DEPARTMENT OF PHYSICS

DIBRUGARH UNIVERSITY

Syllabus for

B.Sc. with Electronic Science

Approved by the Board of Studies in Electronics held on April 11, 2018

Course Structure (Electronics-Without Major)

Details of courses under B.Sc. (Without Major)

Course	***Credits**	
	Theory+ Practical	Theory+Tutorials
I. Core Course **(12 Papers)** 04 Courses from each of the 03 disciplines of choice	12X4= 48	12X5=60
Core Course Practical / Tutorial* **(12 Practical/ Tutorials*)** 04 Courses from each of the 03 Disciplines of choice	12X2=24	12X1=12
II. Elective Course **(6 Papers)** Two papers from each discipline of choice Including paper of interdisciplinary nature.	6x4=24	6X5=30
Elective Course Practical / Tutorials* **(6 Practical / Tutorials*)** Two Papers from each discipline of choice including paper of interdisciplinary nature	6 X 2=12	6X1=6
Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester		
III. Ability Enhancement Courses		
1**. Ability Enhancement Compulsory** **(2 Papers of 2 credits each)** **Environmental Science** **English/MIL Communication**	3 X 2=6	3X2=6
2**. Skill Enhancement Course** **(Skill Based)** **(4 Papers of 2 credits each)**	4 X 2=8	4 X 2=8
	Total credit= 122	**Total credit= 122**

Marks Distribution: End Semester: 80%; In Semester: 20%**

*** wherever there is a practical there will be no tutorial and vice-versa**
**** As per Dibrugarh University regulation**
At least 75% of the experiments listed in the syllabi are required to be performed by each student

Scheme for choice based credit system in B. Sc. with Electronics

Semester	**Core Course (12)**	**Ability Enhancement Compulsory Course (AECC) (3)**	**Skill Enhancement Course (SEC) (2)**	**Elective: Discipline Specific (DSE) (4)**
I	Network Analysis and Analog Electronics	AECC-1 Communicative English		
	DSC-2A	AECC-2 MIL/Communicative Hindi/Alternative English		
	DSC-3A			
II	Linear and Digital Integrated Circuits	AECC-3 Environmental Science		
	DSC-2B			
	DSC-3B			
III	Communication Electronics		SEC-1	
	DSC-2C			
	DSC-3C			
IV	Microprocessors and Microcontrollers		SEC-2	
	DSC-2D			
	DSC-3D			
V			SEC-3	DSE-1A
				DSE-2A
				DSE-3A
VI			SEC-4	DSE-1B
				DSE-2B
				DSE-3B

SEMESTER	COURSE OPTED	COURSE NAME	CREDIT
I	Ability Enhancement compulsory course- I	Communicative English	2
	Ability Enhancement compulsory course- II	MIL/ Communicative Hindi/Alternative English	2
	Core Course - I	Network Analysis and Analog Electronics	4
	Core Course - I Practical/ Tutorial	Network Analysis and Analog Electronics Lab	2
	Core Course- II	DSC-2A	6
	Core Course- III	DSC-3A	6
II	Ability Enhancement compulsory course- III	Environmental Science	2
	Core Course - IV	Linear and Digital Integrated Circuits	4
	Core Course - IV Practical/ Tutorial	Linear and Digital Integrated Circuits Lab	2
	Core Course- V	DSC- 2B	6
	Core Course- VI	DSC- 3B	6
III	Core Course - VII	Communication Electronics	4
	Core Course - VII Practical/ Tutorial	Communication Electronics Lab	2
	Core Course- VIII	DSC- 2C	6
	Core Course- IX	DSC- 3C	6
	Skill Enhancement Course-1	SEC-1	2
IV	Core Course - X	Microprocessors and Microcontrollers	4
	Core Course - X Practical/ Tutorial	Microprocessors and Microcontrollers Lab	2
	Core Course- XI	DSC-2D	6
	Core Course- XII	DSC-3D	6

	Skill Enhancement Course-2	SEC-2	2
V	Skill Enhancement Course-3	SEC-3	2
	Discipline Specific Elective- 1	DSE-1A	6
	Discipline Specific Elective- 2	DSE-2A	6
	Discipline Specific Elective- 3	DSE-3A	6
VI	Skill Enhancement Course-4	SEC-4	2
	Discipline Specific Elective- 4	DSE-1B	6
	Discipline Specific Elective- 5	DSE-2B	6
	Discipline Specific Elective- 6	DSE-3B	6
TOTAL CREDIT			**122**

B.Sc. with Electronics

Core Course Electronics (Credit: 06 each) (Core Course/DSC 1-4):

1. Network Analysis and Analog Electronics (4) + Lab (4)
2. Linear and Digital Integrated Circuits (4) + Lab (4)
3. Communication Electronics (4) + Lab (4)
4. Microprocessor and microcontrollers (4) + Lab (4)

Discipline Specific Elective Course (Credit: 06 each) (DSE 1, DSE 2): Choose 2

1. Semiconductor Devices Fabrication (4) + Lab (4) DSE-1
2. Electronic Instrumentation (4) + Lab (4) DSE-1
3. Antenna Theory and wireless Network (5) + Tutorial (1) DSE-2
4. Dissertation DSE-2

Skill Enhancement Course (Credit: 02 each) - SEC 1 to SEC 4

1. Computational Physics Skills SEC-1
2. Electrical circuits and network Skills SEC-2
3. Renewable Energy and Energy harvesting SEC-3
4. Applied Optics SEC-4

SEMESTER I

Course Code: ELECTRONICS-DSC-1A
Course Title: NETWORK ANALYSIS AND ANALOG ELECTRONICS
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory – 04, Practicals-02

Course objective: At the end of this course, a student will be able to

1. Learn about semiconductor device like diode, transistor etc.
2. Analyze electronic circuits employing active devices
3. Design simple circuits for applications

ELECTRONICS-DSC 1A: NETWORK ANALYSIS AND ANALOG ELECTRONICS (THEORY)
(60 Lectures, 60 Marks)

Unit-I **(14 Lectures, 14 Marks)**

Circuit Analysis:
Concept of Voltage and Current Sources. Kirchhoff's Current Law, Kirchhoff's Voltage Law. Mesh Analysis. Node Analysis. Star and Delta networks, Star-Delta Conversion. Principal of Duality. Superposition Theorem. Thevenin's Theorem. Norton's Theorem. Reciprocity Theorem. Maximum Power Transfer Theorem. Two Port Networks: h, y and z parameters and their conversion.

Unit-II **(18 Lectures, 18 Marks)**

Junction Diode and its applications:
PN junction diode (Ideal and practical)-constructions, Formation of Depletion Layer, Diode Equation and I-V characteristics.Idea of static and dynamic resistance, dc load line analysis, Quiescent (Q) point. Zener diode, Reverse saturation current, Zener and avalanche breakdown. Qualitative idea of Schottky diode. Rectifiers- Half wave rectifier, Full wave rectifiers (centre tapped and bridge), circuit diagrams, working and waveforms, ripple factor and efficiency. Filter-Shunt capacitor filter, its role in power supply, output waveform, and working. Regulation- Line and load regulation, Zener diode as voltage regulator, and explanation for load and line regulation.

Unit-III **(20 Lectures, 20 Marks)**

Bipolar Junction Transistor and Amplifiers:
Review of the characteristics of transistor in CE and CBconfigurations, Regions of operation (active, cut off and saturation), Current gains α and β. Relations between α and β. dc load line and Q point.

Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor S. Transistor as a two port network, h-parameter equivalent circuit. Small signal analysis of single stage CE amplifier. Input and Output impedance, Current and Voltage gains. Class A, B and C Amplifiers.
Two stage RC Coupled Amplifier and its Frequency Response.
Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative only).

Unit-IV **(4 Lectures, 4 Marks)**

Sinusoidal Oscillators: Barkhausen criterion for sustained oscillations. Phase shift and Colpitt's oscillator. Determination of Frequency and Condition of oscillation.

Unit-V **(4 Lectures, 4 Marks)**

Unipolar Devices: JFET. Construction, working and I-V characteristics (output andtransfer), Pinchoff voltage. UJT, basic construction, working, equivalent circuit and I-V characteristics.

Recommended readings:

- Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004)
- Electrical Circuits, M. Nahvi& J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)
- Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
- Network, Lines and Fields, J.D. Ryder, Prentice Hall of India.
- Electronic Devices and Circuits, David A. Bell, 5th Edition 2015, Oxford University Press.
- Electronic Circuits: Discrete and Integrated, D.L. Schilling and C. Belove, Tata McGraw Hill
- Electrical Circuit Analysis, Mahadevan and Chitra, PHI Learning
- Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6thEdn., Oxford University Press.
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)

ELECTRONICS-DSC-1A: NETWORK ANALYSIS AND ANALOG ELECTRONICS (LAB)
60 Lectures, 20 Marks

AT LEAST 06 EXPERIMENTS FROM THE FOLLOWING BESIDES #1

1. To familiarize with basic electronic components (R, C, L, diodes, transistors), digital Multimeter, Function Generator and Oscilloscope.
2. Measurement of Amplitude, Frequency & Phase difference using Oscilloscope.
3. Verification of (a) Thevenin's theorem and (b) Norton's theorem.
4. Verification of (a) Superposition Theorem and (b) Reciprocity Theorem.
5. Verification of the Maximum Power Transfer Theorem.
6. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.
7. Study of (a) Half wave rectifier and (b) Full wave rectifier (FWR).
8. Study the effect of (a) C- filter and (b) Zener regulator on the output of FWR.

9. Study of the I-V Characteristics of UJT and design relaxation oscillator.
10. Study of the output and transfer I-V characteristics of common source JFET.
11. Study of Fixed Bias and Voltage divider bias configuration for CE transistor.
12. Design of a Single Stage CE amplifier of given gain.
13. Study of the RC Phase Shift Oscillator.
14. Study the Colpitt's oscillator.

Recommended readings:

- Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill (2005)
- Networks, Lines and Fields, J.D.Ryder, Prentice Hall of India.
- J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
- Allen Mottershead, Electronic Devices and Circuits, Goodyear Publishing Corporation.

Mode of Assessment/ Assessment Tools (%)

Internal: 20

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 10

Written Test for theory and/or Viva Voce for Laboratory: 10

Final (End Semester): 80

Written Test for theory and/or Laboratory experiments: 80

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Understand the fundamental principles of the semiconductor device
2. Design small electronics circuit/systems for solving/applying in real life situations.

SEMESTER II

Course Code: ELECTRONICS-DSC-1B
Course Title: LINEAR AND DIGITAL INTEGRATED CIRCUITS
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory – 04, Practicals-02

Course Objectives: At the end of this course, a student will be able to

1. Learn about LSI/MSI analog and digital integrated circuits (IC).
2. Analyze circuits using OP-AMP and Boolean algebra.

ELECTRONICS-DSC-1B: LINEAR AND DIGITAL INTEGRATED CIRCUITS (THEORY)
60 Lectures, 60 Marks

Unit-I **(18 Lectures, 18 Marks)**

Operational Amplifiers (Black box approach):
Characteristics of an Ideal andPractical Operational Amplifier (IC 741), Open and closed loop configuration, Frequency Response. CMRR. Slew Rate and concept of Virtual Ground.

Applications of Op-Amps:
(1) Inverting and non-inverting amplifiers, (2) Summingand Difference Amplifier, (3) Differentiator, (4) Integrator, (5) Wein bridge oscillator, (6) Comparator and Zero-crossing detector, and (7) Active low pass and high pass Butterworth filter (1^{st} order only).

Unit-II **(24 Lectures, 24 Marks)**

Number System and Codes:
Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, BCD code. Binary, octal and hexadecimal arithmetic; addition, subtraction by 2's complement method, multiplication.

Logic Gates and Boolean algebra:
Truth Tables of OR, AND, NOT, NOR, NAND, XOR, XNOR, Universal Gates, Basic postulates and fundamental theorems of Boolean algebra.

Combinational Logic Analysis and Design:
Standard representation of logic functions (SOP and POS), Minimization Techniques (Karnaugh map minimization up to 4 variables for SOP).

Arithmetic Circuits:
Binary Addition. Half and Full Adder. Half and Full Subtractor, 4-bit binary Adder/Subtractor.

Data processing circuits:
Multiplexers, De-multiplexers, Decoders, Encoders.

Unit-III **(18 Lectures, 18 Marks)**

Clock and Timer (IC 555):
Introduction, Block diagram of IC 555, Astable and Monostable multivibrator circuit

Sequential Circuits:
SR, D and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-slave JK Flip-Flop.

Shift registers:
Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits).

Counters (4 bits):
Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.

D-A and A-D Conversion:
4 bit binary weighted and R-2R D-A converters, circuit and working. Accuracy and Resolution. A-D conversion characteristics, successive approximation ADC. (Mention of relevant ICs for all).

Recommended readings:

- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
- Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
- Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

ELECTRONICS LAB- DSC- 1B LAB: LINEAR AND DIGITAL INTEGRATED CIRCUITS (LAB)

60 Lectures, 20 Marks

At least 04 experiments each from section A, B and C Section-A: Op-Amp. Circuits (Hardware)

1. To design an inverting amplifier using Op-amp (741,351)for dc voltage of given gain
2. (a) To design inverting amplifier using Op-amp (741,351) & study its frequency response
   (b) To design non-inverting amplifier using Op-amp (741,351) & study frequency response
3. (a) To add two dc voltages using Op-amp in inverting and non-inverting mode
   (b) To study the zero-crossing detector and comparator.
4. To design a precision Differential amplifier of given I/O specification using Op-amp.
5. To investigate the use of an op-amp as an Integrator.
6. To investigate the use of an op-amp as a Differentiator.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8. To design a circuit to simulate the solution of simultaneous equation and $1^{st}/2^{nd}$order differential equation.
9. Design a Butterworth Low Pass active Filter (1^{st} order) & study Frequency Response
10. Design a Butterworth High Pass active Filter (1^{st} order) & study Frequency Response
11. Design a digital to analog converter (DAC) of given specifications.

Section-B: Digital circuits (Hardware)

1. (a) To design a combinational logic system for a specified Truth Table.
   (b) To convert Boolean expression into logic circuit & design it using logic gate ICs.
   (c) To minimize a given logic circuit.
2. Half Adder and Full Adder.
3. Half Subtractor and Full Subtractor.

4. 4 bit binary adder and adder-subtractor using Full adder IC.
5. To design a seven segment decoder.
6. To design an Astable Multivibrator of given specification using IC 555 Timer.
7. To design a Monostable Multivibrator of given specification using IC 555 Timer.
8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
9. To build JK Master-slave flip-flop using Flip-Flop ICs
10. To build a Counter using D-type/JK Flip-Flop ICs and study timing diagram.
11. To make a Shift Register (serial-in and serial-out) using D-type/JK Flip-Flop ICs.

Section-C: ***SPICE/MULTISIM simulations for electronic circuits and devices***

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
4. Design and Verification of op-amp as integrator and differentiator
5. Design the 1^{st}order active low pass and high pass filters of given cutoff frequency
6. Design a Wein`s Bridge oscillator of given frequency.
7. Design clocked SR and JK Flip-Flop`s using NAND Gates
8. Design 4-bit asynchronous counter using Flip-Flop ICs
9. Design the CE amplifier of a given gain and its frequency response.

Recommended readings:

- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4^{th}edn., 2000, Prentice Hall
- R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
- Digital Electronics, S.K. Mandal, 2010, 1^{st} edition, McGraw Hill

Mode of Assessment/ Assessment Tools (%)

Internal: 20

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 10

Written Test for theory and/or Viva Voce for Laboratory: 10

Final (End Semester): 80

Written Test for theory and/or Laboratory experiments: 80

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Understand the basics of various integrated circuit components and their working.
2. Analyze and design moderately advanced electronics circuits using ICs.
3. Build real life applications using ICs.

SEMESTER III

Course Code: ELECTRONICS- DSC-1C
Course Title: COMMUNICATION ELECTRONICS
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory – 04, Practicals-02

Course Objectives: At the end of this course, a student will be able to

1. Learn the basic techniques of electronic communication like modulation
2. Apply the knowledge to understand the current generation communication technologies.

ELECTRONICS- DSC-1C: COMMUNICATION ELECTRONICS (THEORY)
(60 Lectures, 60 Marks)

Unit-I **(20 Lectures, 20 Marks)**

Electronic communication:

Introduction to communication–means and modes. Needfor modulation. Block diagram of an electronic communication system. Brief idea of frequency allocation for radio communication system in India (TRAI). Electromagnetic communication spectrum, band designations and usage. Channels and base-band signals. Concept of Noise, signal-to-noise (S/N) ratio.

Analog Modulation:

Amplitude Modulation, modulation index and frequency spectrum. Generation of AM Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector),Qualitative idea of Super heterodyne receiver

Unit-II **(18 Lectures, 18 Marks)**

Analog Pulse Modulation:

Channel capacity, Sampling theorem, Basic Principles-PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.

Digital Pulse Modulation:

Need for digital transmission, Pulse Code Modulation,Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).

Unit-III **(22 Lectures, 22 Marks)**

Introduction to Communication and Navigation systems:

Satellite Communication:

Introduction, need, Geosynchronous satellite orbits, geostationary satellite advantages of geostationary satellites. Satellite visibility, transponders (C - Band), path loss, ground station, simplified block diagram of earth station. Uplink and downlink.

Mobile Telephony System:

Basic concept of mobile communication, frequency bandsused in mobile communication, concept of cell sectoring and cell splitting, SIM number, IMEI number, need for data encryption, architecture (block diagram) of mobile communication network, idea of GSM, CDMA, TDMA and FDMA technologies, simplified block diagram of mobile phone handset, 2G, 3G and 4G concepts (qualitative only). GPS navigation system (qualitative idea only).

Recommended readings:

- Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
- Advanced Electronics Communication Systems- Tomasi, 6th edition, Prentice Hall.
- Modern Digital and Analog Communication Systems, B.P. Lathi, 4th Edition, 2011, Oxford University Press.
- Electronic Communication systems, G. Kennedy, 3rdEdn., 1999, Tata McGraw Hill.
- Principles of Electronic communication systems – Frenzel, 3rd edition, McGraw Hill
- Communication Systems, S. Haykin, 2006, Wiley India
- Electronic Communication system, Blake, Cengage, 5th edition.
- Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press

ELECTRONICS-DSC-1C: COMMUNICATIONELECTRONICS (LAB)
60 Lectures, 20 Marks

AT LEAST 03 AND 05 EXPERIMENTS RESPECTIVELY FROM FOLLOWING USING HARDWARE AND SIMULATIONS.

1. To design an Amplitude Modulator using Transistor
2. To study envelope detector for demodulation of AM signal
3. To study FM - Generator and Detector circuit
4. To study AM Transmitter and Receiver
5. To study FM Transmitter and Receiver
6. To study Time Division Multiplexing (TDM)
7. To study Pulse Amplitude Modulation (PAM)
8. To study Pulse Width Modulation (PWM)
9. To study Pulse Position Modulation (PPM)
10. To study ASK, PSK and FSK modulators

Reference Books:

- Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
- Electronic Communication system, Blake, Cengage, 5th edition.

Mode of Assessment/ Assessment Tools (%)

Internal: 20

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 10

Written Test for theory and/or Viva Voce for Laboratory: 10

Final (End Semester): 80

Written Test for theory and/or Laboratory experiments: 80

(Equal weightage to be assigned to each credit)

Expected Learning outcomes: This course will enable the students to

1. Identify the basic techniques of communication like carrier modulation/demodulation.
2. Analyse the modulations schemes and their applicability.
3. Analyse present generation systems.

SEMESTER IV

Course Code: ELECTRONICS-DSC-1D

Course Title: MICROPROCESSOR AND MICROCONTROLLER

Nature of the Course: CORE

Total Credits assigned: 06

Distribution of credit: Theory – 04, Practicals-02

Course Objectives: At the end of the course, a student will be able to

1. Learn about microprocessors and microcontroller.
2. Learn assembly language programming of microprocessors and microcontroller.

ELECTRONICS-DSC-1D: MICROPROCESSOR AND MICROCONTROLLER (THEORY)

(60 Lectures, 60 Marks)

Unit-I (25 Lectures, 25 Marks)

Microcomputer Organization:

Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

8085 Microprocessor Architecture:

Main features of 8085. Block diagram. Pin-outdiagram of 8085. Data and address buses.Registers.ALU. Stack memory. Program counter.

8085 Programming:

Instruction classification, Instructions set (Data transfer includingstacks. Arithmetic, logical, branch, and control instructions). Subroutines, delay loops. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI. Hardware and software interrupts.

Unit-II **(35 Lectures, 35 Marks)**

Introduction to embedded system:

Embedded systems and general purpose computer systems. Architecture of embedded system. Classifications, applications and purpose of embedded systems.

8051 microcontroller:

Introduction and block diagram of 8051 microcontroller,architecture of 8051, overview of 8051 family, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

8051 I/O port programming:

Introduction of I/O port programming, pin out diagram of8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 (using assembly language), I/O programming: Bit manipulation.

8051 Programming:

8051 addressing modes and accessing memory locations usingvarious addressing modes, assembly language instructions using each addressing mode, arithmetic and logic instructions, 8051 programming in C: for time delay & I/O operations and manipulation, for arithmetic and logic operations, for ASCII and BCD conversions.

Reference Books:

- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- Microprocessor and Microcontrollers, N. Senthil Kumar, 2010, Oxford University Press
- 8051 microcontrollers, Satish Shah, 2010, Oxford University Press.
- Embedded Systems: Design & applications, S.F. Barrett, 2008, Pearson Education India
- Introduction to embedded system, K.V. Shibu, 1st edition, 2009, McGraw Hill
- Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, Cengage Learning

ELECRONICS-DSC-1D: MICROPROCESSOR AND MICROCONTROLLER (LAB)
60 Lectures, 20 Marks

At least 06 experiments each from Section-A and Section-B

Section-A: Programs using 8085 Microprocessor

1. Addition and subtraction of numbers using direct addressing mode
2. Addition and subtraction of numbers using indirect addressing mode
3. Multiplication by repeated addition.
4. Division by repeated subtraction.
5. Handling of 16-bit Numbers.
6. Use of CALL and RETURN Instruction.
7. Block data handling.
8. Other programs (e.g. Parity Check, using interrupts, etc.).

Section-B: Experiments using 8051 microcontroller:

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's.
5. Program to glow the first four LEDs then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle '1234' as '1324' in the seven segment LED display.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement & display on LCD.

Reference Books:

- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.
- Embedded Systems: Architecture, Programming & Design, Raj Kamal, 2008, Tata McGraw Hill
- The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
- 8051 microcontrollers, Satish Shah, 2010, Oxford University Press.
- Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, Cengage Learning.

Mode of Assessment/ Assessment Tools (%)

Internal: **20**

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 10

Written Test for theory and/or Viva Voce for Laboratory: 10

Final (End Semester): **80**

Written Test for theory and/or Laboratory experiments: 80

(Equal weightage to be assigned to each credit)

Expected Learning outcomes: This course will enable the students to

1. Understand architecture and programming model of microprocessors 8085 and microcontroller 8051
2. Apply the assembly language programming knowledge to build various small systems based on microprocessors 8085 and microcontroller 8051.

DISCIPLINE SPECIFIC ELECTIVE (DSE)

Course Code: ELECTRONICS-DSE-1
Course Title: SEMICONDUCTOR DEVICES FABRICATION
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory – 04, Practicals-02

Course Objectives: At the end of this course, a student will be able to

1. Learn the fundamental physics of the semiconductor materials and devices.
2. Learn about the semiconductor materials fabrication techniques.
3. Identify and asses various fabrication techniques of semiconductor devices.

ELECTRONICS-DSE-1: SEMICONDUCTOR DEVICES FABRICATION (THEORY) (60 Lectures, 60 Marks)

Unit-I **(25 Lectures, 25 Marks)**

Introduction:

Review of energy bands in materials. Metal, Semiconductor and Insulator. Doping in Semiconductors, Defects: Point, Line, Schottky and Frenkel. Single Crystal, Polycrystalline and Amorphous Materials. Czochralski technique for Silicon Single Crystal Growth.

Thin Film Growth Techniques and Processes:

Vacuum Pumps: Primary Pump (Mechanical) and Secondary Pumps (Diffusion, Turbo-molecular, Cryopump, Sputter - Ion) basic working principle, Throughput and Characteristics in reference to Pump Selection. Vacuum Gauges (Pirani and Penning). Sputtering, Evaporation (Thermal, electron-Beam, Pulse Laser Deposition (PLD), Chemical Vapor

Deposition (CVD). Epitaxial Growth, Deposition by Molecular Beam Epitaxy (MBE). Thermal Oxidation Process (Dry and Wet) Passivation. Metallization. Diffusion of Dopants. Diffusion Profiles. Ion implantation.

Unit-II **(15 Lectures, 15 Marks)**

Semiconductor Devices:

Review of p-n Junction diode, Metal-Semiconductor junction,Metal-Oxide-Semiconductor (MOS) capacitor and its C-V characteristics, MOSFET (enhancement and depletion mode) and its high Frequency limit.Microwave Devices:Tunnel diode.

Memory Devices:

Volatile Memory: Static and Dynamic Random Access Memory(RAM), Complementary Metal Oxide Semiconductor (CMOS) and NMOS, Non-Volatile - NMOS (MOST, FAMOS), Ferroelectric Memories, Optical Memories,Magnetic Memories, Charge Coupled Devices (CCD).

Unit-III **(12 Lectures, 12 Marks)**

VLSI Processing:

Introduction of Semiconductor Process Technology, Clean RoomClassification, Line width, Photolithography: Resolution and Process, Positive and Negative Shadow Masks, Photoresist, Step Coverage, Developer. Electron Beam Lithography. Idea of Nano-Imprint Lithography. Etching: Wet Etching. Dry etching (RIE and DRIE). Basic Fabrication Process of R, C, P-N Junction diode, BJT, JFET, MESFET, MOS, NMOS, PMOS and CMOS technology. Wafer Bonding, WaferCutting, Wire bonding and Packaging issues (Qualitative idea).

Unit-IV **(8 Lectures, 8 Marks)**

Micro Electro-Mechanical System (MEMS):

Introduction to MEMS, Materialsselection for MEMS Devices, Selection of Etchants, Surface and Bulk Micromachining, Sacrificial Subtractive Processes, Additive Processes, Cantilever, Membranes. GeneralIdea MEMS based Pressure, Force, and Capacitance Transducers.

Recommended readings:

- Physics of Semiconductor Devices, S. M. Sze. Wiley-Interscience.
- Handbook of Thin Film Technology, Leon I. Maissel and ReinhardGlang.
- Fundamentals of Semiconductor Fabrication, S.M. Device and G. S. May, John-Wiley and Sons, Inc.
- The science and Engineering of Microelectronics Fabrication, Stephen A. Champbell, 2010, Oxford University Press.
- Introduction to Semiconductor materials and Devices, M. S. Tyagi, John Wiley & Sons
- VLSI Fabrication Principles (Si and GaAs), S.K. Gandhi, John Wiley & Sons, Inc.

ELECTRONICS- DSE-1: SEMICONDUCTOR DEVICES FABRICATION (LAB)

60 Lectures, 20 Marks

AT LEAST 05 EXPERIMENTS FROM THE FOLLOWING

1. Fabrication of alloy p-n Junction diode and study its I-V Characteristics.
2. Study the output and transfer characteristics of MOSFET.
3. To design and plot the static & dynamic characteristics of digital CMOS inverter.
4. Create vacuum in a small tube (preferably of different volumes) using a Mechanical rotary pump and measure pressure using vacuum gauges.
5. Deposition of Metal thin films/contacts on ceramic/thin using Thermal Evaporation and study IV characteristics.
6. Selective etching of Different Metallic thin films using suitable etchants of different concentrations.
7. Wet chemical etching of Si for MEMS applications using different concentration of etchant.
8. Calibrate semiconductor type temperature sensor (AD590, LM 35, LM 75).
9. Quantum efficiency of CCDs.
10. To measure the resistivity of a semiconductor (Ge) crystal with temperature (up to 150^{o}C) by four-probe method.
11. To fabricate a ceramic and study its capacitance using LCR meter.
12. To fabricate a thin film capacitor using dielectric thin films and metal contacts and study its capacitance using LCR meter.
13. Study the linearity characteristics of
    (a) Pressure using capacitive transducer
    (b) Distance using ultrasonic transducer

Recommended readings:

- Physics of Semiconductor Devices, S. M. Sze. Wiley-Interscience.
- Handbook of Thin Film Technology, Leon I. Maissel and ReinhardGlang.
- The science and Engineering of Microelectronics Fabrication, Stephen A. Champbell, 2010, Oxford University Press.
- VLSI Fabrication Principles (Si and GaAs), S.K. Gandhi, John Wiley & Sons, Inc.

Mode of Assessment/ Assessment Tools (%)

Internal:	**20**
Assignment /Presentation/ attendance/ Class room interaction/quiz etc:	10
Written Test for theory and/or Viva Voce for Laboratory:	10
Final (End Semester):	**80**
Written Test for theory and/or Laboratory experiments:	80

(Equal weightage to be assigned to each credit)

Expected Learning outcomes: This course will enable the students to

1. Understand semiconductor material properties and fabrication techniques
2. Apply the knowledge for fabrication of semiconductor materials for research purpose

---

Course Code: ELECTRONICS-DSE-1
Course Title: ELECTRONIC INSTRUMENTATION
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory-04, Practicals-02

Course Objectives: At the completion of this course, a student will be able to

1. Learn about the various measurement instruments and the measurement techniques involved.
2. Handle different instruments like power supply, Oscilloscope etc.
3. Develop the knowledge of the students about transducers and sensors.

ELECTRONICS-DSE-1: ELECTRONIC INSTRUMENTATION (THEORY)
(60 Lectures, 60 Marks)

Unit-I **(20 Lectures, 20 Marks)**

Measurements:

Accuracy and precision. Significant figures. Error and uncertainty analysis. Shielding and grounding. Electromagnetic Interference.

Basic Measurement Instruments:

DC measurement-ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating). Digital Multimeter; Block diagram principle of measurement of I, V, C. Accuracy and resolution of measurement.

Measurement of Impedance:

A.C. bridges, Measurement of Self Inductance (Anderson's bridge), Measurement of Capacitance (De Sauty's bridge), Measurement of frequency (Wien's bridge).

Unit-II **(25 Lectures, 25 Marks)**

Power supply:

Block Diagram of a Power Supply, Qualitative idea of C and L Filters.IC Regulators (78XX and 79XX), Line and load regulation, Short circuit protection. Idea of switched mode power supply (SMPS) and uninterrupted power supply (UPS).

Oscilloscope:

Block Diagram, CRT, Vertical Deflection, Horizontal Deflection. Screensfor CRT, Oscilloscope probes, measurement of voltage, frequency and phase by Oscilloscope.Digital Storage Oscilloscopes. LCD display for instruments.

Lock-in-amplifier:

Basic Principles of phase locked loop (PLL), Phase detector (XOR edge triggered), Voltage Controlled Oscillator (Basics, varactor), lock and capture. Basic idea of PLL IC (565 or 4046). Lock-in-amplifier, Idea of techniques for sum and averaging of signals.

Signal Generators:

Function generator, Pulse Generator, (Qualitative only).

Unit-III **(5 Lectures, 5 Marks)**

Virtual Instrumentation:

Introduction, Interfacing techniques (RS 232, GPIB, USB), Idea about Audrino microcontroller and interfacing software (like lab View).

Unit-IV **(10 Lectures, 10 Marks)**

Transducers:

Classification of transducers, Basic requirement/characteristics oftransducers, Active and Passive transducers, Resistive (Potentiometer- Theory, temperature compensation & applications), Capacitive (variable air gap type), Inductive (LVDT) & piezoelectric transducers.Measurement of temperature (RTD, semiconductor IC sensors), Light transducers (photo resistors & photovoltaic cells).

Reference Books:

- W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
- E.O. Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition (2003).
- David A. Bell, Electronic Devices and Circuits, Oxford University Press (2015).
- Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Butterworth Heinmann-2008).
- S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
- Introduction to measurements and instrumentation, 4thEdn., Ghosh, PHI Learning

ELECTRONICS-DSE-1: ELECTRONIC INSTRUMENTATION (LAB)
60 Lectures, 20 Marks

AT LEAST 05 EXPERIMENTS FROM THE FOLLOWING

1. Measurement of resistance by Wheatstone bridge and measurement of bridge sensitivity.
2. Measurement of Capacitance by De Sauty's bridge
3. To determine the Characteristics of resistance transducer - Strain Gauge (Measurement of Strain using half and full bridge.)
4. To determine the Characteristics of LVDT.
5. To determine the Characteristics of Thermistors and RTD.
6. Measurement of temperature by Thermocouples.
7. Design a regulated power supply of given rating (5 V or 9V).

8. To design and study the Sample and Hold Circuit.
9. To plot the frequency response of a microphone.

Recommended readings:

- W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
- David A. Bell, Electronic Instrumentation & Measurements, Prentice Hall (2013)
- S. Rangan, G. R. Sarma and V. S. Mani, Instrumentation Devices and Systems, Tata Mcgraw Hill (1998).
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1990, Mc-Graw Hill

Mode of Assessment/ Assessment Tools (%)

Internal:	**20**
Assignment /Presentation/ attendance/ Class room interaction/quiz etc:	10
Written Test for theory and/or Viva Voce for Laboratory:	10
Final (End Semester):	**80**
Written Test for theory and/or Laboratory experiments:	80

(Equal weightage to be assigned to each credit)

Expected Learning outcomes: This course will enable the students to

1. Have the necessary knowledge to use and apply various measurement instruments.
2. Be able to measure resistance, capacitance, temperature using available bridge methods.
3. Learn to design circuits for systems like power supply and sample and hold circuits etc.
4. Learn the theory and practical knowledge about various sensors.

Course Code: ELECTRONICS-DSE-2
Course Title: ANTENNA THEORY AND WIRELESS NETWORK
Nature of the Course: ELECTRONICS
Total Credits assigned: 06
Distribution of credit: Theory – 05, Tutorial-01

Course Objectives: At the end of this course, a student will be able to

1. Learn the basics of antenna and its various parameters.
2. Learn about modes of propagation of radio waves.
3. Learn the basics of wireless communication systems and modern communication

systems like cellular technology.

ELECTRONICS-DSE-2: ANTENNA THEORY AND WIRELESS NETWORK (THEORY)
(75 Lectures, 80 Marks)

Unit-I: (35 Lectures, 35Marks)

Introduction:
Antenna as an element of wireless communication system, Antenna radiation mechanism, Types of Antennas, Fundamentals of EMFT: Maxwell's equations and their applications to antennas.

Antenna Parameters:
Antenna parameters: Radiation pattern (polarization patterns,Field and Phase patterns), Field regions around antenna, Radiation intensity, Beam width, Gain, Directivity, Polarization, Bandwidth, Efficiency and Antenna temperature.

Antenna as a Transmitter/Receiver:
Effective Height and Aperture, Power deliveredto antenna, Input impedance. Radiation from an infinitesimal small current element, Radiation from an elementary dipole (Hertzian dipole), Reactive, Induction and Radiation fields, Power density and radiation resistance for small current element and half wave dipole antenna.

Radiating Wire Structures (Qualitative idea only):
Monopole, Dipole, Folded dipole, Loop antenna and Biconical broadband Antenna. Basics of Patch Antenna and its design. Examples of Patch antenna like bowtie, sectoral, fractal, etc.

Unit-II: (10 Lectures, 10Marks)

Propagation of Radio Waves:
Different modes of propagation: Ground waves, Spacewaves, Space Wave propagation over flat and curved earth, Optical and Radio Horizons, Surface Waves and Troposphere waves, Ionosphere, Wave propagation in the Ionosphere. Critical Frequency, Maximum usable frequency (MUF), Skips distance. Virtual height. Radio noise of terrestrial and extraterrestrial origin. Elementary idea of propagation of waves used in Terrestrial mobile communications.

Unit-III: (30 Lectures, 35Marks)

Introduction: History of wireless communication, Wireless Generation and Standards, Cellular and Wireless Systems, Current Wireless Systems, Cellular Telephone Systems, Wide Area Wireless Data Services, Broadband Wireless Access, Satellite Networks, Examples of Wireless Communication Systems. Idea about Global Mobile communication system.

Modern Wireless Communication Systems:
Second Generation (2G) CellularNetworks, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL), Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks(PANs). Idea about Wi-Fi, 4G and LTE, and 5G.

Cellular Concept and System Design Fundamentals:
Cellular Concept and CellularSystem Fundamentals, Frequency Reuse, Channel Assignment Strategies, Handoff strategies, Interference and System Capacity, Trunking and Grade of

Service. Improving Coverage & Capacity in Cellular Systems. Cell Splitting and Sectoring. CellularSystems design Considerations (Qualitative idea only).

Recommended readings:

- Ballanis, Antenna Theory, John Wiley & Sons, (2003) 2nd Ed.
- Jordan and Balmain, E. C., Electro Magnetic Waves and Radiating Systems, PHI, 1968 Reprint (2003) 3rd Ed.
- Andrea Goldsmith, Wirelerss communications, (2015) Cambridge University Press
- D. Tse and P. Viswanathan, Fundamentals of Wireless Communication, (2014) Cambridge University Press.
- Wireless communication and Networks, UpenaDala, 2015, Oxford University Press.
- Antenna and Wave Propagation, Yadava, PHI Learning.
- Haykin S. &Moher M., Modern Wireless Communication, Pearson, (2005) 3rd Ed.
- Lee, William C.Y., Mobile Communciation Design and Fundamentals, (1999) 4th Ed

Mode of Assessment/ Assessment Tools (%)

Internal:	**20**
Assignment /Presentation/ attendance/ Class room interaction/quiz etc:	10
Written Test for theory and/or Viva Voce for Laboratory:	10
Final (End Semester):	**80**
Written Test for theory and/or Laboratory experiments:	80

(Equal weightage to be assigned to each credit)

Expected Learning outcomes: This course will enable the students to

1. Acquire the basic knowledge of antenna as a transmitter and receiver.
2. Understand about propagation of radio waves and the various wireless communication systems.
3. Recognise various techniques involved in cellular communication systems.

SKILL ENHANCEMENT COURSE - SEC1 TO SEC4

Course Code: ELECTRONICS-SEC-1
Course Title: COMPUTATIONAL PHYSICS SKILL
Nature of the Course: ELECTRONICS
Total Credits assigned: 02
Distribution of credit: Theory 02

Course objective: At the end of this course, a student will be able to

1. Learn computer programming and numerical analysis and understand its role in solving problems in Physics and Science.
2. Solve problems on computers applying FORTRAN language and computational methods to solve physical problems in LINUX operating system.
3. Acquire practical experience on scientific word processing with LaTeX, graphical analysis and visualization of computational data with Gnuplot.

ELECTRONICS-SEC-1: COMPUTATIONAL PHYSICS SKILL (THEORY)
(30 Lectures, 40 Marks)

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics and Science.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics/science problems
- Course will consist of hands on training on the Problem solving on Computers.

Unit-I: (4 Lectures, 5Marks)

Introduction:

Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor.

Algorithms and Flowcharts:

Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) Lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

Unit-II: (6 Lectures, 8Marks)

Scientific Programming:

Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

Control Statements:

Types of Logic(Sequential, Selection, Repetition), BranchingStatements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function

Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

Unit-III: (6 Lectures, 8 Marks)

Programming:

1. Exercises on syntax on usage of FORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commands and working in an editor to write sources codes in FORTRAN.
3. To print out all natural even/ odd numbers between given limits.
4. To find maximum, minimum and range of a given set of numbers.
5. Calculating Euler number using exp(x) series evaluated at x=1

Unit-IV: (8 Lectures, 9 Marks)

Scientific word processing: Introduction to LaTeX:

TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages.

Equation representation:

Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colours, errors.

Visualization:

Introduction to graphical analysis and its limitations. Introduction to Gnuplot. Importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

Unit-V: (6 Lectures, 10 Marks)

Hands on exercises:

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.

10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

Recommended readings:

- Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt. Ltd.
- Computer Programming in Fortran 77". V. Rajaraman (Publisher:PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
- Computational Physics: An Introduction, R. C. Verma, etal. New Age International Publishers, New Delhi(1999)
- Elementary Numerical Analysis, K.E.Atkinson,3rd Edn., 2007, Wiley India Edition.

Mode of Assessment/ Assessment Tools (%)

Internal:	**20**
Assignment /Presentation/ attendance/ Class room interaction/quiz etc:	10
Written Test for theory and/or Viva Voce for Laboratory:	10
Final (End Semester):	**80**
Written Test for theory and/or Laboratory experiments:	80

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Apply their knowledge on computer programming and numerical analysis in solving real physical problems.
2. Acquire Knowledge of FORTRAN programming language and LINUX operating system will make them enabled dealing scientific computing in different areas of Physics.

Course Code: ELECTRONICS- SEC-2
Course Title: ELECTRICAL CIRCUITS AND NETWORK SKILLS
Nature of the Course: ELECTRONICS
Total Credits assigned: 02
Distribution of credit: Theory 02

Course objective: At the end of this course, a student will be able to

1. Learn the basic circuit concepts and devices like resistors, capacitors and inductors.
2. Learn about AC and DC circuit analysis.
3. Understand different theorems of network analysis.

ELECTRONICS- SEC-2: ELECTRICAL CIRCUITS AND NETWORK SKILLS (Theory)
(30 Lectures, 40 Marks)

Unit-I: (10 Lectures, 14 Marks)

Basic Electricity Principles:

Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

Electrical Circuits:

Basic electric circuit elements and their combination. Rules toanalyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.

Electrical Drawing and Symbols:

Drawing symbols. Blueprints.Reading Schematics.Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

Unit-II: (10 Lectures, 12 Marks)

Generators and Transformers:

DC Power sources. AC/DC generators. Inductance, capacitance and impedance. Operation of transformers.

Electric Motors:

Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.

Solid-State Devices:

Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Unit-III: (10 Lectures, 14 Marks)

Electrical Protection:

Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device.

Electrical Wiring:

Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power

in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wire nuts, crimps, terminal blocks, and solder. Preparation of extension board.

Recommended readings:

- Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
- A text book in Electrical Technology - B L Theraja - S Chand & Co.
- A text book of Electrical Technology - A K Theraja
- Performance and design of AC machines - M G Say ELBS Edn.

Mode of Assessment/ Assessment Tools

Internal: 10

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 5

Written Test for theory and/or Viva Voce for Laboratory: 5

Final (End Semester): 40

Written Test for theory and/or Laboratory experiments: 40

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Acquire foundation knowledge about voltage, current and passive devices.
2. Analyse Ac and DC circuits using available techniques.
3. Attain the necessary skill to analyse different types of networks using the standard network theorem.

Course Code: ELECTRONICS-SEC-3
Course Title: RENEWABLE ENERGY AND ENERGY HARVESTING
Nature of the Course: ELECTRONICS
Credits: 02

Course objective: At the end of this course, a student will be able to

1. Learn about the viable, sustainable and renewable sources of energy.
2. Understand renewable energy, its importance, utility and conversion into various forms.
3. Learn about the various technologies involved in the energy harvesting processes, their applications, limitations and importance in the everyday world.

ELECTRONICS-SEC-3: RENEWABLE ENERGY AND ENERGY HARVESTING (THEORY)
(30 Lectures, 40 Marks)

Unit-I: (4 Lectures, 6 Marks)

Fossil fuels and Alternate Sources of energy:

Fossil fuels and nuclear energy, theirlimitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Unit-II: (18 Lectures, 22 Marks)

Solar energy:

Solar energy, its importance, storage of solar energy, solar pond, nonconvective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

Wind Energy harvesting:

Fundamentals of Wind energy, Wind Turbines and differentelectrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Ocean Energy:

Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

Geothermal Energy:

Geothermal Resources, Geothermal Technologies.

Hydro Energy:

Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Unit-III: (8 Lectures, 12 Marks)

Piezoelectric Energy harvesting:

Introduction, Physics and characteristics ofpiezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

Electromagnetic Energy Harvesting:

Linear generators, physics mathematical models, recent applications. Carbon captured technologies, cell, batteries, power consumption. Environmental issues and Renewable sources of energy, sustainability.

Demonstrations and Experiments:

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials
3. Conversion of thermal energy into voltage using thermoelectric modules.

Recommended readings:

- Non-conventional energy sources, B.H. Khan, McGraw Hill
- Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.

- Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rdEdn., 2012, Oxford University Press.
- Renewable Energy Sources and Emerging Technologies, Kothari et.al., 2nd Edition, PHI Learning.
- Solar Energy: Resource Assesment Handbook, P Jayakumar, 2009
- J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
- http://en.wikipedia.org/wiki/Renewable_energy

Mode of Assessment/ Assessment Tools

Internal: 10

Assignment /Presentation/ attendance/ Class room interaction/quiz etc: 5

Written Test for theory and/or Viva Voce for Laboratory: 5

Final (End Semester): 40

Written Test for theory and/or Laboratory experiments: 40

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Understand in depth the application of heat transfer processes and thermodynamic cycles to various energy harvesting systems
2. Pull together the background knowledge in real life examples and equip them to design and evaluate various energy based models with efficient applications.
3. Pursue a career in energy technology

Course Code: ELECTRONICS-SEC-4
Course Title: APPLIED OPTICS
Nature of the Course: ELECTRONICS
Credits: 02

Course objective: At the end of this course, a student will be able to

1. Learn about various optical devices, components and systems.
2. Learn various experiments related to optoelectronic devices.
3. Learn about Fourier transform spectroscopy, holography and various aspects of fibre optics.

ELECTRONICS-SEC-4: APPLIED OPTICS (THEORY)
(30 Lectures, 40 Marks)

Unit-I: (9 Lectures, 12 Marks)

Sources and Detectors:
Lasers, Spontaneous and stimulated emissions, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.

Experiments on Lasers:

a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser.
b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser.
c. To find the polarization angle of laser light using polarizer and analyzer
d. Thermal expansion of quartz using laser

Experiments on Semiconductor Sources and Detectors:

a. V-I characteristics of LED
b. Study the characteristics of solid state laser
c. Study the characteristics of LDR
d. Photovoltaic Cell
e. Characteristics of IR sensor

Unit-II: (6 Lectures, 8 Marks)

Fourier Optics

Concept of Spatial frequency filtering, Fourier transforming property of a thin lens.

Experiments on Fourier Optics:

a. Fourier optic and image processing

1. Optical image addition/subtraction
2. Optical image differentiation
3. Fourier optical filtering
4. Construction of an optical 4f system

b. Fourier Transform Spectroscopy

Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science.

Experiment:

To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.

Unit-III: (6 Lectures, 8 Marks)

Holography

Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition

Experiments on Holography and interferometry:

1. Recording and reconstructing holograms
2. Constructing a Michelson interferometer or a Fabry Perot interferometer
3. Measuring the refractive index of air

4. Constructing a Sagnac interferometer
5. Constructing a Mach-Zehnder interferometer
6. White light Hologram

Unit-IV: (9 Lectures, 12 Marks)

Photonics: Fibre Optics

Optical fibres and their properties, Principal of light propagation through a fibre, Thenumerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating

Experiments on Photonics: Fibre Optics

a. To measure the numerical aperture of an optical fibre
b. To study the variation of the bending loss in a multimode fibre
c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern
d. To measure the near field intensity profile of a fibre and study its refractive index profile
e. To determine the power loss at a splice between two multimode fibre

Recommended readings:

- LASERS: Fundamentals & applications, K.Thyagrajan & A.K. Ghatak, 2010, Tata McGraw Hill
- Fibre optics through experiments, M.R. Shenoy, S.K. Khijwania, et.al. 2009, Viva Books
- Optical Electronics, Ajoy Ghatak and K. Thyagarajan, 2011, Cambridge University Press
- Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
- Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.

Mode of Assessment/ Assessment Tools (%)

Internal:	**10**
Assignment /Presentation/ attendance/ Class room interaction/quiz etc:	5
Written Test for theory and/or Viva Voce for Laboratory:	5
Final (End Semester):	**40**
Written Test for theory and/or Laboratory experiments:	40

(Equal weightage to be assigned to each credit)

Expected learner outcomes: This course will enable the students to

1. Acquire knowledge about various optoelectronic devices and their applications.
2. Understand the basics of Laser and their uses.
3. Understand about Fourier transform spectroscopy and will learn to use this technique for various purposes.
4. Understand the use of optical fibres and related information.