficient at the load
   (ii) Calculate the return loss (R_{loss})
   (iii) Find the VSWR on the line
4. a) For a common distributed circuit element explain the method of determination of input impedance (Z_{in}) using a known load (Z_L) and reflection coefficient, (7)
   b) Find out the input impedance of a Transmission line with Z_0= 50 that has a length of /8 and is connected to a load impedance Z_L= 50 + j 50 (7)

5. a) Explain the steps involved in Maximum gain Amplifier design and also for a low noise amplifier design. (7)

   b) Design a high gain amplifier for a Power gain of 15 dB at a frequency of 3 GHz. The selected Bipolar transistor has the following S-Parameters (at V_{CE}= 4 V and I_C= 5 mA) (7)

$$S \quad \begin{matrix} 0.7 & 155^0 & 0 \\ 4 & 180^0 & 0.51 \quad 20 \quad {}^0 \end{matrix}$$

6. Explain different design methods of large signal (class A operation) amplifiers in detail. (14)

7. Explain the following in detail.

   a) Signal distortion due to inter modulation products under large signal conditions. (7)

   b) Two-Tone measurement technique. (7)

8. Answer the following.

   a) Explain the basic differences between Oscillators design and Amplifiers design. (4)

   b) Explain the design procedure for transistor oscillator clearly at RF / Microwave frequency. (4)

   c) Fixed frequency oscillators using lumped element circuits. (3)

   d) Frequency tunable oscillators. (3)

GPS AND APPLICATIONS

Subject Code : MTRM-2.2 **Max. Marks:70**

Answer any Five Questions

1. (a) Describe the GPS Seattleite constellation with a neat diagram. (7)

   (b) How GPS aided Geo-augmented navigation (GAGAN) improves the GPS signal performance. (7)

2. Explain with a neat block diagram, the signal structure of L1 and L2 frequencies with the corresponding C/A, P- code and Navigation message (14)

3. (a) What are the important satellite orbital parameters that are used in the Satellite position computation in ECEF coordinate system (8)

   (b) What is WGS 84 system and how it is related to the GPS position computation (6)

4. (a) What is RINEX format (6)

   (b) Describe the Navigation message and Observation data files (8)

5. What are errors that are limiting the GPS system performance (7)

   (b) Describe ionospheric error with its contribution to the pseudorange estimation (7)

6. Explain with the relevant Equations, how the ionospheric error is eliminated in a two frequency GPS receiver (14)

7. (a) What is the difference between the Geo centric and Geodetic coordinate systems? (7)

   (b) Compare the GALILEO signal structure with the GPS signal structure (7)

8. Write any two of the following (14)

   (a) GPS time (b) Antispoofing (c) Selective Availability

CELLULAR AND MOBILE COMMUNICATIONS

Subject Code : MTRM-2.3(Elective-III) **Max Marks : 70**

Note : Answer any **FIVE** questions

1. Discuss sequence of steps in initiating a cell from one cell user to the others.

2. (a) What is meant by frequency reuse concept and what are the important points to be considered in frequency reuse concept.

   (b) Discuss near field and far field problems in cellular systems.

3. Explain clearly forward and reverse channels for CDMA systems.

4. (a) Discuss clearly the important parameters of multipath channels.

(b) Discuss important indoor propagation models.

5. Discuss important power control strategies used in mobile communications.

6. Discuss different methods to improve the capacity and coverage of existing cellular system.

7. (a) Discuss the advantages of space diversity antennas used at cell site.

(b) Discuss different hand-off strategies.

8. Write short notes on the following.

(a) Rake receiver

(b) Personal mobile satellite communications

(c) LEO

MICROCONTROLLERS AND EMBEDDED SYSTEMS

Subject Code: MTRM-2.4(Elective-IV) **Max. Marks:70**

Answer any Five Questions

1. (a) List and define the three main characteristics of embedded systems that distinguish such systems from other computing system. (2)
   (b) List and define the three IC technologies. What are the benefit of using each of the three different IC technologies. (4)
   (c) What is a Single-Purpose Processor? Design a custom Single-Purpose Processor? Explain with an example. (8)
2. (a) Explain the software development process of an embedded system. (7)
   (b) Enumerate the similarities and differences between a Microcontroller and Digital Signal Processor. (7)
3. (a) Given a 100MHz Crystal-Controlled Oscillator and a 32-bit and any number of 16-bit terminal counters. Design a relative clock that outputs the date and time down to milliseconds. You can ignore leap years. Draw a diagram and indicate terminal-count values for all counters. (9)
   (b) A watchdog timer uses two cascaded 16-bit up-counters is connected to an 11.981MHz oscillator . A time out should occur if the function watchdog-reset is not called within 5 minutes. What value should be loaded into the up-counter pair when the function is called. (5)
4. (a) Explain the cache impact on system performance with an example. (7)
   (b) Given the following three cache designs, find the one with best performance by calculating the average cost of access. Show all calculations.
      i. 4 Kbyte, 8-way set-associative cache with a 6% miss rate cache hit costs one cycle, cache miss cost 12 cycles.
      ii. 8 Kbyte, 4-way set-associative cache with a 4% miss rate cache hit costs two cycle, cache miss cost 12 cycles.
      iii. 16 Kbyte, 2-way set-associative cache with a 2% miss rate cache hit costs three cycle, cache miss cost 12 cycles. (7)
5. (a) Draw the timing diagram for a bus protocol that is handshaked non-addressed and transfers 8-bits of data over a 4-bit data bus. (7)
   (b) Explain the benefits an interrupt address table over fixed and vector interrupt methods. (7)
6. List the modifications made in Implementation: 2 (Microcontroller and CCDPP) and Implementation: 3 Microcontroller and CCDPP/ Fixed –Point DCT and discuss why each was beneficial in terms of performance. (14)

7. (a) Define the following terms: (7)

(i) Finite-state machines concurrent processor,

(ii) Real-time systems, and

(iii) Real-time operating systems.

(b) List three requirements of real-time systems and briefly describe each. Give examples of actual Real-time systems to support your arguments. (7)

8. Write notes on the following.

(a) Common Memory Types. (7)

(b) Stepper Motor Controllers. (7)

PHASED ARRAY RADARS

Subject Code: MTRM-3.1(Elective-V) **Max Marks : 70**

Answer any **FIVE** questions

1. (a) Describe directive properties of arrays?

   (b) Explain radar and communication systems considerations?

2. What are the lines of distributions and point out their pattern characteristics?
3. (a) Differentiate linear and planar arrays in terms of directivity and pattern characteristics?

   (b) What did you mean by grating lobe and discuss the conditions under which they are produced?

4. What is meant by thinning of arrays and describe different space distributions by which thinning is possible?

5. Differentiate broad side and end-fire arrays and explain how do you obtain characteristics from broad side array.

6. Describe Woodward method of synthesis and obtain amplitude distribution required to produce sector beam between 45^{o} to 45^{o} .

7. (a) What are the types of electronic scanning and compare them in detail? (b) Explain how phase shift is produced in phased array radars?

8. Write short notes on

   (a) Phase design techniques

   (b) Circular arrays

   (c) Adaptive arrays.

COMPUTER AND COMMUNICATION NETWORKS

Subject Code :MTRM – 3.2(Open Elective) Maximum: 70 marks

Answer any **FIVE** questions
All questions carry equal marks.

1. a) Define Time Division Multiplexing. b) Write a note on TCP protocol.
   c) Distinguish between packet and circuit switching. d) Write a note on HDLC.
   e) Write a note on sliding window ARQ. f) What is data transparency?
   g) What is PCS?
2. Explain OSI model in detail.
3. Explain the process of Analog .vs. digital transmission.
4. Explain GSM.
5. a) Write a note on various wireless LANs applications (IEEE 802.11 a, b, c, g). b) What are the advantages of biphase scheme?
6. Explain error control techniques with an example.
7. Write a short note on:
   a) LAP – B
   b) ARPANET DLC
8. Explain the following:
   a) Virtual circuits and datagrams. b) X.25
   c)Frame and cell relay.