BHARATHIDASAN UNIVERSITY, TIRUCHIRAPPALLI – 620 024

M.Sc., Applied Physics [Instrumentation]– Course Structure under CBCS

(applicable to the candidates admitted from the academic year 2008-2009 onwards)

Semester	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
						Int.	Ext.	
I	Core Course – I (CC)	Principles of Instrumentation and Transducers	6	5	3	25	75	100
	Core Course – II (CC)	Applied Mathematics	6	5	3	25	75	100
	Core Course – III (CC)	Microprocessors and Applications	6	5	3	25	75	100
	Core Course –IV (CC)	Analog and Digital Electronics	6	5	3	25	75	100
	Core Course – V (CC) (Lab)	Practical – I – Workshop Practical)	6	5	4	40	60	100
II	Core Course – VI (CC)	Electrical and Electronic Instrumentation	6	5	3	25	75	100
	Core Course – VII(CC)	Materials Science	6	5	3	25	75	100
	Core Course – VIII(CC)	Mechanical and Industrial Instrumentation	6	5	3	25	75	100
	Core Course – IX (CC) Lab*	Practical – II Instrumentation Lab – I	6	5	4	40	60	100
	Elective Course – I (EC)	Numerical Methods and Computer Programming	6	4	3	25	75	100
III	Core Course – X (CC)	Communication Systems	6	5	3	25	75	100
	Core Course – XI (CC)	Analytical Instrumentation	6	5	3	25	75	100
	Core Course – XII (CC) Lab*	Practical – III Instrumentation Lab - II	6	5	4	40	60	100
	Elective Course – II (EC)	Microcontroller and Digital Signal Processing	6	4	3	25	75	100
	Elective Course – III (EC)	Process Control	6	4	3	25	75	100
IV	Core Course – XIII (CC) Lab*	Practical – IV Programming Lab	6	5	4	40	60	100
	Core Course – XIV (CC) Viva voice – 20 marks Dissertation – 80 marks	Project Work	12	5	--	--	--	100
	Elective Course – IV (EC)	Bio-medical Instrumentation	6	4	3	25	75	100
	Elective Course – V (EC)	Nano-science and Nano-technology	6	4	3	25	75	100
			120	90				1900

*** Practical examination at the end of every semester**

Note:

Core Courses include Theory, Practicals & Project

No. of Courses	14 - 17
Credit per Course	4 - 5
Total Credits	70

Elective Courses

(Major based / Non Major / Internship)

No. of Courses	4 – 5
Credit per Course	4 – 6
Total Credits	20

	Internal	External
Theory	25	75
Practicals	40	60

Project

Dissertation	80 Marks	[2 reviews – 20+20	=	40 marks
		Report Valuation	=	40 marks]
Viva	20 Marks			20 marks

Passing Minimum in a Subject

CIA	40%	Aggregate 50%
UE	40%	

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CORE COURSE - I PRINCIPLES OF INSTRUMENTATION AND TRANSDUCERS

Unit-I Generalized performance characteristics of instruments

Static characteristics – accuracy – precision – repeatability-reproducibility-Resolution- sensitivity-linearity-drift-span-range-Dynamic characteristics-Transfer Function-Zero order instruments-First order instruments-step and ramp response of first order instruments-frequency response of first order instruments-second order instruments –step-ramp response of second order instruments-dead time elements-errors-types of errors-cross errors-systematic errors-random errors.

Unit-II Transducers-I

Introduction-Primary and secondary transducers-Electrical Transducers-Active and passive transducers-Resistive transducers-Potentiometers-Strain Gauges-Resistance thermometers- Thermistor - Inductive transducers-LVDT-Capacitive Transducers.

Unit-III Transducers-II

Introduction- Thermoelectric transducers- Piezoelectric Transducers-magnetostrictive transducer-Ionization Transducers- Digital Transducers-switching magnetic sensors-Squid sensor-Fiber Optic sensor-Temperature pressure and displacement measurement.

Unit-IV Electro analytical Sensors

Introduction- electro chemical cell- cell potential- Standard Hydrogen Electrodes-Liquid Junction and other potentials –Sensor electrodes-electro ceramics in general media-chem FET-Smart Sensors.

Unit- V Data manipulation and Recording

A/D conversion techniques- D/A conversion- A/D conversion-ramp –Integrating – Potentiometric A/D conversion- recorders- graphic recorders-strip chart recorders- XY recorders- magnetic tape recorders- digital storage oscilloscope-ratio telemetry.

Books for study

1. A.K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurement and Instrumentation, Dhanpat Rai &Sons, New Delhi 2000. (Units I, II, III, V)

2. D.Patranabis, Sensors and Transducers, Prentice – Hall of India (P) Ltd., New Delhi (2003). (Unit-IV).

Books for reference

1. D.V.S. Murty, Transducers and Instrumentation, Prentice – Hall of India (P) Ltd., New Delhi (1995).

2. Ernest O. Doebelin, Measurement system applications and design, McGraw Hill International Book Company, Singapore (1983).

CORE COURSE – II APPLIED MATHEMATICS

Unit – I Complex Analysis

Function of complex variables – Analyticity and singularity of functions – Cauchy-Reimann condition – Polar form – Line integral and Cauchy's integral theorem – Cauchy's integral formula for the nth derivative – Liouvilles theorem – Taylors and Laurent's theorem – Cauchy Residue theorem – Application to trigonometric function.

Unit – II Fourier Series and Fourier Transform

Fourier series: Determination of Fourier coefficient – Fourier series of periodic functions – Half range series – Fourier cosine and Fourier sine series – Applications.

Fourier Transform: Fourier transforms – Fourier cosine and sine transforms – Properties – Applications – Heat equation (one-dimension).

Unit – III Laplace transform

Properties of Laplace transform – Inverse Laplace transforms – Laplace transform derivatives – Convolution theorem – Solution of linear ordinary differential equations, simultaneous equations and electrical circuits – Introduction to Z-transform.

Unit – IV Differential equations

First order ordinary differential equation – Existence and Uniqueness theorem 0-Systems of linear order differential equation – Linear ordinary differential equation of higher order with constant and variable coefficients – Application to LCR circuits – Introduction to partial differential equations.

Unit – V Error analysis

Types of error – systematic and random errors – Accuracy and precision – Significant figures and round-off – Uncertainties and probable error - Random variable – Mean, variance and standard deviation – Normal distribution – sampling technique – propagation of errors – Estimates of mean and errors – Instrumental uncertainties – statistical fluctuations – Chi square test – Goodness of fit.

Books for study

1. Ervin Kreyszig, Advanced Engineering Mathematics, John - Wiley & Sons Ltd., New Delhi (2001). (Units – I, II, III and IV).

2. B. C. Nakra and K. K. Chaudry, Instrumentation, Measurement and Analysis, Tata Mcraw Hill Ltd, New Delhi (Unit-V).

Books for reference

1. L. A. Pipes and L. R. Harvil, Applied Mathematics for Engineers and Physicists, Mc Graw Hill Company, Singapore, 1967.

2. H. K. Dass, Advanced Engineering Mathematics, S. Chand & Co., New Delhi (1998).

CORE COURSE – III MICROPROCESSORS AND APPLICATIONS

Unit-I 8085 Microprocessor architecture

Architecture of 8085- Instruction classification- data transfer instructions- arithmetic instructions- logical instructions- branching instructions- machine and control operations- instruction format- addressing modes- stack and subroutines – simple programs- 8 bit addition, 16 bit addition, 8 bit subtraction-multiplication-division and smallest and biggest numbers in a given array

Unit –II Interfacing memory and Peripherals

Interfacing memory and devices- I/O and Memory mapped I/O- Type of interfacing devices- Data transfer schemes- programmed and DMA data transfer schemes, Programmable Peripheral Interface (8255A)- 8253 Timer Interface- DMA controller- Programmable Interrupt controller (8259)- Programmable communication Interface (8251)

Unit- III Applications of 8085 Microprocessor

Digital to Analog converter and waveform generator- Analog to digital converter- segment display- stepper motor interfacing- Temperature measurement and control- Water level indicator- Traffic light controller.

Unit-IV 8086 Microprocessor

Pin description of 8086- minimum and maximum mode signals – internal Architecture – register organization- General purpose, index, pointer, segment regsisters and flags- Bus structure – Effective and Physical address and pipeline- addressing modes.

Unit-V 8086 Instructions

8086-instruction set-instructions- data transfer - arithmetic, logical, branching and string manipulation instructions- Assembler and Assemble directives- Simple programs – addition, subtraction, multiplication and division- data transfer using string instructions.

Books for Study

1. S.Gaonkar, Microprocessor architecture, Programming and applications with 8085, Penram International, Third Edition, New Delhi,1995. (Units – I, II, III).

2. Douglas V.Hall, Microprocessors Interfacing, Programming Hardwares- Tata McGraw Hill Publishing Pvt. Ltd., New Delhi, 2003 (Units - IV & V)

Books for Reference

1. Lance A.Leventhal, Introduction to Microprocessors Software, Hardware Programming, Prentice Hall of India, New Delhi, 1995.

2. B.Ram, Advanced microprocessor and Interfacing, Tata McGraw Hill Publishing company Ltd., New Delhi, 2003.

3. B. Ram, Fundamentals of Microprocessors, Dhanpat Rai Sons, New Delhi, 2002 (Units-I, II & III)

CORE COURSE – IV - ANALOG AND DIGITAL ELECTRONICS

Unit-I IC Circuit fabrication

Classification-IC chip size and circuit complexity- monolithic IC Technology- Fabrication of typical circuit- Active and Passive components- Fabrication of FET's- Thick and Thin film technology.

Unit-II Operational Amplifier: Characteristics and applications

Basic information of operational amplifier- AC and Dc characteristics-Basic operational amplifier applications: -multiplier, divider, differentiator, integrator-instrumentation amplifier-AC amplifier-voltage and current and current to voltage converter-sample and hold circuit-log and antilog amplifiers-electronic analog computation-simultaneous and linear differential equation – comparator

Unit-III Active Filters, Oscillators and 555 Timer

Active filters-low pass, high pass, band pass, band reject filters-filter design – oscillators- principles and various types- Phase shift oscillator – wien's bridge oscillator– 555 timer; – monostable, astable and bistable multivibrator-phase lock loop –operating principles and monolithic phase-lock loops-PLL applications

UNIT - IV Boolean algebra, logic gates and K-Map

Basic theorems and properties of Boolean algebra- Boolean functions – Demorgan's theorem– Digital logic gates – Universality of NAND and NOR gates. Simplification of Boolean functions – The map method -three and four variable maps – SOP and POS simplifications

Unit-V Combinational & Sequential Circuits

Combinational logic design procedure: Adders - Sub tractors – Exclusive OR function – parity generation and checking- BCD adder – Decoders – Demultiplexers – Encoders – Multiplexers.

Flip Flop and Counters: Flip Flops – Triggering of Flip Flops - Flip Flops characteristics table - Flip Flops excitation tables- RS, JK, D and T flip flop – design of counters – Ripple counters and synchronous counter-Johnson counter.

Books for study

1. D.Roy Choudhury, Shail Jain, Linear Integrated Circuits, New Age International Pvt., Ltd., New Delhi, 1999 (Unit-I, II& III)

2. Malvino & Leach, Digital Principles and Applications, Tata McGraw Hill Publishing, New Delhi, 2000 (Unit IV & V)

Books for Reference

1. R.A.Gayakwad, Operational amplifier and Linear Integrated Circuits, PHIPvt., Ltd., New Delhi, 1999.

2. Moris Mano, Digital Computer Design, Prentice Hall of India, New Delhi, 2000.

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CORE COURSE – V WORKSHOP PRACTICALS

Bench work and Fitting

Practice in filing, sawing and making, drilling and tapping in metal- Fitting – Fabrication of simple items – Trisquare and Caliper

Lathe Work

Job setting- cutting- grinding and polishing of metal facing- straight and taper turning-Thread cutting, knurling

Welding

Preparation of joints- making of butt, lap, T-corner and edge joints by electric arc.

PCB Fabrication

Layout for a given circuit- Layout working on the copper clad- marking- drilling and etching.

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CORE COURSE – VI - ELECTRICAL AND ELECTRONIC INSTRUMENTATION

Unit I-Potentiometers

Introduction to potentiometers – Construction details of potentiometer – Standardization of Potentiometer – Cromptons Potentiometer – Multirange – Potentiometer – Vernier potentiometer – Applications of DC potentiometers – Self balancing potentiometer- AC Potentiometers – Standardization of AC potentiometer – Types of AC potentiometers – Dryscale potentiometer – Gall Tinsely Potentiometer – Applications of AC Potentiometer.

Unit II- Galvanometer and Flux meter

Introduction to Galvanometer – Dynamic behavior of Ballistic Galvanometer – Theory and construction details of Moving coil type ballistic Galvanometer – Calibration of ballistic Galvanometer – Flux meter – Construction of flux meter- Advantages and disadvantages of flux meter.

Unit III- Measurement of Power, Energy and Instrument transformers

Principle of Power Measurement – Dynamometer type wattmeter –principles of energy measurement - Induction type energy meter – Instrument transformers (IT) – uses of IT – ratio of IT – Current Transformer – Construction - Characteristics – Potential Transformer – Difference between CT and PT – Construction – Characteristics.

Unit IV- Measurement of Resistance, Inductance and Capacitance

Resistance Measurement – Classification of Resistance – Measurement of Low resistance – Kelvin Double bridge – AC bridges – General equation for bridge balance – Measurement of self inductance by Maxwell's bridge – Hay's bridge – Owen's bridge – Measurement of capacitance – Desauty's bridge – Schering's bridge – Measurement of Mutual inductance by Heaviside bridge and Cambell's bridge – Anderson bridge.

UNIT V- Basic Electronics Instrumentation

CRO – Construction – Deflection Schemes – Working details of CRO – Application of CRO – Signal Generators - Q Meter – Measurement methods – Wave analyzers – Frequency selective wave analyzer – Heterodyne wave Analyzer – Applications of wave analyzers – Spectrum analyzer.

Book for study

1. A.K. Sawhney, A Course in Electrical and Electronic and Instrumentation, Dhanpat Rai and Sons, New Delhi, (2000). (Unit I, II, III, IV & V)

Books for Reference

1. Dr. Sanjay, N. Talbar, Electronics and Instrumentation, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, (2001).

2. David A. Bell, Electronic Instrumentation and Measurements – Prentice Hall of India Private Limited, New Delhi, (2003).

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CORE COURSE VII - MATERIALS SCIENCE

Unit-I: Crystal Structure and Defects

Bonding of solids - crystal structure- NaCl, CsCl and ZnS-Reciprocal lattice-Method of Determining crystal structure – X ray Diffraction – Electron Diffraction – Neutron Diffraction – Structure Determination – Imperfection in crystals – Point defects – Line imperfection – Burger vector

Unit –II Crystal Growth and Nucleation

Nucleation and thermodynamics of crystal growth – Theories of crystal growth – Volume theory – Kossel Theory – Bravais theory – BCF theory – Low temperature solution growth – Evaporation method –Gel method – Melt method – Bridgmann method – Czochralski crystal pulling technique – Chemical Vapour transport method

Unit-III: (a) Mechanical Properties

Strength _Elasticity- Plasticity- Ductility- Malleability-Toughness- Hardness-Testing of Materials- Non-destructive Tests –Radiographic –Photo elastic and Ultrasonic methods of testing –Methods of Hardness Testing –Mechanism of deformation –Griffth's theory of fracture.

(b) Alloys: Ceramics and glasses – cement and concrete- organic polymers composite materials.

UNIT-IV Electrical Properties of Materials

Properties of Metals-Free electron Gas- Free electron theory-Zone theory of solids-Classification of conductors, insulators and semiconductors based on Zone theory-one dimensional Brillouine Zones –construction-Variation of electrical conductivity with temperature-Fermi level-carrier concentration of Intrinsic semiconductor-Barrier potential across PN Junction-Junction properties rectifier equation-Hall effect, Hall mobility, Experimental Determination of Hall coefficient, Dielectrics-Types of Polarizability-Clausius-Mosotti relation.

Unit-V- Nonlinear optical materials

Wave propagation in an anisotropic crystal – Polarization response of materials to light – Harmonic generation – Second harmonic generation – Sum and difference frequency generation – Phase matching – Borates - Urea, Thiourea complex.

Books for study

1. Kittel, C Solid State physics, Wiley and Sons, New York, (1983). (Unit I, III)
2. P.Santhanaragavan, P.Ramasamy, Crystal Growth Processes and Methods, KRU Publications, Kumbakonam, (1998). (Unit II)
3. Gupta, Kumar Solid State Physics, S. Chand & Co., New Delhi, (1983) (Unit IV)
4. B. B. Laud, Lasers and Nonlinear Optics, 2nd edition, New Age International (P) Ltd., New Delhi, 1991.

Books for reference

1. M.Wilson, K. K. G. Smith, M. Simmons, B.Ragase, Nanotechnology, Overseas Press India Pvt., Ltd., New Delhi, First Edition, (2005).
2. Hajra and Chowdhry, Material Science and Process, India Book Distribution Co., New Delhi (2001)

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CORE COURSE - VIII - MECHANICAL AND INDUSTRIAL INSTRUMENTATION

Unit I - Displacement and Dimensional measurement

Classification of displacement measuring devices – gauge blocks – surface plates – comparators – optical methods – monochromatic light – optical flats – surface roughness – thickness measurement – contact type thickness gauge – inductive and capacitive methods - Ultrasonic methods – Laser based non-conductive thickness gauge – Radiation type non-conductive – measurement of casting thickness – Laser based length measurements – Camera based width measurement – Laser diameter gauge.

Unit II-Measurement of Temperature and pressure

Temperature – Temperature Scales – electrical temperature instruments – Radiation Pyrometers – optical pyrometer – fiber optic temperature measurement system – Ultrasonic thermometer – Calibration of thermometers-Different types of pressure – Elastic Pressure transducer – C type Bourdon tube – Diaphragm – Bellows – Measurement of Vaccum – McLeod gauge – Thermal conductivity gauge – Ionization gauge – Dead weight piston gauge – Calibration of Pressure measurements.

Unit III –Measurement of Force, Torque, Speed and Vibration

Measurement of force – strain gauge of load cell- hydraulic force meter – pneumatic force meter – measurement of Torque – Inline rotating and Stationary torque – Sensor – Proximity torque sensor – measurement of speed – eddy current tachometer – contactless tachometer – measurement of vibration – accelerometers – LVDT – Piezo electric methods.

Unit IV- Measurement of Density, Viscosity and Humidity

Density measurement – Purpose of density measurement – Types of density measurement – Solid, liquid and gas density measurements – magnetic methods – Radiation density meters – Refractometric density meter-Viscosity measurement – Falling sphere viscometer – Rotating cylinder viscometer-Humidity – dew point – Relative humidity – determination of moisture content of fabrics and materials.

Unit V- Measurement of Level and Flow

Capacitance level indicator – Laser level sensors – radiation level detector – Microwave reflection level detector – optical level detector-eddy current level detector – ultrasonic level detector-Flow measurement – Venturimeter – Orifice meter – Pitot tube – Rotameter – Electromagnetic flow meter – Hotwire anemometer – Ultrasonic flow meter.

Books for Study

1. S.K. Singh – Industrial Instrumentation and Control, Tata McGraw Hill Co., New Delhi, (2003). (Unit – I, II, III, IV & V)

2. A.K.Sawhney, A Course in Mechanical Measurements and Instrumentation, Dhanpat Rai & Sons, New Delhi, (1997). (Unit III & V)

Books for Reference

1. D.S. Kumar, Mechanical Measurements and Control Metropolitan, New Delhi, (1989).

CORE COURSE – IX INSTRUMENTATION LAB-I (Electronics & Instrumentation)

Any **TWENTY-FIVE** of the following experiments to be done

1. Logic gates – Universality of NAND / NOR gates Using IC's
2. Verification of Demorgans theorems and Boolean Expressions
3. Astable and bistable and monostable multivibrator using IC 555
4. Schmitt Trigger using IC 555
5. Characteristics of UJT and Relaxation oscillator
6. Characteristics of SCR
7. FET amplifier (CD and CS configuration)
8. Phase shift network and Oscillator using IC 741
9. Wien's bridge oscillator using IC 741
10. Construction of dual regulated power supply
11. Half and Full wave precision rectifier using IC 741
12. Characteristics of LVDT
13. Characteristics of LDR
14. Calibration of pressure gauge
15. Calibration of thermistor
16. Calibration of thermocouple
17. Calibration of RTD
18. Study of the characteristics of Strain gauge
19. Study of the characteristics of Load cell
20. Study of the characteristics of torque transducer
21. Study of the characteristics of piezo electric transducer
22. Study of the characteristics of Hall effect transducer
23. Study of the characteristics of Eddy current transducer
24. Digital to analog converter - R-2R method and Weighted method
25. Study the function of multiplexer and demultiplexer
26. Study the function of decoder and encoder
27. Flip flops
28. Half adder and Full adder (using only NAND & NOR gates)
29. Half subtractor and Full Subtractor (using only NAND & NOR gates)
30. Digital comparator using XOR and NAND gates
31. BCD to seven segment display
32. Study of counter using IC 7490 (0-9 and 00-99)
33. Measurement of Resistance using AC Wheatstone bridge
34. Measurement of Capacitance using AC Desauty's bridge
35. Measurement of Inductance using Anderson's method

ELECTIVE COURSE – I
NUMERICAL METHODS AND COMPUTER PROGRAMMING

Unit I Errors and the measurements

General formula for errors – Errors of observation and measurement – Empirical formula – Graphical method – Method of averages – Least square fitting – curve fitting – parabola, exponential.

Unit II Numerical solution of algebraic and transcendental equations

The iteration method – The method of false position – Newton – Raphson method – Convergence and rate of convergence – C program for finding roots using Newton – Raphson method.

Simultaneous linear algebraic equations

Gauss elimination method – Jordon's modification – Gauss–Seidel method of iteration – C program for solution of linear equations.

Unit III Interpolation

Linear interpolation – Lagrange interpolation Gregory – Newton forward and backward interpolation formula – Central difference interpolation formula – Gauss forward and backward interpolation formula – Divided differences – Properties – Newton's interpolation formula for unequal intervals – C programming for Lagrange's interpolation.

Unit IV Numerical differentiation and integration

Newton's forward and backward difference formula to compute derivatives – Numerical integration : the trapezoidal rule, Simpson's rule – Extended Simpson's rule – C program to evaluate integrals using Simpson's and trapezoidal rules.

Unit V Numerical Solutions of ordinary differential equations

N^{th} order ordinary differential equations – Power series approximation – Pointwise method – Solutions of Taylor series – Euler's method – Improved Euler's method – Runge-Kutta method – second and fourth order – Runge-Kutta method for solving first order differential equations – C program for solving ordinary differential equations using RK method.

Books for study and Reference :

1. Introductory Methods of Numerical analysis – S.S. Sastry, Prentice – Hall of India, New Delhi (2003) 3rd Edition.
2. Numerical Methods in Science and Engineering – The National Publishing Co. Madras (2001).
3. Numerical Recipes in C, W.H. Press, B.P.Flannery, S.A.Teukolsky, W.T. Vetterling, Cambridge University (1996).
4. Monte Carlo : Basics, K.P.N. Murthy, ISRP, Kalpakkam, 2000.
5. Numerical Methods in C and C++, Veerarajan, S.Chand, New Delhi (2006).

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CORE COURSE - X - COMMUNICATION SYSTEMS

Unit I- Communication system

Theory of amplitude modulation – Theory of frequency modulation – Theory of phase modulation. Noise: Internal noise-External noise-noise calculation –noise figure-noise temperature-Antennas: antenna equivalent circuits-coordinate system-radiation fields –Polarization-power gain of Antenna-Hertzian dipole-Half wave dipole-Vertical antenna-Loop ferrite rod antenna-non-resonant antenna-driven array Parastic arrays-UHF-VHF antenna-microwave antenna.

Unit II -Digital Communication

Pulse amplitude modulation-pulse code modulation- delta modulation-Pulse frequency modulation-pulse time modulation-pulse position modulation-pulse width modulation –digital carrier systems – Amplitude shift keying- Frequency shift keying- Phase shift keying- differential and quadrapolar phase shift keying-error control coding-multiplex transmission-frequency and time division multiplexing.

Unit III- Microwaves and Radar communication

Generation of microwaves- Klystron: Reflex Klystron- Multicavity Klystron-Magnetron-detection of microwaves-IMPATT, TRAPATT and Gunn diodes – Radar-radar equation-Pulse and CW radar –MTI and automatic tracking radar.

Unit IV- Optic fiber Communication

Fiber optics-Different types of fiber: Step index and Graded index fibers- signal degradation fibers: Absorption, attenuation, Scattering losses and dispersion-Optical sources and detectors (quantitative Only)-Power launching and coupling: Source to fiber launching -fiber joints- Splicing techniques- general optical communication system

Unit V- Satellite and Cellular communication

Satellite links -Eclipses- orbits and inclination- satellite construction –Satellite communication frequencies-Different domestic satellites-Intelsat system- MARISAT satellites-telemetry- Cellular concept- Multiple Access Cellular Systems- Cellular system Operation and Planning-General Principles- analog cellular systems- Digital Cellular mobile Systems- GSM- CDMA- Cellular standards.

Books for Study

1. Dennis Roddy and John Coolen, Electonic communication-fourth edition, PHI private Ltd, (1999). (Unit I, II & V)
2. G. Kennedy and Davis, Electronic communication system, TMH, New Delhi, (1999). (Unit-III)
3. Gerd Keiser, Optical Fiber Communication, Third Edition, McGraw-Hill, Singapore, (2000). (Unit IV)
4. Raj Pandya, Mobile and Personal Communication Services and Systems, Prentice Hall of India Private Ltd., New Delhi, (2003). (Unit V)

Books for Reference

1. Sanjeev Gupta, Electronic Communication Systems, Khanna publications, New Delhi, (1995).
2. N.D.Deshandae, P.K Rangole, Communication Electronics, Tata McGraw Hill Pvt.Ltd, (1998).
3. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, Kumbakonam, (2002).

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CORE COURSE - XI ANALYTICAL INSTRUMENTATION

Unit I- X-Ray, UV, IR and Raman Spectroscopy

Classification of instrumental methods – introduction to spectroscopy – properties of EMR – EM Spectrum – X-ray – Instrumentation for X-ray spectrometry- X-ray diffractometer- X-ray absorption- UV spectroscopy- Orgin and theory- Instrumentation – applications- Theory of IR – Instrumentation –Applications- Raman spectroscopy- Mechanism for Raman effect- Instrumentation – Applications.

Unit II- NMR, ESR and Emission Spectroscopy

Introduction to NMR – Quantum description of NMR – Instrumentation – Chemical shift – spin – spin coupling –applications- Theory of ESR – Instrumentation – Hyperfine splitting – determination of 'g' value – line width – theory of emission spectroscopy – instrumentation- applications

Unit III – Mass and Atomic absorption Spectroscopy

Theory of mass spectrometer – components of mass spectrometer -applications– Principles of atomic Absorption Spectroscopy – Instrumentation – Single and Double beam Atomic Absorption Spectrometers

Unit IV -Thermal methods and Chromatography

Introduction to thermal methods analysis – thermo gravimeter – differential thermal analysis- Chromatography- Basic parts of chromatography- Methods of measurement – Liquid chromatography – Types- amino acid analyzer- Gas Chromatography

Unit V – Electromechanical Instruments

Electrochemical cell- Types of Electrodes- Conductivity meter- Polorography- Coulometers- Amperometers- Aqua meter- P^H measurement- Principle- P^H meters- Selective ion electrodes.

Books for study

1. H.H. Willard, L.L. Merit, J.A. Dean, F.A. Settle, Instrumental Methods of Analysis, CBS Publishers and Distributors, New Delhi, (1986). (Unit I, II & III)

2. R.S. Khandpur, Handbook of analytical instrumentation, Tata McGraw Hill Pvt Ltd., New Delhi, (2001). (Unit IV & V)

Books for Reference

1. G.Chatwal, S.Anand, Instrumental Methods of Chemical Analysis, Himalaya Publications House, New Delhi, (1996).

2. Robert, D. Braun, Introduction to Instrumental analysis, McGraw Hill Book House, New Delhi, (1986).

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CORE COURSE - XII – INSTRUMENTATION LAB – II (Electronics & Instrumentation)

Any **FIFTEEN** of the following experiments

1. Construction of Variable regulated power supply using IC
2. Signal generation using operational amplifier (Square, triangular, saw tooth)
3. Op-Amp applications – Adder, Subtractor, Multiplication, Division, Integration, Differentiation
4. Solving simulations equation using operational amplifier
5. Power amplifier using IC's
6. Quadrature Oscillator using operational amplifier
7. Construct Instrumentation amplifier using operational amplifier
8. Signal conditioning Circuit using operational amplifier
    i. Current to Voltage Converter
    ii. Voltage to Current converter
    iii. Voltage to frequency converter
9. Active filters using operational amplifier
10. Amplitude modulation and demodulation
11. Frequency modulation and demodulation
12. FSK modulation and demodulation
13. Pulse position modulation using IC 555
14. Pulse Width Modulation using IC 555
15. Construct Pre emphasis and De emphasis circuit
16. Circuit construction and verification using Karnaugh map
17. Electronic PID controller
18. Intensity measurement using LDR
19. Liquid level measurement using capacitive transducer
20. Abbe refractometer – measurement of refractive index
21. Characteristics of photo transistor or photodiode
22. Characteristics of different LED's
23. Determination of wavelength –grating using laser
24. Relaxation oscillator using operational amplifier

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ELECTIVE COURSE – II - MICROCONTROLLER AND DIGITAL SIGNAL PROCESSING

Unit-I 8051 Microcontroller Architecture

Microprocessors and microcontrollers-8051 architecture- microcontroller hardware-program and data memory-External memory- counters- timers- serial data I/O- interrupts

Unit-II 8051 Microcontroller Instructions and Simple programs

Addressing modes- Instructions – data transfer instructions- logical- arithmetic-jump and call instructions- bit manipulation -Addition- sum of N numbers, Multibyte addition- subtraction- multiplication-division-biggest and smallest numbers.

Unit –III Discrete time signals and Linear system

Block diagram of DSP system – Advantages and disadvantages- applications of DSP- Classification of signals – signal representation – standard discrete time signals – Classification of discrete time signals – operation on signals – Discrete time system – analog to digital conversion

Unit – IV DFT and FFT

Discrete Fourier transform – Properties of FFT – Linear and circular convolution – Filtering long duration sequence FFT – Decimation in time algorithm and frequency algorithm

Unit – V FIR and IIR filters

Magnitude and phase response of digital filters – frequency response of LPFIR filters- IIR filter design by approximate of derivatives by impulse invariant method and by Bilinear transformation – Butterworth - Chebyshew – Inverse Chebyshew and Elliptic filters

Books for Study

1. Kenneth J.Ayala, The 8051 microcontroller, architecture, programming and applications, Thomson, Delmar Learning (ISE). (2004). (Unit-I &II).
2. P.Ramesh Babu, Digital Signal Processing, Scientech Publishing Pvt., Ltd., Chennai, (2003). (Unit III, IV & V)

Book for Reference

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 microcontroller and Embedded system, Pearson Education, (2004).
2. Sanjit K. Mitra, Digital Signal Processing – A Computer based Approach, Tata McGraw Hill Publishing Ltd., New Delhi. (2003)

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ELECTIVE COURSE – III PROCESS CONTROL

Unit I -Transfer function

Open loop system - Closed loop system – transfer function modeling – properties of transfer function – transfer function of electrical network – block diagram reduction technique – signal flow graph – mason's gain formula – signal flow graph conversion from block diagram.

Unit II- Mathematical modeling of dynamical system

Mathematical modeling of dynamical system – automatic control System - transient response analysis - Modeling in state space – State space representation of Dynamic systems –Mechanical systems – Electrical and Electronic system – Linearization of Non linear Mathematical Models – Liquid level systems – pneumatic systems – Hydraulic systems – Thermal systems.

Unit III- Stability and Root locus analysis

Characteristic equation of control system – stability condition – Routh's stability criterion- Nyquist stability criterion- special cases- Definition Root Locus -construction root loci- Rules (1-12).

Unit IV- Controllers

Basic control action- proportional, integral and derivative action- Proportional Integral Controller – Proportional Derivative Controller – Proportional – Integral Derivative Controller – Controllers with Limited action – Interaction between Derivative and Integral elements – Non linear effects- Types of Control Schemes – Examples of Cascade Control – Controller settings for cascade systems – Response of Cascade systems to load changes – Feed forward modifications – Interacting control systems.

Unit –V Controlling elements

Self – operated controllers – Pneumatic, Hydraulic, Electrical and Electronic Controllers – theory of automatic controller circuits – two positions and floating controllers- Actuators- Pneumatic actuators – Hydraulic actuators – Electric Motor Actuators – Two position Motor Actuators – Final element power Failure – Fluid flow through control valves – sliding stem control valves – rotating shaft control valves control valve sizing – throttling electrical energy.

Books for study

1. Katsuhiko Ogatta, Modern Control Engineering, PHI Pvt Ltd., New Delhi, (2002).
   (Unit I &II)
2. S.Palani, Control Systems, Shanmuga Priya publishers, Tiruchirappalli,(1999). (Unit III)
3. Peter Harriott, Process Control, Tata Mcgraw Hill, New York, (1972). (Unit-IV)
4. Donald P Eckman, Automatic Process Control, Wiley Eastern Ltd., Mumbai, (1958) (Unit-V)

Books for Reference

1. Richard C.Dorf, Robert H. Bishop, Modern Control System, Adison Wesley,New Delhi, (1998).
2. Sudhir Gupta, Elements of Control system, PHI Pvt Ltd., New Delhi, (2002).

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CORE COURSE - XIII Practical – IV – PROGRAMMING LAB

Any **TWENTY** of the following experiments

8085 Microprocessor

1. Simple programs: addition, subtraction, multiplication and division
1. Find the smallest and biggest numbers in a given array
2. Find the ascending and descending order in a given array
3. Block of data transfer using string instructions
4. Find the character in a string
5. Traffic light controller
6. Relay control
7. Logic controller

8051 Microcontroller

8. Simple programs, addition, subtraction, multiplication and division
9. Program to convert gray code to 8 bit binary number
10. Fibonacci series
11. Find the factorial of a number
12. Find the square root of a number
13. Stepper motor interface
14. D/A converter (Generate square, triangular, saw tooth wave forms)
15. Interface BCD to 7-segment display
16. A/D converter

Programming in C

17. Newton – Raphson method
18. Gauss elimination method
19. Lagnangians interpolation method
20. Trapezoidal rule
21. Simpson rule
22. Eulers method
23. Range Kutta method (fourth order)
24. Finite difference method
25. Curve fitting (Least square)
26. Mean, mode and standard deviation
27. Chi square test

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ELECTIVE COURSE – IV - BIO MEDICAL INSTRUMENTATION

Unit I- Bio electric signals and Electrodes

Fundamentals of medical instrumentation- physiological system of the body- sources of biomedical signals- basic medical instrumentation- intelligent medical instrumentation system- Origin of Bio electric signals- Recording Electrodes – Silver – Silver chloride electrodes-Electrodes for ECG-Electrodes for EEG-Electrodes for EMG Electrical conductivity of Electrode Jellies and Creams-Micro electrodes.

Unit II- Recording systems and recorders

Basic recording system-General considerations for signal conditioners-preamplifiers-source of noise in low level measurements- Biomedical signal analysis technique- main amplifier and driver stage- writing systems- direct writing recorders-the ink jet recorders-potentiometric recorder-digital recorders-Instrumentation tape recorders-Electrocardiograph, Vector cardiograph, Phonocardiograph – Electroencephalograph - Electromyograph and other Biomedical recorders- Bio feed back instrumentation.

Unit III - Measurement and analysis techniques

The Heart and cardiovascular system - Heart Blood pressure - Characteristics of Blood flow - Heard Sounds (the cardiovascular system) -Electro cardiography-measurement of Blood pressure- measurement of Blood flow and cardiac output, Plenthysmography - measurement of heat sounds-The physiology of the respiratory system of tests and instrumentation for the mechanics- breathing-Respiratory therapy Equipment- Origin of EEG-Action Potentials of the brain-evoked potentials- Anatomy of the brain- brain waves- placement of electrodes-Recording set up- Analysis of EEG.

Unit IV - Magnetic Resonance and Ultrasonic Imaging systems

Principles of NMR Imaging system - Image reconstruction Techniques-Basic NMR components- Biological efforts of NMR Imaging- Advantages of NMR Imaging System -Diagnostic ultra sound- physics of ultrasonic waves-medical ultra sound- basic pulse – echo apparatus, A – scan - echocardiograph (M mode)- B-scanner-Real time ultrasonic Imaging systems-Multi element Linear Array Scanners- Digital Scan converter-Biological effects of Ultra sound.

Unit V - Advanced Bio medical systems

Pacemakers- Need for Cardiac pacemaker- External Pace makers- Implantable Pace makers- recent developments in Implantable Pacemakers-Pacing system Analyzer-Defibrillators- Need for a Defibrillator- DC Defibrillator- Implantable Defibrillators-Pacer - Cardioverter –Defibrillator Analyzers - Physio therapy and electro therapy equipment- High frequency heat therapy – short wave diathermy – microwave and ultrasonic therapy – pain relief through electrical simulation

Books for Study

1. R.S. Khandpur, Handbook of Biomedical instrumentation, Tata McGraw Hill Publishing Company Limited. New Delhi, (2003). (Unit I, II, IV & V)

2. Lestlie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Bio medical instrumentation and measurements, PHI, New Delhi. (Unit-III)

Book for Reference

1.M.Arumugam, Biomedical Instrumentation, Anuradha Agencies, Kumbakonam, (2000).

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ELECTIVE COURSE – V - NANO-SCIENCE AND NANO-TECHNOLOGY

Unit I Background to Nano-Technology

Scientific revolution- Atomic structures-Molecular and atomic size-Bohr radius – Emergence of Nanotechnology – Challenges in Nanotechnology - Carbon age– New form of carbon. (from Graphene sheet to CNT)

Unit II Nucleation

Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly process-grain boundary volume in nanocrystals-defects in nanocrystals-surface effects on the properties.

Unit III Types of Nanostructures

Definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire-Core/Shell structures.

Unit IV Nanomaterials and properties

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO_2, CeO_2, ZnO) - Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor- Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties.

Unit V Applications of nanomaterials

Molecular electronics and nanoelectronics – Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification.

Books for study and References

1. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), *The chemistry of nanomaterials: Synthesis, properties and applications*, Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
3. Kenneth J. Klabunde (Eds), *Nanoscale Materials Science*, John Wiley & Sons, InC, 2001.
4. C.S.S.R.Kumar, J.Hormes, C.Leuschner, *Nanofabrication towards biomedical applications,* Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
5. W. Rainer, *Nano Electronics and information Technology*, Wiley, 2003.
6. K.E.Drexler, *Nano systems*, Wiley, 1992.
7. G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.