

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION, RAJASTHAN, JODHPUR
 TEACHING AND EXAMINATION SCHEME FOR
Diploma II Year (ELECTRONICS ENGINEERING)
ANNUAL SCHEME SESSION 2011-2012 & ONWARDS

Code No.	Subjects	Distribution of Time				Distribution of Max. Marks/ Duration							Total Marks
		Hours per week				Board's Exam.				Sessional			
		L	T	P	Tot	TH	Hrs.	PR	Hrs.	CT	TU	PR(S)	
*EL 201	Electronic Components & Shop Practice	2	--	2	4	70	3	50	3	30	--	50	200
*EL 202	Circuit Analysis	2	2/2	--	3	70	3	--	--	30	50	--	150
*EL 203	Electronic Measurement & Instrumentation	2	--	2	4	70	3	--	--	30	--	50	150
*EL 204	Electronic Devices & Circuits	2	--	2	4	70	3	50	3	30	--	50	200
*EL 205	Digital Electronics	2	--	2	4	70	3	50	3	30	--	50	200
*EL 206	Wave Propagation & Communication Engg.	2	--	2/2	3	70	3	--	--	30	--	50	150
*EL 207	Microprocessor	2	--	2	4	70	3	--	--	30	--	50	150
*EL 208	Audio & Video System	2	--	2/2	3	70	3	--	--	30	--	50	150
*EL 209	Electronic Instruments	2	--	2/2	3	70	3	--	--	30	--	50	150
*EL 210	C-Programming	2	--	2	4	70	3	--	--	30	--	50	150
	Practical Training	--	--	--	--	--	--	100	--	--	--	--	100
	Total	20	1	15	36	700		250		300	50	450	1750
Grand Total :													1750

- | | |
|--|--|
| 1. L : Lecture | 5. PR : Marks for Board's Examination for Practicals |
| 2. T : Tutorial | 6. CT : Marks for Class Tests |
| 3. P : Practical | 7. TU : Marks for Tutorials |
| 4. TH : Marks for Board Examination for Theory | 8. PR(S) : Marks for Practical and Viva |

*EL 201/ 202/ 203/ 204 / 205 / 206/ 207/ 208/ 209 Same as EF 201/ 202/ 203/ 204 / 205 / 206/ 207/ 208/ 209

*EL 210 same in all branches except AR/CC/CE/CS/ EE /IT

ELECTRONIC COMPONENTS AND SHOP PRACTICE

CODE EL 201
EF 201

L T P
2 -- 2

RATIONALE

Every electronic circuit uses electronic components, it is therefore essential to know about the construction, working and identification of different components, hardwares and transducers to enable the students to assemble any project. Soldering techniques and operation of different general instruments also included in this subject.

CONTENTS

1. Resistors :

- 1.1 Classification of resistors
- 1.2 Colour coding, tolerance and various parameters related with resistor
- 1.3 Constructional details, specifications, applications of various types of resistors
 - 1.3.1 Fixed - carbon composition, metal film, carbon film, wire wound, alloy
 - 1.3.2 Semi-variable - carbon (vertical and horizontal type) presets cermet, multiturn trimpot
 - 1.3.3 Variable - carbon and wire wound (log and linear) with and without switch, multi turn pot and ganged pot,
 - 1.3.4 Special resistors - LDR, VDR, Thermistor, Sensistors, Fusible resistors.
- 1.4 Failures in resistors

2. Capacitors :

- 2.1 Classification of capacitors
- 2.2 Constructional detail, specification, application of various types of capacitors-
 - 2.2.1 Fixed capacitor - mica, paper, ceramic, plastic film and electrolytic
 - 2.2.2 Variable capacitor - Gang (Air and PVC). Trimmers
- 2.3 Failures in capacitors
- 2.4 Identification marking of capacitor

3. Inductors and Coil :

- 3.1 Classification of inductor
- 3.2 Construction detail, specification, application of fixed and variable inductors - Aircore, Iron core and Ferrite core inductors
- 3.3 Term related to coil
 - 3.3.1 Skin effect
 - 3.3.2 Dielectric losses
 - 3.3.3 Distributed capacitance
 - 3.3.4 Quality factor

4. Soldering and De-Soldering Techniques :

- 4.1 Soldering - connection, flux alloy, different soldering materials and problems
- 4.2 Different soldering methods - hand, wave, dip and ultrasonic
- 4.3 De-soldering technique

5. Printed Circuit Board Fabrication :

- 5.1 Introduction
- 5.2 Types and specification of PCB
- 5.3 Basic steps of fabrication
 - 5.3.1 Master art preparation
 - 5.3.2 Resist Coating (tape resist, resist paint, silk screen, photographic)
 - 5.3.3 Etching technique
 - 5.3.4 Resist removal

- 5.3.5 Drilling
- 5.3.6 Lacquer coating
- 5.4 Advantage and limitation of PCB
- 5.5 Safety recommendation
- 5.6 Block diagram of PCB plant
- 5.7 Preparation of PCB art work for (simple electronics circuit)

6. Transformer:

- 6.1 Principle of transformer
- 6.2 Voltage, current and turn ratio relationship
- 6.3 Construction details of following transformers.
 - 6.3.1 Core type
 - 6.3.2 Shell type
 - 6.3.3 Auto transformer
- 6.4 Design procedure of iron core small transformers and numerical problems
- 6.5 Constructional details of transformers winding machine
- 6.6 Construction of IFT
- 6.7 Block diagram & working of impregnation plants.

7. Brief idea of surface mounted devices. (SMD)

PRACTICALS

1. Study of different tools used in electronics workshop.
2. Study of analog and digital multimeters and their uses for measuring voltage, current and resistance.
3. To study and read data manual for different components (diodes & transistors) and their equivalents.
4. Use of CRO for voltage, frequency and phase measurements.
5. Use of function generator for different waveform generation.
6. Soldering and de-soldering of different components on PCB by soldering iron
7. Soldering and de-soldering of different SMD on PCB.
8. Cable preparation for RJ - 11, RJ-45, flat ribbon and 9-pin D-type connectors and their testing.
9. Identification of different type of connectors
10. Study of coil winding machine
11. Familiarization with different type of stampings and bobbin
12. To design winding and test small transformer of single and tapped secondary
13. To design winding and test the transformer of multiple secondary
14. Study of PCB plant equipment
15. To prepare art work PCB using software (circuit maker / Easy PC/ multi sim).
16. Design and fabrication of PCB using silk screen / photography methods.

REFERENCE BOOKS :

- | | |
|--|------------------------------|
| 1. Electronics Component & Shop Practice | K.R. Nahar |
| 2. Hand Book of Philips Component | |
| 3. Maintenance of Electronic Equipments | K.S. Jamwal |
| 4. Electronic Shop Practice. | Madhavia Joshi. |
| 5. Electrical & Electronic Materials | M.L. Gupta |
| 6. Coil Winding & Fabrication Practice | K.R. Nahar |
| 7. Transformer & Coil | BPB Publication |
| 8. PCB - Design & Technology | W.C. Bosshort |
| 9. Electrical & Electric Workshop | A.K. Sanaydhya & A.K. Khatri |
| 10. Electronics Workshop | A.K. Sanaydhya |

CIRCUIT ANALYSIS

CODE EL 202
EF 202

L T P
2 2/2 --

RATIONALE

Analysis of any electronics circuit is essential for any electronics engineer. To analyse any circuit the knowledge of network elements and their behaviour, different types of networks and networks configuration is essential. Different network theorem and laws guide the proper way to analyse the networks. Laplace transformation helps an engineer to reduce the mathematical calculations.

CONTENTS

1. General Network Concept :

- 1.1 Network Elements (Definition and examples)
 - 1.1.1 Active and passive, Linear and non-linear, Unilateral and bilateral, Lumped and distributed circuit parameters
- 1.2 Initial conditions in elements
- 1.3 Mutual inductance (coupling coefficient and dot rule)
- 1.4 Voltage and current sources (ideal and practical)
- 1.5 Dependent and independent sources
- 1.6 Accompanied and unaccompanied sources
- 1.7 Classification of networks (Definition and examples)
 - 1.7.1 One port network
 - 1.7.2 Two port network
- 1.8 Network configuration (No formula derivation)
 - 1.8.1 Balanced and unbalanced T section
 - 1.8.2 Symmetrical and Asymmetrical π (Pie) section
 - 1.8.3 L section
 - 1.8.4 Lattice section
 - 1.8.5 Bridge
 - 1.8.6 Bridge T section
 - 1.8.7 ladder network

2. Mesh and Nodal Analysis :

- 2.1 Definition of branch, node, mesh, loop and tree.
- 2.2 Kirchhoff's laws
- 2.3 Voltage and current equations for simple meshes and nodes
- 2.4 Cramer's Rule
- 2.5 Simple problems upto three variable using Cramer's rules (for DC circuits only)

3. Network Theorems :

- 3.1 Statement, proof, application and numerical problems (DC circuit only) related to
 - 3.1.1 Superposition theorem
 - 3.1.2 Reciprocity theorem
 - 3.1.3 Thevenin's theorem
 - 3.1.4 Norton's theorem
 - 3.1.5 Millman's theorem
 - 3.1.6 Maximum power transfer theorem

- 3.1.7 Tellegen's theorem (Only statements)
- 3.1.8 Star Delta conversion

4. Laplace Transformation :

- 4.1 Introduction to Laplace transformation
- 4.2 Solution of first order and second order differential equations (no initial condition)
- 4.3 Laplace transform of -
 - 4.3.1 Unit step function
 - 4.3.2 Ramp function
 - 4.3.3 Exponential function
 - 4.3.4 Impulse function
 - 4.3.5 Sinusoidal functions
 - 4.3.6 Parabolic function
 - 4.3.7 Derivative of function
 - 4.3.8 Integral of function
- 4.4 Laplace transforms theorems
 - 4.4.1 Shifting theorem
 - 4.4.2 Initial and final value theorem
- 4.5 Inverse Laplace transformation for simple, multiple and conjugate complex roots.
- 4.6 Application of Laplace transformation for simple RL, RC and RLC series circuits
- 4.7 D.C. transients in RL, RC and RLC circuits
 - 4.7.1 Determination of initial condition
 - 4.7.2 Determination of final condition
 - 4.7.3 Simple numerical problems

5. Two Port Networks:

- 5.1 Introduction
- 5.2 Open circuit impedance parameters
- 5.3 Short circuit admittance parameters
- 5.4 Hybrid (h) parameters
- 5.5 Transmission parameters
- 5.6 Inter-relationship between Z and Y parameters
- 5.7 Equivalent models of Z and Y parameters
- 5.8 Reciprocity and symmetry of two port networks
- 5.9 Equivalent T and π (Pie) section representation
- 5.10 Determination of Z and Y parameters for some special networks (T, π , lattice, bridge T)
- 5.11 Idea of image impedance, characteristics impedance for two port networks

6. Resonance :

- 6.1 Series resonance in uncoupled circuits
 - 6.1.1 Definition, reactance curves, resonance condition, selectivity and bandwidth
- 6.2 Parallel resonance in uncoupled circuits
 - 6.2.1 Circuit and phasor diagram
 - 6.2.2 Derivation of resonance conditions
 - 6.2.3 Selectivity and bandwidth
- 6.3 Q factor, Q factor on energy basis

7. Line Filters:

- 7.1 Constant K type & m- derived filter
 - 7.1.1 Low pass filter
 - 7.1.2 High pass filter
 - 7.1.3 Band stop filter
- 7.2 Composite filter

REFERENCE BOOKS:

- | | |
|---------------------------------|------------------------------|
| 1. Network Analysis | Arumugan & Prem Kumar |
| 2. Network Analysis | Dhar & Gupta |
| 3. Network Analysis | Ven Valenburg |
| 4. A Course in Circuit Analysis | Soni & Gupta |
| 5. A Course in Circuit Analysis | Umesh & Sinha |
| 6. Circuit Theory | Iyer |
| 7. Electric Circuits | Josheep Edminster |
| 8. Network Analysis | Suba Rao & Prasad |
| 9. Circuit Analysis | Hayt |
| 10. Network Analysis | A.K. Sanaydhya & A.K. Khatri |

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ELECTRONIC MEASUREMENT AND INSTRUMENTATION

CODE EL 203
EF 203

L T P
2 -- 2

RATIONALE

Instrumentation can be defined as the science and technology of measurement, analysis, recording, telemetering, control and display. This course aims at imparting the basic concepts of instrumentation and control system. As measurement forms the backbone of all scientific and technological research work the need for instrumentation and control in industrial environment is tremendous. The industrial processes are becoming more and more complex day by day. The requirements of instrumentation engineers are also increasing. Therefore it is appropriate to introduce a course such as instrumentation to diploma students which will expose the students to the field of measurement and instrumentation.

CONTENTS**1. Basic Concept of Measurement :**

- 1.1. Introduction.
- 1.2. Generalized configuration of measuring system.
- 1.3. Characteristics of measuring devices
 - 1.3.1. Accuracy.
 - 1.3.2. Resolution.
 - 1.3.3. Precision.
 - 1.3.4. Expected Value.
 - 1.3.5. Error (Gross, Systematic and Random error).
 - 1.3.6. Sensitivity.
 - 1.3.7. Linearity.
 - 1.3.8. Hysterisis.
 - 1.3.9. Repeatability.
 - 1.3.10. Threshold
- 1.4. Calibration of measuring devices.

2. Transducers :

- 2.1 Concept of Primary and Secondary transducers.

- 2.2 Difference between active and passive transducer.
- 2.3 Difference between analog and digital transducer.
- 2.4 Construction and working of the following transducers and measurement of quantities such as Displacement (Linear and angular), Strain, Stress, Temperature, Pressure, Flow level, pH value.
 - 2.4.1 Potentiometers
 - 2.4.2 Strain gauge (resistance and semiconductor type)
 - 2.4.3 Resistance Temperature detectors (RTD)
 - 2.4.4 Thermo couples, thermistor.
 - 2.4.5 Linear variable differential transformer (LVDT).
 - 2.4.6 Capacitive transducer
 - 2.4.7 Load Cell
 - 2.4.8 Piezo Electric Transducer
 - 2.4.9 Photo Cells
 - 2.4.10 Photo Voltaic Cell
 - 2.4.11 Techogenerator
 - 2.4.12 Ultrasonic method for level measurement
 - 2.4.13 Electro magnetic flow meter.
 - 2.4.14 pH electrodes

3. Measuring Instruments :

- 3.1 Classification of measuring instruments
- 3.2 General consideration of torques employed in indicating type instrument (deflection torque, control torque, damping torque)
- 3.3 Construction and working of voltmeter and ammeter
 - 3.3.1 Moving iron type
 - 3.3.2 Moving coil type
 - 3.3.3 Rectifier type
 - 3.3.4 Dynamometer type
- 3.4 Ohmmeter
 - 3.6.1 Series type
 - 3.6.2 Shunt type

4. Range Extension and Calibration :

- 4.1 Significance of range extension
- 4.2 Use of series and shunt multipliers
- 4.3 Multirange ammeter and voltmeter
- 4.4 Simple problems

5. Signal Conditioning :

- 5.1 Introduction.
- 5.2 DC Signal Conditioning.
- 5.3 AC Signal Conditioning.
- 5.4 Brief idea of data acquisition system

6. Control System :

- 6.1 Concept of open loop and close loop system
- 6.2 Automatic control system
- 6.3 Transfer function
- 6.4 Block diagram reduction techniques
- 6.5 Concept of feedback control and its effects

7. Control System Components :

- 7.1 Working principle and construction of -
 - 7.1.1 Synchro Transmitter
 - 7.1.2 Synchro receiver
 - 7.1.3 Control transformer
 - 7.1.4 Construction & working principle of D.C. motor
 - 7.1.5 DC and A.C. servo motors
- 7.2 Characteristics of servo amplifier for A.C. and D.C. error signals

PRACTICALS

1. To measure the linear and displacement by LVDT.
2. To measure the linear and displacement by Potentiometer.
3. To measure the angular displacement by RVDT Capacitive transducer.
4. Measurement of speed of the shaft by contact and non contact methods photo electric transducer.
5. Measurement of speed of the shaft by contact and non contact methods Magnetic transducer
6. Measurement of speed of the shaft by contact and non contact methods Techogenerator
7. Measurement of force by strain gauge bridge
8. Measurement of pH value using pH meter
9. Error detection by synchro pair
10. Measurement of temperature and draw the characteristics of following Thermocouple.
11. Measurement of temperature and draw the characteristics of following RTD
12. Measurement of temperature and draw the characteristics of following Thermister
13. To draw the torque and speed curve for servo motor.
14. Measurement of level by capacitive transducer.
15. To observe the output wave form of synchro transmitter on CRO and find the electrical zero.
16. Use of series multiplier for voltage range extension.
17. Use of shunt multiplier for current range extension.

REFERENCE BOOKS :

- | | |
|---|---------------------------|
| 1. Automatic Control System | B.C. Kuo. |
| 2. Control System Engineering | I.J. Nagrath & Gopal |
| 3. A Course in Electrical & Electronics
Measurement & Instrumentation. | A.K. Shawney. |
| 4. Instrumentation Measurement and Feed Back | Barry E Jones. |
| 5. Instrumentation Devices and System | C.S. Ranga, Sharma, Mani. |
| 6. Instrumentation. | R.K. Jain. |
| 7. Control Engineering | N.M. Morris |
| 8. Measurement Systems Application & Design. | E.O. Deoblin. |
| 9. Electronic Instruments | Helpric Cooper |

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ELECTRONIC DEVICES AND CIRCUITS

CODE EL 204
EF 204

L T P
2 -- 2

RATIONALE

Today is the day of electronics. This subject covers the basic concept of electronics for engineers, this subject is foundation of electronics which helps the student to study the other subject.

CONTENTS

1. Semiconductor and PN Junction :

- 1.1 Metal, non metals and semiconductors and their Energy Band Diagram.
- 1.2 Intrinsic and Extrinsic Semiconductors.
- 1.3 Effect of temperature on extrinsic semiconductor
- 1.4 Energy band diagram of extrinsic semiconductor
- 1.5 Fermi Level and fermi dirac distribution
- 1.6 Drift and diffusion current
- 1.7 Hall effect
- 1.8 P-N Junction Diode
 - 1.8.1 Space charge region, Barrier potential and effect of temperature
 - 1.8.2 Energy band diagram
 - 1.8.3 Biasing of diode.
 - 1.8.4 V-I characteristics
 - 1.8.5 Static and dynamic resistance
 - 1.8.6 Transition and diffusion capacitance
 - 1.8.7 Zenner and Avalanche breakdown
- 1.9 Working, characteristics and application of
 - 1.9.1 Tunnel diode
 - 1.9.2 Zener diode
 - 1.9.3 Varactor diode
 - 1.9.4 Photo diode
 - 1.9.5 Light emitting diode (LED)
- 1.10 Photo conductors
- 1.11 Cds photo conductive cells and photo voltaic cell.

2. Bipolar Junction Transistor (BJT) :

- 2.1 Working of PNP & NPN transistor
 - 2.1.1 Charge transport phenomenon
 - 2.1.2 Transistor amplifying action
 - 2.1.3 Relation between different currents in a transistor
 - 2.1.4 Simple problems
- 2.2 Configuration of transistor (CB, CE and CC)
- 2.3 Behavior of BJT in Active, Cut off and Saturation regions
 - 2.3.1 Transistor as a switch
 - 2.3.2 Transistor as an amplifier
- 2.4 Low frequency and small signal hybrid model of BJT.

3. Transistor Biasing and Bias Stability :

- 3.1 D.C. and A.C. Load line.
- 3.2 Operating point and its stability
- 3.3 Factors affecting bias stability
- 3.4 Stability factors
- 3.5 Bias stabilization
- 3.6 Calculation of operating point and stability factor for
 - 3.6.1 Fixed Bias Circuit.
 - 3.6.2 Collector to base biasing.
 - 3.6.3 Voltage Divider biasing (Self bias)
- 3.7 Bias Compensation techniques using
 - 3.7.1 Diode.
 - 3.7.2 Thermistor and Sensistor.
- 3.8 Thermal stability and Thermal runaway

4. Field Effect Transistor :

- 4.1 Construction, operation and characteristics of JFET , E and D MOSFET
- 4.2 Biasing of FET
- 4.3 Small signal model of JFET
- 4.4 Terminology used with JFET
- 4.5 Precaution for handling of MOSFETs

5. Rectifiers and Power Supplies :

- 5.1 Working of rectifiers
 - 5.1.1 Half wave rectifier
 - 5.1.2 Centre tape full wave rectifier
 - 5.1.3 Bridge rectifier
- 5.2 Analysis of rectifiers (for all type)
 - 5.2.1 Calculations for average and RMS values
 - 5.2.2 PIV of diodes
 - 5.2.3 Ripple factor
 - 5.2.4 Regulation and efficiency
- 5.3 Calculation of ripplefactor and working of following filters:
 - 5.3.1 Capacitance filter
 - 5.3.2 Inductance filter
 - 5.3.3 L-C and π (Pie) filters
- 5.4 Voltage Multipliers
- 5.5 Regulated power supply using zener diode
 - 5.5.1 Simple problems on zener regulator.

6. Filter Circuits :

- 6.1 R-C circuit as high pass and low pass circuit
- 6.2 High pass circuit as a differentiator
- 6.3 Low pass circuit as an integrator

- 6.4 Response of high pass filter for step, pulse and square wave input (brief)
- 6.5 Response of low pass circuit for step, pulse and square wave input

7. Clipper and Clamping Circuit :

- 7.1 Various clipping circuits using ideal diode
- 7.2 Transfer characteristics
- 7.3 Transistor clippers
- 7.4 Clamping circuit and its application as a staircase wave form generator

PRACTICALS

1. To plot the V-I characteristics of P-N diode and LED.
2. To plot the V-I characteristics of zener diode and study of zener diode regulator circuit
3. To plot the V-I characteristics of PNP transistor in CB, CE and CC configuration
4. To plot the V-I characteristics of NPN transistor in CB, CE and CC configuration and calculate h-parameter for CE configuration.
5. Study of the different biasing circuits and observe the effect of component variation on operating point
6. Study of half wave and full wave rectifiers.
7. Study of bridge rectifier.
8. To study the filter circuits and measure the ripple factor.
9. To plot the V-I characteristics of JFET.
10. To plot the V-I characteristics of MOSFET.
11. To study the voltage multipliers.
12. To Study Emitter follower circuits and measure its input and output impedances
13. To study the behavior of Cds photo conductive, photo voltaic cell and photo conductors
14. Design a RC high pass filter for a given frequency
 - 14.1 Plot its frequency response
 - 14.2 Observe it as a differentiator (for different time constant)
15. Design a RC low pass filter for a given frequency
 - 15.1 Plot its frequency response
 - 15.2 Observe it as an integrator (for the different time constant)
16. Observe the wave forms of various clipping circuit
17. Observe the wave forms of various clamping circuits

REFERENCE BOOKS :

- | | |
|-------------------------------------|------------------------------|
| 1. Electronic Devices & Circuits | Millman & Halkias |
| 2. Electronic Devices & Circuits | G.K. Mittal |
| 3. Electronic Devices & Circuits | A.Mottershed |
| 4. Functional Electronics | K.V. Ramanan |
| 5. Electronic Devices & Circuits | Mathur, Kulshrestha & Chadda |
| 6. Electronic Devices & Circuits | Sanjeev Gupta |
| 7. Pulse & Wave Shaping Circuits. | Millman & Taub. |
| 8. Pulse Circuits | Rajul Singhal |
| 9. Pulse & Digital Circuits | K.K. Agarwal |
| 10. Electronic Devices & Circuits | G.K. Mithal |
| 11. Wave Shaping & Digital Circuits | Agarwal & Rai |
| 12. Pulse & Wave Shaping Circuits | G.L. Verma |

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DIGITAL ELECTRONICSCODE EL 205
EF 205L T P
2 -- 2**RATIONALE**

Basic digital electronics is the requirement of modern computer, microprocessor and digital communication systems. On account of reliability and accuracy digital electronic systems are replacing conventional analog systems. A diploma pass out having knowledge of digital system will be useful to the industries.

CONTENTS**1. Introduction :**

- 1.1 Digital signal and its representation
- 1.2 Advantages of digital techniques

2. Boolean Algebra :

- 2.1 Historical review - logical statements, logical constants and variables, truth table
- 2.2 Boolean operators
- 2.3 Postulates of Boolean algebra
- 2.4 Laws of Boolean algebra
- 2.5 Duality theorem
- 2.6 De' Morgan's theorem
- 2.7 Simplification of Boolean expressions
- 2.8 Verification of Boolean expressions using truth table

3. Logic Gates :

- 3.1 Introduction
- 3.2 Symbol and truth table of NOT, AND, OR, NAND, NOR, EX-OR and EX-NOR gates
- 3.3 Universal gates
- 3.4 Positive, negative and tristate logic
- 3.5 Classification & Characteristics of digital ICs
- 3.6 Brief idea of RTL, DTL, TTL, CMOS logic families & their comparison

4. Minimization Techniques (K-Mapping) :

- 4.1 Representation of Boolean expression - min. and max. term SOP, POS
- 4.2 Conversion of truth tables in POS and SOP form
- 4.3 Karnaugh map upto 4 variables - implication of logic function with and without don't care conditions
- 4.4 Realization of logic diagrams using NAND/NAND, NOR/NOR gate

5. Combinational Logic Design :

- 5.1 Binary half and full adder
- 5.2 Binary half and full subtractor
- 5.3 Binary serial, parallel and BCD adder
- 5.4 Parity bit generator and checker
- 5.5 Binary comparator
- 5.6 Multiplexer
 - 5.6.1 4 to 1 multiplexer
 - 5.6.2 8 to 1 multiplexer
 - 5.6.3 16 to 1 multiplexer

- 5.7 Demultiplexer
 - 5.7.1 1 to 4 Demultiplexer
 - 5.7.2 1 to 8 Demultiplexer
 - 4.7.2 1 to 16 Demultiplexer
- 5.8 Encoder
 - 5.8.1 Decimal to BCD
 - 5.8.2 Gray to BCD
- 5.9 Decoder
 - 5.9.1 BCD to Decimal
 - 5.9.2 BCD to seven segment
 - 5.9.3 BCD to gray

6. Sequential Systems :

- 6.1 Introduction
- 6.2 Symbol, logic circuit, truth table of R-S, J-K, M/S J-K,D,T flip-flops
- 6.3 Edge and level triggering
- 6.4 Shift registers
 - 6.4.1 Left, right and bi-direction
 - 6.4.2 Series and parallel
 - 6.4.3 Universal shift register
- 6.5 Asynchronous and synchronous counters - up, down and up-down
- 6.6 Mod counters - Mod 5, Mod 9, decade counter
- 6.7 Ring counters, Johnson counter
- 6.8 Use of shift register for simple binary multiplication and division.
- 6.9 Programmable logic device (PLD)
 - 6.9.1 Programmable logic array (PLA)
 - 6.9.2 Programmable Array logic (PAL)

PRACTICALS

1. Verify the truth tables of NOT, AND, OR
2. Verify the truth tables NAND, NOR, EX-OR, EX-NOR gates
3. Design a NOT, AND, OR
4. Design a EX-OR, EX-NOR gates using universal gates
5. Design a binary half and full adder
6. Design a binary half and full subtractor
7. Study of BCD to 7 segment decoder
8. Verify the truth table of RS, D
9. Verify the truth table J-K, M/S J-K,D,T flip-flops.
10. Study of asynchronous binary ripple up, down and up-down and different mod counters
11. Study of synchronous counters
12. Study of decade counter
13. Study of programmable counter
14. Study of a shift register using flip flops
15. Study of ring counter using flip flops
16. Study of twisted ring counter.
17. Study of PLD.

REFERENCE BOOKS :

- | | |
|--|-------------------|
| 1. Digital Principles & Applications | Malvino Leach. |
| 2. Integrated Electronics | Millman & Halkias |
| 3. Digital Electronics | T.C. Bartee |
| 4. Digital Electronics Practice Using IC's | R.P. Jain. |
| 5. Modern Digital Electronics | R.P. Jain |
| 6. Digital Electronics | L. Solanki |
| 7. Digital Integrated Circuit | K.R. Botker |
| 8. Digital Design | Floyd |
| 9. Digital Logic Design | Morris Mano. |

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WAVE PROPAGATION AND COMMUNICATION ENGINEERING

CODE EL 206
EF 206

L T P
2 -- 2/2

RATIONALE

For the transmission and reception of signals in industry and domestic life the basic knowledge of communication engineering is essential. The study of the subject provides the basic knowledge of various modulation, demodulation technique which further provide the fundamentals to understand the operation of communication systems. Detailed knowledge of radio receiver is also included in the syllabus.

CONTENTS**1. Introduction :**

- 1.1 Basic component of communication
- 1.2 Definition of modulation
- 1.3 Need of modulation in communication
- 1.4 Definition of AM, FM, PM, PAM, PPM, PWM and PCM

2. EM Wave Propagation :

- 2.1. Ground Wave propagation and effect of curvature of the earth.
- 2.2. Space Wave Propagation
 - 2.2.1. Line of sight distance.
 - 2.2.2. Effect of Atmosphere and Obstacles. (no derivation)
- 2.3. Sky Wave Propagation
 - 2.3.1. Ionospheric and its characteristics
 - 2.3.2. Critical frequency
 - 2.3.3. Effect of the Earth's magnetic field on ionospheric propagation
 - 2.3.4. MUF and Skip distance.
 - 2.3.5. Ionospheric absorption and disturbances.
 - 2.3.6. Atmospheric noise.
 - 2.3.7. Scatter propagation.
 - 2.3.8. Fading of Radio Waves. (no derivation)

3. Antennas :

- 3.1 Principle of Radiation.
- 3.2 Resonant and non resonant antennas.
- 3.3 Radiation Pattern of $\lambda/2$, λ and $3\lambda/2$ dipoles. Effect of ground on $\lambda/2$ dipole.

- 3.4 Radiation pattern of grounded $\lambda/4$, $\lambda/2$, and λ dipole.
 - 3.5 Radiation resistance, total resistance, efficiency, beam width, gain, aperture area of an antenna. (no derivation)
 - 3.5.1 Antenna Array -
 - 3.5.2 Principle of Pattern Multiplication
 - 3.5.3 Broad Side array
 - 3.5.4 End Fire array
 - 3.6 Folded dipole and Rhombic antenna.
 - 3.7 Yagi antenna and parasitic elements
 - 3.8 Log Periodic and Loop antenna.
 - 3.9 Parabolic antennas and Horn antenna
- 4. Noise and Cross Talk :**
- 4.1 Classification of noise
 - 4.1.1 Atmospheric noise
 - 4.1.2 Shot noise
 - 4.1.3 Thermal noise
 - 4.1.4 Transit time noise
 - 4.1.5 Miscellaneous noise
 - 4.2 Noise figure
 - 4.3 Concept of cross talk
 - 4.4 Cross-talk elimination techniques
- 5. Amplitude Modulation :**
- 5.1 Derivation of AM wave equation
 - 5.2 Modulation index for sinusoidal AM
 - 5.3 Frequency spectrum for sinusoidal AM
 - 5.4 Total power in AM wave.
 - 5.5 Effective voltage and current for sinusoidal AM
 - 5.6 BJT collector amplitude modulator
 - 5.7 General idea of carrier and sideband suppression
 - 5.8 Balance modulator circuits
 - 5.8.1 Using diode
 - 5.8.2 Using FET
 - 5.9 SSB generation by filter and phase shift methods
 - 5.10 Block diagram of AM transmitter
- 6. Frequency Modulation :**
- 6.1 Derivation of FM wave equation
 - 6.2 Modulation index and frequency deviation for FM
 - 6.3 Frequency spectrum for sinusoidal FM
 - 6.4 FET reactance and varactor diode FM modulator circuits
 - 6.5 Block diagram of FM transmitter using direct and indirect method (Armstrong method)
 - 6.6 Comparison of AM and FM system
- 7. Radio Receivers :**
- 7.1 Various types of receivers
 - 7.2 Receiver characteristics and their measurements
 - 7.3 Electronic tuning system

- 7.4 AM demodulator - envelope detection, product demodulator (SSB detection circuit)
- 7.5 FM demodulator - balance slope, Foster Seely and ratio detector circuit
- 7.6 Block diagram of Super heterodyne AM receiver
- 5.7 Block diagram of FM receiver

PRACTICALS

1. Generation of AM and measurement of the modulation index.
2. Perform the AM demodulation (Envelope detector)
3. Generation of F.M.
4. Operation of standard R.F. signal generator.
5. Measurement of selectivity, sensitivity, fidelity of radio receiver
6. Study of F.M. demodulation.
7. Alignment and tuning of a transistor radio receiver.
8. Study of AM receiver
9. Study of FM receiver
10. Study of Folded dipole antenna
11. Study of Yagi-uda antenna
12. Study of Parabolic antenna
13. Study of Horn Antenna
14. Study of Ground wave propagation (visit)
15. Study of space wave propagation (visit)
16. Study of sky wave propagation (visit)
17. Fault finding exercise in a radio receiver.

REFERENCES BOOKS :

- | | |
|---|-----------------|
| 1. Communication System. | George Kennedy. |
| 2. Radio Engg. | G.K. Mithal. |
| 3. Electronic Communications. | Roddy & Coolen. |
| 4. Carrier Communication | N. N. Biswas |
| 1. Electronic Communication System | Kennedy |
| 2. Radio Engineering | Terman |
| 3. Electro Magnetic Waves and Radiating Systems | Jordan Balman. |
| 4. Antennas | Kraus |
| 6. Antenna & Wave Propagation | K D Prasad |
| 7. Transmission Lines & Networks | Umesh Sinha |
| 8. Basic Communication Engineering | A.K. Sanadhya |

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MICROPROCESSOR

CODE EL 207
EF 207

L T P
2 -- 2

RATIONALE

The development of semiconductor technology has revolutionized the branch of electronics, starting from small scale integrated circuit (SSI), where the complete C.P.U on a single chip which is known as microprocessor has changed the concept of automation as well as has proved itself as a very cost effective and reliable, alternate for automation. Due to this reason the computers and microprocessor based equipment's are invading into every walk of life. In advance technology of electronics field it must be necessary the knowledge of microprocessors and their application for the students of electronics, where the students exposed to the concept of microprocessor programming, interfacing and designing of microprocessor based system.

CONTENTS

1. Number System :

- 1.1 Decimal, binary, octal and hexa-decimal number system
- 1.2 Conversion of a number from one system to another system

- 1.3 Binary addition, subtraction and multiplication
 - 1.4 Representation of positive and negative numbers
 - 1.5 1's complement and 2's complement
 - 1.6 Subtraction using 2's complement
 - 1.7 Parity bit
 - 1.8 Binary codes (Gray, Excess -3, Hamming codes), ASCII code
 - 1.9 Floating point number
- 2. Introduction of Microprocessor :**
- 2.1 Microprocessor concept
 - 2.2 Historical review of microprocessor development
 - 2.3 Organization of a micro computer
- 3. The 8085 Architecture :**
- 3.1 Internal block diagram
 - 3.2 8085 signals and their functions
 - 3.3 Demultiplexing of buses
 - 3.4 Pin configuration and logical diagram.
- 4. 8085 Instructions and Programming :**
- 4.1 Instruction format
 - 4.1.1 Mnemonics
 - 4.1.2 Opcode and operand
 - 4.1.3 Instruction length
 - 4.2 Classification of instruction
 - 4.2.1 Data transfer
 - 4.2.2 Arithmetic
 - 4.2.3 Logical
 - 4.2.4 Branching
 - 4.2.5 Machine control
 - 4.3 Different interrupts of 8085 Microprocessor
 - 4.4 Addressing modes
 - 4.5 Stack operation and related instructions
 - 4.6 Subroutine and related instructions
 - 4.7 Machine and assembly language
 - 4.8 Assembly language programming
 - 4.9 Debugging of programs
- 5. Memory and I/O System :**
- 5.1 Memory types
 - 5.2 Memory organization
 - 5.3 Basic concept of memory interfacing and I/O interfacing
 - 5.4 Difference between peripheral I/O and memory mapped I/O
- 6. Instruction Execution and Timings :**
- 6.1 Instruction cycle - machine cycle, T-states
 - 6.2 Fetch cycle
 - 6.3 Memory read and write cycle
 - 6.4 I/O read and write cycle
 - 6.5 Interrupt acknowledge cycle

- 6.6 Bus idle cycle
- 6.7 DMA cycle
- 6.8 Machine cycle with wait states.
- 6.9 Programs using delays and counters

7. Limitation of 8 bit Microprocessor.

PRACTICALS

1. Study of 8085 microprocessor kit
2. Addition of two 8 bit numbers with and without carry
3. Subtraction of two 8 bit numbers with and without borrow
4. Multiplication of two 8 bit number using successive addition and resistor shifting method
5. Program to find ones compliment of 1 byte number
6. Program to find ones compliment of 2 byte number
7. Program to find MASK OFF for LSB and MSB compliment of 1 byte number
8. Program to find out square of a number.
9. Programs to find sum of first ten natural number involving data arrays
10. Programs to Generating odd numbers.
11. Programs to Data transfer schemes
12. Programs to Sorting of odd/even numbers.
13. Programs to Finding largest and smallest numbers.
14. Programs to Arrange data array in ascending / descending order
15. Programs using stack
16. Programs using subroutine.
17. Debugging of programs using single stepping on kit

REFERENCE BOOKS :

- | | |
|---|---------------------|
| 1. Microprocessor Architecture, Programming & Application | Gaonkar |
| 2. Fundamentals of Microprocessors & MicroComputers | B.Ram |
| 3. Assembly Language Programming | A.Leventhal, Osborn |
| 4. Theory & Problems of Microprocessor Fundamentals | Tokhein |
| 5. Microprocessor & Peripheral Hand book | INTEL |
| 6. Computer Architecture & org. | J.P Hayes |
| 7. Digital Computer Fundamentals | T.C.Bartee |
| 8. An Introduction to Microprocessors | A.P.Mathur |

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AUDIO AND VIDEO SYSTEM

CODE EL 208
EF 208

L T P
2 -- 2/2

RATIONALE

Entertainment electronic equipments with latest trends are essential part of modern living. Sound and video signals can be recorded and play back at any time with the help of some electronic arrangements. Thus to study all these in better manner a subject named "Audio and Video System" is included in the curriculum.

CONTENTS

1. Basic Components of Audio and Video :

- 1.1 Construction & Working of Microphone
 - 1.1.1 Carbon type
 - 1.1.2 Electrodynamic type
 - 1.1.3 Condenser type
 - 1.1.4 Crystal type
- 1.2 Construction & Working of Loud Speaker
 - 1.2.1 Tweeter

- 1.2.2 Wooffer
- 1.2.3 Mid range
- 1.3 CCD Camera

2. **HI-FI and Stereophony :**

- 2.1 Meaning of Hi-Fi
- 2.2 Basic components
- 2.3 Fundamental of sound harmonics
- 2.4 Loudness
- 2.5 Pitch
- 2.6 Timbre
- 2.7 Sensitivity
- 2.8 Stereophony recording
- 2.9 Broadcasting of stereophony and its reproduction
- 2.10 Active and passive audio circuits
 - 2.10.1 Volume control
 - 2.10.2 Tone control
 - 2.10.3 Bass and treble control
 - 2.10.4 Graphic equaliser
- 2.11 Basic idea about audio pre amplifier and power amplifiers

3. **Scanning and Composite Video Signal :**

- 3.1 Scanning Process.
- 3.2 Flicker & Inter lace scanning
- 3.3 Contrast Ratio & Aspect ratio and viewing distance
- 3.4 Composite Video signal dimensions.
- 3.5 Horizontal and vertical sync details.
- 3.6 Scanning sequence and Function of sync pulse train.
- 3.7 TV standards for 625 line system

4. **T.V. Signal Transmission :**

- 4.1 Modulation technique for picture and sound with reason of preferences
- 4.2 Concept of Vestigial Side Band (VSB)
- 4.3 VSB band width and transmission efficiency
- 4.4 TV channel B.W.
- 4.5 Positive and Negative modulation
- 4.6 Block diagram of TV transmitter
- 4.7 Interference suffered by carrier
- 4.8 TV transmitting antenna

5. **T.V. Receiver :**

- 5.1 Principle of TV Receiver.
- 5.2 VSB reception
- 5.3 Block diagram of B/W T.V. Receiver and function of each stage
- 5.4 Balun and its construction

6. **Colour T.V. :**

- 6.1 Colour T.V. Essentials.
- 6.2 Compatibility.
- 6.3 Colour perception and three colour theory
- 6.4 Luminance, hue, saturation, chroma
- 6.5 Colour difference signal

- 6.6 Colour picture tube
 - 6.6.1 Delta gun
 - 6.6.2 Precision in line (PIC)
 - 6.6.3 Trinitron
- 6.7 Colour Signal Transmission (frequency inter leaving technique)
- 6.8 Band width for Colour Signal Transmission.
- 6.9 Modulation of Colour Signals
- 6.10 Weighting factor
- 6.11 Elementary idea for NTSC, PAL, SECAM systems, their merits and demerits.

7. Basic Concept of New Trends :

- 7.1 Audio CD player
- 7.2 Audio conferencing
- 7.3 Digital versatile disk (DVD)
- 7.4 Home theatre system
- 7.5 LCD & LED TV
- 7.6 Plasma TV
- 7.7 Blue ray disc
- 7.8 Simple audio and video compression techniques

PRACTICALS

1. Study of different audio circuits volume, tone, bass, treble and equaliser
2. Study of audio CD player
3. Study of Video CD player
4. Installation and study of different TV receiving antennas.
5. Study of controls of monochrome and colour TV.
6. Study of picture tubes for monochrome and colour TV.
7. Study of different sections of monochrome TV.
8. Study of different sections of Colour TV and observe the waveform.
9. Study of setting up and alignment/adjustment of following using pattern generator.
 - 9.1 Sound IF, picture IF
 - 9.2 Vertical height adjustment, vertical linearity adjustment
 - 9.3 Horizontal linearity and size adjustment
 - 9.4 Tuner adjustment
10. I.F. alignment of TV receiver using Wobbuloscope
11. Trouble shooting of monochrome and colour TV receiver
12. Study of UHF to VHF converter.
13. Colour adjustment of Colour TV
14. Visit of TV studio/Telecasting station.
15. Various faults of colour and B/W receivers and their remedies.
16. Study of LCD and LED TV.
17. Study of DVD player

REFERENCE BOOKS :

- | | |
|--|---------------------------|
| 1. Audio & Video Systems | A.K. Saxena & K.K. Saxena |
| 2. Hand Book of Magnetic Recording | D. Jorgen |
| 3. A Course in Electrical & Electronic Measurement & Instruments | A.K. Sawhney |
| 4. Basic TV & Video System | Bernard Grob |
| 5. Monochrome & Colour TV System | R.R. Gulati. |
| 6. Colour TV Principle & Practice | R.R. Gulati. |
| 7. T.V. Engineering | A.M. Dhake |
| 8. T.V. Engg. Theory & Service | Kiver Kaufman |
| 9. Basic TV Principles | Bernard Grob |
| 10. Audio & Video System | A.K. Sanadhya |
| 11. T.V. Engineering | A.K. Khatri |

ELECTRONIC INSTRUMENTSCODE EL 209
EF 209L T P
2 -- 2/2**RATIONALE**

In order to carry out the preventive maintenance of electronic gadgets, fault location, testing and calibration, knowledge and skill of electronic instruments is essential. The contents of this subject are to cover some of the aspects of electronic instruments.

CONTENTS**1. Multimeter :**

- 1.1 Principle of measurement of
 - 1.1.1 D.C. Voltage and current
 - 1.1.2 A.C. Voltage and current
 - 1.1.3 Resistance
- 1.2 Calculation of shunt and multiplier for range extension
- 1.3 AC and D.C. sensitivity
- 1.4 Loading effect
- 1.5 Specifications and limitations of multimeter.

2. Electronic Voltmeter :

- 2.1 Characteristics of different analog electronic voltmeter
- 2.2 Circuits for D.C. voltmeter using BJTs and FETs (single device and balanced bridge type)
- 2.3 Theory and operation of circuits for average, peak, peak to peak and RMS responding A.C. electronic voltmeters
- 2.4 Comparison of amplifier rectifier type and rectifier amplifier type electronic voltmeter

3. Cathode Ray Oscilloscope (C.R.O) :

- 3.1 Construction of CRT and deflection sensitivity
- 3.2 Block diagram of CRO
- 3.3 Various controls of CRO
- 3.4 Detail of X-Y section and delay line
- 3.5 Horizontal sweep section
- 3.6 Synchronization of sweep and triggered sweep
- 3.7 Measurement of voltage, current, frequency and phase angle using CRO
- 3.8 CRO probes
- 3.9 Construction and working of dual trace and dual beam CROs
- 3.10 Frequency & phase measurement by lissajou figure.

4. Working Principle and Application of :

- 4.1 Q-meter
- 4.2 AF/RF signal generators
- 4.3 Harmonic distortion analyzers.
- 4.4 Transistor Tester
- 4.5 Curve Tracer
- 4.6 LCR bridge
- 4.7 Output power meter (AF)
- 4.8 Spectrum analyzer
- 4.9 Cable fault locator
- 4.10 Magger

5. Digital Displays :

- 5.1 Construction and Working Principle of different type of displays. Such as Diode Matrix, 7-segment using LED and LCD, Dot matrix using LED
- 5.2 Comparison of different type of displays

6. Guarding Techniques:

- 6.1 Safety guard and signal ground.
- 6.2 Ground loops and ground currents.
- 6.3 Common mode and series mode voltage.
- 6.4 Avoiding parasitic voltage.

PRACTICALS

1. Measurement of D.C. voltage and current by multimeter
2. Measurement of A.C. voltage and current by multimeter
3. Measurement of resistance by multimeter
4. Complete study of multimeter and specification.
5. Study of electronic voltmeter
6. Study and use of CRO for voltage measurement
7. Study and use of CRO for voltage frequency and phase angle measurement
8. Measurement of phase and frequency using lissajous figure by CRO
9. Testing of transistors using transistor tester
10. Study of seven segment display (LED and LCD)
11. Measurement of Harmonic distortions of an Amplifier using harmonic distortions Analyzer
12. Measurement of output power of an Audio Amplifier using AF power meter
13. Measurement of L, C, and R by LCR Bridge/ meter
14. Measurement of Q factor of a coil / capacitor by Q meter
15. Study of AF/RF generator
16. Study of spectrum analyser.
17. Study of CRT of CRO.

REFERENCE BOOKS :

- | | |
|--|---------------|
| 1. A Course in Electrical and Electronics Measurement & Instrumental | A.K. Sawhney |
| 2. Modern Electronic Instrumentation and Measurement Techniques | Cooper |
| 3. Electronic Instrumentation Fundamentals | Malvino |
| 4. Electronic Measurement | Terman Pettit |
| 5. Electronic Instruments | David Bell |

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‘C’ PROGRAMMING

CODE EL 210

Same in all branches except AR/CC/CE/CS/ EE /IT

L	T	P
2	--	2

RATIONALE

'C' is computer programming language and also structured programming language. In 'C' programming language we consider various syntax used in programming. By having good knowledge of 'C', students can write modular application and system programs. 'C' can be used in the engineering applications. By acquiring a sound knowledge of 'C' students will be able to understand the concept of all the application areas. This course is specially designed for engineering students of all diploma streams.

CONTENTS**1. Introduction :**

- 1.1 Scope of 'C' Language
- 1.2 Distinction and similarities with other HLLs
- 1.3 Special features and Application areas

2. Elements of 'C' :

- 2.1 Character set
- 2.2 Key words
- 2.3 Data types
- 2.4 Constants and Variables
- 2.5 Operators: unary, binary, ternary
- 2.6 Operator precedence

3. Console Input-Output :

- 3.1 Types of I-O
- 3.2 Console I-O
- 3.3 Unformatted console I-O: getchar(), putchar(), gets(), puts(), getch(), getche()
- 3.4 Formatted I-O: scanf(), printf()

4. Control Flow :

- 4.1 Statements and blocks
- 4.2 if
- 4.3 switch
- 4.4 Loops: for, while, do-while
- 4.5 goto and labels
- 4.6 break, continue, exit
- 4.7 Nesting control statements

5. Arrays :

- 5.1 Basic concepts
- 5.2 Memory representation
- 5.3 One dimensional array
- 5.4 Two dimensional array

6. Functions :

- 6.1 Basic concepts
- 6.2 Declaration and prototypes
- 6.3 Calling
- 6.4 Arguments
- 6.5 Scope rules
- 6.6 Recursion
- 6.7 Storage classes types
- 6.8 Library of functions: math, string, system

7. Pointers :

- 7.1 Basic concepts
- 7.2 &, * operator
- 7.3 Pointer expression: assignment, arithmetic, comparison
- 7.4 Dynamic memory allocation
- 7.5 Pointer v/s Arrays

8. Structure and Enumerated Data Types :

- 8.1 Basic concepts
- 8.2 Declaration and memory map
- 8.3 Elements of structures
- 8.4 Enumerated data types : typedef, enum
- 8.5 Union

PRACTICALS

1. Problems based on arithmetic expression, fixed mode arithmetic.
2. Problems based on conditional statements and control structures.
3. Problems based on arrays (1-D, 2-D), functions and pointers.
4. Problems based on engineering applications.

REFERENCE BOOKS :

- | | |
|-------------------------|---------------------|
| 1. 'C' Programming | Stephen Kochan |
| 2. Programming with 'C' | Schaum's Series |
| 3. 'C' Programming | V.Balguru Swami |
| 4. 'C' Programming | Kernighan & Ritchie |
| 5. Let us 'C' | Yashwant Kanetkar |

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