Dr. Bhimrao Ambedkar University, Agra

A State University of Uttar Pradesh (Paliwal Park, Agra -282004)

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A Documentary Support

for

Matric No. – 1.1.2

employability/ entrepreneurship/ skill development

under the

Criteria – I

(Curriculum Design and Development)

Key Indicator - 1.1

in

Matric No. – 1.1.2

MASTER OF SCIENCE ELECTRONICS & INSTRUMENTATION

2003

Mapping of course to:

Employability | Entrepreneurship | Skills Development

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ANNEXURE – II

DAU DAYAL INSTITUTE OF VOCATIONAL EDUCATION, KHANDARI, AGRA
REVISED COURSE STRUCTURE AND SYLLABUS FOR
M. Sc.(ELECTRONICS AND INSTRUMENTATION)

Semester: I

Course – 1	Solid State Electronics
Course – 2	Digital Electronics and Microprocessors
Course – 3	Instrumentation Technology
Lab – I	Electronic Lab.

Semester: II

Course – 4	Network Analysis
Course – 5	Optical Instrumentation
Course – 6	Vacuum Instrumentation
Lab – II	Optical Instrumentation Lab.

On the Job Training(Six weeks)

Semester: III

Course – 7	Optolectronics
Course – 8	Communication Electronics
Course – 9	Power Electronics
Lab – III	Electronics and Instrumentation Lab.

Semester: IV

Course – 10	Biomedical Instrumentation
Course – 11	Nanomaterials and Nanotechnology
Course – 12	VLSI Circuits and Technology
Lab – III	Major Project

Course – 1: Solid State Electronics

Electronic Transport in semiconductors. PN junction. Diode Equation and diode equivalent circuit. Barrier potential and characteristics of a PN junction, load line of a diode circuit, zener diodes, semiconductor diodes.

Construction of a junction transistor and its characteristics, load line and operating point, transistor parameters, Various transistor configurations and their equivalent circuits, FET, JEST, MOSFET.

Integrated circuits, Advantages and limitations of IC, classifications and fabrications of IC.

Rectifiers, Silicon controlled rectifier (SCR). Regulated power supply.

Principle and classification of amplifiers, single stage amplifier, Multistage amplifiers, Feedback in amplifiers, Frequency response in amplifiers.

Principle and classification of oscillators, Sinusoidal Oscillators, Non sinusoidal oscillators.

Elementary theory of filters, T and section filters, low, high and band pass filters.

Course – 2: Digital Electronics and Microprocessors

Number Systems and binary codes, logic gates, Boolean algebra and minimization techniques, Adders, Encoder and decoder, Multiplexers and demuliplexers. Digital logic families, Flip- Flops, Multivibrators and clock circuits, Shift registers, Counters A/D and D/A converters, Memories.

Introduction to microprocessors, Architecture of 8085 and 8086 microprocessors, Addressing modes, 8085 instruction set, 8085 interrupts, Programming, Memory and 1/0 interfacing, Serial communication protocols,

Introduction of micro controllers (8 bit).

Course – 3: Instrumentation Technology

Transducers – Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Techogenerators, Measurement of displacement, Velocity, acceleration, force, torque, strain, speed and sound temperature, pressure flow humidity, thickness, pH –position.

Measuring Equipment – Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/ time, phase, DVMs, DMMs, CRO, Digital storage oscilloscope, Logic probes, logic state analyzer, Spectrum analyzer, Recorder, Noise and Interference in instrumentation. Instrumentation amplifiers, Radio Telemetry.

Course – 4 :Network Analysis

Introduction: Review of ideal circuit elements, resistive networks, mesh and nodal analysis. Network Theorems linearity and superposition, Thevenin and Norton theorems, maximum power transfer, Wye-delta transformation, Tellegens theorem.

Transient Analysis: Laplace transform approach to solution of networks signals, transform impedances, first order systems, second order systems, state space techniques for formulation of equations and analysis.

Sinusoidal Steady and analysis: Phasers and Phase diagrams, voltage current phase calculation . Two port Networks Deviation of H, Y, Z, ABCD parameters, Inter – Parameters conversions.

Network Synthesis: Introduction to network synthesis, Test for positive real function, Hurwitz polynomials, passive RL, RC, LC network synthesis, Cauer Foster realizations.

Opto-electronics

Course – 5 Optical Instrumentation

Interference with white light, Thin film interference, Non-reflecting and high reflecting film, Localization of freinges, Michelson interferometer and its application multiple beam interference, Fabry perot interferometer, interference fillers.

Diffraction, Fraunhofer diffraction examples in narrow slit rectangular aperture and circular aperture, limit of resolution, diffraction grating, fresnel diffraction, zone plate. Gaussian beam propagation.

Polarization: Production of polarized light, Double refraction, Circular and elliptical polarization, retarders and wave plate analysis of polarized light, optical activity, Dichroism, polarizing prisms (Nicol, Wollaston Rochon Glan – Thomson etc. polaroids photo elasticity).

Optical Components and then characteristics:

Plane mirror, achromatic prism, direct vision prisms, Right angle prisms roof prism, erecting prism system, cube corner prism, beam splitter, cubes, curved mirror, lenses, ophthalmic lenses..

Optical material and fabrication techniques:

Optical glasses and their characteristics, crystalline materials.

Optical machinery:

Grinding, polishing, drilling, trepanning, spherical curve generator optical tools, abrasives and materials.

Making optical components:

Flates, mirrors, parallel plates lenses, prism and polishing crystals.

Optical instrumentation & testing optical components:

Newton's interferoscope, fizeaue interferometers, twyman- green interferometers, Mach – Zehnder interferometer, multiple beam interferometers, fabry – perot interferometers, polarization interferometers, shearing interferometers, autocollimeter.

Compound microscope, binocular microscopes, projection microscopes, binoculars, telescopes, terrestrial and astronomic, profile projectors, theodolites, spectrometer.

Course – 6 : Vacuum Instrumentation

Fundamental, gas flow mechanisms, conductance, calculations concepts of through put and pumping speed.

Rotary roots and oil free pumps, diffusion and sorption pumps, turbo molecular cryo and ion pumps.

Pressure measurement by hydrostatic, thermal conductivity and ionization gauge, gauges calibration using spinning rotor, diaphragm and mecleod gauges.

Vacuum components traps, baffles, valves, seals and feedthroughs.

Vacuum material and fabrication techniques:

Leak detection techniques, mass spectrometer and residual gas analysis.

High vacuum systems design:

Thin film deposition techniques, thermal evaporation and modification, sputtering techniques, advantages and limitations and various modifications.

Course –7: Opto Electronics

Laser Instrumentation: Basic theory, types of lasers and their characteristics, mode locking an Q-switching , He – Ne, Ruby, Nd-YAG, carbon dioxide, argon ion semiconductor etc. lasers, application science and industry, laser safety & Holography, NDT.

Optical fibers: Light propagation in fiber, types of fiber, characteristics parameters, modes, fiber splicing, fiber optic communication system – coupling to and from the fiber, modulation, multiplexing and coding , repeaters, bandwidth and rise time budgets.

Optical sources – LED, Photo detectors – p-n photodiode, PIN photodiode, phototransistors, optocouplers, solar cells, display devices.

Optoelectronic instrumentation basics of electronic specification and identification of components basic circuits for LEDs, laser diodes and photo detectors LCDs, photomilitplier tubes, etc.

Advanced instruments (Including laser based instruments) laser alignment system, laser centering devices, bar scanners, laser printers, rangefinders, guns sight night vision equipment, image tubes.

Microwave

Course – 8: Communication Electronics

Review of Electromagnetic, Maxwell's equations, Time varying field, wave equation and its solution, Plane wave Equation, pointing vector.

Basic principles of amplitude modulation, frequency modulation and phase modulation, Demodulation.

Random signals and noise, External and internal noise, noise temperature and noise figure.

Radio Transmitters and Receivers, Classifications and applications of transmitters and receivers.

Transmission lines-types and parameters, Transmission line equation, Input and output impedances, Characteristic impedance, Reflection coefficient and VSWR, Smith Chart-types and applications.

Basic concept of guided waves, Types of wave guides, Transmission line analogy for wave guides, Propagation phenomenon in different types of wave-guides.

Antenna action, Types of antenna, Fundamental parameters of antenna, antenna measurements.

Course –9: Power Electronics

Characteristics of solid state power devices- SCR, Triac, UJT, Triggering circuits, converters, choppers, inverters AC regulators, Speed control of a.c. and d.c. Motors. Stepper and synchronous motors, three phases controlled rectifier, switch mode power supply, uninterrupted power supply.

Course 10 – Biomedical Instrumentation

Analytical Instruments:

Working principals operation and data analysis of the following instruments, spectrophotometer, electron icroscopes.

Nuclear magnetic resonance spectrometer:

Principles of operation, sample preparation and data analysis, stability of magnetic fields and electronics.

Mass spectrometer, Application area, working, principles of static dynamic instruments analysis of data.

X-ray and techniques and their application to radiography fluorescence and diffractometry, interpretation of data.

Mossbauer spectrometer: Principles of operation, measurements of radioactivity, analysis of data.

Introduction to transducer and their application recording electrodes EEG, ECG, and other potentials, working principles and precaution. Blood pressure measurement, introduction to hemodynamics, introduction to ultrasound and tomographic techniques, interpretation of data and precaution for measurements.

Introduction of working principle and operation of pacemakers, delibrillators, heart lung and other ICU instrumentation.

Course – 11: Nanomaterials and Nanotechnology

Introduction: Nanotechnology, Insights and intervention into the Nanoworld, Building Blocks of Nanotechnology, Types of Nanotechnology & Nanomachines, Applications of Nanotechnology in different fields(Sensors, Solar Cells, PEC Cells), Emerging areas of Nanotechnology.

Nanomaterials

Overview: Nanoparticles, Origin, significance and applications, Health issues, Cost ,The evolution of today's industry for manufacture of carbon blacks, fumed silica, pigmentary titania, ZnO, filamentary nickel, optical fibers and, most recently, for metallic and ceramic and polymeric nanoparticles. Pros and cons of current processes: Flame hot-walls plasmas, Lasers.

Instrumentation Techniques for Nanotechnology

Molecular Nanotechnology- Low Energy Electron Diffraction (LEED), Scanning Probe Microscopy-principle of operation, instrumentation and probes, Low temperature Scanning Probe Microscopy, Auger, SEM, TEM, XRD (Powder/Single crystal), Atomic Forse Microscopy (AFM), Scanning Tunneling Microscopy (STM), EDAX, XRF, ESCA, , UPS (UV Photo electron spectroscopy), Ellipsometry, Nanodots, self assembly and Nanolithography. Physical methods such as various forms of spectroscopy for the analysis of biological systems- Force spectroscopy, XPS, X-ray Photon Spectroscopy, EDS, Electron Dispersion Spectroscopy etc.

Carbon Nanotubes: An introduction to the elementary properties of Carbon Nanotubes, structure current status of the scientific research on Carbon Nanotubes, Synthesis Methods , properties, Characterization Methods & CNT Based Materials

Reference Books:

1. Bhushan Bharat, 2004, Hand Book of nanotechnology, Springer.
2. Yuri Eogotsi, Nanomaterials : A Hand Book, Taylor & Francis (NY)
3. Kohler,M., Fritzsche, W. 2005, Nanotechnology- An Introduction to Nanostructuring Techniques, Willey- VCH Verlag
4. Rachard Booker and Earl Boysen, Nanotechnology, Willey

Course – 12: VLSI Circuit and Technology

MOS-Technology: Basic MOS transistors, MOS technology and VLSI, NMOS and CMOS technology, thermal aspects of processing, Fine line lithography, Dry, etching, Silicon gate and silicates, Isolation in MOS-VLSI.

Circuit Properties of Mosfets: Drain current-voltage relation, transconductance, Maximum operating frequency, Control of threshold voltage, Pass transistor, NMOS-inverter, Aspect ratio, Pull up to pull down ration, CMOS inverter, Equivalent circuit of MOSFET, Latch up in CMOS circuits.

MOS circuit design processes: MOS layers, Stick Diagrams, design rules and layout.

Scaling of MOS- Circuit: The sealing factor, Generalized sealing theory, Limitation of sealing, Sealing of Wires and interconnections, Latch –up in sealed CMOS- circuits.

Recommended Books:

1. Sze, S.N., "VLSI technology" McGrah Hill Co. 1998.
2. Mead C., Conway, L. "Introduction to VLSI Systems" Addition Wesley 1980.
3. Parknell, D.A.E. Schraghian K, "Basic VLSI Design Systems & Circuits" PHI 1989.