**Resolution Number for Academic year 2020-21 syllabus**

**AC/II(20-21).2.RUS16**

# S.P. Mandali's

# Ramnarain Ruia Autonomous College


**Syllabus for T. Y. B. Sc. Applied Component**

**Program: B.Sc.**

**Course: Applied Component: Electronic Instrumentation , C++ programming & Nano-materials**

**(RUSACEI)**

(Credit Based Semester and Grading System with effect from the academic year 2020–2021)

## SEMESTER V

### Theory

| COURSE CODE | UNIT | TITLE | Credits | Lect / Week |
|---|---|---|---|---|
| **RUSACEI 501** | | **ANOLOG CIRCUITS and NANOMATERIAL-I** | | |
| | **I** | Measuring Instruments | 02 | 04 |
| | **II** | Signal conditioning and Power Supplies | | |
| | **III** | Analysis Techniques-I | | |
| | **IV** | Nano-materials-I | | |
| | **Practicals based on above course** | | | |
| **RUSACEI 5P1** | | | 02 | 04 |
| **Total** | | | 04 | |

## SEMESTER VI

### Theory

| COURSE CODE | UNIT | TITLE | Credits | Lect / Week |
|---|---|---|---|---|
| **RUSACEI 601** | | **C++ PROGRAMING AND NANOMATERIAL-II** | | |
| | **I** | Basic Concepts of Object Oriented Programming in C++-I | 02 | 04 |
| | **II** | Programming in C++-II | | |
| | **III** | Analysis Techniques-II | | |
| | **IV** | Nano-materials-II | | |
| | **Practicals based on above course** | | | |
| **RUSACEI 6P1** | | | 02 | 04 |
| **Total** | | | 04 | |

**Course Code: ANOLOG CIRCUITS AND NANOMATERIAL-I**

**Course Title: RUSACEI501**

**Learning Objectives:**

Upon completion of this course, students would acquire the following knowledge & skills:

(1) The ability to apply the principles of physics to solve new and unfamiliar problems
(2) The ability to analyze and interpret quantitative results in the areas of physics
(3) The ability to use contemporary experimental apparatus and analysis tools to acquire, analyze and interpret scientific data
(4) The ability to communicate scientific results effectively in presentations or posters
(5) A comprehensive, quantitative and conceptual understanding of the core areas of physics, including mechanics, optics, thermodynamics, electrostatics, electrodynamics at a level attuned with graduate programs in physics at peer institutions.
(6) To learn functional nanomaterial and its properties.
(7) To study the synthesis of various nanomaterial.
(8) Synthesis and characterization of nanomaterial.
**(9)** To learn the application of nanomaterial

**Learning Outcomes:**

On successful completion of this course, students will be able to:

a) Understand the basics of Temperature measurements using elements as resistance thermometer, thermocouple Thermistor , their applications
b) Understand the basics of **Measuring Instruments such as CRO, DMM, Analog meter and** able to perform calculations using them
c) Understand working of **Signal Generation and Signal Conditioning, power supply and demonstrate in experiments.**
d) Demonstrate quantitative problem solving skill in all the topics covered
e) Understand the functional nanomaterial and its properties.
f) Synthesis of various nanomaterial.
g) Analysis of synthesized nanomaterial.
h) Understand the application of nanomaterial

## Syllabus - SEMESTER V

| RUSACEI501 – ANOLOG CIRCUITS AND NANOMATERIAL-I | | |
|---|---|---|
| | | |
| **Course Code** | **Title** | **Credits** |
| **Unit I** | **Measuring Instruments:**<br>(i) Cathode Ray Oscilloscope:<br>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<br>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**<br>(ii) Analog Electronic Multimeter:<br>Transistor voltmeter, Solid state (Op Amp based) voltmeter<br>Ref. **K: 4.7 & 4.9**<br>(iii) Digital Instruments: D/A Conversion, Variable (weighted) resistor and Binary Ladder (4bit) type D/A Converters.<br>Ref. **M&L: 12.1 & 12.2**<br>**DMM**, 3 ½ Digit, resolution and sensitivity, general specification<br>Ref. **K: 6.2, 5.8, 5.9 & 5.10.** | **15 lectures** |
| **Unit II** | **a) Instrumentation Amplifier & its applications:**<br>Basic Instrumentation Amplifier, Instrumentation system, Applications of Instrumentation Amplifier, Temperature indicator, light intensity meter, analog weight scale.<br>Ref. **K: 14.3, 14.3.2, 14.4, 14.4.1, 14.4.2, 14.4.3**<br>**b) Active filters:**<br>Introduction, Active Filters, 2nd order Low Pass Butterworth filter, 2nd order High Pass Butterworth filter, Band pass Filters, wide band pass filter, wide band rejection filter and narrow band rejection filter.<br>Ref. **G: 7.1, 7.2, 7.4, 7.6, 7.7, 7.8, 7.8.1, 7.9.1 & 7.9.2**<br>**c) Power Supplies**<br>i) Principle, block diagram, working, important specifications and operating procedures for- Fixed voltage power supply, variable power supply, dual power supply, CV and CC supply, SMPS, DC toDC converter, UPS.<br>Ref. B. S. Sonde, Power Supplies, TMH<br>ii) Linear and switching regulators<br>Fixed output voltage regulator with current booster.<br>Ref. **C & D: 16.11, 16.12, 16.1 M: 24.5**<br>iii) Constant current source (ground load) using OP-Amp and pnp transistor-Ref **C & D: 5.5.2**<br>iv) Basic and Monolithic Switching regulators (buck, boost and buck – boost) (Only basic Configurations) Ref **M: 24.7** | **15 lectures** |

| | | |
|---|---|---|
| | **References:**<br>1. 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.**(BKG)**<br>2. Modern Electronic Instrumentation &Measurement Techniques by Albert D. Helfrick & William D. Cooper (PHI) Edition. **(H & C)**<br>3. Electronic Instrumentation by H. S. Kalsi, 2nd Edition, Tata McGraw Hill.**(K)**<br>4. Digital electronics by G. L. Tokheim (6th Editon) (Tata Mc Graw Hill)**(T)**<br>5. "OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll (6th Edition), Eastern Economy Education, PHI**(C & D)**<br>6. OPAMPs & linear integrated circuits by R. A. Gayakwad,(4th Edition, PHI)**(G)**<br>7. "Electronic Principles" by A. P. Malvino (6th edition, PHI).**(M)**<br>8. Digital Principle & Applications" by Malvino& Leach (6th edition, TMH) **(M & L)**<br>**Additional References:**<br>The Art of Electronics, by Paul Horowitz & Winfield Hill (2nd Edition) **(H & H)** | |
| **Unit III** | **Analysis Techniques-I**<br>1. Optical spectroscopy: Optical absorption spectroscopy, photoluminescence ,FTIR, Raman spectroscopy<br>2. Electron spectroscopy: XPS, Ultraviolet photo spectroscopy<br>3. Rutherford back scattering spectroscopy(RBS)<br>4. Secondary ion mass spectroscopy(SIMS) | **15 lectures** |
| **Unit IV** | **i) Properties of Nanomaterial**<br>Introduction, Mechanical properties, Structural properties, Melting of nanoparticles, Electric conductivity, Optical Properties, Magnetic Properties.<br>Ref. SK: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6 & 7.7<br>**ii) Nanolithography**<br>Introduction, Lithography using photon, Lithography using particle beams, Scanning probe lithography, Soft lithography.<br>Ref. SK: 8.1, 8.2, 8.3, 8.4 & 8.5.<br>**References:**<br>1. Nanotechnology, Principles & Practices by Sulabha Kulkarni<br>2. Introduction to Nanotechnology by C.P.Poole,Jr. and F.J.Owens<br>3. Instrumental Methods of Analysis by H.H.Willard,I.I. Merit & J.A.Dean<br>4. X-ray structure Determination by G.H.Stout and I.H.Jensen<br>5. Fundamentals Of Molecular Spectroscopy by C .Banwell and McCash<br>6. Nanomaterial by A.K. Bandyopadhyay | **15 lectures** |

## Semester VI

| Course Code | Title | Credits |
|---|---|---|
| **RUSACEI 601** | **C++ PROGRAMING AND NANOMATERIAL-II** | |

| | | |
|---|---|---|
| **Unit I** | **Basic Concepts of Object Oriented Programming and C++**<br>**(1) Basics of Object-Oriented Programming & Beginning with C++:**<br>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.<br>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.<br>**Ref EB: 1.3, 1.4, 1.5, 1.6, 1.7 & 1.8**<br>**EB: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7 & 2.8** | **15 Lecture** |
| **Unit II** | **(2) Tokens and Expressions in C++:**<br>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.<br>**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**<br>**(3) Control Structures and Functions:**<br>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.<br>**Ref EB: 3.24,4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 & 4.11**<br>**References:**<br>1. EB: Object Oriented Programming with C++ by E Balagurusamy, Third /Fourth Edition, Tata McGraw-Hill Publishing Company Limited.<br>**Additional references:**<br>1)Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publ. Company Ltd.<br>2) Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company. | **15 Lecture** |

| | | |
|---|---|---|
| **Unit III** | **Analysis techniques – II**<br>i) XRD, Small angle X – ray scattering (SAXS), Low energy electron diffraction (LEED)<br>ii) Electron Microscopy : SEM, EDAX, TEM, Environmental TEM<br>iii) SPM, AFM, STM<br>iv) Nano magnetic techniques : Super conducting quantum interface device measurement (SQUID), Magneto resistance measurement technique<br>**References :**<br>1. Nanotechnology, Principles & Practices by Sulabha Kulkarni<br>2. Introduction to Nanotechnology by C.P. Poole, Jr. and F.J.Owens<br>3. Instrumental Methods of Analysis by H.H. Willard, I.I. Merit & J.A. Dean<br>4. X – ray Structure Determination by G.H. Stout and I.H. Jensen<br>5. Fundamentals of Molecular Spectroscopy by C. Banwell and E. McCash<br>6. Nanomaterial by A.K. Bandyopadhyay | **15 Lecture** |
| **Unit IV** | **i) Some Special Nanomaterial**<br>Introduction, Carbon nanotubes (CNTs), Porous Silicon, Aerogels, Zeolites, Ordered Porous Materials Using Micelles as Templates.<br>**Ref. SK: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6.**<br>**ii) Applications of nanomaterial**<br>Introduction, Electronics, Energy, Automobiles, Sports and Toys, Textiles, Cosmetics, Domestics Appliances, Biotechnology and Medical Field, Space and Defense, Nanotechnology and Environment.<br>**Ref. SK: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9, 10.10, 10.11.** | **15 Lecture** |
| | **PRACTICAL SEM V** | |
| | **RUSACEI5P1 –Analog Circuit & Instruments & Analysis techniques – I**<br>**Group A**<br>1. Basic Instrumentation Amplifier using 3 Op-Amps couple to Resistance Bridge **(C&D Ch. 8)**<br>2. Second Order active Low Pass/High Pass filter (frequency response & phase relation) **(K.Ch15)**<br>3. Active Notch Filter (frequency response & phase relation) **(K.Ch.15)**<br>4. Diode ROM array<br>5. Adjustable constant Current Source using LM 317 **(C&D Ch. 14)**<br>6. Constant Current source using OPAMP and PNP transistor (o/p current less than 50 mA) **(C&D Ch. 5)**<br>**GROUP B**<br>**B1:** **1.** Synthesis of Graphene & Graphene oxide<br>2. Synthesis of porous silicon<br>3. Synthesis of nanomaterial using electrochemical techniques | |

| | | |
|---|---|---|
| | **B2:** **1.** Characterization study of nanomaterial & study of sensors of semiconductor materials(powder)<br>2. Characterization study of nanomaterial (powder) using XRD techniques.<br>3. Characterization study of nanomaterial (powder) using UV techniques.<br>4. Characterization study of nanomaterial (powder) using FTIR techniques.<br>5. Characterization study of nanomaterial (powder) using RAMAN techniques.<br><br>**References: Group A & B**<br>1. H&C: Modern Electronic Instrumentation & Measurement Techniques by Albert D. Helfrick & William D. Cooper PHI) Edition<br>2. C&D: "OPAMPs and linear integrated circuits" by Coughlin & F. F. Driscoll(6th ed.PHI)<br>3. G: OPAMPs and linear integrated circuits by R.A. Gayakwad (4th edition, PHI)<br>4. M: "Electronic Principles" by A. P. Malvino (6th edition, PHI)<br>5. K: Electronic Instrumentation by H. S. Kalsi (TMH) 2nd Edition<br>6. M&L: Digital Principle and Applications" by Malvino and Leach (5th edition, TMH)<br>7. RPJ: Modern Digital Electronics 3rd edition (TMH) – R .P. Jain<br>8. Nanotechnology, Principles & Practices by Sulabha Kulkarni | |
| | **PRACTICALS SEM VI** | |
| | **RUSACEI 6P1 –Programming in C++ and Analysis techniques – II**<br><br>**Group A**<br>**C++ Programming**<br>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)<br>2) Program based on Control Statements<br>a. Program based on if-else statement<br>b. Program based on nested if statement<br>3) Program based on for loop.<br>4) Program based on while loop and do-while loop.<br>5) Program using switch statements and if-else ladder.<br>6) Program to study function declaration, function calling and function prototype. | |

**GROUP B**

**B1**

1. Synthesis of Graphene & Graphene oxide
2. Synthesis of porous silicon
3. Synthesis of nonmaterial using electrochemical techniques

**B2**

1. Characterization study of nanomaterial & study of sensors of semiconductor materials(powder)
2. Characterization study of nanomaterial ( Thin film ) using XRD techniques.
3. Characterization study of nanomaterial ( Thin film ) using UV techniques.
4. Characterization study of nanomaterial ( Thin film ) using FTIR techniques.
5. Characterization study of nanomaterial ( Thin film ) using RAMAN techniques.

**References: Group A & B**

1. EB: Object Oriented Programming with C++ by E Balagurusamy, Third /Fourth Edition, Tata McGraw-Hill Publishing Company Limited.
2. Starting out with C++ by Tony Gaddis, Third Edition, Addison Wesley Publishing Company.
3.Nanotechnology, Principles & Practices by Sulabha Kulkarni

**Additional references:**

1) Programming with C++ by D. Ravichandran, Tata McGraw-Hill Publishing Company Limited.
2) http://www.cplusplus.com/doc/tutorial

# MODALITY OF ASSESSMENT

**Overall Examination and Marks Distribution Pattern**

**Semester---- V and VI**

| Theory Course | RUSACEI501// RUSACEI 601 | | |
|---|---|---|---|
| | Internal | External | Total |
| | 40 | 60 | 100 |

| Practical Course | RUSACEI5P1 //RUSACEI 6P1 | | |
|---|---|---|---|
| | Internal | External | Total |
| | 40 | 60 | 100 |

**Theory Examination Pattern (Sem V and Sem-VI )**

**A) Internal Assessment (40%) = 40 marks.**

| Theory Paper-Paper code | Test Marks | Assignment | Marks distribution | Total Marks per paper |
|---|---|---|---|---|
| Applied Component Electronics - Instrumentation RUSACEI501 | 20 | 15 Questions on units 1, 2, 3 ,4. | Assessment- 15 mark<br>Viva on it --05 mark<br>---<br>Total= 20 mark | 40 |

**B) Internal test pattern (half an hour test )= 20 marks**

| Questions | options | Marks |
|---|---|---|
| Q.1 | 20 objective questions , all compulsory, each question with 4 options; (half mark each ) | 10 |
| Q.2 | Attempt any two numerical out of four.(3 marks each) | 06 |
| Q.3 | Attempt any one numerical out of two.(4 marks each) | 04 |
| | **Total marks** | **20** |

**C) External examination = ( 60 % ) = 60 marks**

**Semester End Theory Assessment - 60 marks**

i. Duration - These examinations shall be of **2 hours** duration.

ii. Paper Pattern- All questions shall be compulsory with internal choice within the questions.

| Questions | Options | Marks | Questions on |
|---|---|---|---|
| *Q.1)A)* | *Any 1 out of 2* | *6* | *Unit I* |
| *Q.1)B)* | *Any 1 out of 2* | *6* | |
| *Q.2)A)* | *Any 1 out of 2* | *6* | *Unit II* |
| *Q.2)B)* | *Any 1 out of 2* | *6* | |
| *Q.3)A)* | *Any 1 out of 2* | *6* | *Unit III* |
| *Q.3)B)* | *Any 1 out of 2* | *6* | |
| *Q.4)A)* | *Any 1 out of 2* | *6* | *Unit IV* |
| *Q.4)B)* | *Any 1 out of 2* | *6* | |
| *Q.5)A)* | *Any 1 out of 2* | *3* | *Unit I* |
| *Q.5)B)* | *Any 1 out of 2* | *3* | *Unit II* |
| *Q.5C)* | *Any 1 out of 2* | *3* | *Unit III* |
| *Q.5)D)* | *Any 1 out of 2* | *3* | *Unit IV* |

**Practical Examination Pattern (Sem V and Sem-VI)**

**(A) Internal Examination:**

| Sr. No. | Activity | Practical-Group-III (AC – EI) |
|---|---|---|
| **1.** | **Seminar on experiment :**<br>Content- 2 mark<br>Presentation-2 mark<br>Q(Teacher) --2 mark<br>Q(Student) -2 mark | **8 mark** |
| **2.** | **Continuous Assessment** (3 mark per experiment/ **8 regular experiment)** ) | **24 mark** |
| **3.** | **Main Journal** (1 mark per experiment) | **8 mark** |
| | **Total (=1 +2+ 3)** | **40 mark** |
| | **8 experiments as follows:-**<br>**Group A- 6 experiments**<br>**Group B- 1 experiment each from sub-group B1 and B2** | |

**(B) External (Semester-end practical examination):**

| Particulars | Practical 1 |
|---|---|
| ***Laboratory work*** | *50* |
| ***Viva*** | *10* |
| Total | **60** |

**PRACTICAL BOOK/JOURNAL**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination. **In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ coordinator / In-charge of the department; failing which the student will not be allowed to appear for the practical examination.**

**----------X----------X----------**