DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY AURANGABAD

SYLLABUS

M.Sc. ELECTRONICS

Effective from June 2011 onwards

Dr. Babasaheb Ambedkar Marathwada University Aurangabad

M.Sc. Electronics
Effective from June 2010-11

Semester – I

Paper No.	Title of the Paper	Teaching hrs/week	Exam Duration	Marks
EL 101T	Embedded System -I : 8051 Microcontroller	4	3	50
EL 102T	PC Based Instrumentation	4	3	50
EL 103T	Advanced Test and measuring Instruments	4	3	50
EL 104T	Electronic Instrument Design	4	3	50
EL 105P	Practicals based on 101T,102T,103T	8	4	50
EL 106P	Electronic Product development	8	4	50
				300

Semester –II

EL 201T	Embedded System –II (PIC Microcontroller)	4	3	50
EL 202T	Biomedical Electronics and Instrumentation	4	3	50
EL 203T	Industrial Applications of Optoelectronics	4	3	50
EL 204T	Wireless Communication Systems and Networks	4	3	50
EL 205P	Practicals based on 201T,202T,203T	8	4	50
EL 206P	Electronics product development	8	4	50
				300

Semester –III

EL 301T	Sensors and Actuators	4	3	50
EL 302T	Power Electronics	4	3	50
EL 303T	Industrial Controllers PLC & PID	4	3	50
EL 304T	Electives: A. MEMS B. VLSI C. Robotics	4	3	50
EL 305P	Practicals based on 301T,302T, 303T	8	4	50
EL 306P	Electronic product development	8	4	50
				300

Semester –IV

EL 401P	Industrial Training and finished Product development with catalog		6	250
EL 402P	Seminar		2	50
				300

Semester -I

EL 101T: Embedded System -I : 8051 Microcontroller

1. 8051 Microcontroller

Introduction, Microcontrollers and Microcontrollers, history of microcontrollers, embedded versus external memory devices, 8-bit and 16bit microcontrollers, CISC and RISC processors, Harvard and van Neumann architecture, 8051 features, architecture, pin diagram, memory organization, external memory interfacing ,stack.

2. Addressing Modes and Instruction Set

Instruction syntax, data types, subroutines, addressing modes, instruction timings, 8051 instructions, assembly language programming , time delay calculations, software development tools.

3. 8051 Parallel I/O Ports

Basic I/O concepts, port structure and operations, Interfacing push button, switches and LEDs, Interfacing matrix keyboard and seven segment display, interfacing matrix keyboard and LCD, interfacing DAC, Interfacing ADC, interfacing stepper motor.

4. Interrupts, timers/counters and serial communications

Basics of interrupts, 8051 interrupt structure, Timers and counters, 8051 timers/counters, timer/counter operation modes, programming 8051 timers/counters, Data communication, basics of serial data communication, 8051 serial communication, serial communication modes, serial communication programming, RS232.

Books:

1. 8051 Microcontroller – V.Udayashankara, M.S. Mallikarjunswamy Tata McGraw-Hill

2. The 8051 Microcontroller and Embedded systems – M.A. Mazadi, J.G.Mazadi, R.D. McKinlay- Second edition –Pearson

3. Microcontrollers [Theory and Applications] – Ajay Deshmukh, TMH, New Delhi, 2009

EL 102T: PC Based Instrumentation

1. Signal Conditioning and Op Amp Circuits

Principles of signal conditioning, Operational Amplifiers, Amplifiers, Bridge circuits, Filters, other op Amp circuits, Noise and noise reduction techniques

2. Sensors and actuators

Temperature sensors, Displacement sensors, Pressure sensors, Flow sensors, Actuators

3. Principles of Data acquisition

Sampling concept, digital to analog converters, Analog to digital converters, Data acquisition systems, data acquisition configuration

4. Data acquisition using serial interface

Serial communication, serial interface standards, PC serial port, 8051 microcontroller interface, USB interface

Books:

1. PC-Based Instrumentation – N.Mathivanan –PHI
2. Operational Amplifiers -
3. Digital Electronics -

EL 103T: Advance Test and measurement Instruments

1. **Test equipment**
   Block diagram, working principle of Digital multimeter, Frequency counters and timers, RF power meter, EMI and EMC tester, digital pH meter, digital photometer.
2. **Signal generators**
   Block diagram, working principle and procedure of operation of AF generator, RF generator, function generator
3. **Oscilloscopes**
   Block diagram, working principle and procedure of operation of Digital storage oscilloscope, mixed signal oscilloscope
4. **Signal analyzers**
   Block diagram, working principle of Spectrum analyzer, logic analyzer, impedance analyzer, vector signal analyzer, network analyzer, semiconductor parameter analyzer, UV photo spectrometer

References:

1. Test and Measurement Instrument catalog of Agilent
2. Test and Measurement Instrument catalog of Tektronx
3. Test and Measurement Instrument catalog of National Instruments
4. Test and Measurement Instrument catalog of HP
5. Other related catalog

EL 104T: Electronic Instrument design

1. Development cycle of an Electronic Instrument – System engineering, architecting, concept development, documentation, teamwork, design development, validation, verification and integration, Rapid prototyping, Field testing, failure, iteration and judgment. Documentation types, methods, layouts, audience oriented preparation, presentation and preservation

2. Instrument-human interface, user centered design, ergonomics, utility, principles of appropriate operation, Case studies

3.

Packaging and enclosures-design for manufacturing, assembly and disassembly, Wiring, temperature, vibration and shock, rugged systems. Grounding and shielding design, safety and noise.

4. Circuit design, Circuit lay-out, power supplies, power distribution, Cooling – heat transfer, thermal management, cooling choices-heat sinks, heat pipes and thermal pillows, fans and forced air cooling, liquid cooling, evaporation and refrigeration, Tradeoffs in design. Integration, production and logistics.

Books:

1.Electronic Instrument Design,H.R. Fowler, Oxford
2. Principles of Instruments and systems, R.G. Gupta, TMH
3. Industrial Electronics, T.E. Kissell, PHI
4. Instrument Engineer's Handbook– Process Control, B.G. Liptak

EL 105P: Practical-1

Minimum Twelve practical (4 practicals each from EL101T,EL102T,EL103T)

EL 106P: Practical-2

Product development and documentation

Semester – II

EL 201T: Embedded System -II : PIC Microcontroller

1. Embedded Microcontrollers

Microcontroller types, Internal hardware, applications, processor architecture, instructions and software, peripheral functions, memory types, microcontroller communications, device packaging, application development tools, Microchip PIC microcontroller feature summary, features unique to PIC, PIC families.

2. PIC Microcontrollers

PIC microcontroller overview and features, PIC 16C6X/7X: ALU, CPU registers, pin diagram, PIC reset actions, PIC oscillator connections, PIC memory organization, PIC 16C6X/7X instructions, Addressing modes,, I/O ports

3. PIC 16F8XX Flash microcontrollers

Introduction, pin diagram, status register , PCON, option_reg , PIC 16F8XX program memory, PIC 16F8XX data memory, data EEPROM and Flash program EEPROM,Interrupts in 16F877, I/O ports,Timer.

4. Interfacing and Industrial applications of Microcontroller

LED, push buttons, relays and latch connections, keyboard interfacing, interfacing of 7 segment display, LCD interfacing, ADC and DAC interfacing

Books :

1. **Programming and customizing PIC Microcontroller- Myke predko, 3rd edn.TMH**
2. **Microcontrollers : Theory and Applications – Ajay Deshmukh –TMH**
3. **Microchip PIC 16F8XX catalog from website www.microchip.com**

EL 202T: Biomedical Electronics and Instrumentation

1. **Bio-electric Signals and Electrodes:**
   Basic Physics of membrane potential, resting membrane potential of nerves, nerve action potential, origin of bio-electric signals, recording electrodes, polarization, skin contact impedance, electrodes for ECG, electrodes for EEG, electrical conductivity of electrodes jellies and creams, microelectrodes.
   Physiological Transducers: Signal characteristics from cardio-vascular system, pressure transducers, transducers for body temperature measurement, pulse sensors, respiration sensors.

2. **Bio-medical Recorders**: Electro-cardiograph, phonocardiograph, electroencephalograph, electromyography.
   Electrocardiography : Heart as potential source, characteristics of normal ECG, ECG waveforms, standard lead system, other ECG signals, ECG preamplifier, ECG readout devices, ECG machine.

3. Physiological Pressure and other cardiovascular measurement and devices:
   Physiological pressure, pressure measurement, blood pressure measurement, oscillometric and ultrasonic noninvasive pressure measurement, direct method, pressure transducers, pressure amplifiers, typical calibration method, pressure amplifier design, ac carrier amplifier, systolic, diastolic and mean detector circuits, practical problems in pressure monitoring, cardiac output measurement, dilution method, right side heart pressure, blood flow measurement, phonocardiogram, vectorcardiogram, pacemaker.

4. **Instrumentation for measuring brain function :** Brain parameters, instrumentation, cerebral angiographies, electroencephalography, EEG electrodes and 10-20 systems, EEG amplitudes and frequency bands, EEG diagnostic uses and sleep patterns, multi-channel EEG recording system, preamplifiers, EEG system specification.

Books:

1. Handbook of Bio-medical Instrumentation – R.S. Khandpur, TMH, New Delhi
2. Introduction to Bio-medical equipment Technology- J.J Carr, Pearson Pvt.Ltd.
3. Bio-medical Electronics and Instrumentation- S.K.Venkata Ram, Galgotia pub.
4. Bio-medical Instrumentation – L.Cromwell, PHI, 1980

EL 203T: Industrial Applications of Optoelectronics

1.

Revision of basics of reflection, refraction, transmission and absorption of light radiation, Ray-tracing through lenses, convex, concave and plane mirrors, prisms etc. Refractive index, total internal reflection.

2. Lamps and illumination systems, LEDs – working principle and applications, LED lighting, Display devices, indicators, numeric, alphanumeric and special function displays, Liquid Crystal Display elements, Plasma Displays, Multimedia projectors.

3. Gas and solid state LASERs, pulsed lasers, industrial applications of low power lasers. Alignment, Pointing, tracking and particle Size detection Instruments. Laser Level. Wire Diameter Sensor. Laser, Doppler Velocimetry-Principle of Operation. Performance Parameters. Electronic Processing of the Doppler Signal.

4. Photodetectors types and applications, Optocouplers, Optointerruptors, LASCR. used in safety interlocks, power isolators, rotary and linear encoders and remote control. Intrinsic and Extrinsic Fiber optic sensors. Digital camera and automatic inspection systems. Introduction to Optical computing and holography.

Text Books:

1. Optical Engineering Fundamentals, B.H. Walker, PHI
2. Industrial Electronics, T.E. Kissell, PHI
3. Electro-Optical Instrumentation Sensing and Measuring with Lasers**,** Silvano Donati, Pearson
4. Fiber optics and Optoelectronics, R.P. Khare, Oxford Press

EL 204T: Wireless Communication Systems and Networks

1. **Wireless Telecommunication systems and networks:**
   The history and evolution of wireless radio systems, development of modern telecommunication infrastructure, overview of existing network infrastructure, overview of OSI model, wireless network applications
   Evolution and development of cellular telephone system:
   Generations of wireless cellular networks, 1G cellular system, 2G cellular system, 3G cellular system, 3G cellular system, 4G cellular system.

2. **Common Cellular System Components:**
   Common cellular system components, hardware and software views, 3G cellular system components, cellular component identification, cell establishment
   Wireless Network architecture and operations: The cellular concept, cell fundamentals, capacity expansion techniques, cellular backhaul networks, mobile management, radio resources and power management, wireless network security

3. **GSM, TDMA and CDMA Technology:**
   Introduction to GSM and TDMA, GSM network and system architecture, GSM channel concept, GSM identities, GSM system operations, GSM infrastructure communication;TDMA systems, Introduction to CDMA, CDMA network and system architecture, CDMA channel concept, CDMA system operations, 3G CDMA

4. **Cellular wireless data networks:**
   Introduction to mobile wireless data networks, CDPD, GPRS and EDGE data networks, CDMA data networks, Evolution to GSM to 3G, Evolution of CDMA to 3G. SMS,EMS,MMS and MIM services.
   Wireless LAN/IEEE 802.11x : Introduction to IEEE 802.11x technologies, evolution wireless LAN, IEEE 802.11 design issues, services, MAC layer operations, layer 1 details,

   Books:
   1. Introduction to Wireless Telecommunication Systems and Networks – Gary J. Mullett, Delmar Cengage learning, India Edition 2007
   2. Wireless and Mobile Communication – Sanjeev Kumar, New Age Int.2008

EL 205P: Practical-3

Minimum Twelve practical (4 practicals each from EL201T,EL202T,EL203T)

EL 206P : Practical-4

Product development and documentation

Semester - III

EL 301T: Sensors and Actuators

1. **Passive Electrical Transducers:**
   Resistive transducer: resistance thermometer, hot-wire transducer, displacement, strain, pressure, moisture, magnetic flux, optical radiation transducers.
   Inductive transducers : thickness, displacement, movable core, eddy current inductive transducers.
   Capacitive transducers : thickness, displacement and moisture transducers.
2. **Active Electrical Transducers:**
   Thermoelectric, piezoelectric, magnetostictive, hall effect, electromechanical, photoelectric, digital, electrochemical transducers.
3. **Actuators** : electromechanical, electro-thermal, electro-optical and electro-chemical actuators, working principles, specifications and application examples, relays.
   Electric motors: **DC motors**, principle, rotary motion, control of field flux, counter electromotive force, armature reaction, motor selection, basic motor construction, motor classifications, coil terminal identification.
   AC motors: fundamental operation, stator construction and operation, types of AC motors
   Servo motors: Brushless DC motors, stepper motors PM stepper motor, variable reluctance stepper motor, AC servo motors.
4. **Variable Speed drives** :
   DC Drives: Fundamentals, variable voltage DC drive, motor braking.
   AC drives: Fundamentals, AC drive system, drive controller internal circuitry, circuit operation of AC drive.

Books:

1. Transducers and Instrumentation, 2nd Edition- D.V.S.Murty, PHI, 2010
2. Industrial Electronics – Terry Bartelt, DELMAR Cengage learning, 2006.
3. Sensors & Trnsducers - Patranabis
4. Measurement Systems (Application & Design), E.D.Doebelin
5. Transducers & Instrumentation, Rangan Mani Sharma

EL 302T: Power Electronics

1. Power semiconductor Diodes and Transistors:
P-N junction, basic structure of power diode, characteristics of power diode, types of power diode, power transistors, power MOSFET, IGBT.

2. Diode circuit and Rectifiers:
Diode circuits with dc source, freewheeling diodes, diode and L circuit, recovery of trapped energy, single phase diode rectifier, zener diodes, filters.

3. Thyristors:
Terminal characteristics of thyristors, thyristor turn-on methods, switching characteristics of thyristors, thyristor gate characteristics, two transistor model for thyristor, thyristor ratings, thyristor protection, heating, cooling and mounting of thyristor, series and parallel operation of thyristor, other members of thyristor family, GTO basic structure, characteristics, switching performance, firing circuits for thyristors, triac firing circuit.

4. Thyristor commutation technique:
Class A commutation, Class B commutation, Class C commutation, Class D commutation, Class E commutation, Class F commutation .
Phase controlled rectifiers : Principle of phase control, full wave controlled converter, single phase full wave converter.
Choppers : Principle of chopper operation, control strategies, step-up chopper, types of chopper circuits.

Books:

1. Power Electronics- P.S. Bimbhra, Khanna publications 4th Edition 2008.
2. Power Electronics – V. Jagannathan, PHI,2008
3. Power electronics – M.D. Sing, K.B. Khanchandani, TMH 1998.
4. Power Electronics – M.H.Rashid, PHI
5. Industrial Electronics - Paul

EL 303T: Industrial Controllers PLC & PID

1. Introduction to Programmable Controllers

Industrial Motor Control circuits, Relay Ladder Logic Circuits, building a Ladder Diagram, Motor Control Starter Circuit, Rack Assembly, Power Supply, PLC Programming Unit, Input / Output Sections, Processor Unit, Addressing, Relationship of Data File Addresses to I / O Modules

2. Fundamental PLC Programming

PLC Program Execution, Ladder Diagram programming Language, Ladder Diagram Programming, Relay logic Instructions, Timer Instructions, Counter Instructions, Data Manipulation Instructions, Arithmetic Operations, Writing a Program.

3. Advanced Programming, PLC Interfacing and Troubleshooting

Jump Commands, Data Manipulations, Discrete Input / Output Modules, Troubleshooting I / O Interfaces, Analog Input and Output Signals, Special purpose Modules, Troubleshooting Programmable Controllers

4. PID controllers

Control loop characteristics, process equation, process, lead, lag, self regulation, control system parameters, error, variable range, control parameter range, control lag, dead time, cycling, controller modes, ON-OFF control, proportional mode, integral and differential actions, P, PI, PID modes, Analog and digital PID controllers, open/ closed loop tuning of PID, Ziegler-Nicholas method. Auto tuning PID controllers. Practical examples.

Books

1. **Industrial Electronics- Circuits, Instruments and Control Techniques – Terry Bartelt, DELMAR, Cengage Learning India Pvt. Ltd.Delhi, 2009**
2. **Programmable Logic Controllers – Gary Dunning, Cengage learning, DELMAr-2006**
3. **Microprocessor-Based Process Control, C.D.Johnson,Prentice Hall Inc.New Jercy**

EL 304T: Elective :
(A) Micro Electro Mechanical Systems (MEMS)

1. **Introduction to MEMS Technology:**
   Basic definitions, history and evolution of MEMS. Microelectronics and MEMS, Scaling issues in microdomain, scaling laws in electrostatic, electromagnetic MEMS sensors and actuators. Types of MEMS, Applications of MEMS in various disciplines. Introduction to design, modeling and simulation, fabrication, optimization, reliability and packaging of MEMS

2. **Microfabrication/Micromachining**: Overview of micro fabrication, review of micro- electronics fabrication processes like photolithography, deposition, doping, etching, structural and sacrificial materials, and other lithography methods, MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods.

3. **Transduction And Actuation Principles In Microdomain :**
   Radio Frequency (RF) MEMS: Introduction, Review of RF-based communication systems, RF –MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches. **Optical MEMS:** Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS.

4. **MEMS Modeling:**
   Basic modeling elements in electrical, mechanical, thermal and fluid systems, analogy between 2nd order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems. **Case Studies:** case studies of microsystems including microcantilever based sensors and actuators with appropriate selection of material properties: Static and dynamic mechanical response with different force mechanisms: electrostatic, electromagnetic, Thermal etc

Text Books

1. **MEMS- Nitaigour Premchand Mahalik,TMH, 2007.**
2. **Micro and Smart Systems - G.K.Ananthasuresh, K.J. Vinoy, Gopalakrishnan , K.N.Bhat, V.K.Aatre, "", Wiley India, 2010.**
3. **MEMS and Microsystems Design and Manufacture -Tai, Ran Hsu, TMH, 2002.**
4. **Foundations of MEMS- Chang Liu, Pearson International Edition, 2006.**
5. **Fundamentals of Microfabrication- Madou, CRC Press, 1997**

EL 304T: Elective :
(B) VLSI Design, Tools and Technology

1. MOS Technology and Techniques:
MOS technology and VLSI, process parameters and considerations for BJT, MOS and CMOS, electrical properties of MOS circuits and device modeling.

2. MOS circuit design process
MOS layers, stick diagram, layout diagram, propagation delays, examples of combinational logic design, sealing of MOS circuits.

3. Digital circuits and systems :
Programmable logic array (PLA) and finite stste machine, design of ALUs, Memories and Registers

4. Analog VLSI and high speed VLSI:
Introduction to analog VLSI, realization neural networks and switched capacitor filters, sub-micron technology and GaAs VLSI technology.
Hardware Description Language : VHDL background and basic concept, structural specification of hardware design, organization and parameterization.

Text Books

1. Basic VLSI Design Systems and Circuits – Douglas A, Pucknell and Karmran , PHI 1993
2. Modern VLSI Design , 2nd Edition- Wayne Wolf , Prentice Hall, 1998
3. VLSI Design Technology for Analog and Digital Circuits- Randall L Geiger and P E Allen, McGraw Hill International 1990.
4. Introduction to VLSI Design- Fabricious E, McGraw Hill 1990.
5. The Designer's Guide to VHDL- Peter J. Ashenden, Harcourt Asia Private limited 1996.
6. A VHDL primer- J.Bhaskar, Addison Wesley, 1999.

EL 304T: Elective :
(C) Robotics

1. **Robot Organization**:
   Coordinate transformation, kinematics and inverse kinematics, trajectory planning and remote manipulation.
   Robot Hardware : Robot sensors, proximity sensors, range sensors, visual sensors, auditory sensors, robot manipulations, manipulators dynamics, manipulator control, wrists, end efforts, Robot grippers.

2. **Robot and Artificial Intelligence** :
   Principles of AI, Basics of learning, planning movement, basics of knowledge representation, robot programming language.

3. **Robotic Vision Systems**:
   principles of edge detection, determining optical flow and shape, image segmentation, pattern recognition, model directed scene analysis.

4. **Robot Control and Applications**:
   Robot control using voice and infrared, overview of robot applications, prosthetic devices, robots in material handling, processing assembly and storage.

Books:

1. **Robotics for Engineers- Koren, McGraw Hill, 1995**
2. **Introduction to Robotics- Vokopravotic, Springer 1988**
3. **Robotics Control, Sensing, Vision and Intelligence- K.S.Fu, R.C.Gonzally, C.S.G.Lee, McGraw Hill 1997.**
4. **Elements of Industrial Robotics- Barry Leantham, Jones, Pittman Publishing 1987.**
5. **Introduction to Artificial Intelligence- Charniak and McDarmott, McGraw Hill 1986.**

EL 305P: Practical-5

Minimum Twelve practical (4 practicals each from 301T, 302T,303T)

EL 306P: Practical-6

Product development and documentation

Semester –IV

EL 401 P : Industrial training and finished product development with catalog

EL 402 P : Seminar