UNIVERSITY OF MUMBAI

Syllabus for Sem V & VI Program: B.Sc.
Course: Electronic Instrumentation (Applied Component)

(Credit Based Semester and Grading System with effect from the academic year 2017 –2018)

SEMESTER V

Theory

USACEI501	Analog Circuits and Instruments	No. of Credits	Lectures/Week
Unit I	Electronic Components, Transducers and Display Devices	**02**	**04**
Unit II	Measuring Instruments		
Unit III	Signal Generation and Signal Conditioning		
Unit IV	Power Supplies		

Practicals

USACEI5P1	Analog Circuits and Instruments	02	04

Semester VI

USACEI601	Digital Electronics, Microprocessor and its applications, Programming in C++	No. of Credits	Lectures/Week
Unit I	Digital Electronics	**02**	**04**
Unit II	8085 Microprocessor and Basic Assembly Language Programming-I		
Unit III	Basic Assembly Language Programming-II and 8255 PPI		
Unit IV	Basic Concepts of Object Oriented Programming and C++		

Practicals

USACEI6P1	Digital Electronics, Microprocessor and its applications, Programming in C++	02	04

The revised syllabus under the credit based grading system in the subject of Electronic Instrumentation (Applied Component) for Third Year B.Sc. Physics (Single/Twin major subject) will be implemented from the academic Year 2017-18.

The scheme of examination in the subject of Electronic Instrumentation (Applied Component) will be as follows:

Semester V & VI : Theory

Course Code: USACEI501 & USAEI601

(A) Internal Examination: 25 marks

Sr. No	Particulars	Marks
1	One Class Test/case study/online examination to be conducted in the given semester	20
2	Active Participation in routine class instructional deliveries. Overall conduct as a responsible learner, communication and leadership qualities in organizing related academic activities	05

(B)External Examination : 75 marks

- Duration of each Theory paper will be of two and half hours.
- Each theory paper shall consist of five questions, one from each unit and the fifth question will be from all the units. All questions are compulsory and will have internal choice.

Semester V & VI : Practical

Course Code: USACEI5P1 & USAEI6P1

There will not be any internal examination for practicals. The External examination will be conducted as per the following scheme by the respective colleges and the marks will be forwarded to the University:

Sr. No	Particulars of External Practical Examination	Marks
1	Laboratory Work	80
2	Journal	10
3	Viva	10
	TOTAL	100

Total Marks in each semester :

- Duration of each Practical paper will be of 3 Hours per semester.
- A certified Journal of Electronic Instrumentation must contain a minimum of **EIGHT** Experiments in each semester. At least **TWO** experiments from each sub group as mentioned in the syllabus should be performed and reported in journal.
- Every candidate will be required to perform **ONE** experiment (from sub groups A, B or C) at the semester end practical examination.
- A candidate will be allowed to appear for the Practical Examination only if the candidate submits his/her certified Journal or a certificate from the Head of the Department of Physics stating that the candidate has completed the practical Course of Electronic Instrumentation of the respective semester as per requirements.

Semester V

Course Code: USACEI501

Title: ANALOG CIRCUITS AND INSTRUMENTS

Unit 1: Electronic Components, Transducers and Display Devices **(*15 Lectures)***

[***Review of passive components: resistor, capacitor, and inductor***

Ref. BKG: 1.4 & 1.4.1 Introduction to Transducers Ref. K: 1.3.1 & 1.3.2 **]**

(i) Temperature measurements: Resistance thermometer, thermocouple & thermistor.

Ref. H & C: 11.5.1, 11.5.2 &11.5.4

(ii) Pressure & Displacement Transducers: Strain Gauges (derivation of gauge factor is not expected), LVDT, Capacitive transducers, Load Cell.
Ref. K: 13.6, 13.11, 13.13 &13.14

(iii) Optical Transducers & display devices: LED, LCD, and Dot Matrix Display. Seven segment LED display, BCD to seven segment decoder / driver, Liquid crystal displays.

Ref. K: 13.16, 2.10, 2.11 & 2.12.4 T: 6.6, 6.8, 6.9

Unit 2: Measuring Instruments ***(15 Lectures)***

(i) Cathode Ray Oscilloscope:

Introduction, CRO block diagram, CRT connection, Vertical amplifier, Basic function of sweep generator, Horizontal deflection system, Triggered sweep, Trigger Pulse, Delay line. Probes: - 1:1 probe, 10:1 probe, Attenuators (Uncompensated and Compensated), Dual trace CRO

Ref. K: 7.1, 7.4, 7.12, 7.6, 7.3.1, 7.7,7.8, 7.9,7.10,7.28.1, 7.28.2, 7.29, 7.29.1, 7.29.2 & 7.15

(ii)Analog Electronic Multimeters:

Transistor voltmeter, Solid state (Op Amp based)voltmeter

Ref. K: 4.7 & 4.9

(iii)Digital Instruments: D/A Conversion, Variable(weighted) resistor and Binary Ladder (4bit) type D/A Converters.

Ref. **M&L**:**12.1 & 12.2**

DMM, 3 ½ Digit, resolution and sensitivity, general specification

Ref. K: 6.2, 5.8, 5.9 & 5.10.

Unit 3: <u>Signal Generation and Signal Conditioning</u> (*15 Lectures)*

(i) Signal generators and Clippers using op-amps and 555 timer applications:

Oscillators: Wien bridge Oscillator ,Triangular Wave generation, Sawtooth wave-generation and Square –triangular wave generator using op-amp. Positive and Negative Clippers using Op-amp. 555 Timer applications: Tone Burst Oscillator (Temperature to frequency conversion) Voltage controlled frequency shifter.

Ref. G: **7.13, 7.16, 7.17 & 8.12.1. C & D : 13.4.1 & 13.4.2**

(ii)Instrumentation Amplifier & its applications: Basic Instrumentation Amplifier, Instrumentation system, Applications of Instrumentation Amplifier, Temperature indicator, light intensity meter, analog weight scale.

Ref. K: **14.3, 14.3.2, 14.4, 14.4.1, 14.4.2, 14.4.3**

(iii)Active filters:

Introduction, Active Filters, 2^{nd} order Low Pass Butterworth filter, 2^{nd} order High Pass Butterworth filter, Band pass Filters, wide band pass filter, wide band rejection filter and narrow band rejection filter.

Ref. G: **7.1, 7.2, 7.4, 7.6, 7.7, 7.8, 7.8.1, 7.9.1 & 7.9.2**

UNIT 4: <u>Power Supplies</u> (*15 Lectures)*

(i) Linear and switching regulators

Adjustable Positive Voltage Regulator (LM 317), Adjustable Negative Voltage Regulator (LM 337), Formation of adjustable bipolar voltage regulator using LM317 and LM337. Fixed output voltage regulator with current booster.

Ref. C & D: **16.11, 16.12, 16.1 M**: **24.5**

Constant current source (ground load) using OP-Amp and pnp transistor

Ref C & D: **5.5.2**

Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations)

Ref M: **24.7**

References:

1. BKG: Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta. Technical Teachers training Institute, Tata McGraw Hill Publishing Company Limited.
2. H & C: Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper (PHI) Edition.
3. K: Electronic Instrumentation by H. S. Kalsi, 2nd Edition, Tata McGraw Hill.
4. T: Digital electronics by G. L. Tokheim (6th Editon) (Tata Mc Graw Hill)
   C & D: "OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th Edition), Eastern Economy Education, PHI
5. G: OPAMPs & linear integrated circuits by R. A. Gayakwad,(4th Edition, PHI)
6. .M: "Electronic Principles" by A. P. Malvino (6th edition, PHI).
7. M & L: Digital Principle & Applications" by Malvino & Leach (6th edition, TMH)

Additional References:

H & H: The Art of Electronics, by Paul Horowitz & Winfield Hill (2nd Edition)

PRACTICALS (Semester V)

Course Code: USACEI5P1

GROUP-A

1. Thermistor Characteristics –Thermal and electrical (H & C)
2. Thermistor as sensor in temperature to voltage converter using OPAMP (C&D Ch.8)
3. Basic Instrumentation Amplifier using 3 OpAmps coupled to resistance bridge (C&D Ch.8)
4. Study of LVDT characteristics(K Ch. 13)
5. Study of Load Cell / Strain Guage (K Ch. 13)

GROUP-B

Note: All the B-group experiments should be performed on breadboard

1. Temperature to frequency Conversion using 555 timer. (C &D Ch. 13)
2. OPAMP D/A Converter weighted resistor / Ladder network (M & L Ch. 12)
3. Positive and Negative Clipper using op-amp.(G Ch. 8)
4. Second Order active Low Pass/High Pass filter (frequency response & phase relation) (K.Ch15)
5. Active Notch Filter (frequency response & phase relation) (K.Ch.15)
6. Square and Triangular wave generator using OPAMPs with concept of duty cycle. (M.Ch 23)

GROUP-C

1. Adjustable Voltage Regulator using LM 317.(C&D Ch 14)
2. Adjustable constant Current Source using LM 317. .(C&D Ch 14)
3. Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA) (C & D Ch 5)
4. Study of Monolithic IC regulator. (M Ch.24)
5. Study of variable dual power supply LM 317 & LM 337 (± 3v to ± 15v). (C & D Ch. 13)

References:

1. H & C : Modern Electronic Instrumentation & Measurement Techniques By Albert D. Helfrick & William D. Cooper PHI) EEEdition
2. C & D : "OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6^{th} edition PHI)
3. G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4^{th} edition, PHI)
4. M: "Electronic Principles" by A. P. Malvino (6th edition, PHI)
5. K: Electronic Instrumentation by H. S. Kalsi (TMH) 2^{nd} Edition
6. M & L : Digital Principle and Applications" by Malvino and Leach (5th edition, TMH)
7. RPJ : Modern Digital Electronics 3rd edition (TMH) – R .P. Jain

Semester VI

Course Code: USACEI601

Title: Digital Electronics, Microprocessor and its applications, Programming in C++

Unit 1 Digital Electronics ***(15 lectures)***

Tri-State Devices, Buffers, Decoders, Encoders, Latch.
Ref: RG: **3.5, 3.5.1, 3.5.2, 3.5.3, 3.5.4 & 3.5.5**
Multiplexers, Their use in Combinational Logic design, multiplexer tree, De-multiplexers, Their use in Combinational Logic design, De-multiplexer tree.
Ref: RPJ: 6.2.1, 6.2.2, 6.3.1 & 6.3.2
Memory Classification, Charge Coupled Device memory.
Ref: RG: 3.2.7. and RPJ: 11.9.1, 11.9.2 & 11.9.3

Unit 2 8085 Microprocessor and Basic Assembly Language Programming-I ***(15 L)***

Introduction, Historical Perspective, Organization of a Microprocessor Based system, How does the Microprocessor works, Machine Language, Assembly Language, Writing and executing an Assembly Language Program, High Level Languages.
Ref: RG: 1.1, 1.1.2, 1.1.3, 1.2 (Omit - 1.2.4)
8085 Bus Organization, 8085 Hardware model, 8085 Programming Model, The 8085 Microprocessor, Microprocessor Communication and Bus Timings, De-multiplexing of Address and Data Bus, Generating Control Signals. A detailed look at 8085 Microprocessor.
Ref RG: 3.1.1, 2.1.1 & 2.1.2, 4.1.1,4.1.2,4.1.3,4.1.4,4.1.5
Instruction, Instruction Word Size, Opcode Format **Ref: RG: 2.3.1 & 2.3.2**, Addressing Modes **Ref: RG: 6.1.1.** The 8085 Instruction Set (Classification) **Ref: RG: 2.2.1,** Data transfer Operations **Ref: RG: 6.1, 7.2.1, 7.2.2 & 7.3.3**, Arithmetic Operations **Ref: RG: 6.2, 7.2.4 & 7.3.1**,

Unit 3 Basic Assembly Language Programming-II and 8255 PPI ***(15 lectures)***

Logical Operations **Ref RG: 6.3, 7.4 & 7.5**, Branch Operations **Ref: RG: 6.4, 9.2** ***{Omit – 9.2.1, 9.2.2}*** **& 9.3** Stack **Ref: RG: 9.1**, Introduction to Advanced Instructions **Ref RG: 10.7**, Flowchart **Ref: RG: 6.1.2**
IC 8255 (PPI): Block diagram of the 8255A, Mode 0: Simple Input or Output, BSR (Bit Set/Reset) Mode. **Ref: RG: 15.1.1, 15.1.2, & 15.1.3**

Unit 4 Basic Concepts of Object Oriented Programming and C++ **(*15 lectures)***

(1) Basics of Object-Oriented Programming & Beginning with C++:

A look at Procedure-Oriented Programming, Object-Oriented Programming Paradigm, Basic concepts of Object-Oriented Programming, Benefits of OOP, Object-Oriented Languages, Applications of OOP.
What is C++?, Applications of C++, A simple C++ program, More C++ Statements, Example with Class, Structure of C++ Program, Creating the Source File, Compiling and Linking.

Ref EB: 1.3, 1.4, 1.5, 1.6, 1.7 & 1.8
EB: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 & 2.8

(2) Tokens and Expressions in C++:
Introduction, Tokens, Keywords, Identifiers and Constants, Basic Data Types, User-Defined Data Types, Derived Data Types, Symbolic Constants, Type Compatibility, Declaration of Variables, Dynamic Initialization of Variables, Reference Variables, Operators in C++, Scope Resolution Operator, Member Dereferencing Operators, Memory Management Operators, Manipulators, Type Cast Operator, Expressions and Their Types, Special Assignment Expressions, Implicit Conversions, Operator Overloading, Operator Precedence.
Ref EB: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 3.20, 3.21, 3.22 & 3.23
(3) Control Structures and Functions:
Control Structures, Functions: The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, Constant Arguments, Function Overloading, Math Library Functions.
Ref EB: 3.24,4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11

Main References:

1. RPJ: Modern Digital Electronics by R. P. Jain, 3rd Edition, Tata McGraw Hill.
2. RG: Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5th Edition, Prentice Hall of India.
3. EB: Object Oriented Programming with C++ by E Balagurusamy, Third */Fourth Edition, Tata McGraw-Hill Publishing Company Limited.*

Additional references:

1) **Microprocessor and Applications** by Vibhute and **Borole,** Techmax Publications,
2) Microprocessor, Principles & Applications by Gilmore (2nd Ed) TMH
3)Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
4) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.

PRACTICALS (Semester VI)

Course Code: USACEI6P1

GROUP A

1) Study of 3:8 Decoder (74LS138) and study of 8:3 Priority Encoder (74LS148) and their applications.(**RPJ**)
2) Study of Latch (74LS373) and its applications.(**RPJ**)
3) Study of 8:1 Multiplexer (74LS151) and its applications.(**RPJ**)
4) Study of1: 4 De-multiplexer (74LS155) and its applications.(**RPJ**)
5) Study of ROM and its addressing using decoder.(**RPJ & RG**)

GROUP B
8085 Programming

NOTE: The students should be familiar with Keyboard and Display utilities such as READ KEYBOARD, TO DISPLAY ON ADDRESS FIELD, TO DISPLAY ON DATA FIELD, mentioned in their 8085 µp kit's manual.

1) Writing Assembly Language Programs using Direct Register Addressing, Indirect Addressing:-
   i) To Add 8-bit/16-bit numbers with CARRY. (Display/Store result and Carry)
   ii) To Subtract 8-bit/16-bit numbers with BORROW. (Display/Store result and Borrow)
2) Writing Assembly Language Programs:-
   i) To accept 4-bit/8-bits numbers from Keyboard, add/subtract and display/store Result, Carry/Borrow)
   ii) To Add a series of numbers. (Display Result and Carry)
   iii) To multiply two, 8 - bit numbers (Using Direct Register Addressing, Indirect Addressing) and Display result.
3) Writing Assembly Language Programs:-
   i) To transfer a series of block of data from Source to Destination.
   ii) To find odd/even numbers from a series of block of data. (Display result)
4) Writing Assembly Language Programs:-
   i) To find positive/negative nos. from a series of block of data. (Display result)
   ii) To find maximum/minimum from a series of block of data. (Display result)
5) Writing Assembly Language Programs:-
   i) To divide two, 8 - bit nos. (Display Quotient and Remainder)
   ii) To arrange, 8 – bit nos. in ascending/descending order.
6) Write a program to blink Port C bit n (n = 0 to 7 any one) of the 8255 PPI available on your 8085 kit. Use Bit Set/Reset mode. Find port addresses from manual and use them.

7) Using 8255 Design a system (both Software and Hardware) that will cause 4 LEDs to flash 10 times when a push button switch is pressed, use suitable delay. (use breadboard to design hardware part)

References:

1. H & C : Modern Electronic Instrumentation & Measurement Techniques By Albert D. Helfrick & William D. Cooper (PHI) EEEdition
2. C & D : "OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6^{th} edition PHI)
3. G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4^{th} edition, PHI)
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5. K: Electronic Instrumentation by H. S. Kalsi (TMH) 2^{nd} Edition
6. M & L : Digital Principle and Applications" by Malvino and Leach (5th edition, TMH)
7. RPJ : Modern Digital Electronics 3rd edition (TMH) – R .P. Jain

GROUP C

C++ Programming

1) Program based on Input, Output Statements.
   (Programs to read any two numbers through keyboard and to perform simple arithmetic operations and to display the result)
2) Program based on Control Statements
   i) Program based on if-else statement
   ii) Program based on nested if statement
3) Program based on for loop, while loop and do-while loop.
4) Program using switch statements and if-else ladder.
5) Program to study function declaration, function calling and function prototype.

Main References:

1. RPJ: Modern Digital Electronics by R. P. Jain, 3^{rd} Edition, Tata McGraw Hill.
2. RG: Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar, 5^{th} Edition, Prentice Hall of India.
3. EB: Object Oriented Programming with C++ by E Balagurusamy, Third */Fourth Edition, Tata McGraw-Hill Publishing Company Limited.*

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2) Microprocessor, Principles & Applications by Gilmore (2^{nd} Ed) TMH
3) Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
4) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company. 5 http://www.cplusplus.com/doc/tutorial