M.Sc. (Tech.) Engineering Physics - Scheme and Syllab



M.Sc. (Tech.) ENGINEERING PHYSICS

RULES AND REGULATIONS SCHEME OF INSTRUCTION AND SYLLABI

of

P.G. Programs

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NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL 506 004

M.Sc. (Tech.) ENGINEERING PHYSICS

COURSE STRUCTURE

I Year (Common to Electronics, Photonics, Instrumentation) I Semester

S. No.	Course No.	Course Name	L	Т	Ρ	С
1	MA5012	Complex Variables and Integral Transforms	4	0	0	4
2	PH5101	Electromagnetic Theory	4	0	0	4
3	PH5102	Quantum and Statistical Mechanics	4	0	0	4
4	PH5103	Modern Optics	4	0	0	4
5	PH5104	Electronics Devices and Circuits	4	0	0	4
6	PH5105	Optics I Laboratory	0	0	3	2
7	PH5106	Electronics Laboratory	0	0	3	2
8	ME5039	Engineering Graphics	0	0	3	2
		Total				26

I Year (Common to Electronics, Photonics, Instrumentation) II Semester

S. No.	Course No	Course Name	L	Т	Ρ	С
1	MA5061	Numerical Methods and				
		Optimization Techniques	4	0	0	4
2	PH5151	Laser Physics and Systems	4	0	0	4
3	PH5152	Digital Electronics	4	0	0	4
4	PH5153	Solid State Physics	4	0	0	4
5	PH5154	Computer Programming and				
		Data Structures	4	0	0	4
6	PH5155	Solid State Physics Laboratory	0	0	3	2
7	PH5156	Computer Programming and				
		Data Structures Laboratory	0	0	3	2
8	ME5087	Workshop Practice	0	0	3	2
9	PH5191	Seminar	0	0	3	1
		Total				27

S. No.	Course No	Course Name	L	Т	Ρ	С
1	PH6101	Linear IC Applications and Data Converters	4	0	0	4
2	PH6201	Opto Electronics	4	0	0	4
3	PH6102	Digital System Design	4	0	0	4
4	PH6103	Microprocessors and Interfacing	4	0	0	4
5		Elective I	3	0	0	3
6	PH6104	Linear IC Applications Laboratory	0	0	3	2
7	PH6105	Digital System Design Laboratory	0	0	3	2
8	PH6106	Microprocessor and Interfacing Laboratory	0	0	3	2
		Total				25

II Year (Electronics Specialisation) I Semester

II Year (Photonics Specialisation) I Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH6101	Linear IC Applications and Data Converters	4	0	0	4
2	PH6201	Opto-Electronics	4	0	0	4
3	PH6202	Optical System Design	4	0	0	4
4	PH6203	Optical Materials, Production and Testing	4	0	0	4
5		Elective I	3	0	0	3
6	PH6104	Linear IC Applications Laboratory	0	0	3	2
7	PH6204	Optical System Design Laboratory	0	0	3	2
8	PH6205	Optics II Laboratory	0	0	3	2
		Total				25

II Year (Instrumentation Specialisation) I Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH6101	Linear IC Applications and				
		Data Converters	4	0	0	4
2	PH6301	Control Systems	4	0	0	4
3	PH6302	Nuclear Instrumentation	4	0	0	4
4	PH6303	Transducers and Measurement				
		Techniques	4	0	0	4
5		Elective I	3	0	0	3
6	PH6104	Linear IC Applications Laboratory	0	0	3	2
7	PH6304	Transducers & Measurements				
		Laboratory	0	0	3	2
8	PH6305	Nuclear Instrumentation Laboratory	0	0	3	2
		Total				25

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH6151	Micro Controllers and Embedded Systems	4	0	0	4
2	PH6152	Communication Theory	4	0	0	4
3	PH6251	Fiber Optic Communication	4	0	0	4
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6	PH6153	Communication Laboratory	0	0	3	2
7	PH6253	Fiber Optic Communication				
		Laboratory	0	0	3	2
8	PH6154	Micro Controllers Laboratory	0	0	3	2
9	PH6191	Seminar	0	0	3	1
		Total				25

II Year (Electronics Specialisation) II Semester

II Year (Photonics Specialisation) II Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH6152	Communication Theory	4	0	0	4
2	PH6251	Fiber Optic Communication	4	0	0	4
3	PH6252	Optical Instrumentation	4	0	0	4
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6	PH6153	Communication Laboratory	0	0	3	2
7	PH6253	Fiber Optic Communication			-	-
		Laboratory	0	0	3	2
8	PH6254	Optical Instrumentation Laboratory	0	0	3	2
9	PH6191	Seminar	0	0	3	1
		Total				25

II Year (Instrumentation Specialisation) II Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH6151	Micro Controllers and Embedded	4	~	0	4
		Systems	4	0	0	4
2	PH6252	Optical Instrumentation	4	0	0	4
3	PH6351	Process Instrumentation	4	0	0	4
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6	PH6154	Micro Controller Laboratory	0	0	3	2
7	PH6254	Optical Instrumentation Laboratory	0	0	3	2
8	PH6352	Process Instrumentation Laboratory	0	0	3	2
9	PH6191	Seminar	0	0	3	1
		Total				25

S. No.	Course No	Course Name	L	Т	Ρ	С
1	PH7101	Digital Signal Processing	4	0	0	4
2	PH7102	Microwaves and Wave Propagation	4	0	0	4
3		Elective IV	3	0	0	3
4		Elective V	3	0	0	3
5		Elective VI	3	0	0	3
6	PH7103	Digital Signal Processing Laboratory	0	0	3	2
7	PH7142	Comprehensive Viva				2
		Total				21

III Year (Electronics Specialisation) I Semester

III Year (Photonics Specialisation) I Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH7201	Opto Electronic Sensing and MOEMS	4	0	0	4
2	PH7202	Integrated Optics	4	0	0	4
3		Elective IV	3	0	0	3
4		Elective V	3	0	0	3
5		Elective VI	3	0	0	3
6	PH7203	Opto Electronic Sensing Laboratory	0	0	3	2
7	PH7142	Comprehensive Viva				2
		Total				21

III Year (Instrumentation Specialisation) I Semester

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH7301	Analytical Instrumentation	4	0	0	4
2	PH7302	Nondestructive Testing	4	0	0	4
3		Elective IV	3	0	0	3
4		Elective V	3	0	0	3
5		Elective VI	3	0	0	3
6	PH7303	Analytical Instrumentation and NDT Laboratory	0	0	3	2
7	PH7142	Comprehensive Viva				2
		Total				21

S. No.	Course No	Course Name	L	т	Ρ	С
1	PH7199	Project Work (22 weeks)	0	0	0	20
		Total				20

III Year (Electronics, Photonics, Instrumentation) II Semester

LIST OF ELECTIVES

Electronics Specialisation

Elective I

PH6111	VLSI Basics
PH6211	Laser Technology
PH6311	Sensors and Transducers

Elective II, III

PH6161	Computer Organization and Operating Systems
PH6162	Industrial Electronics
PH6261	Nonlinear Optics
PH6262	Nanophotonics
PH6361	Fundamentals of Control Systems
PH6362	Device Materials and Fabrication Techniques

Elective IV, V, VI

PH7111	Data Communication
PH7112	Medical Physics and Physiological Measurements
PH7113	Electronic Instrumentation
PH7211	IR Optics and Thermal Imaging
PH7212	Biophotonics
PH7213	Laser Applications
PH7214	Fourier Optics and Holography
PH7311	Digital and Distributed Control Systems
PH7312	PC Based Instrumentation

LIST OF ELECTIVES

Photonics Specialisation

Elective I

PH6112 Digital Systems and Micropro	ocessors
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- PH6211 Laser Technology
- PH6311 Sensors and Transducers

Elective II, III

PH6161	Computer Organization and Operating Systems
PH6162	Industrial Electronics
PH6261	Nonlinear Optics
PH6262	Nanophotonics
PH6361	Fundamentals of Control Systems
PH6362	Device Materials and Fabrication Techniques

Elective IV, V, VI

PH7111	Data Communication
PH7112	Medical Physics and Physiological Measurements
PH7113	Electronic Instrumentation
PH7211	Infrared Optics and Thermal Imaging
PH7212	Biophotonics
PH7213	Laser Applications
PH7214	Fourier Optics and Holography
PH7311	Digital and Distributed Control Systems
PH7312	PC Based Instrumentation

LIST OF ELECTIVES

Instrumentation Specialisation

Elective I

PH6112	Digital systems and Microprocessors
PH6211	Laser Technology

PH6311 Sensors and Transducers

Elective II, III

PH6161	Computer Organization and Operating Systems
PH6162	Industrial Electronics
PH6262	Nanophotonics
PH6263	Fiber Optics
PH6361	Fundamentals of Control Systems
PH6362	Device Materials and Fabrication Techniques

Elective IV, V, VI

PH7111	Data Communication
PH7112	Medical Physics and Physiological Measurements
PH7113	Electronic Instrumentation
PH7211	Infrared Optics and Thermal Imaging
PH7212	Biophotonics
PH7213	Laser Applications
PH7214	Fourier Optics and Holography
PH7311	Digital and Distributed Control Systems
PH7312	PC Based Instrumentation

<u>Syllabus</u>

M.Sc. (Tech.) ENGINEERING PHYSICS

MA5012 COMPLEX VARIABLES AND TRANSFORM TECHNIQUES

(4-0-0)4

Analytic function - complex integration - Taylor's and Laurent's series expansions - evaluation of real integrals using residue theorem - Laplace Transform - inverse Laplace transform - Solution of linear differential differential equations - Fourier transform, inverse Fourier transform - Fourier sine and cosine transforms - fast Fourier transform.

Reading:

- 1. R.V. Churchill, *Complex Variables and Applications*, McGraw Hill, 1960.
- 2. R.V. Churchill, Operational Mathematics, McGraw Hill, 1954.
- 3. M.R. Spiegel, Laplace Transforms (Schaum Series), McGraw Hill, 1999.
- 4. M.R.Spiegel, *Complex Variables (Schaum Series)*, McGraw Hill, 1999.

PH 5101

ELECTROMAGNETIC THEORY

(4-0-0)4

Electrostatics and Magnetostatics-Maxwell's Equations-Boundary conditions- Propagation of plane electromagnetic waves - Reflection and refraction of plane waves - Poyinting Vector - Waveguides - parallel plate, rectangular - TE,TM waves - Propagation of EM waves in waveguides with dielectric medium - Transmission Lines.

Reading:

- 1. Jordan E.C.Balmain K.G, *Electromagnetic Waves and Radiating Systems*, 2nd Edition, Prentice Hall, 2008.
- 2. G.Keiser, Optical Fiber Communications, McGraw Hill, 2007.
- 3. D.J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall, 2002.

PH 5102 QUANTUM AND STATISTICAL MECHANICS

(4-0-0)4

Operators - Schrodinger wave equation (time-independent and time-dependent) – problems in one and three dimensions – perturbation theory – approximation methods – Matrix representation of wave equation – Angular momentum – Ensembles – MB, FD and BE statistics.

Reading:

- 1. Schiff,L., Quantum Mechanics, TMH, 2005.
- 2. Beiser, Concepts of Modern Physics, TMH, 2004.
- 3. G. Aruldas, Quantum Mechanics, PHI, 2006.

PH 5103

MODERN OPTICS

(4-0-0)4

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Wave Optics - EM Waves - Interferometers - Coherence - Theory of Diffraction - Ray optics - Ray matrices - Polarization - Jones vectors - crystal optics - Gaussian beams - Electromagnetic Optics - Elements of Fourier optics.

Reading:

- 1. Saleh, B.E.A. and Carl Teich, M., *Fundamentals of Photonics,* John Wiley & Sons, New York, 2002.
- 2. Hecht, E., Optics, 2nd Edition, Addison-Wesley, London, 2003.

PH 5104 ELECTRONICS DEVICES AND CIRCUITS

Network theory, mesh and node analysis, Network Theorems, Diode-BJT,FET-Working-h-parameter analysis-Small signal and power amplifiers-analysis and design-SCR, UJT, Tunnel Diode, Photo Diode LED-Working and applications.

Reading:

- 1. Millman, J. and Halkias, C., *Electronic Devices and Circuits*, TMH, 2000.
- 2. John D. Ryder, *Electronic Fundamentals and Applications*, PHI, 2002.

OPTICS - I LABORATORY

Beam parameters of a laser - Michelson interferometer - Fabry-Perot interferometer - Polarization, birefringence of materials, optical Isolator - Coherence and lasers, frequency separation between the axial modes - thickness of cladding on an optical fiber by diffraction.

ELECTRONICS LABORATORY

PH 5106

Transistor, FET characteristics- RC coupled amplifier using BJT - Emitter follower - Common source amplifier-FW, Bridge rectifiers with C and Pi filters - Constant current source ramp generator - Source follower-Voltage-series feedback amplifier - Voltage-shunt feedback amplifier - Class-A power amplifier.

ME5039 ENGINEERING GRAPHICS (0-0-3)2

Principles of orthographic projections, Geometric construction, Projection of points, lines, planes and solids, Conversion of isometric views to orthographic views.

Reading:

- 1. Bhatt, N.D., *Elements of Engineering Drawing*, Charotar Publishers, 2005
- 2. Sham Tikoo., Understanding AutoCAD 2002, Tata McGraw Hill Book Company, New Delhi, 2001.
- 3. Lakshminarayanan, V. and Vaishwanar, R.S., *Engineering Graphics including AutoCAD 2002,* Jain Brothers, New Delhi, 2005.

MA5061 NUMERICAL METHODS AND OPTIMIZATION TECHNIQUES (4-0-0)4

Numerical Methods : Curve fitting - Regula-Falsi method Newton-Raphson's method - interpolation - Numerical Integration - Numerical solution of first order ODE. Optimization Techniques : One dimensional minimization methods, Unconstrained Optimization methods, Direct search methods, Descent methods.

Reading:

- 1. S.S.Sastry, Introductory Methods of Numerical Analysis, PHI, 2010.
- 2. S.S.Rao, Optimization Theory and Applications, Wiley Eastern, 2004.
- 3. M.K.Jain, S.R.K.Iyengar and R.K.Jain, *Numerical Methods for Scientific and Engineering Computation,* New Age International, 2008.

LASER PHYSICS AND SYSTEMS

PH 5151

Stimulated emission - Einstein's coefficients- gain medium - Line broadening- threshold condition-population inversion - pumping mechanism - Cavity modes - Resonator stability - Q switching - mode locking - Basic laser systems - Solid state lasers

Reading:

- 1. Orazio Svelto, *Principles of Lasers*, 6th Edition, Springer, 2010.
- 2. Willaim T Selfvast, *Laser Fundmentals,* Cambridge Univ-Press, 1996.
- 3. Saleh, B.E.A. and Carl Teich, M., Fundamentals of Photonics, John Wiley & Sons, New York, 2002.

PH 5152

DIGITAL ELECTRONICS

Digital circuits: logic signals and gates. Combinational logic design: switching algebra, theorems, logic functions, combinational, circuit analysis, synthesis, circuit minimization, Karnaugh maps.

Reading:

- 1. Walkerly, J.F., *Digital Design: Principles and Practices,* 3rd Edition, Pearson, 2002.
- 2. Floyd Thomas L, *Digital Fundamentals,* 2nd Edition, Perason, 2006.

PH 5153

Readina:

engineering materials.

SOLID STATE PHYSICS

relation in dielectrics - Superconductivity - types of superconductors - Semi-conductors - Current trends in

Crystallography - Magnetic materials - Weiss theory of ferromagnetism. Dielectrics - Clausius - Mosotti

1. Puri, R.K. and Babbar, V.K., Solid State Physics and Electronics, S. Chand Company, 2003.

2. Pillai, S.O., Solid State Physics, New Age International, 2002.

PH 5105

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PH5154 COMPUTER PROGRAMMING AND DATA STRUCTURES

(4-0-0)4

Introduction to computer programming- basics of C++ language - Procedural Abstraction - functions - Objects and Classes - Structures-Abstract Data Types - Branching and looping mechanism - Arrays - Pointers-Dynamic Arrays - Data structures- Stack-Queue-Trees - Binary Tree-Search ADT. *Reading:*

1. Walter Savitch, *Problem Solving with C++,* 6th Edition, Pearson, 2008.

2. Weiss M.A., Data Structures and Algorithm Analysis in C++, Pearson Addison-Wesley, 2006.

PH 5155 SOLID STATE PHYSICS LABORATORY (0-0-3)2

Energy band gap - surface structures of specimens - Dielectric behavior of the sample-Temperature dependence on resistance and determination of energy gap - lattice constant of cubic crystal - Curie temperature - characteristics of Photodiode - Phototransistor - Preparation of crystals.

PH 5156 COMPUTER PROGRAMMING AND DATA STRUCTURES LABORATORY (0-0-3)2

Familiarization of a computer - Editing of documents in Unix - Simple problems involving expression evaluation, conditional branching, iterations. structures - Top down design functions - Examples on recursion - data types - Use of arrays, pointers-Stacks, queues and expressions - Binary trees.

ME5087 WORKSHOP PRACTICE (0-0-3)2

Exposure is given to students in the following trades: Fitting and Machine shop.

PH6101 LINEAR IC APPLICATIONS AND DATA CONVERTERS (4-0-0)4

Operational amplifier- construction, characteristics, specification of parameters, applications; Specialized IC applications - 555 timer, Voltage controlled oscillator, Phase locked loop, function generators, IC voltage regulators; Data converters- analog multiplexers, A/D and D/A converters.

Reading:

- 1. Ramakanth, A. and Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4th Edition, PHI, 2000.
- 2. Roy Choudhury, D. and Shail B. Jain, *Linear Integrated Circuits,* 4th Edition, New Age International, 2011.
- 3. Bakshi U.A., Godse A.P., Bakshi A.V., *Linear Integrated Circuits and Applications*, Technical Publishers, 2010.

PH6102

DIGITAL SYSTEM DESIGN

(4-0-0) 4

Combinational circuit design: barrel shifter, floating point and dual-priority encoder, VHDL, sequential circuit design features and practices, SSI latches and flip-flops, counters, shift registers in VHDL, introduction to memory. CPLDS and FPGAS: ROM & RAM-structure, decoding, timing and applications, CPLDS and FPGAS and programming.

Reading:

- 1. John F. Walkerly, *Digital Design: Principles and Practices,* 3rd Edition, Pearson, 2002.
- 2. Yalamanchili Sudhakar, Introductory VHDL: from Simulation to Synthesis, Pearson, 2002.

PH6103 MICROPROCESORS AND INETERFACING (4-0-0)4

Micro processor architecture, addressing modes, assembly language programming, Memory and I/O mapping, Interfacing I/O devices - 8279, 8254,82655. Interrupts and DMA, Pentium processors. *Reading:*

- 1. Douglas V. Hall, *Microprocessors and Interfacing: Programming and Hardware*, TMH, 1998.
- 2. Barry E. Bray, *The Intel Microprocessors: Architecture, Programming of Interfacing,* 6th Edition, PHI, 2000.

PH6104 LINEAR IC APPLICATIONS AND DATA CONVERTERS LABORATORY (0-0-3)3

Inverting and non-inverting and summing amplifiers, Precision rectifiers, Second order low pass and high pass filters, Multivibrators, Function generator using 8038, Dual slope A/D converter, 4-bit D/A converter using R-2R ladder, Applications using DAC 0800, Power supply with three terminal voltage regulators.

PH6105 DIGITAL SYSTEM DESIGN LABORATORY (0-0-3)3

Biquinaryand BCD counting, Shift Register, prime number detector, data selectors and decoders, Four-bit prime number detector, 3 to 8 binary decoder, Eight input priority encoder (like 74 x 148), Four bit binary counter (like 74163), Ones counting machine using VHDL.

PH6106 MICROPROCESSORS AND INTERFACING LABORATORY (0-0-3)3

Assembly language programming and interface experiments with INTEL 8086 using digital I/O card on PC for the following-Stepper Motor, LVDT - Calibration and Measurement, Temperature measurement using PT 100-IC sensors and thermocouples, Strain gauge.5. Proximity detection and relay operation.

PH6201 OPTO ELECTRONICS

Optical circular waveguides and their modes of propagation. Optical fiber structures, materials, fabrication, and cables. Signal degradation and design optimization of SM fibers. Semiconductor light sources and detectors for Optical communications. Light modulators and display devices.

Reading:

- 1. G. Keiser, Optical Fiber Communications, MGH, 2000.
- 2. J. Wilson and J.F.B. Hawkes, *Optoelectronics An Introduction*, PHI, 2009.
- 3. S. M. Sze, Semiconductor Devices, Wiley, 2002.

PH6202

OPTICAL SYSTEM DESIGN

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Introduction to Optical systems, Ray tracing procedures, Aberrations, Multi lens systems, Photometry of optical systems, Mirrors and prisms, Image evaluation, Optical systems, Optimization techniques.

Reading:

- 1. Kingslake, R., *Optical System Design,* 2nd Edition, Academic Press, 2010.
- 2. Smith, W.J., *Modern Optical Engineering*, 3rd Edition, McGraw Hill, 2000

PH6203 OPTICAL MATERIALS PRODUCTION AND TESTING (4-0-0)4

Types of Optical glass - IR materials - gallium arsenide - Optical glass making, IR materials manufacturing - abrasives, polishing compounds - Tools and fixtures - spherical and plano tools - Optical fabrication - Optical shop testing.

Reading:

- 1. Hank H. Karow, *Fabrication Methods for Precision Optics*, John Wiley and Sons, New York, 1993.
- 2. David Malacara, *Optical Shop Testing*, John Wiley and Sons, New York, 1992.

PH6204 OPTICAL SYSTEM DESIGN LABORATORY (0-0-3)2

Ray tracing - lay output of an optical system - Computation of Aberrationst - Design of aplanatic objective -Seidal aberrations - zonal spherical aberration - apochromatic objective - Tracing oblique meridional rays and skew rays - primary lateral colour - Triplet design.

PH6205 **OPTICS II LABORATORY** (0-0-3)2

Fabrication of optical flat, lens, prism - Measurement of thickness, curvature, focal length - Testing by Interferometers - Rotation of the plane of polarization - electro-optic and Acoustic-optic modulator - LED and ILD- Light Detectors - Index profile of graded index fibers - Measurement of NA, attenuation - Waveguide and Chromatic dispersion in fibers using PC.

CONTROL SYSTEMS

Open and closed systems, mathematical modeling, block diagrams, Transient response analysis, steady state error analysis, stability, Root locus, frequency domain analysis, Bode plot, polar plot, Nyquist stability criteria, lead, lag compensators, PI, PD, PID controllers, sampled data control systems. *Reading:*

1. K. Ogata, Modern Control Engineering, PHI, 2002.

2. Benjamin C Kuo, Automatic Control Systems, PHI, 2003.

PH6302 NUCLEAR INSTRUMENTATION

Radioactivity and matter: Nuclear properties; Radiation detection and measurement, Nuclear techniques and analytical instruments, X.R.F techniques, Industrial instruments, density estimation of the fluids, Medical instrumentation, thyroid estimation, CT, MRI.

Reading:

PH6301

- 1. Michael Sayer and Abhai Mansingh, *Measurement, Instruments and Experimental Design in Physics and Engineering*, PHI, 2000.
- 2. Glen F. Knoll, *Radiation Detection and Measurement,* 4th Edition, Wiley Science, 2010.

PH6303 TRANSDUCERS AND MEASUREMENT TECHNIQUES (4-0-0)4

Characteristics of instrument systems: Static and Dynamic characteristics; Errors in measurement and calibration: Transducers for the measurement of physical parameters like temperature, pressure, displacement etc., telemetry systems and recorders.

Reading:

- 1. Liptak.B.G, Philadelphia Chilton, Instrument Engineers Handbook, Vol-I and II, 1970.
- 2. Murty, D.V.S., *Transducers and Instrumentation*, Prentice Hall of India, 1995.

PH6304 TRANSDUCERS AND MEASUREMENT TECHNIQUES LABORATORY (0-0-3)2

Temperature measurement with RTD, Thermistor, Thermocouple and calibration, Displacement measurement using capacitive and inductive Transducers, Speed and torque measurement- Calibration of LVDT load cell, Strain and Gaugefactor measurement - measurement of pH.

PH6305 NUCLEAR INSTRUMENTATION LABORATORY (0-0-3)2

GM detection-inverse square law for gamma rays - End point energy of Beta rays-activation and decay characteristics using a neutron source - Resolution and linearity of Na (TI) detector - linear absorption coefficient-gamma emitter - mass absorption coefficient- Energy analysis of an unknown source-counting statistics of a radioactive source.

PH6151 MICRO CONTROLLERS AND EMBEDDED SYSTEMS (4-0-0)4

The Intel MCS-51 Microcontrollers Architecture - Assembly Language Programming of 8051-instructions-PIC Microcontrollers - PIC18F452 - Special features of CPU-Programming with PIC microcontrollers-Development tools - Interfacing of different devices - Serial and Wireless communication protocols. *Reading:*

- 1. Kenneth.J.Ayala, *The 8051 Microcontroller Architecture Programming and Applications*, 3rd Edition, Thomson Publications, 2004.
- 2. Muhamad Ali Mazdi, *The 8051 Microcontroller and Embedded Systems Using Assembly and C,* 2nd Edition, Pearson Education India, 2007.

PH6152

COMMUNICATION THEORY

(4-0-0)4

Introduction: overview of modulation and demodulation. Analog communication: introduction, amplitude modulation, DSB suppressed carrier modulation and detection. Digital communication: introduction to pulse modulation, sampling process. Introduction to error control coding.

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Reading:

- 1. Kennedy, Davis, *Electronic Communication Systems*, 4th Edition, TMH, 2008
- 2. Simon Haykin, Communication Systems, 3rd Edition, John Wiley and Sons, New York, 1996.
- 3. Wayne Tomasi, Advanced Electronics Communication Systems, 6th Edition, Pearson, 2004.

PH6153 COMMUNICATION SYSTEMS LABORATORY (0-0-3)2

Amplitude modulation - BJT, IC 1496 - Balanced modulator - IC 1496-Frequency modulation - VCO-Detection of AM-Detection of FM - PLL-PWM, PPM using 555 timer and Op-amp S/H - FSK generation using 555 timer FSK detection using PLL.

PH6154 MICROCONTROLLERS LABORATORY (0-0-3)2

Simulation of traffic control signal sequence - Study of Latch, Buffer, Decoder and RAM -Interfacing DC motor and simulation, Elevator using DYNA - 51 kit- A/D Conversion using PIC - Development of LCD driver for PIC DEM2 PLUS board- Interfacing Temperature sensor to PIC 18F452 - D/A conversion using PIC micro controller.

PH6251 FIBER OPTIC COMMUNICATION (4-0-0)4

Elements of optical fiber link, advantages and applications. power launching, joints, splices, connectors, and test methods. Optical receiver and transmission systems - power and rise time budget, noise effects. WDM concepts and components, Optical amplifiers, Optical networks- SONET/SDH, Nonlinear effects, Solitons, Ultrahigh Capacity Networks.

Reading:

- 1. G. Keiser, Optical Fiber Communications, McGraw Hill, 2008,
- 2. G. P. Agrawal, Fiber Optic Communication Systems, John Wiley, 2008,
- 3. J. M. Senior, *Optical Fiber Communications*, PHI, 2009.

PH6252

OPTICAL INSTRUMENTATION

(4-0-0)4

Radiometry: basic concepts; Visual Systems: magnifiers and eyepieces; Projection Systems: profile projectors; IR and Medical Systems: thermal imaging instruments; Metrology Instruments: interferometric instruments, online optical sensing of temperature and flow.

Reading:

- 1. Malcara, D., *Geometrical and Instrumental Optics*, Academic Press, London, 2000.
- 2. Kingslake, R. Applied Optics and Optical Engineering, Vol. 4 and 5, Academic Press, London, 2001.

PH6253 FIBER OPTIC COMMUNICATION LABORATORY (0-0-3)2

Source coupling and Misalignment losses in fibers, Practice of preparing fiber ends and fiber splicing, Characterization of Components for fiber Communication, Design aspects of fiber optic communication system, studies on fiber optic analog and digital links, Time division multiplexing of signals in fibers.

PH6254 OPTICAL INSTRUMENTATION LABORATORY (0-0-3) 2

Guild spherometer- Abbe refractometer- Auto collimator-thread angle, pitch measurement-Mach - Zehnder interferometer, thickness of transparent media, testing of optical components-Angle of wedge -Laser interferometer, precision distance measurement- diffraction strain gauge-Shear plate interferometer.

PH6351 PROCESS INSTRUMENTATION (4-0-0)4

Introduction to process control; Analog and digital signal condition-ing;Thermal, mechanical and optical transducers - Final control - mechanical, electrical control elements; Controller principles - process characteristics; Analog and Digital control principles; supervisory and direct digital control, control system quality, stability, frequency response methods.

Reading:

- 1. Curtis D. Johnson, Process Control Instrumentation Technology, PHI, 2011
- 2. S.K. Singh, Process Control Concepts, Dynamics and Applications, PHI, 2009

PH6352

PROCESS INSTRUMENTATION LABORATORY

(0-0-3)2

Pressure control process, level control process, flow control process, pneumatic control valve, Optical absorption studies of Semi-conducting samples from UV to IR Range, Determination of absorption and Transmission Coefficients of the samples using UV-IR spectro-photometry.

PH6111

VLSI BASICS

(3-0-0)3

NMOS and PMOS transistors; Processing Technology: Wafer processing; Design rules and layout: transistor sizing and scaling principles; CMOS design principles: design strategies; CMOS testing: need for testing, design strategies for test, chip;

Reading:

- 1. Neil, H.E.W., Kamran, E., *Principles of CMOS VLSI Design a System Perspective*, Addison Wesley, 2000.
- 2. Wayne, W., Modern VLSI Design System on Chip Design, PHI, 2000.

PH6161 COMPUTER ORGANIZATION AND OPERATING SYSTEMS (3-0-0)3

Computer Organization-Computer hardware and software, Micro-programmed control Input-Output organization, Memory, Pipelining, Computer peripherals; Operating Systems-OS concepts, Process management, Threads, CPU scheduling, Process synchronization.

Reading:

- 1. Carl, Hamacher, Z. Vranesic, S. Zaky, *Computer Organization*, 5th Edition, TMH, 2011.
- 2. Silberschatz, Galvin, Gagne, Operating Systems Concepts, 8th Edition, Wiley, 2011.

PH6162 INDUSTRIAL ELECTRONICS

(3-0-0)3

Line commutated converters and inverters: SCR Converter circuits, parallel and series inverters, forced commutated inverters, step up, multiphase and AC choppers. DC drive circuits, Relay timers and resistance welding circuits, DC and AC operated time delay relays, battery chargers, UPS, photo thyristors, LED's opto couplers & isolators.

Reading:

- 1. Harish C. Rai, Industrial and Power Electronics, Umesh Publishers, 2001.
- 2. Rama Murthy, *Thyristors*, East West Publishers Pvt. Ltd., 2001.

PH 6211

LASER TECHNOLOGY

(3-0-0)3

Power source for CW and pulsed lasers: Energy transfer in solid state laser systems, ion laser systems, molecular lasers, organic dyes and liquid dye lasers. Semiconductor lasers, Excimer lasers and metal vapor lasers, Optics for lasers, damage in optical components.

Reading:

- 1. Ready, J.F., Industrial Applications of Lasers, Academic Press, 2nd Edition, 2000.
- 2. Charschan, S.S., *Lasers in Industry*, Van Nostrand, 2001.

PH6261

NON LINEAR OPTICS

(3-0-0)3

Nonlinear Optical Interactions - Polarization response of materials to light - Harmonic generation- Phase matching - bistability - self focusing - Third-Order Nonlinear Susceptibility- Self-Phase Modulation- Optical Solitons - Four-Wave Mixing - Kerr effect - Multiphoton processes- Stimulated Brillouin and Raman scattering.

Reading:

- 1. R Boyd, Nonlinear Optics, Academic Press, 3rd Edition, 2008.
- 2. Govind P. Agrawal, Nonlinear Fiber Optics, 3rd Edition, AP, 2001

Evanescent fields-propagation and focusing of optical fields - spatial resolution and position accuracy - light generation by nanostructures - Quantum emitters - Nanolasers - Photonic crystals - surface plasmas. Reading:

NANOPHOTONICS

- 1. Lukas Novotny, Bert Hecht, Principles of Nano Optics, Cambridge Univ. Press, 2009.
- 2. P.N. Prasad, Nano Photonics, John Wiely, 2004.

SENSORS AND TRANSDUCERS PH6311

Principles, Classification, Characteristics - Mechanical and Electromechanical Sensors - Thermal Sensors - Magnetic Sensors - Radiation Sensors - Electro-analytical Sensors-Smart Sensors - Recent trends in Sensor technologies - Applications.

Reading:

PH6262

- 1. D. Patranabis, *Sensors and Transducers*, 2nd Edition, PHI, 2002.
- 2. B.C.Nakra and K.K.Chaudhary, Instrumentation, Measurement and Analysis, PHI, 2000.

PH6361 FUNDAMENTALS OF CONTROL SYSTEMS (3-0-0)3

Open and closed systems, Block diagrams and reduction, mathematical modeling of physical systems, Transient response analysis of I and II order systems, steady state error analysis, BIBO stability, Root locus, frequency domain analysis, Bode plot, polar plot, Nyquist stability criteria, lead, lag compensators, PI, PD, PID controllers.

Reading:

1. K. Ogata, Modern Control Engineering, PHI, 2002.

2. Benjamin C Kuo, Automatic Control Systems, PHI, 2003.

DEVICE MATERIALS AND FABRICATION TECHNIQUES PH6362 (3-0-0)3

Growth of semi conducting materials, vapor phase epitaxy, CVD, molecular beam epitaxy, epitaxial evaluation and doping, optical, electron and X-ray lithography. diffusion at high temperatures, Solar cells, IC processing, NMOS and CMOS IC technology, MOS memory technology, IC Fabrication and assembly technologies.

Reading:

- 1. Sze, S.M, VLSI Technology, McGraw Hill, 1988.
- 2. Botkar, K.R., Integrated Circuits, Khanna Publishers, 2001.

PH 7101

DIGITAL SIGNAL PROCESSING

Signals and systems-Convolution and correlation - CT and DT - Fourier series and Fourier transform, DFT and FFT-algorithms, Z-Transform, Filter Structures, Design of IIR and FIR Filters, Finite word length effects, Applications.

Reading:

- 1. Alan, V.O. and Alan, S.W., Signals and Systems, 2nd Edition, Pearson, 2004.
- 2. John, G.P. and Dimitris, G.M., Digital Signal Processing Principles Algorithms and Applications, PHI, 1996.

PH 7102 **MICROWAVES AND WAVE PROPAGATION** (4-0-0)4

Introduction-microwave regions-bands-Passive and active devices, Microwave slow wave structures-Microwave solid state devices- Microwave ICs- Antenna fundamentals-Wave Propagation- Ground wave, Surface wave, Space wave propagation-duct propagation.

Reading:

- 1. Samuel Y. Liao, Microwave Devices and Circuits, 3rd Edition, PHI, 2011.
- 2. George Kennedy, Electronics Communication Systems, 4th Edition, McGraw Hill, 2008
- 3. KD Kraus, Antennas, 3rd Edition, McGraw Hill, 2008.

(3-0-0)3

(3-0-0)3

(4-0-0)4

PH7103 DIGITAL SIGNAL PROCESSING LABORATORY

(0-0-3)3

Linear convolution, Circular convolution, Auto correlation and Cross convolution - Sampling and Reconstruction - Fourier Transforms - DFT - FFT - Analog filter design - IIR Filter design - FIR filter design - Using MATLAB.

PH 7201 OPTOELECTRONIC SENSING AND MOEMS

(4-0-0)4

Optoelectronic sensors - classification; Materials interactions for sensing; Components and optical fibers for sensing; Optoelectronic systems for sensing Displacement, Temperature, Pressure, Flow, Level, etc., and distributive sensing. FBGs and LPGs for Smart structures. MOEMS for sensing applications.

Reading:

1. B. Culshaw, *Optical Fiber Sensors,* Artech House, 2006.

- 2. D.A. Krohn, Fiber Optic Sensors- Fundamentals and Applications, Instrument Society of America, 2010.
- 3. J.W. Gardner, *Microsensors, MEMs, and Smart Structures,* John Wiley, 2002.

PH 7202

INTEGRATED OPTICS

(4-0-0)4

Optical waveguides: modes, losses - Planar waveguides, Channel waveguides, Bent and curved waveguides, Branching waveguides-Waveguide excitation- Simulation and Measurements techniques - Waveguide couplers and Gratings - Materials - Electro-optics - Acousto-optics - Fabrication technology - Applications. *Reading:*

1. Robert G. Hunsperger, Integrated Optics: Theory and Technology, Springer, 2009.

2. Ajoy Kumar Ghatak, K. Thyagarajan, *Optical Electronics,* Cambridge University Press, 1989.

PH7203 OPTOELECTRONIC SENSING LABORATORY (0-0-3)2

Fiber Optic Sensors: Proximity, Liquid level, Microbend, Temperature, Refractive index, Pressure/strain, Shutter and grating. Fiber Optic Polarimetric Sensor, FBG Sensor, Rotation sensor, Chemical sensor, Distributive sensor.

PH7301 ANALYTICAL INSTRUMENTATION (4-0-0)4

UV-Vis, Fluorescence and Phosphorescence Spectrophotometry; Atomic Emission, Infrared, Raman spectroscopy, Magnetic resonance spectroscopy: NMR , ESR, Bainbridge types of Spectrometers, Thermal Analysis: DSC (or DTA) and TG - TMA - DMAs; Imaging Techniques: SEM, TEM, STM and AFM.

Reading:

- 1. Willards, Merrit et. al, Instrumental Methods and Analysis, CBS, 2011.
- 2. Pavia Lampman Kriz, Introduction to Spectroscopy, Thomson, 2002.
- 3. G R Chatwal, S K Anand, *Instrumental Methods of Chemical Analysis,* Himalaya Publishing House, 2009.

PH7302

NONDESTRUCTIVE TESTING

(4-0-0)4

Ultrasonic instrumentation technology in non destructive evaluation, Standardization and calibration, Electrical instrumentation and surface testing techniques, Principles of eddy currents; Residual stress analysis, Mechanical and Thermal and Radiographic NDT methods, Thermo-graphic inspection, Crack depth gauges, Surface texture analysis.

Reading:

- 1. J.Prasad, C.G.Krishnadas Nair, *Non-Destructive Test and Evaluation of Material*, TMH, 2008.
- 2. Paul E. Mix, AJohn, Introduction to Non-Destructive Testing, A Training Guide, 2nd Edition, Wiley & Sons, 2005.

PH7303 ANALYTICAL INSTRUMENTATION AND NDT LABORATORY (0-0-3)2

Liquid penetration, Magnetic particle inspection - Measurements of velocities and young's moduli - Evaluation of defects in solids using ultrasonic flaw detector - Calibration -spectral studies - by NMR spectrometer and ESR spectrophoto meter, absorption and transmission coefficients of the samples- UV-IR spectrometers.

PH 7111

DATA COMMUNICATION

(3-0-0) 3

Basic concepts of data communication: Data communication networks. Protocol basics and data link protocols: Error control, and different protocols. Data communication networks: wired and wireless LANs. Reading:

- 1. Fred Halsall, Data Communications, Computer Networks and Open Systems, 4th Edition, Pearson, 2001.
- 2. Wayne Tomasi, Advanced Electronic Communication Systems, 5th Edition, PHI, 2001.

PH 7112 MEDICAL PHYSICS AND PHYSIOLOGICAL MEASUREMENTS (3-0-0)3

Overview of Human body - Origin of biopotentials -ENG, EMG, ECG and EEG- Heart and ECG Waveform standard lead system and functional blocks - Biofluid mechanics - Blood pressure measurement - Different blood flow meters - Electric impedance plethysmography - photo plethysmography - pulse oximetry.

Reading:

- 1. Brown, B.H., Medical Physics and Biomedical Engineering, Institute of Physics Publishing, 1999.
- 2. John. G. Webster, Medical Instrumentation : Application and Design, 2nd Edition, John Wiley and Sons, 1995.

PH7113 **ELECTRONIC INSTRUMENTATION** (3-0-0)3

Digital storage Oscilloscopes and logic analyzers, probing, clocking, triggering, advanced measurement techniques- Signal sources, arbitrary waveform and pattern generators - Spectrum and network analyzers, instrument drivers and driver software, GPIB - VXI, PCI and PXI bus standards, application software lab view, calibration of practical instruments - DMM, oscilloscopes, DSO's.

Reading:

1. Kularatna, A.D.V.N., Digital and Analogue Instrumentation: Testing and Measurement, PHI, 2001.

2. David A Bell, *Electronic Instrumentation and Measurements*, Oxford University Press, 2007.

INFRARED OPTICS AND THERMAL IMAGING PH7211 (3-0-0)3

Unique features of the infrared region - materials, effect of temp on optical properties and athermalization methods, Optical design and material selection, tolerances, Reflective and transmitive infrared zoom systems, Thermal imaging instruments, Night vision equipment. Applications in industry and defence.

Reading:

- 1. Mann Allen, Infrared Optics and Zoom Lenses, SPIE, 2002.
- 2. R. Kingslake, Applied Optics and Optical Engineering, Vol. 4 and 5, Academic, 2002.
- 3. Michael Vollmer, Infrared Thermal Imaging: Fundamentals, Research and Applications, Wiley, 2010.

PH 7212

BIOPHOTONICS

(3-0-0)3

Light Sources, Delivery systems and Spectroscopy: Basics of Biology: Tissue structure - Features of living tissues from the point of optics.- Fundamentals of light-matter interactions. Bioimaging, Biosensors, Tissue engineering, Flow cytometry.

Reading:

Paras N. Prasad, Introduction to Biophotonics, John Wiley and Sons, 2003. 1.

2. Katzir. A, Lasers and Optical Fibers in Medicine, AP, 1993.

PH7213

LASER APPLICATIONS

(3-0-0)3

Material processing and testing, optical radar, Raman backscattering, absorption, pollution control, alignment surveying and tooling, range finding-rotation rate and velocity measurement, surface inspection, displays, information storage, optical computing, speckle interferometry, ophthalmology, surgery and diagnosis, dentistry.

Reading:

- 1. Ready, J.F., *Industrial Applications of Lasers*, 2nd Edition, AP, 2000.
- 2. Charschan, S.S., Lasers in Industry, Van Nostrand, 2001.

PH7214

FOURIER OPTICS AND HOLOGRAPHY

(3-0-0)3

Frequency response technique for image formation in coherent and incoherent light, Theory of partial coherence - statistical optics, Optical imaging systems and their analysis, Spatial filtering and optical information processing, holography, statistical properties of laser speckle patterns, speckle reduction.

Reading:

- 1. Goodman, J.W., Introduction to Fourier Optics, McGraw Hill, 2001.
- 2. Collier, R.J. et. al, Optical Holography, AP, 2000.

PH 7311 DIGITAL AND DISTRIBUTED CONTROL SYSTEMS (3-0-0)3

Sampling and reconstruction, Transformation analysis of sampled data systems, Transform design of digital control, examples. State variable analysis and design, Liapnov's stability analysis, Optimal control systems, parameter optimization. Self tuning control, Advances in control systems: Adaptive control.

Reading:

- 1. Nagarath, I.J. and Gopal, M., Control System Engineering, New Age International Publication, 2005.
- 2. Gopal, M., *Control Engineering*, New age International Publication, 2000.
- 3. Norman, S.N., *Control Systems Engineering*, John Willey and Sons, 2003.

PH7312

PC BASED INSTRUMENTATION

(3-0-0)3

The IBMPC and compatibility - PC expansion system - Assembly language programming - IEEE488 Bus Interfacing - Software packages - Applications - Reliability and Fault finding - System configuration. *Reading:*

- 1. Michael H. Tooley, *PC Based Instrumentation and Control*, 3rd Edition, Elsevier Science, 2003.
- 2. Mathivanan N, PC based Instrumentation, Concepts and Practice, PHI, 2007.