

Rayat Shikshan Sanstha's  
Yashavantrao Chavan Institute of Science, Satara (Autonomous)  
**Department of Electronics**  
Syllabus for Bachelor of Science (Electronics)  
W.E.F. (2018-2019)

**1. SUBJECT: Electronics**

**2. YEAR OF IMPLEMENTATION:** New Syllabi for the B.Sc. Electronics will be implemented from June 2018 onwards.

**3. PREAMBLE:**

Bachelor of Science is an integrated academic degree in faculty of Science. The faculty is not ignoring the developments in the field of Electronics. The revision of existing syllabus of Electronics subject in science faculty is essential. This is a humble endeavor to initiate the process towards an era of knowledge. The students from science faculty should also be competent for this change in the technology.

In this year, a student will be able to understand handling of laboratory equipment's, build Electronics circuits with confidence. In the subject, the student will also get a basic and proper knowledge in the field of Embedded System design

**4. GENERAL OBJECTIVES OF THE COURSE:**

1. To create graduates with sound knowledge of fundamentals of Electronics, who can contribute towards advancing science and technology.
2. To create graduates with sufficient capabilities in Electronics who can become researchers and developers to satisfy the needs of the core Electronics industry.
3. To develop ability among students to formulate, analyze and solve real life problems faced in Electronics industry.
4. To provide opportunity to students to learn the latest trends in Electronics and make them ready for life-long learning process.
5. To make the students aware of professional ethics of the Industry, and prepare them with basic soft skills essential for working in community and professional teams.
6. To prepare the students for graduate studies through competitive examinations, enabling them to reach higher echelons of excellence
7. To produce electronic professionals who can be directly employed or start his/her own work as Electronic circuit Designer, Electronics consultant, testing professional, Service engineer and even an entrepreneur in electronic industry.

**5. DURATION:**

**03 Years (Full Time)**

**6. PATTERN:**

**SEMESTER EXAM (CBCS)**

**7. MEDIUM OF INSTRUCTIONS: ENGLISH**

## 8. STRUCTURE OF COURSE:

### B.Sc.I(Electronics)

#### 1. FIRST SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-I: BET101	5	4	Practical Paper – I : BEP103	4	2
		Paper-II: BET102					

#### 2. SECOND SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO&Paper Code	No. of lectures Per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-III: BET201	5	4	Practical Paper – II : BEP203	4	2
		Paper-IV: BET202					

#### 3. Structure and Title of Papers of B. Sc. Course:

- **B. Sc. I Semester I**

**Paper I: BET101:** Basic Circuit Theory and Network Analysis

**Paper II: BET102:** Semiconductor Devices

- **B. Sc. I Semester II**

**Paper III: BET201:** Digital Electronics

**Paper IV: BET202:** Electronic Circuits

## B.Sc.II(Electronics)

### 1. THIRD SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-V: BET301	6	4	Practical Paper – III: BEP303	8	4
		Paper-VI: BET302					

### 2. FOURTH SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO& Paper Code	No. of lectures Per week	Credits		No. of lectures Perweek	Credits
1	Electronics	Paper-VII: BET401	6	4	Practical Paper – IV: BEP403	8	4
		Paper-VIII: BET402					

### 3. Structure and Title of Papers of B. Sc.Course:

#### 1. B. Sc. II Semester III

**Paper V: BET301:** Analog Communication

**Paper VI: BET302:** Wave Shaping and Operational Amplifier

#### 2. B. Sc. II Semester IV

**Paper VII: BET401:** Digital Communication

**Paper VIII: BET402:** 8085 microprocessor and 8051microcontroller

## B.Sc.III(Electronics)

### 1. STRUCTURE OF COURSE:

#### 1. FIFTH SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-IX: BET501	12	8	Practical Paper – V & VI (BEP508& BEP509)	20	8
		Paper-X: BET502					
		Paper-XI: BET503					
		Paper-XII: BET50X (Elective: BET504/505/506)					
		SECCEP510	01	01	SECCEP510	02	01

#### 2. Structure and Title of Papers of B.Sc.Course:

- **B. Sc. III Semester V**

**Paper IX: BET501:** Power Electronics Devices and Applications

**Paper X: BET502:** Linear Integrated Circuit

**Paper XI: BET503:** 8051 microcontroller Interfacing and Application

**Paper XII: BET50X:** Elective

Elective: BET50X

1. **BET504:** Optoelectronics and IoT
2. **BET505:** Mechatronics
3. **BET506:** Nanoelectronics

**SECCEP507: Numerical Skill: MATLAB Programming**

**SECCEP510: MATLAB Programming LAB**

### 3. SIXTH SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-XIII: BET601	12	8	Practical Paper – VII & VIII (BEP 608& BEP 609)	20	8
		Paper-XIV: BET602					
		Paper-XV: BET603					
		Paper-XVI: BET60X (Elective: BET604/605/606)					
		SECCET607	01	01	SECCEP610	02	01

#### 4. Structure and Title of Papers of B. Sc.Course:

**Paper XIII: BET601:** Electronic Instrumentation

**Paper XIV: BET602:** Antennas and Wave Propagation

**Paper XV: BET603:** Advanced Microcontroller: PIC

**Paper XVI: BET60X:** Elective

Elective: BET60X

1. **BET604:** Digital Signal Processing and Artificial Intelligence
2. **BET605:** Industrial Process control and PLC Programming
3. **BET606:** Robotics

**SECCET607: Entrepreneurship Development Program**

SECCEP610: Industrial Project

**BET/Pxyz:**

B: B.Sc.

E: Electronics

T: Theory

P: Practical

x: Semester I to VI

yz: 01 to 10

**SECC:** Skill Enhancement Compulsory Course

## 9. OTHER FEATURES:

### a. LIBRARY:

#### • REFERENCE BOOKS

1. R. S. Sedha, Textbook of Applied Electronics, S. Chand Publication
2. Soni and Gupta, Network Analysis,
3. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004)
4. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw-Hill.(2005)
5. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004)
6. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill(2005)
7. Alexander and M. Sadiku, Fundamentals of Electric Circuits , McGraw Hill (2008)
8. S. M. Sze, Semiconductor Devices: Physics and Technology, 2<sup>nd</sup> Edn, Wiley India edition (2002).
9. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
10. Dennis Le Croisette, Transistors, Pearson Education (1989)
11. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
12. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
13. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson Education (2006)
14. M. Morris Mano Digital System Design, Pearson Education Asia, (Fourth Edition)
15. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)
16. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2000)
17. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)
18. Electronic Devices and circuit theory, Robert Boylestad and Louis Nashelsky, 9th Edition, 2013, PHI
19. Electronic devices, David A Bell, Reston Publishing Company
20. D. L. Schilling and C. Belove, Electronic Circuits: Discrete and Integrated, Tata McGraw Hill (2002)
21. Donald A. Neamen, Electronic Circuit Analysis and Design, Tata McGraw Hill (2002)
22. J. Millman and C. C. Halkias, Integrated Electronics, Tata McGraw Hill (2001)
23. J. R. C. Jaegar and T. N. Blalock, Microelectronic Circuit Design, Tata McGraw Hill (2010)
24. J. J. Cathey, 2000 Solved Problems in Electronics, Schaum's outline Series, Tata McGraw Hill (1991)
25. Allen Mottershed, Electronic Devices and Circuits, Goodyear Publishing Corporation
26. R. S. Sedha, Textbook of Applied Electronics, S. ChandPublication
27. Electronic Communication Systems: Fundamentals through Advanced, W. Tomasi, Pearson Education, 3rd Edition
28. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
29. Modern digital and analog Communication systems- B. P. Lathi, 4rd Edition 2009 Oxford University press.
30. Principles of Electronic communication systems Frenzel, 3rdedition, McGraw Hill.
31. Communication Systems, S. Haykin, 2006, Wiley India
32. Electronic Communication systems, G. Kennedy, 3rd Edn, 1999, Tata McGraw Hill.
33. Electronic Communication system, Blake, Cengage, 5th edition.
34. Op-amp and Linear Integrated Circuits-Ramakant Gaikwad.
35. Op-Amp with Linear integrated circuits-William D Stanley(Pearson)
36. Electronics Devices and Circuits:An Introduction- Allen mottershed.Electronic
37. Communication Systems: Fundamentals through Advanced, W.Tomasi, Pearson Education, 3<sup>rd</sup> Edition.
38. Principles of Electronic communication systems – Frenzel, 3<sup>rd</sup> edn, McGraw Hill
39. Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3<sup>rd</sup> Edn.
40. Martin S. Roden, Analog & Digital Communication Systems, Prentice Hall, Englewood Cliffs, 3<sup>rd</sup> Edn.
41. Modern digital and analog Communication systems- B. P. Lathi, 4<sup>th</sup> Edition 2009 Oxford University press.

42. Telecommunication Switching Systems and Networks, Thiagarajan Vishwanathan, Prentice Hall of India.
43. Communication Systems, S. Haykin, 2006, Wiley India
44. Wireless Communications Principles and Practice, Theodore S. Rappaport, 2<sup>nd</sup> Edition, Pearson Education Asia.
45. Electronic Communications, D. Roddy and J. Coolen, Pearson Education India.
46. Mobile Communication Design and Fundamentals, Lee, William C.Y., (1999) 4<sup>th</sup> Ed
47. Electronic Communication systems, G. Kennedy, 3<sup>rd</sup> Edn., 1999, Tata McGraw Hill.
48. Electronic Communication system, Blake, Cengage, 5<sup>th</sup> edition.
49. Wireless communications, Andrea Goldsmith, 2015, Cambridge University Press
50. 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.
51. The 8051 Microcontroller, Kenneth Ayala, 3<sup>rd</sup> edition, CENGAGE Learning.
52. Microprocessor Architecture, Programming and Applications with the 8085, Ramesh S. Gaonkar, 3<sup>rd</sup> edition.
53. Microcontrollers ( Theory and Applications ), Ajay V. Deshmukh, Tata McGraw Hill.
54. An Embedded Software Primer by David E Simon, Addison Wesley
55. Embedded Systems: Design & applications, S.F. Barrett, 2008, Pearson Education India
56. Introduction to embedded system, K.V. Shibu, 1st edition, 2009, McGraw Hill
57. Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, Cengage Learning
58. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002

•        **JOURNALS AND PERIODICALS**

1. Journal of Instrument Society of India
2. Express Computer
3. Embedded For You
4. Electronics Maker
5. Electronics For You
6. PCQUEST
7. Digit

**b. SPECIFIC EQUIPMENTS:**

Computers, Laptops, Printers, Scanners, LCD Projectors, E- Podium, Smart Board, Document Camera, Visualizer, 3D printer

**c. LABORATORY EQUIPMENTS:**

- i. Digital storage Oscilloscope: 60 MHz
- ii. Signal generator
- iii. Microwave Test bench (Gunn Source)
- iv. Antenna Trainer
- v. Arduino Development Board
- vi. CPLD development boards
- vii. Microcontroller Boards – 8051, MSP430, PIC18F, AVR MEGA32, ARDUINO NANO, UNO, MEGA
- viii. KEIL - IDE
- ix. Mikro C Compilers for 8051, PIC and ARM
- x. Soft Computing Tools – SCILAB, MATLAB
- xi. PCB Designing Tool: DipTrace

**Semester V**

**Paper IX: BET501: Power Electronics Devices and Applications**

• **Learning Objectives:**

1. To learn about Power Electronic Devices and their characteristics
2. To study simple Power circuits and their performance parameters
3. To learn different control techniques and applications of Power Circuits as case studies
4. To understand Safety Measures, Protections and Measurements

**Unit I: Power Devices**

**15**

**Introduction:** Need for semiconductor power devices, Power diode, Enhancement of reverse blocking capacity, Introduction to family of thyristors.

**Silicon Controlled Rectifier (SCR):** structure, I-V characteristics, Turn-On and Turn-Off characteristics, ratings, Factors affecting the characteristics/ratings of SCR,

**Diac and Triac:** Basic structure, working and V-I characteristics, application of a Diac as a triggering device for a Triac, Triac as a switch.

**Insulated Gate Bipolar Transistors (IGBT):** Basic structure, I-V Characteristics, switching characteristics, device limitations and safe operating area (SOA) etc.

**Power MOSFETs:** operation modes, switching characteristics, power BJT, second breakdown, saturation and quasi-saturation state.

**Unit II: Controlled Rectifier**

**09**

Gate-triggering circuits, Control circuits design and Protection circuits (Snubber circuit).

**Application of SCR:** SCR as a static switch, phase controlled rectification, single phase half wave, full wave and bridge rectifiers with inductive & non-inductive loads; AC voltage control using SCR with inductive and non-inductive load.

**Unit III: Power Inverters and Choppers**

**11**

**Power Inverters:** Need for commutating circuits and their various types, Invertors: Parallel capacitor commutated invertors with and without reactive feedback and its analysis, Series Invertor, limitations and its improved versions, bridge invertors.

**Choppers:** Basic chopper circuit, types of choppers (Type A-D), step-down chopper, step-up chopper, operation of DC chopper circuits using self-commutation (A & B-type commutating circuit), cathode pulse turn-off chopper (using class D commutation), load sensitive cathode pulse turn-off chopper (Jones Chopper), Morgan's chopper, Smart Grid.

**Unit IV: Electromechanical Machines**

**10**

DC Motors, Basic understanding of field and armature, Principle of operation, EMF equation, Back EMF, Factors controlling motor speed, Thyristor based speed control of dc motors.

AC motor (Induction Motor only), Rotor and stator, torque & speed of induction motor, Thyristor control of ac motors (block diagrams only).

BLDC motor, Introduction to e-vehicle, renewable energy.



• **Learning Outcomes:**

1. Build and test circuits using power devices such as SCR, IGBT and MOSFET.
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters.
3. Able to design regulated power supplies.
4. Able to understand working Principle of DC and AC Motors.

• **Reference Books:**

1. Power Electronics, P.C. Sen, TMH
2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid.
5. Power Electronics, Applications and Design, Ned Mohan, Tore.
6. Power Electronics, K. HariBabu, Scitech Publication.
7. Power Electronics, M.S. JamilAsghar, PHI.

## Semester V

### Paper X: BET502: Linear Integrated Circuits

- **Learning Objectives:**

1. To learn operational amplifier and their parameters, applications.
2. To learn Signal conditioning circuits.
3. To study applications of Operational amplifier
4. To study operation of phase lock loop and their applications.

#### **Unit I: Op-Amp as Analog System Building Blocks**

**12**

Open and closed loop configuration, Frequency response of an op-amp in open loop and closed loop configurations, Concept of Virtual Ground. Inverting, Non-inverting, Summing and difference amplifier, Bridge amplifier, DC differential amplifier, Voltage to current converter, Current to voltage converter. Sample and hold Circuits, Integrator, Differentiator, Log and antilog amplifiers.

#### **Unit II: Non-Linear Analog Systems**

**12**

**Comparators:** Basic comparator, Level detector, Voltage limiters, Schmitt Trigger, Zero Crossing Detector.

**Signal generators:** Phase shift oscillator, Wein bridge oscillator, Square wave generator, triangle wave generator, saw tooth wave generator.

#### **Unit III: Filters**

**11**

**Active filters:** Advantages of active filters over passive filters, Study and design low pass, high pass, band pass and band stop and all pass filters. (up to second order), Butterworth filter, Chebyshev filters (low pass).

#### **Unit IV: Phase Locked Loop (PLL)**

**10**

Functional block diagram— Phase detector/Comparator, Voltage Controlled Oscillator, Low pass filter, Applications: Frequency multiplier/ Division, AM detection, IC565.

- **Learning Outcomes:**

1. Able to design and develop various analog Op-Amp circuits.
2. Able to design OP-Amp filters of various orders.
3. Avail the skill of design and development of PLL system
4. Able to design Operational amplifier Circuits.

- **Reference Books:**

1. Op-Amps and Linear IC's, R. A. Gaikwad, Pearson Education (2003)
2. Operational amplifiers and Linear Integrated circuits, R. F. Coughlin and F. F. Driscoll, Pearson Education (2001)
3. Integrated Electronics, J. Millman and C.C. Halkias, Tata McGraw-Hill, (2001)
4. Electronic Principals, A. P. Malvino, 6<sup>th</sup> Edition, Tata McGraw-Hill, (2003)
5. OP-AMP and Linear Integrated Circuits, K. L. Kishore, Pearson (2011)

## Semester V

### Paper XI: BET503: 8051 microcontroller Interfacing and Application

- **Learning Objectives:**

1. To study basics of C programming
2. To study 8051 C programming
3. To learn the advanced architectures for advanced Embedded systems
4. Student should perform I/O port, timer, counter and interrupt operations

#### **Unit I: Serial communication in 8051**

**12**

Serial Port : Serial port of 8051, RS-232 standard and IC MAX-232, Concept of Baudrate, Baud rate in 8051, Baud rate doubling using crystal frequency and PCON, SBUF, SCON registers, various modes of serial port, Importance of TI and RI flags, programming for data transmission and reception in mode-1 in ALP External Hardware Interrupts Programming and Setting Priority.

#### **Unit II: Programming of 8051 in C**

**12**

Advantages and disadvantages of Program in 8051-C & Assembly Language. Data types and time delay in 8051-C, I/O programming in 8051-C, Accessing SFR addresses in 8051-C, Logical operation in 8051 C. Data conversion programs in 8051 C. Accessing code ROM space in 8051 C, programming for Time delay generation (using timer), external interrupts (Level and edge triggering) and transmits, receive data serially

#### **Unit III : Real World Interfacing of 8051**

**10**

Interfacing LED, LCD, Switch, Relay, 4X4 matrix keyboard, opto-coupler, thumb wheel switch and seven segment display, seven segment (multiplexing mode), Stepper Motor, DAC0808 and ADC0804, RTC, Speed Control of DC motor by PWM technique.

#### **Unit IV: Applications of 8051**

**11**

Case study's: i) Temperature measurement using LM35, ADC0804, LCD. ii) Water level controller iii) Traffic Light controller iv) speed measurement of motor v) Gate Emulator (Logic Gate study using microcontroller) (Use ALP/C during programming)

- **Learning Outcome:**

1. Avail the skill of write code using embedded C
2. Able to write code for 8051 using C programming
3. Design and test advanced Embedded systems using 8051 microcontrollers
4. Able to perform interfacings of various real world devices

- **Reference Books:**

1. The 8051 Microcontroller -K. J. Ayala, (Penram International)
2. The 8051 Microcontroller and Embedded Systems, M. A. Mazadi, J. G. Mazadi, Pearson Education, Asia
3. Programming and customizing the 8051 Microcontroller - MYKE Predko (TMH, New Delhi)
4. C and the 8051: Programming and Multitasking, Schultz, P T R Prentice-Hall, Inc. Embedded C, Michael J. Pont

**Semester V**  
**Elective**  
**BET504: Optoelectronics and IoT**

• **Learning Objectives:**

1. To avail the knowledge of Light behavior in glass medium.
2. To study the basic principles of optical fiber communication
3. To study and Implementing IOT concepts with python
4. To Design and Development IOT system for various applications.

**Unit I: Optical Communication**

**12**

Principle of optical communication, total internal reflection, optical fiber modes and configuration, step index & graded index fiber, single mode fiber, fiber materials, fiber fabrication, basic structure of optical fiber. Overview of optical fiber communication system, transmission link, fiber optic transmitter and receiver, advantages and applications of optical fiber communication.

Signal degradation in optical fiber, attenuation, intrinsic & extrinsic absorption losses, scattering losses, bending losses and joint loss linear & nonlinear scattering losses, distortion in optical wave guide, fiber to fiber joints, fiber splicing technique, fiber connectors.

**Unit II: Photonic Devices**

**10**

Optical Sources: LASER, Basic concepts of laser, Optical emission from semiconductors, Semiconductor injection laser (ILD), Injection laser characteristics. LED: power and efficiency, LED structures, LED characteristics.

Optical detectors: p-n photodiodes, p-i-n photodiodes, Avalanche photodiodes, Phototransistor.

Optical receiver: Receiver operation, digital receiver performance and noise.

**Unit III: Introduction to IoT**

**12**

**Basics of internet of things (IoT):** Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Levels.

**IOT Enabling Technologies:** Wireless sensor networks, Cloud Computing, Big data Analytics, Communication Protocols.

**Domain Specific IOTs:** Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

**Unit IV: Developing IOTs**

**11**

**Developing Internet of Things & Logical Design using Python:** Introduction, IOT Design Methodology, Installing Python, Python Data Types & Data Structures, Control Flow, Functions, Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages.

**IOT Physical Devices:** What is an IOT Device, Exemplary Device, Board, Linux on Raspberry Pi, Arduino, Node MCU, Interfaces, and Programming & IOT Devices.

• **Learning Outcomes:**

1. Able to design, fabrication and characterization of photonic materials & evaluate their interaction with light.
2. Able to differential the behavior of light in different mediums
3. Design IOT applications in different domain and be able to analyze their performance
4. Implement basic IOT applications on embedded platform

• **Reference Books:**

1. Optics, Ajoy Ghatak, Tata McGraw Hill, New Delhi (2005)
2. Vijay Madiseti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
3. Optics, E. Hecht, Pearson Education Ltd. (2002)
4. Optoelectronics: An Introduction, J. Wilson and J. F. B. Hawkes, Prentice Hall India(1996)
5. Optoelectronics and Photonics: Principles and Practices, S. O. Kasap, Pearson Education (2009)

6. Introduction to fiber optics, Ghatak A. K. and Thyagarajan K., Cambridge Univ. Press. (1998)
7. Optical Fiber Communication – G. Keiser – MGH
8. Fundamentals of Optics – Jenkins & White - MGH
9. Optical Fiber Communication – J.M. Senior - PHI
10. Optical Communication – Gagliardi & Karp - Wiley
11. Semiconductor Optoelectronics Devices-Bhattacharya & Pallab - Pearson Education.
12. Optoelectronics an Introduction to Materials and Devices - Singh, & Jasprit - McGraw-Hill
13. Fiber Optics & Optoelectronics - Khare, R.P. - Oxford Univ. Press
14. Text Book of Optical Fiber Communication & Its Applications- Gupta & S.C. Pren
15. Walteneus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice

**Semester V**  
**Elective**  
**BET505: Mechatronics**

• **Learning Objectives:**

1. To avail the knowledge of Mechatronics
2. To study the basic principles of Mechatronics
3. To study and Implementing Signal Conditioning in System
4. To Design and Development Mechatronics system for various applications.

**Unit I : Introduction to Mechatronics**

**12**

Introducing Mechatronics, Sensors and Transducers, Signal Conditioning, Digital Signals, Digital Logic

**Unit II :Actuation Systems**

**11**

Pneumatic and Hydraulic Actuation Systems, Mechanical Actuation Systems, Electrical Actuation Systems

**Unit III :Properties of Models**

**12**

Basic System Model, System Models, Dynamic Responses of System, System Transfer Functions, Frequency Response

**Unit IV :Application of Mechatronics**

**10**

Closed-loop Controllers, Input/Output Systems, Communication Systems, Fault Finding, Mechatronic Systems

• **Learning Outcomes:**

1. Able to design, fabrication of Mechatronics based systems.
2. Able to design Hydraulic Actuation Systems
3. Design Fault Finding, Mechatronic Systems
4. Implement basic Mechatronics applications.

**Reference Books**

1. William. Bolton, Mechatronics, fourth Edition, New Delhi : Pearson Education in South Asia, 2011
2. Principles, Concepts and Applications – Mechatronics” by Nitaigour and Premchand Mahilik
3. Introduction to Mechatronics and Measurement Systems” by David G Alciatore and Michel BiHstand
4. Introduction to Mechatronics (Oxford Higher Education)” by Dr K K Appukuttan
5. Mechatronics : Principles, Concepts and Applications” by W Bolton

**Semester V**  
**Elective**  
**BET506: Nanoelectronics**

• **Learning Objectives:**

1. To present the state of the art in the areas of semiconductor device physics and materials technology to enable the Nanoelectronics.
2. To make aware various growth techniques of nanomaterial's
3. To study the measuring properties and characterization techniques for nanomaterial's
4. To study fabrication of nanomaterial with different structured nanomaterials

**Unit I: Introduction of Nanoelectronics** 12 Introduction: Definition of Nano-Science and Nano Technology, Applications of Nano-

Technology. Introduction to Physics of Solid State: Size dependence of properties, bonding in atoms and giant molecular solids, Electronic conduction, Systems confined to one, two or three dimension and their effect on property Quantum Theory for Nano Science: Time dependent and time independent Schrodinger wave equations. Particle in a box, Potential step: Reflection and tunneling (Quantum leak). Penetration of Barrier, Electron trapped in 2D plane (Nano sheet), Quantum confinement effect in nanomaterials. Quantum Wells, Wires and Dots: Preparation of Quantum Nanostructure; Size and Dimensionality effect, Fermi gas; Potential wells; Partial confinement; Excitons; Single electron Tunneling, Infrared detectors; Quantum dot laser Superconductivity

**Unit II: Growth Techniques of Nanomaterials**

**12**

Synthetic aspects: bottom up and top down approaches, Lithographic and Nonlithographic techniques, Sputtering and film deposition in glow discharge, DC sputtering technique (p-CuAlO<sub>2</sub> deposition). Thermal evaporation technique, E-beam evaporation, Chemical Vapour deposition (CVD), Synthesis of carbon nano-fibres and multi-walled carbon nanotubes, Pulsed Laser Deposition, Molecular beam Epitaxy, Sol-Gel Technique (No chemistry required), Synthesis of nanowires/rods, Electro deposition, Chemical bath deposition, Ion beam deposition system, Vapor-Liquid-Solid (VLS) method of nanowire

**Unit III :Methods of Measuring Properties and Characterization techniques 11** Microscopy:

Scanning Probe Microscopy (SPM), Atomic Force Microscopy (AFM), Field Ion Microscopy, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM)

including energy dispersive X-ray (EDX) analysis, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED)

Spectroscopy: Infra-red and Raman Spectroscopy, X-ray Spectroscopy, Magnetic resonance, Optical and Vibrational Spectroscopy Characterization and application like biopolymer tagging and light emitting semiconductor quantum dots

**Unit IV:Carbon nanotubes, nano cuboids, graphene, carbon quantum dots 10**

Fabrication, structure.electrical, mechanical, and vibrational properties and applications. Use of nano particles for biological application, drug delivery and bio-imaging, Impact of nanotechnology on the environment.

• **Learning Outcomes:**

1. Elaborate the fundamentals of classical CMOS technology and the issue in scaling MOSFET.
2. Elucidated the need for non-classical transistors with new device structure and nano materials
3. The issues in realizing Germanium and compound semiconductor MOSFET will be presented.
4. Fabricate nanoparticles with various size and shape for biomedical applications



• **Reference Books:**

1. Antenna and Wave Propagation, Yadava, PHI Learning. Nanoscale Science and Technology, Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan, John Wiley & Sons, Ltd., UK, 2005.
2. Nanomaterials: synthesis, properties and applications, Institute of Physics, 1998.
3. Introduction to Nanotechnology, Charles P. Poole Jr and Frank J. Owens, Wiley Interscience, 2003.
4. Electron Microscopy and analysis, 2nd ed. Taylor and Francis, 2000.
5. Bio-Inspired Nanomaterials and Nanotechnology, Edited by Yong Zhou, Nova Publishers.
6. Quantum dot heterostructures, Wiley, 1999.
7. Modern magnetic materials: principles and applications, John Wiley & Sons, 2000.
8. Nano: The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
9. Nanobiotechnology, concepts, applications and perspectives, Wiley-VCH, 2004.

**Semester V**  
**Numerical Skills**

**SECCET507: Mathematical Methods and Circuit Analysis using MATLAB**

• **Learning Objectives:**

1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand Laplace Transform and Fourier series and its applications.
4. To use MATLAB as a simulation tool.

**Unit I: Fundamentals of MATLAB**

05

Introduction, starting and ending a MATLAB session, MATLAB environment, Help feature, types of MATLAB files, MATLAB commands, MATLAB toolboxes, advantages of MATLAB, disadvantages of MATLAB, Introduction to top-down design Techniques, MATLAB editor, MATLAB programming- creating M-files, types of M-files, function subprograms, types of functions, function Handles, errors and warnings, MATLAB Debugger.

**UNIT II: Simulink Basics**

05

Introduction, starting Simulink, Simulink modeling- Collecting blocks to create a model, modifying block parameters, labeling blocks, connecting blocks, labeling signal lines, saving the model, solvers, simulating a model, using variable from MATLAB, data import/export, state space modeling & simulation, simulation of non-linear systems.

**Unit III: Fourier Series and Laplace Transform and its applications**

05

Definition, Evaluation of Fourier Coefficient, Fourier series for square wave, triangular, sawtooth wave, half wave & full wave rectifiers. MATLAB exercise: To evaluate Fourier coefficients for given waveform function, Definition, Laplace transform of simple functions, properties of L.T. (Linearity, shifting, change of scale), Inverse L.T., Partial fraction technique to find inverse L.T. function Applications. Series RC circuit, RL circuit, RLC circuit for dc input. MATLAB Exercises: 1. To find Laplace Transform and Inverse LT of any given function. 2. Transient analysis of RC / RL / RLC (series) circuit

**Unit-4. Mathematical Applications**

05

Curve fitting (Straight line, Exponential) and its application to Diode characteristics, Ohm's Law, RC Filter. MATLAB Exercises: Real root of algebraic equation

• **Outcomes:**

1. Develop MATLAB applications in different domain and be able to analyze their performance
2. Implement basic MATLAB applications on simulation platform

• **Reference books:**

1. MATLAB and Its applications in Engineering- Bansal, Goel, Sharma- Pearson.
2. Getting Started with MATLAB – Rudra Pratap- Oxford University Press
3. MATLAB Programming for Engineers- Chapman- Cengage Learning
4. Programming in MATLAB- Herniter- Cengage Learning
5. Stephen J. Chapman MATLAB Programming For Engineers. Thomas Learning

**Semester V**  
**Practical V**  
**BEP508: Power Electronics Devices and Linear Integrated Circuits Lab**  
**(Hardware and Circuit Simulation Software)**

• **Course Objectives:**

1. To study simple Power circuits and their performance parameters
2. To learn different control techniques and applications of Power Circuits as case studies
3. To study filter design circuits.
4. To learn design and development of Op-Amp circuits.

**GROUP A**

1. Study of AC Voltage controller
2. Study of SCR firing by UJT / Phase Shift control of SCR
3. Study of ON/OFF Temperature controller (LM34/LM35/AD590)
4. Study of DC/AC Timer
5. Study of DC Motor /AC motor Control/ BLDC motor control
6. Design a power supply for 5/9/12V
7. Design of RC triggering circuit HWCR and FWCR
8. Design of Single phase full wave controlled rectifier

**GROUP B**

1. To design an inverting amplifier/non-inverting amplifier using Op-amp (741,351)for dc voltage of given gain& study frequency response
2. To Study Op amp as adder and subtractor
3. To Study Op amp as integrator and differentiator
4. To Study Op amp as Schmitt trigger
5. To design phase shift and Wien bridge oscillator for given frequency using an op-amp.
6. To study the zero-crossing detector and comparator.
7. To design a precision rectifier using an op-amp.
8. To Study of VCO using IC 565

• **Learning Outcomes:**

- 1) Build and test circuits using power devices such as SCR, IGBT and MOSFET.
- 2) Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters, how to analyze these inverters and some basic application examples.
- 3) Design various Op-amp circuits for different applications
- 4) Study of op amp IC 741 characteristics

• **Reference Books:**

1. Power Electronics, P.C. Sen, TMH
2. Power Electronics & Controls, S.K. Dutta
3. Power Electronics, M.D. Singh & K.B. Khanchandani, TMH
4. Power Electronics Circuits, Devices and Applications, 3rd Edition, M.H. Rashid,
5. Op-Amps and Linear IC's, R. A. Gaikwad, Pearson Education (2003)
6. Integrated Electronics, J. Millman and C.C. Halkias, Tata McGraw-Hill,(2001)
7. OP-AMP and Linear Integrated Circuits, K. L. Kishore, Pearson(2011)

**Semester V**  
**Practical VI**  
**BEP509:8051 microcontroller Interfacing, Optoelectronics and IoT/Mechatronics/Nanoelectronics**  
**Lab**  
**(Hardware and Circuit Simulation Software)**

• **Course Objectives:**

1. To learn the basic programming concepts of 8051
2. To learn different Interfacing using 8051
3. To learn the principles of a sensor and transducer
4. To learn Arduino development board and modern OPC

**GROUP A**

1. To generate 10 kHz square wave using 8051 microcontroller
2. To study the implementation & interfacing of LCD
3. To study implementation & interfacing of LED Matrix
4. Interfacing of seven segment using thumbwheel switch display
5. To study implementation & interfacing DC /stepper motor with 8051 microcontroller
6. To study implementation & interfacing of keypad with 8051 microcontroller
7. To study implementation & interfacing of servo motor with 8051 microcontroller
8. Interfacing of Relay/Optocoupler with 8051 microcontroller

1. Frequency Modulation and Pulse Width Modulation System
2. Study of Propagation loss and Bending loss in Optical Fiber
3. Measurement of Optical Power using Optical power meter
4. Measurement of Propagation Loss using OPM and Numerical Aperture
5. Interfacing with Bluetooth module with IoT Platform.
6. Interfacing of:
  - A) Ultrasound transceiver, IR range sensor of different range, Analog IR proximity sensors
  - B) Analog directional light intensity sensors, Position encoders
  - C) Interfacing of Gyroscope, Accelerometer, Magnetometer, GPS receiver
7. Interface Wi-Fi module with IoT Platform to toggle LEDs and control relays
8. To develop IoT system for Smart Homes

**OR**

**Elective**

**BET505:Mechatronics**

**Group B**

1. Study of Signal conditioning unit
2. Designing of Mechanical Actuation Systems
3. Designing of Proportional Controller
4. Development of application of mechatronics: rain sensor wiper
5. Development of application of mechatronics: line following robot
6. Development of application of mechatronics: solar tracker)
7. Car Engine temperature management System
8. Distance measurement using ultrasonic sensor

**OR**  
**Elective**  
**BET506:Nanoelectronics**  
**Group B**

1. Calculate thickness of given films using weight difference method
2. Preparation of thin film of given sample using electrodeposition method
3. Preparation of ZnO thin film using chemical bath Deposition method
4. Preparation of given material using Sol Gel technique
5. To study the plotting tools of given data using Origin software
6. Calculation of bandgap properties of given sample using UV visible spectrometer
7. To study IR spectroscopy properties of given material
8. To study the X-Ray Diffraction properties of a given sample

• **Learning Outcomes:**

- 1) Familiarize with the assembly level and embedded C programming using 8051.
- 2) Familiarize with the Keil  $\mu$  Vision-3/4
- 3) Design circuits for various applications using microcontrollers.
- 4) Apply the concepts on real- time applications.
- 5) Students will become versatile with basic principles of measurement techniques and extend their analytical abilities with exposure to the modern OPC and tools.
- 6) Students will get knowledge of OFC and extend their analytical abilities with exposure to learn and use modern OPC and tools.
- 7) Implement basic IOT applications on embedded platform

• **Reference Books:**

1. The 8051 Microcontroller -K. J. Ayala, (Penram International)
2. The 8051 Microcontroller and Embedded Systems, M. A. Mazadi,J. G. Mazadi.
3. Programming and customizing the 8051 Microcontroller - MYKE Predko.
4. C and the 8051: Programming and Multitasking, Schultz, P T R Prentice-Hall, Inc.
- 5. Optical Fiber Communication Sciencetech 2502**
6. Vijay Madiseti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"
7. WalteneusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

**Semester V**  
**Numerical Skills**  
**SECCEP510: MATLAB Programming LAB**

• **Learning Objectives:**

- 1.To Study the Fundamental concepts of MATLAB
- 2.To study MATLAB programming
- 3.To Design and Development MATLAB Application

**LAB**

1. Arithmetic & Logical Operation
2. Basic Operation on Matrices
3. Debugging, Functions and problems solving
4. Data Input/Output functions
5. Conditional statement and Loops
6. MATLAB for Numerical Techniques
7. Generation of Various Signals & sequences (periodic and a periodic)
8. Study of toolbox.

• **Outcomes:**

1. Develop MATLAB applications in different domain and be able to analyze their performance
2. Implement basic MATLAB applications on simulation platform

• **Reference books:**

1. MATLAB and Its applications in Engineering- Bansal, Goel, Sharma- Pearson.
2. Getting Started with MATLAB –RudraPratap- Oxford University Press
3. MATLAB Programming for Engineers- Chapman-Cengage Learning
4. Programming in MATLAB- Herniter- Cengage Learning

### 3. SIXTH SEMESTER

Sr. No.	SUBJECT TITLE	Theory			Practical		
		PAPER NO & Paper Code	No. of lectures per week	Credits		No. of lectures Per week	Credits
1	Electronics	Paper-XIII: BET601	12	8	Practical Paper – VII & VIII (BEP 608& BEP 609)	20	8
		Paper-XIV: BET602					
		Paper-XV: BET603					
		Paper-XVI: BET60X (Elective: BET604/605/606)					
		SECCET607	01	01	SECCEP610	02	01

#### 4. Structure and Title of Papers of B. Sc.Course:

**Paper XIII: BET601:** Electronic Instrumentation

**Paper XIV: BET602:** Antennas and Wave Propagation

**Paper XV: BET603:** Advanced Microcontroller: PIC

**Paper XVI: BET60X:** Elective

Elective: BET60X

5. **BET604:** Digital Signal Processing and Artificial Intelligence

6. **BET605:** Industrial Process control and PLC Programming

7. **BET606:** Robotics

**SECCET607: Entrepreneurship Development Program**

SECCEP610: Industrial Project

**Semester VI**  
**Paper XIII: BET601: Electronics Instrumentation**

• **Learning Objectives:**

1. To learn the principles of a sensor and transducer
2. To give exposure to the modern instruments and tools
3. To learn the principles of Various Biomedical Instruments, construction & working
4. To give exposure to the modern biomedical instruments and tools

**Unit I: Measurements**

**12**

Specifications of instruments, their static and dynamic characteristics, Accuracy and precision, Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis. Statistical analysis of data and curve fitting.

**Basic Measurement Instruments:** PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement, Digital voltmeter systems (integrating and non-integrating types), digital multimeters, digital frequency meter system (different modes and universal counter).

**Connectors and Probes:** low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, RS 232, GPIB, USB etc.

**Unit II: Measurement of Resistance and Impedance**

**12**

Low Resistance: Kelvin's double bridge method, Medium Resistance by Voltmeter Ammeter method, Wheatstone bridge method, High Resistance by Megger, A.C. bridges, Measurement of Self Inductance, Maxwell's bridge, Hay's bridge, and Anderson's bridge, Measurement of Capacitance, Schering's bridge, DeSauty's bridge, Measurement of frequency, Wien's bridge. Data acquisition systems: Block diagram, brief description of preamplifier, signal Conditioner

**Unit III: Oscilloscopes**

**11**

CRT, waveform, display and electrostatic focusing, time base and sweep synchronization, measurement of voltage, frequency and phase by CRO, Dual trace oscilloscope, Sampling Oscilloscope, DSO and Powerscope: Block diagram, principle and working, Advantages and applications, CRO specifications (bandwidth, sensitivity, rise time).

Signal Generators: Audio oscillator, Pulse Generator, Function generators.

**Unit IV: Transducers and sensors**

**10**

Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area Type – Variable Air Gap type – Variable Permittivity type), Inductive (LVDT ) and piezoelectric transducers. Transducers for Measurement of displacement, velocity and acceleration (translational and rotational). Transducers for Measurement of pressure (manometers, diaphragm, bellows), Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Bio-medical instrumentation: Bio-Amplifiers: Bio potentials -Bio-electricity - Necessity for special types of amplifiers for biological signal amplifications - Different types of Bio-OP - Amps. Electrodes for ECG, EEG, and EMG, block diagram of ECG and EEG systems, brief analysis of graphs. Green Electronics (E-waste awareness and management)

• **Learning Outcomes:**

1. Students will become versatile with basic principles of measurement techniques.
2. Students will get knowledge of various instruments and extend their analytical abilities with exposure to learn and use modern instruments and tools.
3. Students will get detail knowledge of various biomedical instruments Electrodes, other tools and can handle it properly



• **Reference Books:**

1. Electronic Instrumentation, H. S. Kalsi, TMH(2006)
2. Electronic Instrumentation and Measurement Techniques, W. D. Cooper and A. D. Helfrick, Prentice- Hall (2005).
3. Instrumentation Measurement and analysis: Nakra B C, Chaudry K, TMH
4. E.O.Doebelin, Measurement Systems: Application and Design, McGraw Hill Book - fifth Edition(2003).
5. Elements of Electronic Instrumentation and Measurement, Joseph J Carr, Pearson Education (2005)
6. Electronic Instrumentation and Measurements, David A. Bell, Prentice Hall (2013).
7. Electronic Measurements and Instrumentation, Oliver and Cage, TMH (2009).
8. Measurement and Instrumentation Principles, Alan S. Morris, Elsevier (Buterworth Heinmann-2008).
9. Electrical and Electronics Measurements and Instrumentation, A. K Sawhney, DhanpatRai and Sons(2007).
10. Instrumentation Devices and Systems, C. S. Rangan, G. R. Sarma and V. S. Mani, Tata McgrawHill(1998).
11. Electrical Measurement in Measuring Instruments, Goldwing E.W. and Widdies
12. Handbook of biomedical instrumentation: Khandpur R S, TMH
13. Measurement systems applications and design: Doeblin E O, McGraw Hill, 1990.

## Semester VI

### Paper XIV: BET602: Antennas and Wave Propagation

#### • Learning Objectives:

1. To analyze and understand the Uniform plane wave propagation in various media
2. To solve the electric field and magnetic fields for a given wire antenna.
3. To study electromagnetic radio signal
4. To Study different mode of Radio waves Propagation.

#### Unit I: Antenna Basics

12

**Antenna Parameters:** Introduction, Radiation Mechanism, Antenna Parameters-Radiation Patterns, Main Lobe and Side Lobes, Beam widths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Impedance, Antenna Apertures, Aperture Efficiency, Effective Height.

#### Unit II: Antenna as a Transmitter/Receiver

12

Power delivered to 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.

#### Unit III: Radiating wire Structures (Qualitative idea only)

09

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. Concept of smart antenna.

#### Unit IV: Propagation of Radio Waves

12

Different modes of propagation: Ground waves, Space waves, 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.

#### • Learning Outcomes:

1. Formulate the wave equation and solve it for uniform plane wave
2. Analyze the given wire antenna and its radiation characteristics
3. Identify the suitable antenna for a given communication system
4. Avail the knowledge of Electromagnetic signals

#### • Reference Books:

1. Principles of Electromagnetics, M. N. O. Sadiku, Oxford University Press (2001)
2. Fundamentals of Electromagnetics with MATLAB, Karl E. Longren, Sava V. Savov, Randy J. Jost., PHI
3. Engineering Electromagnetics, W. H. Hayt and J.A. Buck, Tata McGraw Hill (2006)
4. Field and Wave Electromagnetics, D. C. Cheng, Pearson Education (2001)
5. Electromagnetics, J. A. Edminster, Schaum Series, Tata McGraw Hill (2006)
6. Elements of Engineering Electromagnetics, N. Narayan Rao, Pearson Education (2006)
7. Antennas and Propagation, G. S. N. Raju, Pearson Education (2001)
8. Antenna Theory, Ballanis, John Wiley & Sons, (2003) 2<sup>nd</sup> Ed.

## Semester VI

### Paper XV: BET603: Advanced Microcontroller: PIC

- **Learning Objectives:**

1. To perform I/O port, timer, counter and interrupt operations
2. To learn the advanced architectures for advanced Embedded systems
3. To learn design and development of Electronics systems using PIC
4. To make able to use Embedded system to solve daily life problems

#### **Unit I: Introduction to Embedded Systems**

**12**

Overview of Embedded Systems, Features, Requirements and Applications, Recent Trends in the Embedded System Design, Common architectures for the Embedded System Design, Embedded Software design issues. Introduction to microcontrollers, Overview of Harvard architecture and Von Neumann architecture, RISC and CISC microcontrollers

#### **Unit II: PIC 18Fxx Microcontrollers**

**12**

Introduction to PIC Microcontrollers, Architecture overview, status register, general purpose register file, memories, Instruction set, Data Transfer Instructions, Arithmetic and Logic Instructions, Branch Instructions, Bit and Bit-test Instructions, MCU Control Instructions. Simple programs in Assembly Language / C Language, I/O port programming in PIC

#### **Unit III: Timers, Interrupts and on chip Peripherals in PIC 18Fxx**

**10**

Introduction to System Clock, Reset sources, Introduction to interrupts, External interrupts, IO Ports, 8-bit and 16-bit Timers, Introduction to different modes, Input Capture and Compare Match.

Analog Comparator, Analog-to-Digital Converter, Serial Peripheral Interface (SPI), The Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART), Two Wire Interface (TWI) / I2C bus

#### **Unit IV: Real World Interfacing with PIC**

**11**

Interfacing of LED, switch, Relay, optocoupler, seven segment displays, LCD, Keypad, stepper motor, servo motor, speed control of DC motor using PWM technique. Interfacing of sensors and actuators.

- **Learning Outcomes:**

1. Student should design electronic systems using PIC
2. Design and test advanced Embedded systems using PIC microcontrollers
3. Student should perform interfacings of various real world devices
4. Able to implement Electronics in industry

- **Reference Books:**

1. PIC Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, PHI
2. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002
3. An Embedded Software Primer, David E Simon, Addison Wesley

## Semester VI

### Elective

#### BET604: Digital Signal Processing and Artificial Intelligences

• **Learning Objectives:**

1. To give the comprehension of the concepts of discrete-time signals and systems and about the most important issues in sampling and reconstruction.
2. To give the comprehension of the Z- and their inverse.
3. To introduce fundamental concepts of artificial intelligence and provide them the ability to analyze and design intelligent systems.
4. To study application of Artificial Intelligence (AI) techniques to improve the performance of DSP.

**Unit I: Discrete-Time Signals and Systems**

**12**

Classification of Signals, Transformations of the Independent Variable, Periodic and A periodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties. Impulse Response, Convolution Sum, Graphical Method, Analytical Method, Properties of Convolution, Commutative, Associative, Distributive, Shift Sum Property System Response to Periodic Inputs, Relationship Between LTI System Properties and the Impulse Response, Causality, Stability, Invertibility, Unit Step Response.

**Unit II: Discrete Fourier Transform**

**12**

Need of transform, Discrete-Fourier Transform & Fast Fourier Transform, The discrete Fourier Series and its Properties Fourier Transform of Periodic Signals, Sampling the Fourier Transform, The Discrete-Fourier Transform, Properties of DFT, Linear Convolution using DFT. FFT-Efficient Computation of DFT, Goertzel Algorithm, radix2 Decimation-in-Time and Decimation - in - Frequency FFT Algorithms, Introduction to other transforms.

**Unit III: Z-Transform**

**10**

Definition and properties, Inverse Z Transform and stability Inverse  $z$ -Transform, Relationship Between  $z$ -Transform and Discrete-Time Fourier Transform,  $z$ -plane, Region-of-Convergence, Properties of ROC, Time Reversal, Differentiation in the  $z$ -Domain, Power Series Expansion Method (or Long Division Method), Analysis and Characterization of LTI Systems, Transfer Function and Difference-Equation System, Solving Difference Equations.

**Unit IV: Digital Filters and Artificial Intelligence**

**11**

Analog filter review, Advantages and Disadvantages of Digital Filters, Types of Digital Filters, FIR and IIR Filters; Difference Between FIR and IIR Filters, Design of FIR and IIR filter, Windowing Method, Rectangular, Triangular, Kaiser Window. Introduction to Digital signal processor, Application of digital signal processing, Introduction to AI, Artificial intelligence: History, Trends and Future Application of Artificial Intelligence (AI).

• **Learning Outcomes:**

1. The student will be capable of calibrating and resolving different frequencies existing in any signal.
2. The student will be in position to understand use of different transforms and analyze the discrete time signals and systems.
3. The student will realize the use of LTI filters for filtering different real world signals.
4. The student will be in a position to understand fundamental of AI.

• **Reference Books:**

1. John G Prokis, Manolakis, Digital Signal Processing-Principles, Algorithms and Application, 4th Edition, Pearson Education Publication
2. Salivahanam, A Vallavaraj, C. Guanapriya, Digital Signal Processing, 1st Edition, Tata McGrawHill, New Dehli
3. P. Ramesh Babu, Digital Signal Processing, 4th Edition, Scitech Publication.
4. A. Ambardar, Digital Signal Processing: A Modern Introduction, Cengage Learning India Pvt Ltd, New Dehli
5. P. Pirsch, Architectures for Digital Signal Processing, John Wiley publication, New Delhi
6. Phil Lapsley, DSP Processor Fundamentals: architectures and Features, Wiley publication
7. S.K. Mitra, Digital Signal Processing Computer Based Approach, TMH. New Dehli. 2009

## Semester VI

### Elective

#### BET605: Industrial Processes control and PLC programming

- **Learning Objectives:**

1. To understand the fundamentals of automation and various automation systems used in industry such as PLC, DCS, and SCADA.
2. To understand how to design Automation system.
3. To Study of Ladder programming language.
4. Able to design PI,PD and PID Controllers

#### **UNIT I: Introduction to control system**

**12**

Basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, comparison closed-loop system and open-loop control, feed-forward control system, adaptive control system, classification of control system. ON-OFF controller, proportional controller, PI controller, PD controller and PID controller.

#### **UNIT II: Components of Control System:**

**10**

Op-Amp as a zero crossing detector, non-inverting comparator, inverting comparator, Two position controller using op-Amp, proportional controller, integral controller using Op-Amp, derivative controller, PI controller, PID controller.

#### **UNIT III: Introduction to PLC**

**12**

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, block diagram of PLC, Input/output modules, power supplies, isolators, features like scan time, system scale, user interface. Modular PLC and Redundant PLC and Applications, communication protocols: RS485, Profibus, Modbus.

Distributed control system, DCS components/block diagram, SCADA, adaptive control system.

#### **UNIT IV: Ladder Programming basics**

**11**

**Basic components:** fuse, pushbutton, selector switches, limit switches, indicators, relay, time

Delay relays functions and symbols. General PLC programming procedures, programming on-off Inputs/outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.

Ladder Programming: Programs for Boolean logic and flip-flops, counters, timers, flasher.

Application: Bottle filling plant, elevator control, washing machine control, Four-wheeler parking.

- **Learning Outcomes:**

1. Able to design PLC based application by proper selection and sizing criteria and ladder program.
2. Able understand evolution and architecture of DCS, SCADA architecture.
3. Able to design communication systems in SCADA, develop any application based on SCADA.
4. Able design Automation Plant programming using Ladder programming Language

- **Reference Books :**

1. John W. Webb and Ronald A. Reiss, Programmable Logic Controllers – Principle and Applications, Fifth Edition, PHI
2. Programmable Logic Controllers And Industrial Automation : An Introduction by Madhuchhanda Mitra
3. JR. Hackworth and F.D Hackworth Jr. Programmable Logic Controllers – Programming Method and Applications. – Pearson, 2004..
4. Introduction To Programmable Logic Controller- Gray and Dunning ( 2nd edition Thomson Education)

**Semester VI**  
**Elective**  
**BET606: Robotics**

• **Learning Objectives:**

1. To study robotics Fundamentals.
2. To study sensors and actuators in robotics.
3. To learn the various I/O devices interfacing with robots.
4. To establish communication of robot with various protocols.

**Unit I: Programming Environments**

**12**

Integrated Development Environment (IDE) for AVR microcontrollers, free IDEs like AVR Studio, WIN AVR. Installing and configuring for Robot programming, In System Programmer (ISP), loading programme on Robot

**Unit II: Sensors and Actuators**

**11**

**Actuators:** DC Motors, Gearing and Efficiency, Servo Motors, Stepper motors, Motor Control and its implementations

**Sensors:** White line sensors , IR range sensor of different range, Analog IR proximity sensors , Analog directional light intensity sensors, Position encoders, Servo mounted sensor pod/ Camera Pod, Wireless colour camera , Ultrasound scanner , Gyroscope and Accelerometer, Magnetometer, GPS receiver, Battery voltage sensing, Current Sensing

**Unit III: Interfacing I/O Devices**

**10**

LCD interfacing with the robot (2 x 16 Characters LCD), Other indicators: Indicator LEDs, Buzzer, Timer / Counter operations: PWM generation, Motor velocity control, Servo control, velocity calculation and motor position Control, event scheduling

**Unit IV: Communication**

**12**

Wired RS232 (serial) Communication, Wireless ZigBee Communication, USB Communication, Simplex infrared Communication (IR remote to robot)

• **Learning Outcomes:**

- 1) Able to develop programs for robots
- 2) Able to interface various sensors and actuators with robots as per need
- 3) Able to interface various displays and indicators robots as per need
- 4) Able to operate robot from remote locations

• **Reference Books:**

1. Saha, S.K., Introduction to Robotics, 2nd Edition, McGraw-Hill Education, New Delhi, 2014
2. R.K. Mittal, I.J. Nagrath, "Robotics & Control", Tata McGraw & Hills, 2005.
2. Electricity and Magnetism: J. H. Fewkes and John Yarhood ,Vol I , Publication by Oxford University Press Vth Edition.

**Semester VI**  
**SECCET607: Entrepreneurship Development programme (EDP)**

- **Learning Objectives:**

1. To study the product design and development process
2. Identification of opportunities for development
3. To learn the mechanism of finance and fund raising
4. To understand the importance of marketing for better business opportunities

**Unit I: Product Design and Development** **05**

Introduction, Product development basics, Product development stages, Identification of customer requirements, Designing the product, Techno commercial feasibility of a product, Pilot production batch, Product assessment, Failure rates of electronic components, Touch screen, Multi- touch technology.

**Unit II : Entrepreneurship Development** **05**

Introduction to entrepreneurship, Identification of opportunities for entrepreneurship, Concept of different occupations: - business, employment and profession. Functions of an entrepreneur. Business idea and plan, Types of businesses / ownerships – Sole Proprietorship, Partnership, Private limited company, Public limited company, Joint stock Company, Co-operative society.

**Unit III: Sources of Finance** **05**

Preparation of project report for business, Sources of finance – government and nongovernment agencies, Working capital, Cash flow, Fund flow, Preparation of basics of financial statements, costing and pricing, Policies and incentives.

**Unit IV: Marketing Management** **05**

Small business management and entrepreneurship, Woman entrepreneurship, Features of small business firms, Process of management in small business, Concept of data and information, Information as a commodity, Study of marketing strategy and marketing mix, Decision-making models, Types of decisions, Decision Support Systems, Introduction to e-commerce, types – B2B, B2C, C2B, C2C. Case study on Small scale Electronic industries in India.

- **Learning Outcomes:**

1. Able to identify feasibility of product design and development
2. Able to get the idea about IP rights
3. Avail the financial and marketing skill
4. Able to prepare the proposal for small scale industry.

- **Recommended Books:**

1. R. G. Kaduskar, V. B. Baru. Electronic Product Design. Second edition Wiley India
2. Alpana Trehan. Entrepreneurship. Wiley India
3. G. N. Pandey. A complete guide to successful Entrepreneurship, Vika

## Semester VI

### Practical VII

#### BEP 608: Electronics Instrumentation and Antennas and Wave Propagation Lab (Hardware and Circuit Simulation Software)

- **Course Objectives:**

1. To learn the principles of a sensor and transducer
2. To give exposure to the modern instruments and tools
3. To study of antenna radiations
4. To study of beam width, front to back ratio of antenna

#### GROUP A

1. Study of thermocouple (594/595)
2. Study of characteristics of RTD(PT-100)
3. Study of Instrumentation Amplifier( TL084/LM324)
4. Measurement using Strain Gauge and Bridge Amplifier
5. Study of AC Timer / DC Timer
6. Measurement of displacement using LVDT.
7. To study the Characteristics of LDR/Photodiode/ Phototransistor
8. Study the linearity characteristics Pressure using capacitive transducer

#### GROUP B

1. Study of Simple Dipole ( $\lambda/2$ ) antenna
2. Study of Folded Dipole ( $\lambda/2$ ) antenna
3. Study of Simple Dipole ( $\lambda/4$ ) antenna
4. Study of Yagi-UDA 3/ 5Element Simple dipole antenna
5. Study of Yagi-UDA 3Folded dipole antenna
6. Study of Yagi-UDA 5Folded dipole antenna
7. Study of Hertz/Helix antenna
8. Study of Ground Plane antenna

- **Learning Outcomes:**

1. Students will become versatile with basic principles of measurement techniques and extend their analytical abilities with exposure to the modern instruments and tools.
2. Students will get knowledge of various instruments and extend their analytical abilities with exposure to learn and use modern instruments and tools.
3. Student will able to develop Antenna radiation pattern
4. Able to calculate beam width

- **Reference Books:**

1. Electronic Instrumentation, H. S. Kalsi, TMH(2006)
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, India.
3. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3<sup>rd</sup>
4. Digital Signal Processing, S. K. Mitra, McGraw Hill, India.
5. Electronic Instrumentation and Measurement Techniques, W. D. Cooper and A. D. Helfrick, Prentice- Hall (2005).
6. **Motorized Antenna Unit Sciencetech 2261A**
7. Antenna Theory, Balanis, John Wiley & Sons, (2003) 2<sup>nd</sup> Ed.



**Semester VI  
Practical VIII**

**BEP 609: Advanced Microcontroller: PIC, Digital Signal Processing and Artificial Intelligences /  
Industrial Processes control and PLC programming /Robotics  
Lab (Hardware and Circuit Simulation Software)**

• **Course Objectives:**

1. To learn design and development of electronic systems using PIC18Fxx
2. To make able to use Embedded system to solve daily life problems
3. To learn Scilab/MATLAB Programming
4. To study of signal processing

**GROUP A**

1. Interfacing of LED and RELAY using PIC18Fxxcontroller with MPLAB
2. Write an assembly language program to add, subtract, multiply, divide 16 bit data by PIC18Fxxmicrocontroller.
3. Write an assembly language program to generate 10 KHz frequency using interrupts on P1.2.
4. To study Serial communication using PIC18Fxx
5. Programming of PIC18Fxx on chip ADC
6. Interfacing KEYPAD to display value on LCD when a key is pressed
7. Interfacing GSM modem to send and receive the message
8. Display a message using I2C Protocol

**Elective**

**BET604: Digital Signal Processing and Artificial Intelligences**

**Group B**

1. Generation of unit sample sequence, unit step, ramp function, discrete time sequence, real sinusoidal sequence.
2. Given  $x[n]$ , write program to find  $X[z]$ .
3. To study Fourier Transform, Discrete Fourier Transform and Fast Fourier Transform
4. Design of a Butterworth analog filter for low pass and high pass.
5. Write a program to generate and plot the following sequences: (a) Unit sample sequence  $(\delta[n])$ , (b) unit step sequence  $(u[n])$ , (c) ramp sequence  $(r[n])$ , (d) real valued exponential sequence  $= 0.8^n$  for  $0 \leq n \leq 50$ .
6. Write a program to compute the convolution sum of a rectangle signal (or gate function) with itself for  $N = 5$
7. Given a casual system  $H(z) = 0.9z^{-1} + 1$  (a) Find  $(\sigma_c)$  and sketch its pole-zero plot (b) Plot the frequency response  $|H(e^{j\omega})|$
8. Design a digital filter to eliminate the lower frequency sinusoid of  $x[n] = \sin 7n + \sin 200n$ . The sampling frequency is  $f_s = 500$ . Plot its pole zerodiagram, magnitude response, input and output of the filter.

**OR**

**Elective**

**BET605: Industrial Processes control and PLC programming**

**Group B**

1. Study of PLC Simulator (TriLOGI Software) and implementing Boolean function.
2. Programming PLC for sequential logic RS -FF,JK-FF,T-FF,D-FF
3. Study of PLC timers and Counters
4. Programming PLC for Bottle filling plants
5. Programming PLC for Automatic parking Gate
6. Programming PLC for Elevator control
7. Programming PLC for Traffic Light Control
8. Study and implementation of proportional controller using opamp.

**OR**  
**Elective**  
**BET606: Robotics**  
**Group B**

1. Robot I/O and buzzer programming
2. Robot Motion controlling
3. Robot velocity control using PWM
4. On Board Robot LCD interfacing
5. On Board Robot ADC interfacing
6. Accessing robot On Board Interrupts
7. Proximity sensors interfacing for autonomous robot working
8. Designing of obstacle avoiding robot

**• Learning Outcomes:**

1. Student should design electronic systems using PIC
2. Design and test advanced Embedded systems using PIC microcontrollers
3. Student will able to develop MATLAB programs
4. Able to solve signals and system problems

**• Reference Books:**

1. PIC Microcontroller and Embedded Systems: Using Assembly and C by Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, PHI
2. Embedded system Design - Frank Vahid and Tony Givargis, John Wiley, 2002
3. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, India.
4. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd
5. Digital Signal Processing, S. K. Mitra, McGraw Hill, India.

**SECCEP610: Industrial Project**

**Course Work:**

**25**

Industrial Visits and report writing, Preparation of entrepreneurship Proposal and Presentation.

**Nature of Question Paper:**

**1. ISE-I : Marks =10:**

**Unit 1:** Online Examination: (1X10)

**2. ISE-II: Marks =10:**

**Unit 2 & 3:** Descriptive short questions (2X5)

**3. ESE: Marks =50:**

**Unit 1 to 4:**

Q.1. Attempt the following (5 X2=10)

Q.2. Attempt any two out of three (2X10=20)

Q.3. Attempt any four out of six (4X5=20)

(ISE- Internal Semester Examination, ESE – End Semester Examination)

Mr. J. A. Wagh  
Chairman  
**B.O.S. (Electronics)**