Unit 5: Inverse LT and Application of LT

Convolution Theorem. Inverse LT. Application of Laplace Transforms to 2^{nd} order Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits, Coupled differential equations of 1^{st} order. Solution of heat flow along infinite bar using Laplace transform. **(12 Lectures)**

Expected learning outcomes: *At the end of this course, the students will be able to represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems. Students are also expected to, obtain power series solution of differential equation of second order with variable coefficient using Frobenius method, understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations, recurrence relations, learn about Laplace transform and inverse transform along with their applications.*

Reference Books:

i. Ordinary and Partial Differential Equations by M.D. Raisinghania, S Chand Publisher.
ii. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
iii. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
iv. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
v. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
vi. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
vii. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press.
viii. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books.

PHYDSC252T

ELECTRONICS

Contact Hours: 60

Full Marks = 100 [ESE (70) CCA(30)]

Course objective: *The emphasis of course is on building basic concepts of electronics covering both analog and digital parts. The course will also expose students to fundamental concepts of semiconductor devices and their wide range of applications. The topics covered in this course will also give flavours of digital electronics connecting both arithmetic and sequential circuits.*

Unit 1:

Semiconductor Diodes: Conductivity and Mobility, Concept of Drift velocity. Formation & V-I characteristics of p-n junction diode. Current Flow Mechanism in Forward and Reverse Biased Diode. Static & Dynamic resistance of p-n junction diode. Half-wave and Full-wave Rectifiers, Calculation of Ripple Factor and efficiency. C & π -filter. Zener and avalanche breakdown, Zener Diode and Voltage Regulation. LED & Solar cell (Principle and working).

(10 Lectures)

Unit 2:

Bipolar Junction transistors: Working of n-p-n and p-n-p transistors. Characteristics of CB and CE Configurations, Active, Cut-off and Saturation Regions. Current gains α and β. DC Load line and Q-point and its importance. Classification of Class A, B & C amplifiers.

Transistor biasing and stabilization: Transistor Biasing and Stabilization Circuits. Fixed bias and voltage divider Bias circuits along with derivation of stability factor.

Feedback in Amplifiers: Concepts of positive and negative feedback. Voltage gain of feedback amplifiers. Effect of feedback on impedance, Gain, Stability and BW. **(14 Lectures)**

Unit 3:

Amplifiers: Hybrid parameter & its Equivalent Circuit. Expressions of various gains and impedances for a CE amplifier using *h*-parameter. Idea of frequency response of two stage R-C coupled amplifier - gain & band width (No derivation).

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. Working of RC Phase shift oscillator and expression of frequency of oscillation (No derivation).

Operational Amplifiers: Characteristics of an ideal and practical OPAMP(IC-741), CMRR, Slew rate, concept of Virtual ground. Inverting and non-inverting amplifiers, Adder, Differentiator & Integrator. **(14 Lectures)**

Unit 4:

Boolean Algebra: Binary Numbers. Decimal to binary and binary to decimal conversion. BCD. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR Gate. De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Idea of Minterms and Maxterms. Canonical SOP & POS. Conversion of a Truth table into Equivalent Logic Circuit. Karnaugh Map. **(10 Lectures)**

Unit 5:

Arithmetic Circuits: Binary Addition and Subtraction using 1's complement. Half adder and Full Adder. 2-bit half subtractor and 2-bit Full subtractor.

Sequential Circuits: SR, JK & MS JK flip flop. Race-around condition in JK Flip-Flop.

Data processing circuits: Multiplexers and De-multiplexers. **(12 Lectures)**

Expected learning outcomes: *At the end of this course the students are expected to be conversant with semiconductors devices like junction diodes, transistors along with their applications. Students are also expected to have the clear idea of synthesis of Boolean functions, simplification and construction of digital circuits like flipflops, multiplexers, adders by employing Boolean algebra.*

Reference Books:

1. A Textbook on Electronics by S. Chattopadhay (Publisher: NCBA, 2016).
2. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
3. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.
4. Electronic devices & circuits, Sanjeev Gupta & Santosh Gupta, Dhanpat Rai Pub.(P), Ltd.
5. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.