EXTC/old/RSA/Sem V/May 2017

17/05/17.

Q.P. Code : 586200

(3 Hours) [Total Marks : 100

N.B. : (1) Question **No.1** is **compulsory**.
(2) Solve **any Four** from remaining questions.
(3) Assume suitable **data** wherever **necessary** and state it **clearly**.

1. (a) State the theorem of total probability. 5
(b) Distinguish between a discrete and a continuous random variable. 5
(c) State and explain central limit theorem. 5
(d) Define Strict Sense Stationary and Wide Sense Stationary Process. 5

2. (a) Define probability distribution function of random variable. State important properties of it and prove. 10
(b) The joint Probability density function of (x, y) is given by 10

$$f_{XY}(x,y) = Ke^{-(x+y)} \; ; \; 0 < x < y < \infty$$

Find : K
(i) Marginal densities of x and y
(ii) Are X and Y independent?

3. (a) Suppose X and Y are two random variables. Define covariance and correlation coefficient of X and Y. When do we say that X and Yare (i) orthogonal (ii) independent and (iii) uncorrelated? Are uncorrelated random variables independent? 10
(b) A stationary process is given by $X(t) = 10 \cos [100\,t + \Theta]$ where is a random variable with uniform probability distribution in the interval $[-\pi, \pi]$. Show that it is a wide sense stationary process. 10

4. (a) State and prove Bayes Theorem. 10
(b) Obtain the Mean and Autocorrelation of the output process Y (t) if WSS input is applied to LTI systems. 10

TURN OVER

5. (a) Explain Power Spectral Density. State its important properties and prove any one properly. 10

   (b) State and prove Chapman-Kolmogorov equation. 10

6. (a) Find the characteristic function of the Poisson distribution and hence find the values of the first four central moments. 10

   (b) Three boys A, B and C are throwing a ball to each other .A always throws the ball to B and B always throws the ball to C, but C is just as likely to throw the ball to B as to A. Show that the process is Markovian. Find the transition matrix and classify the states. 10

7. Write short notes on : 20

   (a) Joint and conditional probability

   (b) Moment generating function

   (c) Ergodic process

   (d) Sequence of random variable

EXTC / RSA / CBGS / Sem V / May 2017

17/05/17.

Q.P. Code : 587801

(03 Hrs.) Total Marks: 80

N.B.:

1) Question Number 1 is Compulsory
2) Attempt any Three questions from the remaining Five questions
3) Assumptions made should be clearly stated.
4) Use of normal table is permitted

---

1 Answer the following

a) For an LTI system with stochastic input prove that autocorrelation of output is given by convolution of cross-correlation (between input-output) and LTI system impulse response. 05

b) Suppose that a pair of fair dice are tossed and let the RV X denote the sum of the points. Obtain probability mass function and cumulative distribution function for X. 05

c) If $Z = X + Y$ and if X and Y are independent then derive pdf of Z as convolution of pdf of X and Y. 05

d) Write a note on the Markov chains. 05

2a) Define and Explain moment generating function in detail. 05

b) Let $Z = X/Y$. Determine $f_Z(z)$ 05

c) The joint cdf of a bivariate r.v. (X, Y) is given by

$$F_{XY}(x,y) = (1-e^{-\alpha x})(1-e^{-\beta y}), x \geq 0, y \geq 0, \alpha, \beta > 0$$
$$= 0 \text{ otherwise.}$$

i) Find the marginal cdf's of X & Y. 02
ii) Show that X & Y are independent. 02
iii) Find $P(X \leq 1, Y \leq 1)$, $P(X \leq 1)$, $P(Y > 1)$ & $P(X > x, Y > y)$ 06

3a) Explain strong law of large numbers and weak law of large numbers. 05

b) Write a note on birth and death queuing models. 05

c) A distribution with unknown mean μ has variance equal to 1.5. Use central limit theorem to find how large a sample should be taken from the distribution in order that the probability will be at least 0.90 that the sample mean will be within 0.5 of the population mean. 10

4a) State and prove Chapman-Kolmogoruv equation. 05

b) State and prove Bayes theorem. 05

c) (i) State any three properties of power spectral density. 03
(ii) If the spectral density of a WSS process is given by 07

$$S(w) = b(a-|w|)/a, \quad |w| \leq a$$
$$= 0 \quad , \quad |w| > a$$

Find the autocorrelation function of the process.

5a) The joint probability function of two discrete r.v.'s X and Y is given by $f(x, y) = c(2x + y)$, where x and y can assume all integers such that $0 \leq x \leq 2$, $0 \leq y \leq 3$ and $f(x, y) = 0$ otherwise. Find $E(X)$, $E(Y)$, $E(XY)$, $E(X^2)$, $E(Y^2)$, $\text{var}(X)$, $\text{var}(Y)$, $\text{cov}(X, Y)$, and ρ. 10

[Turn Over

b) Prove that if input LTI system is WSS the output is also WSS. What is ergodic process? 5

6a) The transition probability matrix of Markov Chain is 5

	1	2	3
1	0	1	0
2	½	0	½
3	½	½	0

Find the limiting probabilities.

b) An information source generates symbols at random from a four letter alphabet {a, b, c, d} with probabilities P[a] = 1/2, P[b] = ¼ and P[c] = P[d] = 1/8. A coding scheme encodes these symbols into binary codes as follows: 05

a	0
b	10
c	110
d	111

Let X be the random variable denoting the length of the code, ie, the number of binary symbols.

i) What is the range of X?

ii) Sketch the cdf $F_X(x)$ of X, and specify the type of X.

iii) Find P[X≤1], P[1<X≤2], P[X>1] & P[1≤X≤2].

c) Write notes on the following: 10

i) Block diagram and explanation of single & multiple server queuing system

ii) M/M/1/∞ queuing system

END

T3125 / T0517 MICROCONTROLLERS AND APPLICATIONS

EXTC / SY / QP(CBSGS) / MAY 25-5-19

Q.P. Code : 587902

(3 Hours) **[Total Marks : 80**

N.B.

1. Question No. 1 is compulsory
2. Attempt any 3 questions from Q.2 to Q6.
3. Figures to the right in the bracket indicate full marks
4. Assume suitable data if necessary

Q1 A) Explain program status register of 8051 Microcontroller [5 M]

Q1 B) Explain features of ARM 7 [5 M]

Q1 C) Explain concept of Cortex-A,Cortex-R and Cortex-M [5 M]

Q1 D) Explain SCON register of 8051 microcontroller [5 M]

Q2 A) Draw and explain internal memory organization of 8051 microcontroller [10M]

Q2 B) Explain addressing modes of ARM7 processor with examples. [10M]

Q3 A) Draw and explain architecture of ARM7 processor. [10M]

Q3 B) Explain timer modes of operation of 8051 microcontroller [10M]

Q4 A) Explain digital camera as an example of embedded system. [10M]

Q4 B) Design a 8051 based system with following specifications [10M]

i) 32KB EPROM using 8KB devices.

ii) 16KB RAM using 8KB devices.

Q5 A) Explain ARM instructions

a) EOR R1, R0, #3

b) MLA R4, R3, R7, R8

c) CMP R0, R1

d) ADD R0, R2, R3, LSL #1

e) MVN R0, #4

Q5 B) Draw and explain internal structure of port0 and port3 of 8051 microcontroller [10M]

Q6 Write short notes on (Any Four)

a) Compare features of 89C51, 89C52, 89C2051 and 89C2052 [5 M]

b) Operating modes of ARM7 processor. [5 M]

c) Design metrices of embedded system. [5 M]

d) Addressing modes of 8051 microcontroller. [5 M]

e) Interrupt structure of 8051 microcontroller. [5 M]

Extc/ V / 040 / MPMC/ 28-5-13

Q.P. Code : 586300

(3 Hours) | **Total Marks : 100**

N.B. : (1) Question **No.1** is **Compulsory.**
(2) Solve any **four** questions from the remaining **six** questions.
(3) **Figures** to the **right** indicate full **marks.**
(4) Assume suitable data where necessary.

1. (a) Explain the difference between SJMP, AJMP and LJMP instruction of 8051. **5**
   (b) Write features of ARM processor. **5**
   (c) Draw format of flag register of 8085 and explain. **5**
   (d) Explain internal RAM organization of 8051. **5**

2. (a) Draw and explain architecture of 8085 microprocessor. **10**
   (b) Explain mode 1 for input and output of 8255 with suitable diagram. **10**

3. (a) Write initialization sequence of 8259 PIC with neat flow diagram. **10**
   (b) Interface DAC 0808 with 8051 microcontroller and write an assembly language program to generate square wave with 50% duty cycle. **10**

4. (a) Draw and explain timing diagram of ADD M. **10**
   (b) Design 8085 based system as per following specifications. **10**
   (i) CPU at 5 MHz
   (ii) EPROM of 16KB using 8KB
   (iii) RAM of 8 KB using 4 KB chips
   Explain the design with memory map.

5. (a) Explain addressing modes of ARM processor. **10**
   (b) Draw block diagram of 8259 PIC and explain. **10**

6. (a) Draw and explain ARM architecture. **10**
   (b) Compare RISC and CISC. **10**

7. Write note on **any four.** **20**
   (a) Interrupts of 8085.
   (b) Features of 8155.
   (c) Interface stepper motor with 8051 microcontroller.
   (d) Memory mapped I/O and I/O mapped I/O.
   (e) SCON register of 8051.

EXTC | sem V | CBSGS | RFMA | 29/5/17 (Original)

T3125 / T0518 R F MODELING AND ANTENNAS

Q.P. Code : 588001

(3 Hours) **[Total Marks 80]**

N.B. 1) Question No.1 is Compulsory.
2) Solve any three questions from the remaining.
3) Assume suitable data wherever necessary and justify the assumption.
4) Draw suitable diagrams wherever required.

1. a) Compare Binomal filter and chebyshev filter. 5
   b) What is reactive near field. Explain its importance in communication and its applications. 5
   c) Compare Broadside and Endfire array. 5
   d) Find the gain of an antenna when physical aperture is 5 m^2 at 2 GHz with efficiency 70%. 5

2. a) Design a composit high pass filter by image parameter method with the following specification. 10
   $R_0 = 75\ \Omega$, $f_c = 50$ MHz, $f_\infty = 48$ MHz.
   b) Design a LPF whose input and output ports are matched to 50Ω impedance with cut off frequency of 3 GHz, equi ripple of 0.5 dB and rejection of atleast 40 dB at approx twice the cut off frequency. 10

3. a) Derive friss transmission formula state its significance in wireless communicaiton. What is maximum power received at a distance of 0.75 km over free space for 1GHz frequency. The system consist of transmitting antenna with 3dB gain and receiving antenna with 17dB gain and antenna is fed with 200 W power. 10
   b) Derive radiation resistance of small dipole. Explain its significance. 10

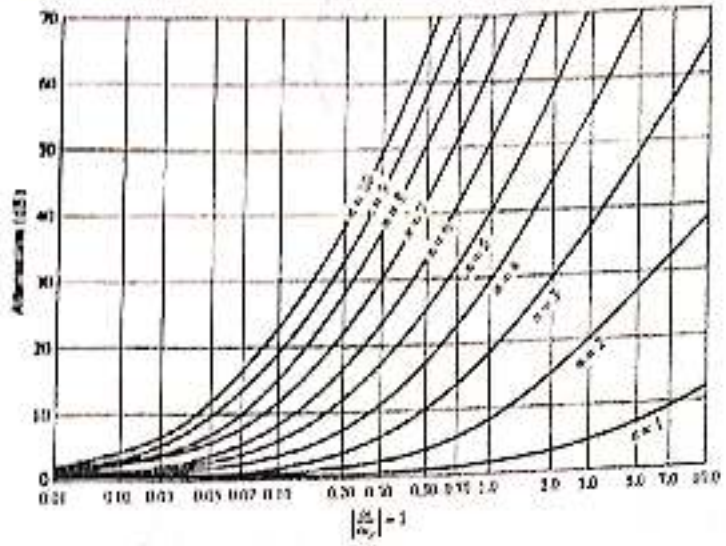
4. a) Find the radiation pattern for an array of 4 elements fed with same amplitude and opposite phase. Find its HPBW and BWFN. 10
   b) Draw the structure of microstrip antenna. Discuss its characteristics, limitations and applications. 10

5. a) Describe parabolic reflector antenna and its different feeding methods. 10
   b) Explain important features of loop antenna. Discuss use of loop antenna in radio direction finding. 10

6. **Write short notes on :** 20
   a) RF field effect transistor
   b) Binomial array
   c) RF behavior of resistor and capacitor
   d) Helical antenna

****

A6E0A59D8F071DC752F7D8786E8558D5



Attenuation versus normalized frequency for equal-ripper filter prototypes.
(a) 0.5 dB ripple level.

EXTC | Sem IV | OLD | RFCD | 29/5/17

T3115 / T0444 R F CIRCUIT DESIGN

Q.P. Code : 586401

(3 Hours) [Total Marks : 100

N.B. : (1) Question No.1 is compulsory
(2) Answer any four questions out of remaining six questions
(3) Assume suitable data is necessary

1. (a) Define the term skin depth. Compute skin depth for copper at 1GHz and 10 GHz. 5
The conductivity of copper is, $\sigma_{cu} = 64.516 \times 10^6$ s/m

(b) Starting with basic definition of standing wave ratio (SWR) show that it can be expressed as, 5

$$SWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

(c) Draw the equivalent circuit and find the odd and even mode parameters for coupled transmission line. 5

(d) Explain the current flow in pn junction and give the expression for I_{diff} in terms of diffusion constant and V_{diff} in terms of doping concentration. 5

2. (a) Explain RF behaviour of resistor, capacitor and inductor. 10

(b) For a transmission line circuit having source and load terminations of $Z_G = 60\Omega$ and $Z_L = 50\Omega$ respectively and $Z_o = 75\Omega$, compute the input power and power delivered to the load. Assume length of line to be $\lambda/4$ and source voltage of $V_G = 8V$. 10

3. (a) Discuss power consideration in transmission line when 10
(i) Source and load impedances are matched
(ii) Load impedance is matched and source impedance is mismatched.

(b) Design a prototype Low pass butterworth filter that will provide at least 20dB attenuation at the freqn of $f = 2 f_{3dB}$. Compute and plot the amplitude response for 0 to 5 GHz. 10

TURN OVER

A6E0A59D8F071BC752F7D8786E879F29

Q.P. Code : 586401

4. (a) Identify the following normalized impedances and convert into admittances using smith chat. Also find corresponding reflection coefficients and SWR 10

(i) $Z = 0.1 + j\,0.7$ (ii) $Z = 0.2 - j\,0.7$ (iii) $Z = 0.5$

(b) Explain the following filter parameters 10

(i) Insertion loss (ii) Ripple factor (iii) Bandwidth

(iv) Shape factor (v) Rejection

5. (a) Draw the Ebers moll model of large signal BJT and explain in detail the transport representation and injection form. 10

(b) Explain construction and functionality of high electron mobility transistor. 10

6. (a) Define and derive Ac parameters for BJT and FET. 10

(b) Plot and compare the fraqn response of BJT, FET and HEMT. 10

7. Write short note on 20

(a) Microstrip transmission line

(b) Chebyshev filter

(c) Physical properties of semiconductors

(d) Measuremants of AC parameters of BJT.

EXTC / Sem V / OLD / SS / 05/06/17

T3115 / 70445 SIGNALS & SYSTEMS

Q. P. Code : 586502

Maximum Marks : 100
Duration : 3 Hrs

N.B. : - i) Question No. 1 is **compulsory.**
ii) Answer any **four** questions out of remaining **six** questions.
iii) Figure to the **right** indicates **full marks.**
iv) **Illustrate** the answers with **sketches** wherever **required.**

Q.1. Solve **any four** 20M

a) Draw even and odd part of the following signals
   i) $x(t) = 2\,r(t) - 2\,r(t-1) - 2\,u(t-3)$
   ii) $x(t) = u(t) - r(t) + 2\,r(t-2) - r(t-3) + u(t-4) - 2u(t-5)$

b) Explain whether the following signals are power signals or energy signals
   i) $x(t) = 0.9e^{-3t}\,u(t)$
   ii) $x(t) = A\sin t$

c) List the properties of Laplace transform.

d) Perform convolution of the following continuous time system using Laplace transform $2u(t)$ with $u(t)$.

e) Find impulse response and plot $H(z) = \dfrac{2}{1+2Z^{-1}}$, $|z| < 2$

Q. 2

a) Find the even and odd components of 8M
   i) $x(t) = \sin 2t + \cos t + \sin t \cdot \cos t$
   ii) $x(t) = t^3 + 3t$

b) Convolute $x(n) = (1/3)^n u(n)$ with $h(n) = (1/2)^n$ using convolution sum formula and verify using Z transform 6M

c) Sketch the following signal : $x(t) = 2\,u(t) + 2\,u(t-2) - 2\,u(t-4) - 2\,u(t-6)$ 6M

Q.3.

a) Referring to the Figure 3 (a) as given below, sketch the following signal 9M
   i) $x[4-n]$, ii) $x[2n+1]$, iii) $x[n] \cdot u[2-n]$

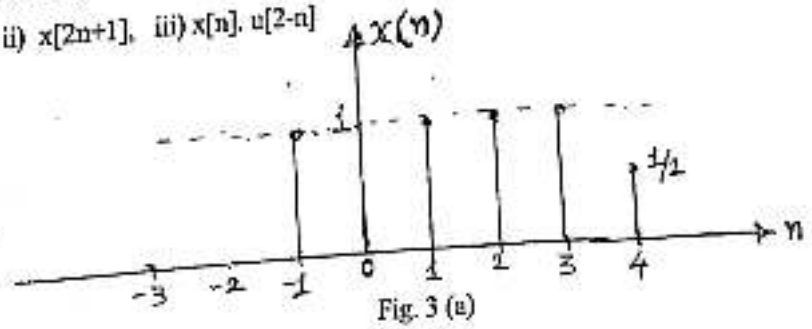


Fig. 3 (a)

TURN OVER

a) State and prove frequency shift property of Fourier transform. 5M

b) Determine the following system is Dynamic, Causal, Linear, Time Invariant 5M

i) $y(t) = x(t^2)$

ii) $y(n) = x(n) \cos(100\pi n)$

Q.4

a) Draw the Direct Form structure of the FIR system described by the transfer function 10M

$$H(z) = 1 + \frac{1}{2}z^{-1} + \frac{3}{4}z^{-2} + \frac{1}{4}z^{-3} + \frac{1}{2}z^{-4} + \frac{1}{8}z^{-5}$$

b) What are the properties of ROC in Z-transform? 4M

c) Obtain Direct Form-I, Direct Form-II realization of the LTI system governed by equation 6M

$$y(n) = x(n) - 1.5\,x(n-1) - 0.4\,x(n-2) - 0.6\,y(n-1) - 0.7\,y(n-2)$$

Q.5

a) A system has the following system function 10M

$$H(z) = \frac{z}{(z-0.25)(z-0.5)}$$

i) Find the impulse response of the system if the system is stable.

ii) Find the step response of the system.

b) Using Z transform solve the difference equation and find out impulse response of 5M

$$y[n] - 2\,y[n-1] - y[n-2] = x[n] + 3\,x[n-1]$$

c) Derive relationship between Z-transform and Fourier Transform 5M

Q.6

a) Consider a continuous time LTI system described by $\frac{dy(t)}{dt} + 2\,y(t) = x(t)$. Using Fourier transform find the o/p to each of the following input i) $x(t) = e^{-t}u(t)$, ii) $x(t) = u(t)$ 6M

b) Determine the state model of the system governed by equation 4M

$y(n) = -2\,y(n-1) - 3\,y(n-2) - 0.5\,y(n-3) + 2\,x(n) + 1.5\,x(n-1) + 2.5\,x(n-2) + 4\,x(n-3)$

c) Find the system output of a system having differential equation 10M

$$\frac{d^2y(t)}{dt^2} + \frac{5dy(t)}{dt} + 6y(t) = \frac{dx(t)}{dt} + x(t)$$

With initial condition $y(0) = 1$; $\frac{dy(0)}{dt} = 1$; $x(t) = e^{-4t}u(t)$

TURN OVER

Q7. 7M

a) The State model of a discrete time system is given by

$A=\begin{bmatrix}2 & 0\\ 3 & 1\end{bmatrix}$; $B=\begin{bmatrix}1\\ 2\end{bmatrix}$; $C=[1 \quad 3]$; $D=3$

Find the response of the discrete time system for the unit step input. Assume zero initial condition 7M

b) Realize the given system in cascade and parallel form

$$H(z)=\frac{\left(1+\frac{1}{2}z^{-1}\right)}{\left(1-z^{-1}+\frac{1}{4}z^{-2}\right)\left(1-z^{-1}+\frac{1}{2}z^{-2}\right)}$$

c) If the system matrix $A=\begin{bmatrix}-3 & 0\\ 0 & -2\end{bmatrix}$. Find the state transition matrix of discrete time System. 6M

EXTC / Sem V / CBSGS / AC / 05/06/17

T3125 / T0519 ANALOG COMMUNNICATIONS

Q.P. Code : 588101

(3 Hours) **[Total Marks : 80**

N.B. : (1) Question **No.1** is **compulsory**.
(2) Attempt **any three** questions out of remaining **five**.
(3) **Figures** to the **right** indicate **full marks**.
(4) Assume suitable **data** if **required** and **mention** the same in **answer sheet**.

1. Solve **any four** :- **20**
   (a) Classify and explain the various types of noise affecting communication.
   (b) AM is a wastage of power and bandwidth, justify the statement.
   (c) Compare between FM and PM.
   (d) Explain Pre-emphasis and De-emphasis.
   (e) What is companding.

2. (a) A modulating signal 20 sin ($2\pi \times 1000\ t$) is used to modulate a carrier signal 80 sin ($2\pi \times 10000\ t$). Find the percentage modulation, frequencies of the sideband components and their amplitudes. What is the BW of the modulated signal? Also draw the spectrum of the AM wave. **10**
   (b) Explain with neat block diagram **any one** method for suppression of unwanted sideband. **10**

3. (a) What are different methods of FM generation? Sketch the circuit and explain the principle of reactance modulator? **10**
   (b) State and prove sampling theorem for band limited signal. What is aliasing effect? **10**

4. (a) Explain with neat block diagram working of Adaptive delta modulator. What are the drawbacks of delta modulator? **10**
   (b) What is signal multiplexing? Explain FDM in detail. **10**

5. (a) Explain with neat block diagram and waveform of AM Super- heterodyne radio receiver. **10**
   (b) Explain operation of Foster Seeley discriminator with the help of circuit and phasor diagram. **10**

TURN OVER

Q.P. Code : 588101

20

6. Write short notes on **any four** :-
   (a) Vestigial Side Band (VSB) transmission.
   (b) Practical diode detector with delayed AGC.
   (c) Generation and detection of PPM.
   (d) Amplitude limiting and thresholding in FM.
   (e) Quadrature amplitude modulation.

EXTC/CBSGS/SemV/IC) 9/6/2017

T3125 / T0520 INTEGRATED CIRCUITS

Q. P. Code : 588201

Time: 3Hours **Marks:80**

N.B: (1) Question **No.1** is **compulsory.**
(2) Solve **any three** questions from the remaining **five.**
(3) Figures to the right indicate full marks.
(4) Assume suitable data if required and mention the same in the answer sheet.

1. Solve **any five :-** 20
(a) Compare the inverting & non inverting configurations of operational amplifiers.
(b) Draw the diagram for a grounded load voltage to current converter and derive the expression for the output current.
(c) Design a first order non-inverting high pass filter to provide a cut-off frequency of 5 kHz.
(d) Explain the functional block diagram of Timer IC 555.
(e) Draw the waveforms for the outputs of IC 7490 with respect to the clock and hence explain its working as a decade counter.
(f) Explain simple current limit protection in voltage regulators.

2. (a) Draw a neat circuit diagram of an instrumentation amplifier using three op amps. Derive the expression for its gain. How can its gain be varied? What are its advantages over a difference amplifier using single op amp? 10
(b) With the help of a neat diagram explain the working of an R C phase shift oscillator using op amp. Derive the expression for its frequency of oscillation. What are the values of R & C if the frequency of oscillation is 5 kHz? 10

3. (a) With the help of a neat diagram, input and output waveforms and voltage transfer characteristics explain the working of an inverting Schmitt trigger. Derive the expressions for the upper & lower threshold levels. Explain how these levels can be varied. 10
(b) With the help of a neat diagram and waveforms at appropriate points in the circuit explain the working of a square and triangular waveform generator using op amps. Explain how the duty cycle of the square and triangular waveforms can be varied. 10

4. (a) Draw the functional block diagram of IC 723 voltage regulator and explain its working as a basic low voltage regulator. Design the same for an output of 5 V and load current upto 200 mA. 10
(b) With the help of a neat functional block diagram explain the working of IC LT 1070 Monolithic Switching regulator. 10

5. (a) Draw the diagram of a monostable multivibrator using timer IC 555. With the help of waveforms at the trigger input, across the charging capacitor and at the output explain its working. Design the same for a pulse width of 11 ms. 10
(b) With the help of neat circuit diagrams explain the working of a universal shift register IC 74194 as a ring counter and twisted ring counter. 10

6. Write short notes on **any four** 20
(a) IC 74181 Arithmetic Logic Unit
(b) IC 74169 4-bit up/down binary counter
(c) IC 74164 serial input parallel output shift register
(d) IC XR2206 waveform generator
(e) IC 534 multiplier

E&TC/ SE/ OLD/ EVS / 15.6.17

T3115 / T6447 ENVIRONMENT STUDIES

Q.P. Code :10741

[Marks:50]

[Time: 2 Hours]

Please check whether you have got the right question paper.

N.B:
1. **Question Number 1 is compulsory.**
2. **Attempt any four questions from Q2 to Q7.**
3. **Draw neat labelled diagrams wherever required.**
4. **Figures to right indicate full marks.**

1 Attempt any five from the following: 10

a. What are the causes and effects of Thermal pollution?
b. Explain energy flow in any ecosystem.
c. Explain the importance of Human Rights.
d. What are the reasons and effects of ozone layer depletion?
e. Why our natural mineral resources are depleting?
f. Which are the non-renewable energy resources? What are their limitations?
g. What is 'Biological Prospecting'?

Q2 a. Why our natural forests resources are depleting? What will be its impact? 05
b. What is wasteland reclaimation? How it is carried out? 05

Q3 a. What is the impact of growing population on environment? 05
b. What are the causes and effects of marine pollution? 05

Q4 a. Explain briefly the Salient features of Air Pollution Prevention and Control Act. 05
b. Which are the different threats to biodiversity? 05

Q5 a. What are the urban problems pertaining to energy? 05
b. What are the causes and effects of Air Pollution? 05

Q6 a. Write Characteristic features and functions of Aquatic Ecosystem. 05
b. How disaster management techniques are implemented at the time of landslides? 05

Q7 a. What is sustainable development? What are the ways to achieve it?
b. Explain briefly the different techniques implemented for solid waste management.

F3C29913FC3827BC317A6A930