PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

PERIYAR MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University)
Established Under Sec. 3 of UGC Act, 1956 • NAAC Accredited
think • innovate • transform

Criterion 1 – Curricular Aspects

Key Indicator	1.1	Curriculum Design and Development
Metric	1.1.3	Average percentage of courses having focus on employability/ entrepreneurship/ skill Development offered by the department

DEPARTMENT OF PHYSICS

SYLLABUS COPY OF THE COURSES HIGHLIGHTING THE FOCUS ON EMPLOYABILITY/ ENTREPRENEURSHIP/ SKILL DEVELOPMENT

1. List of courses for the programmes in order of

S. No.	Programme Name
i.	Bachelor of Science (Physics)(Full Time)
ii.	Master of Science (Physics)(Full Time)

2. Syllabus of the courses as per the list.

Legend : Words highlighted with **Blue Color** - Entrepreneurship
Words highlighted with **Red Color** - Employability
Words highlighted with **Purple Color** - Skill Development

1. List of Courses

Name of the Course	Course Code	Year of introduction	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
Communication electronics	XPH502A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Mathematical Physics	XPH503A	2021-22	Skill Development - Problem solving
Measurement and Instrumentation	XPH504A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Measurement and Instrumentation Lab	XPH506A	2021-22	Skill Development - Problem solving
Microprocessor and C programming Lab	XPH506B	2021-22	Skill Development - Problem solving
Laser Physics	XPH603A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Nano Material and Applications	XPH603B	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Power electronics	XPH604A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Astronomy and Astrophysics	XPH604B	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Introduction of Microcontroller	XPH605A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Quantum mechanics	XPH605B	2021-22	Skill Development - Problem solving
Mathematical Methods of Physics - I	YPH101	2021-22	Skill Development - Problem solving

- Electronics	YPH103	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
- Instrumental Methods of Analyses	YPH104C	2021-22	Skill Development - Problem solving
Mathematical Methods of Physics-II	YPH201 -	2021-22	Skill Development - Problem solving
Quantum Mechanics -I	YPH202	2021-22	Skill Development - Problem solving
Microprocessor and Microcontroller	YPH203	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Digital & Microprocessor Laboratory	YPH205	2021-22	Skill Development - Problem solving
Quantum Mechanics -II	YPH302	2021-22	Skill Development - Problem solving
Micro Electro Mechanical Systems (MEMS)	YPH304A	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Solar Thermal and Photovoltaic Technology	YPH304B	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill
Industrial Electronics	YPH304C	2021-22	Employability - Implementing skill-applying problem solving, reasoning skill

Course Code			XPH502A	L	T	P	C
Course Name			COMMUNICATION ELECTRONICS	3	1	0	4
C	P	A		L	T	P	H
3	0	0		3	1	0	4

COURSE OUTCOMES On the successful completion of this course students would able to		DOMAIN	LEVEL
CO1	Understanding the basic knowledge about amplitude and frequency modulation	Cognitive	Remember and Understand
CO2	Develop the knowledge about fibre optic communication	Cognitive	Analyze & Understand
CO3	Understanding the basic idea about radar communication	Cognitive	Remember and understand
CO4	Explain the function of satellite and list the type of satellites	Cognitive	Remember and understand
CO5	Describe the working of mobile communication and explain various function and usage of mobile.	Cognitive	Analyze and understand

UNIT – I: RADIO TRANSMISSION AND RECEPTION	**9+3**
Transmitter-modulation-need for modulation- types of modulation amplitude, frequency and phase modulation- modulation factor-sideband frequencies in AM wave-limitations of amplitude modulation – frequency modulation-block diagram of AM and FM Transmitter. Receiver- demodulation-AM & FM radio receivers-super heterodyne radio receiver.	
UNIT – II: FIBER OPTIC COMMUNICATION	**9+3**
Introduction –structure of optical fiber –total internal reflection in optical fiber – principal and propagation of light in optical fiber - acceptance angle – numerical aperture – types of optical fibers based on material – number of modes – refractive index profile - fiber optical communication system (block diagram) - fiber optic sensors – Temperature sensor – fiber optic endoscope.	
UNIT – III: RADAR COMMUNICATION	**9+3**
RADAR – Principle of radar – Radar performance factors – Radar equation – Radar– Pulsed systems – Basic pulsed radar system – Antennas and scanning – Display methods – Pulsed radar systems – Moving target indication – Radar beacons – Transmitting systems – Radar antennas – Duplexer – Radar receivers uses of radar.	
UNIT – IV: SATELLITE COMMUNICATION	**9+3**
Introduction – history of satellites – satellite communication system – satellite orbits – classification of satellites – types of satellites – basic components of satellite communication – constructional features of satellites- multiple access –communication package – antenna-power source – satellite foot points- satellite communication in India.	
UNIT – V: MOBILE COMMUNICATION	**9+3**
GSM – mobile services- concept of cell – system architecture – radio interface – logical channels and frame hierarchy – protocols – localization and calling – Handover- facsimile (FAX) – application – VSAT (very small aperture terminals) – Modem – IPTV (internet protocol television) – Wi-Fi - 3G (Basic ideas only).	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. A K Chhabra & Anokh Singh, "*Principles of Communication Engineering*", 17th edition, S. Chand Publishing , A–27, 2nd Floor, Mohan Co–operative Industrial Estate, New Delhi – 110044,,2013.
2. George Kennedy , Brendan Davis, Srm Prasanna , "*Kennedy's Electronic Communication Systems*", 5th Edition, McGraw Hill Education, 2011
3. *Mani P., "Engineering Physics", Dhanam Publications, Chennai, 2007.*

REFERENCE BOOK

1. I.Poornima Thangam, "*Satellite Communication*", Charulatha Publications, 2012.
2. Dennis Roddy , John Coolen "Electronic Communications", 4th edition , Pearson, 1995.

E REFERENCES

1. DEEPA VENKITESH, Department of Electrical Engineering,IIT Madras, "Fiber Optic Communication Technology", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/108/106/108106167/
2. Kalyankumar Bandyopadhyay, Electronics and Electrical Communication,IIT Kharagpur, "Satellite Communication Systems", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/117/105/117105131/

Mapping with Programme Outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	0	3	3	3	0	1
CO2	3	2	0	2	3	2	0	1
CO3	3	2	0	2	3	2	3	2
CO4	3	2	0	2	3	2	0	2
CO5	3	2	0	2	3	2	0	2
Total	15	10		11	15	11	3	8
Scaled to 1, 2, 3	3	2		3	3	3	1	1

Course Code			**XPH503A**	**L**	**T**	**P**	**C**
Course Name			**MATHEMATICAL PHYSICS**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**1**	**0**	**4**

COURSE OUTCOMES On the successful completion of this course students would able to		**DOMAIN**	**LEVEL**
CO1	solve problems on Matrices and apply them to relevant problems	Cognitive	Analyze
CO2	apply Stoke's and Gauss theorems to suitable physical problems	Cognitive	Evaluate
CO3	solve problems on Analytic Function and apply them to relevant problems	Cognitive	Apply
CO4	analyze gamma and beta functions and their applications	Cognitive	Apply
CO5	Apply and solve problems on Fourier Series And Transforms	Cognitive	Apply and evaluate

UNIT – I: MATRICES **9+3**

Introduction – special types of Matrices – Transpose of a Matrix – The Conjugate of a Matrix –

Conjugate Transpose of a Matrix – Symmetric and Anti symmetric – Hermitian and skew Hermitian – Orthogonal and Unitary Matrices – Properties – Characteristic equation – Roots and characteristic vector – Diagonalization of matrices – Cayley–Hamilton theorem –Problems

UNIT – II: VECTOR CALCULUS **9+3**

∇ Operator – Divergence – Second derivative of Vector functions or fields – The Laplacian Operator – Curl of a Vector – Line Integral – Line Integral of a Vector field around an infinitesimal rectangle – Curl of Conservative field – Surface Integral – Volume Integral (without problem) – Gauss's Divergence theorem and it's proof - Simple problems – Stoke's theorem and its proof - Simple problems.

UNIT – III: COMPLEX ANALYSIS **9+3**

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne–Thomson's method – Conformal mappings: 1/z, az , az+b and bilinear transformation. Line integral – Cauchy's integral theorem (without proof) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only)

UNIT – IV: SPECIAL FUNCTIONS **9+3**

Beta and gamma functions – problems – relation between beta and gamma functions – Bessel's differential equations – Legendre's differential equations – Hermite's differential equations – Laguerre's differential equations – series solutions – Dirac delta functions - properties.

UNIT – V: FOURIER SERIES AND TRANSFORMS **9+3**

Introduction - Periodic functions: Properties - Even & Odd functions – Properties - Special wave forms - Square wave - Half wave Rectifier - Full wave Rectifier - Sawtooth wave - Triangular wave - Euler's Formulae for Fourier Series - Fourier Series for functions of period 2π - Fourier Integral Theorem (statement only) - Fourier Transform of a function - Properties of Fourier Transform - Linearity, Shifting, Change of scale, Modulation - Examples - Fourier Transform of Derivatives – Examples - Convolution Theorem (statement only) - Inverse of Fourier Transform,.

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. S. PRAKASH, "*Mathematical Physics with Classical Mechanics*", sixth edition, S. Chand Publishing , A–27, 2nd Floor, Mohan Co–operative Industrial Estate, New Delhi – 110044, 2014
2. B D Gupta, "*Mathematical Physics*", 4th Edition, Vikas Publication House Pvt Ltd, 2009.

REFERENCE BOOK

1. B S Rajput, "*Mathematical Physics*", A Pragati Edition , Anu Books, 2019.
2. Erwin Kreyszig , "Advanced Engineering Mathematics", 10th Edition, Wiley, 2010.
3. M. C. Jain, "Vector Spaces And Matrices In Physics", Narosa, 2007.

E REFERENCES

1. Saurabh Basu, Department of Physics IIT Guwahati, "Mathematical Physics", National Programme ,on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/115/103/115103036/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	2	3	2	2	3
CO2	3	3	2	3	2	3	1	2
CO3	3	2	2	3	3	2	1	2
CO4	3	3	1	2	3	2	2	2
CO5	3	3	2	1	2	3	3	2
Total	15	13	8	11	13	12	9	11
Scaled to 1, 2, 3	3	3	2	3	3	3	2	3

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

Course Code			**XPH504A**	**L**	**T**	**P**	**C**
Course Name			**MEASUREMENT AND INSTRUMENTATION**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**1**	**0**	**4**

COURSE OUTCOMES On the successful completion of this course students would able to		**DOMAIN**	**LEVEL**
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments.	Cognitive	Remember
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments	Cognitive	Understand
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Cognitive	Apply
CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions	Cognitive	Understand
CO5	**Explain** the construction and working of different types signal conditioners and **Demonstrate** the recent trends in measurement ofAC quantities.	Cognitive	Remember

UNIT – I: INTRODUCTION	**9+3**
Measurements – Errors & classification, Measurement of voltage & current - permanent magnet moving coil and moving iron meters, Measurement of power and energy - dynamometer and induction instruments, Instrument transformers – Current and Potential transformers	
UNIT – II: DC AND AC BRIDGES	**9+3**
Measurement of resistance, inductance and capacitance using dc and ac bridges, Wheatstone bridge, Maxwell bridge, Kelvin's Bridge, Schering Bridge	
UNIT – III: TRANSDUCERS	**9+3**
Active and Passive transducers, Piezoelectric transducer, Photoelectric transducers,	

Thermocouples, Strain gauge transducers, LVDT, differential capacitive transducers, Fiber optic transducers, Resistive, Inductive and capacitive transducers.	
UNIT – IV: SIGNAL CONDITIONING UNITS	**9+3**
Signal conditioners – Instrumentation amplifiers, voltage–current converters, A/D and D/A converters, voltage-frequencyconverters, analog multiplexers and de-multiplexers. Microprocessor Based Measurements, Case Studies in Instrumentation**.**	
UNIT – V: RECORDERS AND DISPLAY	**9+3**
Signal sources – Oscillators, Function generator and pulse generators. Oscilloscopes - CRO, Digital storage and Analog storage Oscilloscope, Digital Phosphor Oscilloscopes. Analog and Digital Recorders and printers. Spectrum Analyzers, Data and Logic Analyzers.	

HOURS	LECTURE	TUTORIAL	TOTAL
	45	15	60

TEXT BOOKS

1. A. K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co., 9th Edition, 2015.
2. Bouwens A. J., "Digital Instrumentation", Tata McGraw Hill Publications, 16th Reprint (2008).
3. Kalsi H.S, "Digital Instrumentation",Tata McGraw-Hill Education, 3rd Edition, 2010.
4. Deobelin, "Measurements Systems", Tata McGraw Hill Publications, 2nd Edition, 2010.

REFERENCE BOOK

1. W. D. Cooper, "Electronic Instrumentation and Measurement Techniques", Prentice Hall of IndiaPublications, 1st Edition, 2009.
2. Rangan C.S., "Instruments Devices and System", Tata McGraw Hill Publications, 2nd Edition,2009.

E REFERENCES

1. NTPEL, Electrical Machines (Web Course), Prof.N.K.De, Prof.T.K.Bhattacharya and Prof. G.D. Roy, IIT Kharagpur.

Course Code			XPH505A	L	T	P	C
Course Name			MEASUREMENT AND INSTRUMENTATION - LAB	0	0	2	2
C	P	A		L	T	P	H
0	1.5	0.5		0	0	4	4

COURSE OUTCOMES On the successful completion of this course students would able to		**Domain**	**Level**
CO1	**Describe** the different errors in measurements and **Describe** the working principle of different measuring instruments	Psychomotor:	Mechanism
CO2	**Understanding** about the instruments used for different types of AC measurements. **Carryout** calibration test for measuring electrical instruments	Psychomotor: Affective:	Analyze, Mechanism Respond
CO3	**Use** different types bridge circuits for the measurements of unknown passive elements. **Relate** the different types of the transducers. **Demonstrate** the use of different bridges and transducers.	Psychomotor: Affective:	Apply Mechanism Receive

CO4	**Explain** the construction and operation of recording and display instruments. **Establish** Relations between analog and digital signal conversions.	Psychomotor: Affective:	Analyze Mechanism Receive
CO5	**Explain** the construction and working of different types signal conditioners. **Demonstrate** the recent trends in measurement ofAC quantities.	Psychomotor: Affective:	Analyze Mechanism Receive

Ex. No	**Experiments**	**Cos**
1.	Calibration of Current Transformer and Potential transformer.	CO1
2.	Measurement of three phase active, Reactive Power and Power factor	CO1
3.	Calibration of Single phase / Three Phase Energy meter	CO1
4.	Resistance measurement using Wheat stone bridge	CO2
5.	Inductance measurement using Maxwell Bridge	CO2
6.	Capacitance measurement using Schering Bridge	CO2
7.	Study of Transducers	CO3
8.	A/D converters	CO4
9.	D/A converters	CO4
10.	Measurement of Current / Voltage / power / Energy using Arduino board.	CO5

	LECTURE	**PRACTICAL**	**TOTAL**
HOURS	**0**	**40**	**40**

TEXT BOOKS

5. A. K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co., 9th Edition, 2015.
6. Bouwens A. J., "Digital Instrumentation", Tata McGraw Hill Publications, 16th Reprint (2008).
7. Kalsi H.S, "Digital Instrumentation",Tata McGraw-Hill Education, 3rd Edition, 2010.
8. Deobelin, "Measurements Systems", Tata McGraw Hill Publications, 2nd Edition, 2010.

REFERENCE BOOK

3. W. D. Cooper, "Electronic Instrumentation and Measurement Techniques", Prentice Hall of IndiaPublications, 1st Edition, 2009.
4. Rangan C.S., "Instruments Devices and System", Tata McGraw Hill Publications, 2nd Edition,2009.

E-Resources:

1. Avishek Chatterjee, Department of Electrical Engineering IIT Kharagpur," Electrical Measurement and Electronic Instruments", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/108/105/108105153/

Course Code			XPH505B	L	T	P	C
Course Name			MICROPROCESSOR AND C PROGRAMMING LAB	0	0	2	2
C	P	A		L	T	P	H
0	1.5	0.5		0	0	4	4

COURSE OUTCOMES On the successful completion of this course students would able to		Domain	Level
CO1	**Describe** the working principle of 8085 and **Explain** the various function of 8085.	Psychomotor :	Mechanism
CO2	**Explain** the function of assembly language programme and **apply** to suitable problems,	Psychomotor : Affective:	Analyze, Mechanism Respond
CO3	**Understanding** the basic concepts of C programming and **list** the various operators.	Psychomotor : Affective:	Apply Mechanism Receive
CO4	**Explain** the various types of artithmetic operators in C programming and **apply** to suitable problems.	Psychomotor : Affective:	Analyze Mechanism Receive
CO5	**Understanding** the basic concepts of data input and output , Arrays function in C programming and **apply** to suitable problems.	Psychomotor : Affective:	Analyze Mechanism Receive

Ex. No	Experiments	COs
1.	Perform the Arithmetic operations (addition and Subtraction) using microprocessor 8085.	CO1
2.	Perform the Arithmetic operations (multiplication and division) using microprocessor 8085.	CO1
3.	Microprocessor – Decimal to Octal and Octal to Decimal Conversion.	CO1
4.	Programs for Sorting and Searching Using 8085	CO2
5.	Interfacing ADC and DAC using 8085.	CO2
6.	Write a program to find sum of two numbers using functions	CO3
7.	Write a program to print the given strings in ascending order	CO4
8.	Write a program to read and display a value using getchar(), putchar(),gets() and puts()	CO5
9.	Write a program to store 10 elements in the 1-D array and print sum of the array.	CO5
10.	Write a program to perform matrix addition and matrix subtraction.	CO5

	LECTURE	PRACTICAL	TOTAL
HOURS	0	40	40

TEXT BOOKS

1. jeri R. Hanly and Elli B.Koffman, "Problem Solving and Program Design in C", 7th edition, Pearson,2004
2. Pradip Dey , Manas Ghosh "Programming in C", 2nd edition, Oxford, 2011
3. B. Ram, "*Fundamentals of Microprocessors and Microcontrollers*", Dhanpat Rai Publications (P) Ltd.-New Delhi, 2012.

REFERENCE BOOK

1. E. Balagurusamy, "Programming in Ansi C", McGraw Hill Education, 1st Edition, 2010
2. Ramesh Gaonkar , "*Microprocessor Architecture, Programming and Applications with the 8085*", 6th edition, Penram International Publishing India Pvt Ltd., 2013.

E-RESOURCES

1. JANAKIRAMAN VIRARAGHAVAN, Department of Computer Science and Engineering, IIT Madras, "C PROGRAMMING AND ASSEMBLY LANGUAGE", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/106/106/106106210/
2. SANTANU CHATTOPADHYAY, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur, "MICROPROCESSORS AND MICROCONTROLLERS", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/108/105/108105102/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	1		2	1	2	3	3
CO2	3	1		2	1	2	3	2
CO3	3	1		1	1	2	2	1
CO4	3	1		2	1	2	3	2
CO5	3	1		2	1	2	3	3
Total	15	5		9	5	10	14	11

Course Code			**XPH603A**	**L**	**T**	**P**	**C**
Course Name			**LASER PHYSICS**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**1**	**0**	**4**

COURSE OUTCOMES On the successful completion of this course students would able to		**DOMAIN**	**LEVEL**
CO1	Understand the fundamentals of Laser.	Cognitive	Remember and Understand
CO2	Describe the production of Laser and its working	Cognitive	Remember, Understand
CO3	List and explain the application of laser in industry	Cognitive	Apply
CO4	List the application of laser in medicine and explain laser with interaction of light	Cognitive	Analyze, Understand
CO5	Understand the fundamentals of laser communication	Cognitive	Understand

UNIT – I: CONVENTIONAL LASERS	**9+3**
Spontaneous and Stimulated Emission - Einstein Coefficients – Levels of laser action: Two level – Three level – Four level lasers – Types of lasers (outline only) – Solid State Lasers: Ruby laser and Nd:YAG laser – Gas lasers : He-Ne laser and CO2 laser – Liquid laser : Dye laser – Liquid Eu3+ laser – Semiconductor laser.	
UNIT – II: ADVANCED LASERS	**9+3**
General description of Q-Switching – Production of Q-Switching : Electro-optic Shutter (Kerr effect and Pockels effect) – Mechanical and Saturable absorber Shutters – Peak power emitted during the pulse – Theory of Giant Pulse dynamics – Laser amplifiers – Mode locking –	

Ultrafast lasers – Fiber optic lasers			
UNIT – III: BASICS OF NONLINEAR OPTICS			**9+3**
Wave propagation in an anisotropic crystal – Polarization response of materials to light – Harmonic generation – Second harmonic generation – Sum and difference frequency generation – Phase matching – Third harmonic generation – Terahertz – Bi-stability.			
UNIT – IV: NONLINEAR ABSORPTION AND REFRACTION			**9+3**
Fundamentals of multi-quantum photoelectric effect – Theory of Two photon process – Experiment evidences of 2PA materials – Multi and Three photon process – Stimulated Raman scattering – Intensity dependent refractive index – Self-focusing of light – Phase Conjugated Optics – Photorefractive effect.			
UNIT – V: APPLICATIONS OF LASER			**9+3**
Materials processing with lasers : Drilling, Cutting, and Welding – Nuclear fusing with lasers – Communication by lasers – Principle of holography – Laser range finders – Laser Gyro – LASIK – Optical computing			
	LECTURE	**TUTORIAL**	**TOTAL**
HOURS	**45**	**15**	**60**

TEXT BOOKS

1. Thyagarajan and Ghatak, "Laser Theory and Applications", Macmillan, India, 1986.
2. W.T. SilfvasT, "Laser Fundamentals", Cambridge Univ. Press, 1998.

REFERENCE BOOK

1. W. Demtroder, "Laser Spectroscopy",3rd edition ,Springer, 2003.
2. R. W. Boyd, "Nonlinear Optics", Academic Press, 2003.

E REFERENCES

1. M R Shenoy , Department of Physics IIT Delhi, "Introduction to Laser", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/115/102/115102124/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	0	2	0	0	0	0	0
CO2	1	2	1	3	1	0	0	0
CO3	0	0	0	0	0	1	2	0
CO4	1	1	2	2	1	0	0	0
CO5	1	2	2	1	0	0	3	0
Total	4	5	7	6	2	1	5	0
Scaled to 1, 2, 3	3	1		2	1	2	3	2

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

Course Code			XPH603B	L	T	P	C
Course Name			NANOMATERIAL AND APPLICATIONS	3	1	0	4
C	P	A		L	T	P	H
3	0	0		3	1	0	4

COURSE OUTCOMES On the successful completion of this course students would able to		DOMAIN	LEVEL
CO1	Describe the importance and properties of nanomaterials.	Cognitive	Remember and Understand
CO2	Explain and list the different types of nanomaterials.	Cognitive	Remember and Understand
CO3	Describe the synthesis process of nanomaterials.	Cognitive	Remember and Understand
CO4	Explain the characterisation studies of nano materials.	Cognitive	Remember and Understand
CO5	List and explain the various applications of nano materials.	Cognitive	Understand & Apply

UNIT – I: INTRODUCTION TO NANOSCIENCE	**9+3**
Nano revolution of the 20th century – Difference between bulk and nanoscale materials and their significance – Properties at the nanoscale – Optical property – Magnetic property and electronic property – Size dependent behavior – Scaling – Mechanical properties of Nano materials and Chemical properties of Nanoparticles.	
UNIT – II: CLASSES OF NANOMATERIALS	**9+3**
Metals and Semiconductor Nanomaterials – Quantum dots – Nano wells – Nano ribbons and Nano Wires – Bucky balls – Carbon nanotubes – Single walled and Multi walled CNT–Structure – Synthesis– Properties– Functionalization and applications – Fullerenes/Bucky Balls/ C60– Synthesis – Properties – Functionalization and application	
UNIT – III: SYNTHESIS OF NANOMATERIAL	**9+3**
Top–down approach – Nanolithography – Soft lithography and hard lithography – Physical Vapor deposition (PVD) – Chemical Vapor Deposition(CVD) – E–beam lithography – Bottom–up approach– Sol–gel processing and chemical methods – Self assembly.	
UNIT – IV: CHARACTERIZATION OF NANOMATERIALS	**9+3**
Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM) – Atomic Force Microscope (AFM) – Scanning Tunneling Microscopy (STM) – Types– Manipulating atoms and Molecules with STM – Scanning Tunneling Spectroscopy and Dip pen Nanolithography.	
UNIT – V: APPLICATIONS OF NANOTECHNOLOGY	**9+3**
Nanotechnology in Energy systems – Electronics – Environment – Space and Aviation – Textiles – Food and Agriculture – Automotive Industry – Solar Technology – Chemical engineering – Building and Construction – Biotech and Biomedical Engineering – Pharmaceutical and drugs – Molecular Nano electronics.	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. Pradeep T, "*Fundamentals of Nanoscience and Nanotechnology*", Mc Graw Hill, 2012.

2. Chris Binns, "*Introduction to Nanoscience and Nanotechnology",* 1st Edition, Willey–Publication, 2010.

REFERENCE BOOK

1. K.K Chattopadhyay, "*Introduction to Nanoscience and Nanotechnology"*, 3rdEdition, Prentice Hall India Learning Private Limited, 2009.
2. Gabor L.Hornyak, H.F.Tibbals, Joydeep Dutta, John J.Moore, "*Introduction to Nanoscience and Nanotechnology"*, 1st edition, CRC Press, 2008
3. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan*, "NanoscaleScience and Technology*,"1st edition, John Wiley and Sons, Ltd., 2005.

E REFERENCES

1. Prathap Haridoss, Department of Metallurgical and Material Engineering, IIT Madras, "NANOTECHNOLOGY, SCIENCE AND APPLICATIONS", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/113/106/113106093/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	0	3	3	3	0	1
CO2	3	2	0	2	3	2	0	1
CO3	3	2	0	2	3	2	3	2
CO4	3	2	0	2	3	2	0	2
CO5	3	2	0	2	3	2	0	2
Total	15	10		11	15	11	3	8
Scaled to 1, 2, 3	3	2		3	3	3	1	2

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

Course Code			**XPH604A**	**L**	**T**	**P**	**C**
Course Name			**POWER ELECTRONICS**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**1**	**0**	**4**

COURSE OUTCOMES On the successful completion of this course students would able to		**DOMAIN**	**LEVEL**
CO1	Understand the structure, operation and characteristics of power switching devices.	Cognitive	Understand
CO2	Determine the operation, characteristics and performan parameters of controlled rectifiers.	Cognitive	Understand
CO3	Analysis the operation of DC - DC choppers.	Cognitive	Analyzing
CO4	Analysis the operation of various inverters and infer thesuitable PWM techniques.	Cognitive	Analyze
CO5	Understand the concept of various types of AC voltage controllers.	Cognitive	Understand

UNIT – I: POWER SWITCHING DEVICES	9+3
Review on Semiconductor devices – I-V characteristics and Switching Characteristics of power Diodes, SCR, TRIAC, power BJT, power MOSFET and IGBT. Triggering and Commutation Circuits.	
UNIT – II: THYRISTOR RECTIFIERS	**9+3**
Single phase half-wave and full-wave thyristor rectifiers – Single phase full-bridge thyristor rectifier with R-load and highly inductive load – Three phase full-bridge thyristor rectifier with R-load and highly inductive load.	
UNIT – III: DC TO DC CHOPPERS	**9+3**
Types of Choppers, Class A to E, step-up and step-down choppers – Analysis of Voltage, Current and Load commutated choppers –Introduction to Resonant converters	
UNIT – IV: INVERTERS	**9+3**
Single phase, Three phase voltage source inverters (Both 120ºand 180ºmode of conductions) – Bipolar sinusoidal modulation and unipolar sinusoidal modulation, Modulation Index - PWM Techniques- Current Source Inverters.	
UNIT – V: AC VOLTAGE CONTROLLERS	**9+3**
Single-phase and three phase AC voltage controllers -. Multi-stage sequence control – step-up and step- down cycloconverter – Single phase to single phase and Single phase to Three phase cyclo converters.	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. Muhammad H. Rashid , "*Power Electronics | Devices, Circuits and Applications |", 4th edition,* Pearson Education, 2017.
2. M D Singh; K B Khanchandani, "*Power Electronics",* 2nd Edition, Tata McGraw-Hill,Delhi, 2007
3. Robbins Mohan, Undeland ,"Power Electronics: Converters Applications and Design, Media Enhanced",3rd edition,wiley,2007.

REFERENCE BOOK

1. Umanand, L., "Power Electronics: Essentials and Applications", Wiley India, 2009
2. Erickson, R.W and Maksimovic, D., "Fundamentals of Power Electronics", Springer Science& Business Media, 2007
3. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., "Thyristorised Power Controllers",Wiley Eastern Limited, 1986

E REFERENCES

1. Bhuvaneshwari, Department of Electrical and Electronics Engineering, IIT Delhi "POWER ELECTRONICS", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/108/102/108102145/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	0	3	3	3	0	1
CO2	3	2	0	2	3	2	0	1
CO3	3	2	0	2	3	2	3	2
CO4	3	2	0	2	3	2	0	2
CO5	3	2	0	2	3	2	0	2
Total	15	10		11	15	11	3	8
Scaled to 1, 2, 3	3	2		3	3	3	1	2

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

Course Code			**XPH604B**	**L**	**T**	**P**	**C**
Course Name			**ASTRONOMY AND ASTROPHYSICS**	**3**	**1**	**0**	**4**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0**	**0**		**3**	**1**	**0**	**4**

COURSE OUTCOMES On the successful completion of this course students would able to		**DOMAIN**	**LEVEL**
CO1	Explain the function of solar system.	Cognitive	Remember, Understand
CO2	Describe the function of wave nature of light and explain basic concepts of Doppler effect.	Cognitive	Remember, Understand
CO3	Understand the concepts of evolution of star.	Cognitive	Remember, Understand
CO4	***Explain*** *the concepts of* Stellar Physics	Cognitive	Remember
CO5	Understand the concepts of galaxies.	Cognitive	Remember

UNIT – I: INTRODUCTION TO ASTRONOMY	**9+3**
Solar System Overview- Constituents- Astronomical measurements- Units of length time and mass-Constellations – Motion of the Sky- Celestial Sphere-Positions- Equinoxes And Eccentricity - The Length Of A Day - The Length Of Daylight - The Length Of A Second - Solar Calendar - Eclipses – Time Zones - The International Date Line.	
UNIT – II: LIGHT AND OBSERVATION	**9+3**
Inertial Frames- Elliptical Orbits -Kepler's Laws Derived the Virial Theorem-Stellar Parallax -The Magnitude Scale - Qualitative Overview: The Wave Nature of Light - Blackbody Radiation Time and Space in Special-Relativity - Relativistic Momentum and Energy-Doppler Effect of Light. Telescopes: Optical Telescopes- Short Overview of Radio Telescopes - Infrared, Ultraviolet, X-ray, and Gamma-Ray Astronomy.	
UNIT – III: THE STARS	**9+3**
Thermonuclear Energy- A Model of the Sun - Solar Neutrinos - The Photosphere - The Chromosphere - The Corona - Sunspots - The Sunspot Cycle - The Active Sun. Stellar Evolution: Models and Observations-The Evolution of a Star-The Stellar Evolution Cycle - Brief overview: Protostars- Giantstars- Death of Stars-Planetary Nebulae-White	

Dwarfs- Exploding White Dwarfs- Novae-Chandrasekhar Limit-Supernovae-Neutron Stars-Black Holes.	
UNIT – IV: STELLAR PHYSICS	**9+3**
The Classification of Binary Stars- Mass Determination Using Visual Binaries - The Formation of Spectral Lines– The Hertzsprung-Russell Diagram - Mass Continuity - Radiative Energy Transport - Energy Conservation - The Equations of Stellar Structure - Opacity – Scaling Relations on The Main Sequence - Nuclear Energy Production - Nuclear Reaction Rates - Solution of The Equations of Stellar Structure - High Energy Phenomena - Novae And Supernovae - Pulsars - Quasars - Gamma ray bursts - Accreting black hole.	
UNIT – V: COSMOLOGY	**9+3**
Mass and Motions in the Milky Way-The Galactic Centre and Edge-Density Waves and Spiral Arms- Early Observations of Galaxies- Distances of Galaxies-Hubble's Law - Olbers' Paradox -Universal gravitation -- The Age Of The Universe - Expansion In A Newtonian World - Thermal History of the Universe - The Early Radiation Era - Photon and Lepton Decoupling - Big Bang-Nucleo synthesis.	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. Bradley Carroll , Dale Ostlie , "*Introduction to Modern Astrophysics*", 2nd edition, Pearson, 2013.
2. Stephen E. Schneider, Thomas T. Arny, , "*Pathways to Astronomy* ", 4th Edition, McGraw-Hill Education, 2014.

REFERENCE BOOK

1. Dinah L. Moche , "*Astronomy: A Self-Teaching Guide*", 7th edition Wiley India Edition, 2010.
2. Linda S. Sparke, and John S. Gallagher , "Galaxies in the Universe: An Introduction", 2nd edition, Cambridge University Press, 2007.
3. Matts Roos, "*Introduction to Cosmology"*, 3rdEdition, John Wiley andSons Ltd, 2003.
4. Richard A. Matzner, Dictionary of Geophysics, *"Astrophysics andAstronomy*," 1st edition, CRC Press, 2001.

E REFERENCES

1. S. Bharadwa, Department of Physics & Meteorology IIT Kharagpur, "Astrophysics & Cosmology", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/115/105/115105046/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	0	3	2	2	1	1
CO2	3	2	0	2	2	2	0	1
CO3	3	2	0	2	2	2	3	1
CO4	3	2	0	2	2	2	1	2
CO5	3	2	0	2	2	2	1	2
Total	15	10		10	10	10	5	7
Scaled to 1, 2, 3	3	2		2	2	2	1	2

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

Course Code			XPH605A	L	T	P	C
Course Name			INTRODUCTION TO MICROCONTROLLER	3	1	0	4
C	P	A		L	T	P	H
3	0	0		3	1	0	4

COURSE OUTCOMES On the successful completion of this course students would able to		DOMAIN	LEVEL
CO1	Describe, understand, construct and report embedded system design and development	Cognitive Affective	Understanding Remembering, Applying
CO2	Understand the architecture, Timing diagrams and Execution cycles of 8051	Cognitive	Understanding
CO3	Understand the types of addressing modes, Instruction types and to understand the basic concepts of programming	Cognitive Affective	Understanding Set Responding
CO4	Understand interfacing design of peripherals like I/O, A/D, D/A, timer etc.	Cognitive Affective	Understanding Set Responding
CO5	Understand communication protocols and interfacing with external devices	Cognitive Affective	UnderstandingSet Responding

UNIT – I: INTRODUCTION TO EMBEDDED SYSTEMS AND DESIGN ANALYSIS	9+3
Complex systems and microprocessors – Embedded system design process – Formalism for system design-ARM processor – Architecture, Instruction sets and programming. CPU: Programming input and output – Coprocessor – Memory system mechanism– Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing	
UNIT – II: THE 8051 ARCHITECTURE	**9+3**
Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles	
UNIT – III: INSTRUCTION SET AND PROGRAMMING	**9+3**
Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and Debugging tools.	
UNIT – IV: MEMORY AND I/O INTERFACING	**9+3**
Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.	
UNIT – V: INTERFACING MICROCONTROLLER	**9+3**

Synchronous and Asynchronous Communication. RS232, SPI, I2C.Introduction and interfacing to
protocols like Blue-tooth and Zig-bee LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. R. Kamal, "Embedded System", McGraw Hill Education, Third Edition, 2017.
2. John H. Davies," MSP430 Microcontroller Basics", Elsevier Ltd., 2008.
3. M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, 2007.
4. K.J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.

REFERENCE BOOK

1. K.UmaRao, AndhePallavi, "The 8051 Microcontrollers, Architecture and programming and Applications", Pearson Education, 2009.
2. I. S. MacKenzie and R.C.W.Phan., " The 8051 Microcontroller.(4/e)", Pearson education, 2008.
3. Ajay.V. Deshmukh "Microcontrollers and Applications", TMGH, 2005.

E REFERENCES

1. SANTANU CHATTOPADHYAY, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur, "MICROPROCESSORS AND MICROCONTROLLERS", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/108/105/108105102/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1	0	2	0	0	0	0	0
CO2	1	2	1	3	1	0	0	0
CO3	0	0	0	0	0	1	2	0
CO4	1	1	2	2	1	0	0	0
CO5	1	2	2	1	0	0	3	0
Total	4	5	7	6	2	1	5	0
Scaled to 1, 2, 3	1	1	2	2	1	1	1	

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

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Course Code			XPH605B	L	T	P	C
Course Name			QUANTUM MECHANICS	3	1	0	4
C	P	A		L	T	P	H
3	0	0		3	1	0	4

COURSE OUTCOMES On the successful completion of this course students would able to		DOMAIN	LEVEL
CO1	Recall the dual nature of light waves.	Cognitive	Remember, Understand
CO2	Explain the fundamental concepts of quantum mechanics.	Cognitive	Remember, Understand
CO3	Describe the one dimensional problems in quantum mechanics,	Cognitive	Understand &Apply
CO4	Understand the quantum theory in hydrogen atom.	Cognitive	Understand
CO5	Explain the effect of field of atoms.	Cognitive	Understand , remember.

UNIT – I: DUAL NATURE OF MATTER	9+3
De Broglie concept of matter waves – De Broglie wavelength – Wave velocity and group velocity for the De Broglie waves – Experimental study of matter waves – Davison and Germer experiment – G.P. Thomon's experiment for verifying De Broglie relation – Heisenberg's uncertainty Principle – Electron microscope –Gamma ray microscope.	
UNIT – II: BASICS OF QUANTUM MECHANICS	**9+3**
Basic postulates of wave Mechanics – Development of Schrodinger wave equation – Time independent and dependent forms of equations – Properties of wave function – Orthogonal and normalized wave function Eigen function and eigen values –Expectation values and Ehrenfest's theorem.	
UNIT – III: QUANTUM MECHANICS IN ONE DIMENSION	**9+3**
Free Particle Solution and Plane Wave Normalization – Particle in a box of length L – Energy Eigen value and normalized Eigen function. **Barrier penetration problems:** Finite potential well – Tunnel effect – Scanning Tunneling Microscope (Principle and Working)**. Simple Harmonic Oscillator**: Classical picture of Harmonic Oscillator – Quantum Harmonic Oscillator wave function – Energy levels – Zero point energy.	
UNIT – IV: QUANTUM THEORY OF HYDROGEN–LIKE ATOMS	**9+3**
Schrödinger's Equation for the Hydrogen Atom (Spherical Polar Coordinates) –Separation of Variables–Quantum Numbers: Principle –Orbital and Magnetic – shapes of the probability densities for ground states– Radiative Transitions and selection rules.	
UNIT – V: EFFECTS OF FIELDS ON ATOMS	**9+3**
Electron angular momentum– Space quantization–Electron Spin and Spin Angular Momentum– Larmor's Theorem–Pauli Exclusion Principle – Symmetric and Antisymmetric Wave Functions–Spin Magnetic Moment and Energy– Stern–Gerlach Experiment – Normal Zeeman Effect – Magnetic dipole moment and energy – spin–orbit coupling and Energy – Lande' g–factor – qualitative discussion of Fine structure – Total angular momentum –L–S and J–J couplings (basic concept only).	

	LECTURE	TUTORIAL	TOTAL
HOURS	45	15	60

TEXT BOOKS

1. Arthur Beiser, Shobhit Mahajan , "*Concepts of Modern Physics*", 6th edition, McGraw Hill Education,2009.
2. K Venkatesan P M Mathews, "*A Textbook Of Quantum Mechanics*", 2nd Edition, Mc Graw Hill India, 2010.

REFERENCE BOOK

1. J. Griffiths David , "*Introduction to quantum mechanics*", 2nd edition, Pearson Education, 2015.
2. Leonard I. Schiff , "Quantum Mechanics ", McGraw-Hill Education / Asia, **1969.**

E REFERENCES

1. P. RAMADEVI Department of Physics, IIT Bombay, "QUANTUM MECHANICS I", National Programme on Technology Enhanced Learning (NPTEL), https://nptel.ac.in/courses/115/101/115101107/

Mapping of COs with POs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	1	3	3	3	0	1
CO2	3	2	2	2	3	2	1	2
CO3	3	2	1	2	3	2	3	2
CO4	3	2	1	2	3	2	1	2
CO5	3	2	0	2	3	2	0	2
Total	15	10	5	11	15	11	5	9
Scaled to 1, 2, 3	3	2	1	3	3	3	1	2

0 – No relation 1 – Low relation 2 – Medium relation 3 – High relation

YPH201			**MATHEMATICAL METHODS OF PHYSICS - II**	**L**	**T**	**P**	**C**
				4	**1**	**0**	**5**
C	**P**	**A**		**L**	**T**	**P**	**H**
3	**0.75**	**0.25**		**4**	**1**	**0**	**5**

PREREQUISITE: Basic knowledge in differential equations.

On the successful completion of the course, students will be able to

	Course Outcome	**Domain**	**Level**
CO1	***Characterize*** the physical system using group operations and tensors.	**Cognitive**	Knowledge, Analyze
CO2	***Classify*** differential equations and choose right method to solve problems.	**Cognitive**	Knowledge, Comprehension
CO3	***Apply*** partial differential equation to solve problems in physics.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Construct*** the recurrence relation of Legendre's differential equation and Bessel's differential equation.	**Cognitive**	Knowledge
CO5	***Evaluate the Gamma function and Obtain the orthogonal relation of Beta function.***	**Cognitive**	Perception, Knowledge

UNIT - I :	Group Theory & Tensor Analysis	12+3
Group Theory: Definitions of a group-elementary properties-sub groups homomorphism and isomorphism of groups-representation of groups-reducible and irreducible representations SU(2), SO(3) groups and their representations. Tensor: Notations and conventions in tensor analysis – Einstein's summation convention covariant and contravariant and mixed tensors-algebraic operations in tensors symmetric and skew symmetric tensors - tensor calculus.		
UNIT - II :	**Ordinary Differential Equations**	**12+3**
Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.		
UNIT - III :	**Partial Differential Equations (PDEs)**	**12+3**
Second order PDEs and their types – Solutions of PDEs – Methods for solving PDEs – Laplace, diffusion and wave equations in Cartesian and polar coordinates – Solution of two and three dimensional Laplace, diffusion and wave equations using separation of variable method - Solving simple practical problems.		
UNIT - IV :	**Special Functions**	**12+3**
Legendre's differential equation: Legendre polynomials – Generating functions – Recurrence Formulae– Rodrigue's formula–orthogonality of Legendre's polynomial; Bessel's differential equation: Bessel's polynomial –generating functions–Recurrence Formulae–orthogonal properties of Bessel's polynomials; Hermite differential equation– Hermite polynomials – generating functions – recurrence relation; Laguerre's differential equation: Laguerre's polynomial –generating function– Recurrence Formulae–orthogonal properties of Laguerre's polynomials		
UNIT - V :	**Gamma, Beta and Error Functions**	**12+3**
Definition of Gamma and Beta functions- Fundamental properties of Gamma functions – Evaluation of (1/2) and graph of the Gamma function- Transformation of Gamma function - Different forms of Beta functions – Relation between Beta and Gamma functions- Reduction of definite integrals to Gamma functions- Error function / probability integral.		

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	15	0	75

TEXT BOOKS:

1. Mathematical Physics - H.K.Dass and R.Verma. S. Chand & Co Pvt Ltd., 1997.
2. Mathematical Physics - B.D. Gupta, Vikas, Publishing House Pvt Ltd., New Delhi; 2003.
3. Mathematical Physics - Satya Prakash, Sultan Chand & Sons; 2014.

REFERENCE BOOKS :

1. Topics in Mathematical Physics, Parthasarathy H, Ane Books Pvt. Ltd, 2007.
2. Advanced Engineering Mathematics, Kreyszig, Wiley Eastern Ltd, 1993.

YPH103			ELECTRONICS	L	T	P	C
				4	1	0	5
C	P	A		L	T	P	H
3	0.75	0.25		4	1	0	5

PREREQUISITE: Basic knowledge in active and passive components in a circuit and semiconductors.

On the successful completion of the course, students will be able to

	Course Outcome	Domain	Level
CO1	***Understand*** the characteristics of various types of diodes and transistors along with their ***applications*** in devices.	**Cognitive**	Knowledge, Analyze
CO2	***Construct*** circuits using op-amp for ***executing*** arithmetic operations, ***design*** circuits for a desired input/ output.	**Cognitive**	Knowledge, Comprehension
CO3	***Explain*** the principal of operation and ***performance*** of various oscillators and converters.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Develop*** an ability to analyse and ***design*** different digital systems.	**Cognitive**	Knowledge
CO5	***Understand*** masking concept as well as IC fabrication technology, ***design*** CMOS layout and Charged coupled device.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Semiconductor Devices**	**12+3**

PN junction diodes - Varactor diode - Schottky diode - tunnel diode - Gunn diode -optoelectronic diode - LASER diode - LED - photo diode - JFET characteristics - Depletion and enhancement type MOSFFT – Characteristics of UJT and SCR – relaxation oscillator - Power control DIAC and TRIAC.

UNIT - II :	**Operational Amplifier**	**12+3**

Operational Amplifier characteristics - inverting and non-inverting amplifier - voltage follower - integrating and differential circuits - log and antilog amplifiers - op-amp as a comparator - voltage to current and current to voltage conversions - active filters: low pass, high pass, band pass and band rejection filters - solving simultaneous and differential equations (Analog computations).

UNIT - III :	**Oscillators and Converters**	**12+3**

Wien bridge and phase-shift oscillators – Triangular, saw-tooth and square-waves generators – Schmitt trigger – Voltage control oscillator – Phase-locked loops -- Basic Digital to Analog conversion (DAC) - Weighted resistor DAC and binary R-2R ladder DAC -- Counter type ADC and successive approximation converter - dual slope ADC.

UNIT - IV :	**Digital Systems**	**12+3**

Digital comparator – Parity generator/checker – Data selector -- BCD to Seven segment decoder – Encoders – RS, JK, D and JK master-slave flip-flops - Serial-in serial-out, serial-in parallel-out and parallel-in serial-out shift registers – Synchronous, asynchronous, ring and up/down (using mod 10) counters -- Multiplexers – Demultiplexers.

UNIT - V :	**IC Fabrication and IC Timer**	**12+3**

Basic monolithic ICs – Epitaxial growth – Masking – Etching impurity diffusion – Fabricating monolithic resistors, diodes, transistors, inductors and capacitors – Circuit layout – Contacts and inter connections – Charge coupled device – Applications of CCDs -- 555 timer: Description of the functional diagram, applications of monostable and astable operations and pulse generation.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	15	0	75

TEXT BOOKS:	
1.	Integrated Electronics - Millman and Halkias, TMH, 2017.
2.	Text Book of Electronics - S. Chattopadhyay, New Central Book Agency P.Ltd, 2012.
REFERENCE BOOKS :	
1.	Electronic Devices and Circuits - Anil K. Maini and Varsha Agarwal, Wiley Publications, 2009.
2.	Electronic principles - Malvino, TMH, 2015.
3.	Op-Amps & Linear Integrated Circuits - R.A. Gayakwad, Printice Hall, New Delhi, 1999.
4.	Linear Integrated Circuit - D. Roy Choudhury and S.B. Jain, New Age International Publications, New Delhi, 2010.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PS0O9	PSO10
CO1	3	2	1	1	2	2	3	3	0	1
CO2	3	3	2	1	1	2	3	3	0	1
CO3	3	2	3	1	2	2	3	3	0	1
CO4	3	2	3	1	2	2	3	3	0	1
CO5	3	3	1	1	3	2	3	3	0	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH105C			INSTRUMENTAL METHODS OF ANALYSES	L	T	P	C
				4	0	0	4
C	P	A		L	T	P	H
3	0.75	0.25		4	0	0	4

PREREQUISITE: Fundamental knowledge on measuring instruments.

On the successful completion of the course, students will be able to

Course Outcome		Domain	Level
CO1	***Explain*** the types of errors in experimental methods of analysis.	Cognitive	Knowledge, Analyze
CO2	***Understand*** the principle and working of thermal methods of analysis such as thermogravimetric analysis and differential scanning calorimetric analysis and apply for material analysis..	Cognitive	Knowledge, Comprehension
CO3	***Understand*** and ***apply*** X-ray diffraction method for analysing crystalline materials.	Cognitive, Psychomotor	Knowledge, Analysis, Set
CO4	***Utilize*** luminescence methods and electron microscopy methods for material analysis and their application.	Cognitive	Knowledge
CO5	***Learn*** the various applications of nanoparticles.	Cognitive	Perception, Knowledge

UNIT - I :	Errors and Analysis of Experimental Data	12

Types of errors - Mean, variance and standard deviation, standard deviation of standard deviation - sampling techniques - Chi square test. Experimental Stress Analysis: Stress analysis by strain gauging-

high temperature strain gauge techniques - photoelasticity and holography.		
UNIT - II :	**Thermal Analysis**	**12**
Introduction - thermo gravimetric analysis - instrumentation of weight loss and decomposition products - differential scanning calorimetric - instrumentation - specific heat capacity measurements - determination of thermo chemical parameters - differential thermal analysis - basic principles - melting point determination and analysis.		
UNIT - III :	**X-ray Analysis**	**12**
Single Crystal and powder diffraction - Diffractometer - interpretation of diffraction patterns - indexing - unknown and phase identification - double and four crystal Diffractometer for epitaxial characterization - lattice mismatch - tetragonal distortion - thin film characterization - X-ray fluorescence spectroscopy - uses.		
UNIT - IV :	**Optical Methods and Electron Microscopy**	**12**
Photoluminescence - light-matter interaction - fundamental transitions - excitons - instrumentation - electroluminescence - instrumentation - photo reflectanceelectronic transitions - behavior of electronic transitions as a function of electric field. Principles of SEM, TEM, EDAX, AFM, EPMA - Instrumentation - sample preparation - analysis of materials - study of dislocations - ion implantation - uses - Nanolithogrphy.		
UNIT - V :	**Electrical Methods**	**12**
Hall Effect - carrier density - resistivity - two probe and four probe methods - scattering mechanism - van der pauw method - CV characteristics - Schottky barrier capacitance - impurity concentration - electrochemical CV profiling - limitations.		

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	0	0	60

TEXT BOOKS:

1. Electron microscopy and Microanalysis of Crystalline Materials - Belk.J.A, Applied Science Publishers, London, 1979.
2. Modern Metallographic Techniques and their Applications - Philips V.A, Wiley Interscience, 1971.

REFERENCE BOOKS :

1. Instrumental Methods of Analysis - Willard.M, Steve.D, CBS Publishers, New Delhi, 1986.
2. Electron Microscopy and Microanalysis of Crystalline materials - Stradling, R.A, Applied Science Publishers, London, 1979.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	3	3	1	1	3	1	2	3	0	1
CO2	2	3	1	1	3	1	2	3	0	1
CO3	3	3	1	1	1	1	2	3	0	1
CO4	3	2	1	1	1	1	2	3	0	1
CO5	2	3	1	1	2	1	2	3	0	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH201			MATHEMATICAL METHODS OF PHYSICS - II	L	T	P	C
				4	1	0	5
C	P	A		L	T	P	H
3	0.75	0.25		4	1	0	5

PREREQUISITE: Basic knowledge in differential equations.

On the successful completion of the course, students will be able to

	Course Outcome	Domain	Level
CO1	***Characterize*** the physical system using group operations and tensors.	**Cognitive**	Knowledge, Analyze
CO2	***Classify*** differential equations and choose right method to solve problems.	**Cognitive**	Knowledge, Comprehension
CO3	***Apply*** partial differential equation to solve problems in physics.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Construct*** the recurrence relation of Legendre's differential equation and Bessel's differential equation.	**Cognitive**	Knowledge
CO5	***Evaluate the Gamma function and Obtain the orthogonal relation of Beta function.***	**Cognitive**	Perception, Knowledge

UNIT - I :	**Group Theory & Tensor Analysis**	**12+3**

Group Theory: Definitions of a group-elementary properties-sub groups homomorphism and isomorphism of groups-representation of groups-reducible and irreducible representations SU(2), SO(3) groups and their representations. Tensor: Notations and conventions in tensor analysis – Einstein's summation convention covariant and contravariant and mixed tensors-algebraic operations in tensors symmetric and skew symmetric tensors - tensor calculus.

UNIT - II :	**Ordinary Differential Equations**	**12+3**

Homogeneous linear equations of second order with constant coefficients and their solutions – ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods – extended power series method for indicial equations.

UNIT - III :	**Partial Differential Equations (PDEs)**	**12+3**

Second order PDEs and their types – Solutions of PDEs – Methods for solving PDEs – Laplace, diffusion and wave equations in Cartesian and polar coordinates – Solution of two and three dimensional Laplace, diffusion and wave equations using separation of variable method - Solving simple practical problems.

UNIT - IV :	**Special Functions**	**12+3**

Legendre's differential equation: Legendre polynomials – Generating functions – Recurrence Formulae– Rodrigue's formula–orthogonality of Legendre's polynomial; Bessel's differential equation: Bessel's polynomial –generating functions–Recurrence Formulae–orthogonal properties of Bessel's polynomials; Hermite differential equation– Hermite polynomials – generating functions – recurrence relation; Laguerre's differential equation: Laguerre's polynomial –generating function– Recurrence Formulae–orthogonal properties of Laguerre's polynomials

UNIT - V :	**Gamma, Beta and Error Functions**	**12+3**

Definition of Gamma and Beta functions- Fundamental properties of Gamma functions – Evaluation of (1/2) and graph of the Gamma function- Transformation of Gamma function - Different forms of Beta functions – Relation between Beta and Gamma functions- Reduction of definite integrals to Gamma functions- Error function / probability integral.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	15	0	75

TEXT BOOKS:

4. Mathematical Physics - H.K.Dass and R.Verma. S. Chand & Co Pvt Ltd., 1997.
5. Mathematical Physics - B.D. Gupta, Vikas, Publishing House Pvt Ltd., New Delhi; 2003.
6. Mathematical Physics – Satya Prakash, Sultan Chand & Sons; 2014.

REFERENCE BOOKS :

3. Topics in Mathematical Physics, Parthasarathy H, Ane Books Pvt. Ltd, 2007.
4. Advanced Engineering Mathematics, Kreyszig, Wiley Eastern Ltd, 1993.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	3	3	1	2	1	1	2	3	2	1
CO2	3	2	1	2	1	1	2	3	2	1
CO3	3	2	1	2	1	1	2	3	2	1
CO4	3	2	1	2	2	1	2	3	2	1
CO5	2	2	1	2	2	1	2	3	2	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH202			QUANTUM MECHANICS - I	L	T	P	C
				4	1	0	5
C	P	A		L	T	P	H
3	0.75	0.25		4	1	0	5

PREREQUISITE: Basic knowledge in calculus.

On the successful completion of the course, students will be able to

Course Outcome		Domain	Level
CO1	***Understand*** the fundamental principles of quantum mechanics and the ***formulation*** of Schrodinger equation.	Cognitive	Knowledge, Analyze
CO2	***Solve*** time-independent stationary state problems for the square well, finite and multiple potential wells.	Cognitive	Knowledge, Comprehension
CO3	***Solve*** linear harmonic oscillator and the hydrogen atom problems.	Cognitive, Psychomotor	Knowledge, Analysis, Set
CO4	***Understand*** the matrix formulation of Schrodinger, Heisenberg and Interaction representations and ***understand*** Symmetry and Anti-symmetry wave functions of identical particles.	Cognitive	Knowledge
CO5	***Solve*** the eigenvalue problems using commutation rules and addition of angular momenta.	Cognitive	Perception, Knowledge

UNIT - I :	Wave Mechanics	12+3

Matter waves- Equation of motion- Schrodinger equation for the free particle - physical interpretation of wave function - normalised and orthogonal wave functions-expansion theorem-admissibility conditions- stationary state solution of Schrodinger wave equation -
Expectation values-probability current density- Ehrenferts theorem. Postulates of wave mechanics - adjoint and self-adjoint operators degeneracy- eigen value, eigen functions-observables – Physical interpretation-expansion coefficients-momentum eigen functions-
Uncertainty principle-states with minimum value-commuting observables - constant of motion-Interacting and Non-interacting systems.

UNIT - II :	**Stationary State and Eigen spectrum**	**12+3**

Time independent Schrodinger equation - Particle in a square well potential – Bound states –eigen values, eigen functions –Potential barrier – quantum mechanical tunnelling-infinite potential – finite potential – multiple potential well –alpha emission.

UNIT - III :	**Exactly solvable Eigen value problems**	**12+3**

One dimensional linear harmonic oscillator - properties of stationary states- abstract operator method - Angular momentum operators- commutation relation-Parity- spherical symmetry systems -Particle in a central potential - radial wave function - Hydrogen atom: solution of the radial equation - stationary state wave functions - bound states-the rigid rotator: with free axis-in a fixed plane-3-Dimentional harmonic oscillator.

UNIT - IV :	**Matrix Formulation of Quantum theory and Equation of Motion**	**12+3**

Quantum state vectors and functions- Hilbert space-Dirac' s Bra - Ket notation-matrix theory of Harmonic oscillator - Schrodinger, Heisenberg and Interaction representation - coordinates and momentum representations - Projection operator Identical Particles and Spin Identical Particles - symmetry and antisymmetric wave functions - exchange degeneracy - Spin and statistics: Pauli' s exclusion principle-Slater determinant- collision of identical particles - spin and Pauli's matrices - density operator and density matrix.

UNIT - V :	**Angular Momentum**	**12+3**

Angular momentum -commutation rules - eigen value spectrum - matrix representation of J in the |jm> basis - spin angular momentum - spin ½ , spin-1- addition of angular momenta-
Clebsch-Gordan coefficients-spin wave functions for a system of two spin- ½ particles.

LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
60	**15**	**0**	**75**

TEXT BOOKS:

1. A Text book of Quantum Mechanics - P. M. Mathews and K. Venkatesan , Tata McGraw –Hill Publications, 2010.
2. Quantum Mechanics - SatyaPrakash, KedarNath Ram Nath and Co. Publications, 2018.
3. QantumMechanics– Theory and applications -A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, 2015.

REFERENCE BOOKS :

1. Quantum Mechanics - V. K. Thankappan, New Age International (P) Ltd. Publication, 2003.
2. Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, 1994.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	1	2	0	3	3	1	2	1	3	1
CO2	1	3	0	3	3	1	2	1	3	1
CO3	1	3	0	3	3	1	2	1	3	1
CO4	1	1	0	3	3	1	2	1	3	1
CO5	1	3	0	1	3	1	2	1	3	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH203			MICROPOCESSOR AND MICROCONTROLLER	L	T	P	C
				4	1	0	5
C	P	A		L	T	P	H
3	0.75	0.25		4	1	0	5

PREREQUISITE: Fundamental knowledge on electronics.

On the successful completion of the course, students will be able to

Course Outcome		Domain	Level
CO1	***Explain*** the basic concepts of digital fundamentals using microprocessor 8085. Also, ***familiarize*** its internal architecture and operation.	**Cognitive**	Knowledge, Analyze
CO2	***Apply*** Knowledge and ***demonstrate*** programming of microprocessor 8085 and identify various addressing modes with transfer instructions.	**Cognitive**	Knowledge, Comprehension
CO3	***Illustrate*** specified programme and ***provide*** assembly language programmes that ***solve*** real-world control applications.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Distinguish*** the properties of microprocessor and microcontroller and ***explain*** the basic concepts and design of microcontroller 8051.	**Cognitive**	Knowledge
CO5	Acquire basic ideas related to instruction set and addressing modes of microcontroller 8051 and apply it to write assembly language programme for various real-world problems.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Microprocessor Architecture and Interfacing**	**12+3**

Intel 8085 microprocessor architecture – Pin configuration – Instruction cycle –Timing diagram – Instruction and data formats – Addressing modes -- Memory mapping and I/O mapping I/O scheme - Memory mapping I/O interfacing - Data transfer schemes -- Synchronous and asynchronous data transfer – Interrupt driven data transfer - Interrupts of Intel 8085.

UNIT - II :	**Assembly Language Programs (8085 only)**	**12+3**

BCD arithmetic -- Addition and subtraction two 8-bit and 16-bit numbers - Largest and smallest numbers in a data set – Ascending order and descending order – Sum of a series of a 8-bit numbers – Sum of a series of multibyte decimal numbers – Square root of a number – Block movement of data - Time delay – Square-wave generator.

UNIT - III :	**Peripheral Devices and Microprocessor Applications**	**12+3**

Generation of control signals for memory and I/O devices -- I/O ports -- Programmable peripheral interface -- Architecture of 8255A -- Control word -- Programmable interrupt controller (8259) -- Programmable counter -- Intel 8253 -- Architecture, control word and operation – Block diagram and

interfacing of analog to digital converter (ADC 0800) – Digital to analog converter (DAC 0800) – Stepper motor – Traffic control.		
UNIT - IV :	**Microcontroller 8051**	**12+3**
Features of 8051 – Architecture – Pin configuration – Memory organization -- External data and program memory -- Counters and timers – Serial data input/output – Interrupt structure – External interrupts – Addressing modes -- Comparison between microprocessor and microcontroller.		
UNIT - V :	**8051 Instruction Set and Programming**	**12+3**
Instruction set – Data transfer, arithmetic and logical instructions – Boolean variable manipulation instructions – Program and machine control instructions – Simple programs – Addition and subtraction of two 8-bit and 16-bit numbers – Division – Multiplication -- Largest number in a set – Sum of a set of numbers.		

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	15	0	75

TEXT BOOKS:

1. Fundamentals of Microprocessor and Microcomputers - B. Ram, Dhanpat Rai Publications, New Delhi, 2006.
2. Microprocessor Architecture, Programming and Applications with 8085 - R. Gaonkar, Penram International Publishing, Mumbai, 2006.
3. Microprocessors and Microcontrollers - A.P. Godse and D.A. Godse, Technical Publishers, Pune, 2008.

REFERENCE BOOKS :

1. The 8051 Microcontroller and Embbeded Systems using Assembly and C - M.A. Mazidi, J.G. Mazidi and R.D. Mckinlay, Dorling Kindersley, New Delhi, 2013.
2. The Microcontroller - K. A, Cengage Learning India, New Delhi, 2013.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	3	2	1	1	2	1	3	2	0	0
CO2	3	3	2	1	1	1	3	2	0	0
CO3	3	2	3	1	2	1	3	3	0	0
CO4	3	2	3	1	2	1	3	2	0	0
CO5	3	3	2	1	3	1	3	2	0	0

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH204			DIGITAL AND MICROPROCESSOR LABORATORY	L	T	P	C
				0	0	3	3
C	P	A		L	T	P	H
0.5	2	0.5		0	0	6	6

PREREQUISITE: Know the basic laws and theory. Have practical experience to apply the theory and measurement tools.

On the successful completion of the course, students will be able to

	Course Outcome	Domain	Level
CO1	***Understand*** the concepts behind various physics experiments.	**Cognitive**	Knowledge, Analyze
CO2	***Construct*** simple electronic circuits and make out the characteristics of transistors, amplifiers, oscillators and filters.	**Cognitive**	Knowledge, Comprehension
CO3	***Know*** the conceptual difference between analog and digital circuits.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Write*** ALP for arithmetic and logical operations in 8051	**Cognitive**	Knowledge
CO5	***Execute*** programs in microprocessor (8051)	**Cognitive**	Perception, Knowledge

S. No.	Experiments
A. Digital Electronics (Any eight experiments)	
1.	Study the function of multiplexer and demultiplexer
2.	Study the function of decoder and encoder
3.	Flip flops - RS, T – FF and D - FF
4.	Flip flops - JK, Master & slave
5.	Study of Boolean logic operations using ICs
6.	Half adder and Full adder, using only NAND & NOR gates.
7.	Half subtractor and Full Subtractor (using only NAND & NOR gates)
8.	BCD to seven segment display
9.	Study of counter using IC 7490
10.	Combinational Logic Circuit Design
11.	Asynchronous counter: Mod-N Counters
12.	Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO (using FF & 7495)
B. Microprocessor and Microcontroller Experiments (Any eight experiments)	
1.	Microprocessor – addition, subtraction (8 Bit)
2.	Microprocessor – addition, subtraction (Array)
3.	Microprocessor – Multiplication 8 bit by 8 bit and 16 bit by 8 bit
4.	Microprocessor – Division 8 bit by 8 bit and 16 bit by 8 bit
5.	Microprocessor – To find the largest and smallest number in an array
6.	Microprocessor – Ascending and descending order.
7.	Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
8.	Write a program using 8085 Microprocessor for Hexadecimal addition and subtraction of two Numbers.
9.	Microprocessor - Counter and Time Delay
10.	Microcontroller – Assembly language program to generate 10KHz square wave

11.	Microcontroller – To study implementation & interfacing of display devices like LCD, LED and seven segment display devices with microcontroller 8051.
12.	Microcontroller – To study implementation & interfacing of different motors like stepper motor, DC motor & servo motors with microcontroller 8051.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
0	0	90	90

TEXT BOOKS:

1.	An Advanced Course in Practical Physics - D. Chattopadhyay, P. C. Rakshit, New Central Book Agency (P) Ltd., 2007.
2.	A Textbook of Advanced Practical Physics - S. K. Ghosh, New Central Publishers, 2000.
3.	Practical Electronics (Microprocessor) – T. Veeramanikandasamy and A. Balamurugan, Technical Publications, Pune, 2011.

REFERENCE BOOKS :

1.	Advanced Practical Physics Volume I – Dr. S.P. Sing, Pragati Prakasan Educational publishers, 2011.
2.	Practical Physics and Electronics – C.C. Ouseph, U.J. Rao, V. Vijayendran, Viswanathan Printers & Publishers Pvt. Ltd., 2007.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	3	3	1	1	3	2	2	3	0	0
CO2	2	3	1	1	3	2	2	3	0	0
CO3	3	3	1	1	1	2	2	3	0	0
CO4	3	2	1	1	1	2	2	3	0	0
CO5	2	3	1	1	2	2	2	3	0	0

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH302			QUANTUM MECHANICS - II	L	T	P	C
				4	1	0	5
C	P	A		L	T	P	H
3	0.75	0.25		4	1	0	5

PREREQUISITE: Basic knowledge in principles of quantum mechanics and calculus.

On the successful completion of the course, students will be able to

Course Outcome		Domain	Level
CO1	***Apply*** perturbation theory in Non-degenerate and degenerate problems in systems under magnetic and electric fields.	Cognitive	Knowledge, Analyze
CO2	***Solve*** problems in time dependent perturbation and semi-classical theory of radiation.	Cognitive	Knowledge, Comprehension
CO3	***Understand*** Born approximation and ***explore*** scattering with screened potential and different scattering cross sections at various potentials.	Cognitive, Psychomotor	Knowledge, Analysis, Set

CO4	***Solve*** the relativistic problems using Klein-Gordan and Dirac equations. Also ***understand*** the theory of field quantization.	**Cognitive**	Knowledge
CO5	***Explore*** the theory of Central field approximation and molecular orbital theory.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Approximation Methods for Time Independent Problems**	**12+3**

Time independent perturbation theory – stationary theory- Non-degenerate case: first and second order-Normal Helium atom– Zeeman effect without electron spin –Degenerate case: Energy correction- stark effect in hydrogen atom. Variation method: Variation Principle – upper bound states-ground state of Helium atom –Hydrogen molecule-WKB approximation - Schrodinger equation-Asymptotic solution-validity of WKB approximation-solution near a turning point – connection formula for penetration barrier – Bohr-Summer field quantization condition tunneling through a potential barrier.

UNIT - II :	**Approximation Methods for Time Dependant Perturbation**	**12+3**

Time dependent Perturbation theory - first order transitions - constant perturbation- transition probability: Fermi Golden Rule - Periodic perturbation -harmonic perturbation - adiabatic and sudden approximation. Semi-classical theory of radiation: Application of the time dependent perturbation theory to semi-classical theory of radiation - Einstein's coefficients - absorption - induced emission - spontaneous emission - Einsteim's transition probabilities- dipole transition - selection rules – forbidden transitions.

UNIT - III :	**Scattering Theory**	**12+3**

Kinematics of scattering process - wave mechanical picture- Green's functions - Born approximation and its validity -Born series - screened coulombic potential scattering from Born approximation. Partial wave analysis: asymptotic behavior - phase shift - scattering amplitude in terms of phase shifts - differential and total cross sections - optical theorem - low energy scattering - resonant scattering - non-resonant scattering-scattering length and effective range- Ramsauer-Townsend effect - scattering by square well potential.

UNIT - IV :	**Relativistic Quantum Mechanics and Quantisation of Field**	**12+3**

Schrodinger relativistic equation- Klein-Gordan equation-charge and current densities - interaction with electromagnetic field- Hydrogen like atom - nonrelativistic limit- Dirac relativistic equation: Dirac relativistic Hamiltonian - probability density- Dirac matrices-plane wave solution - eigen spectrum - spin of Dirac particle - significance of negative eigen states - electron in a magnetic field - spin magnetic moment. Quantisation of the Field Electromagnetic wave as harmonic oscillators - quantisation: classical e.m.wave quantisation of fields oscillators- Photons- number operator – creation and annihilation operators of photons.

UNIT - V :	**Quantum Theory of Atomic and Molecular Structure**	**12+3**

Central field approximation: residual electrostatic interaction - spin orbit interaction- Determination of central field: Thomas Fermi statistical method-Hartree and Hartree-Fock approximations (self consistent fields) - Atomic structure and Huns's rule. Molecules: Born-Oppenheimer approximation - An application: the hydrogen molecule Ion (H_2+) - Molecular orbital theory: LCAO- Hydrogen molecule.

LECTURE	**TUTORIAL**	**PRACTICAL**	**TOTAL**
60	**15**	**0**	**75**

TEXT BOOKS:

1. A Text book of Quantum Mechanics - P. M. Mathews and K. Venkatesan , Tata McGraw –Hill Publications, 2010.

2.	Quantum Mechanics - SatyaPrakash, KedarNath Ram Nath and Co. Publications, 2018.
3.	QantumMechanics– Theory and applications -A. K. Ghatak and Lokanathan, Macmillan India Ltd Publication, 2015.
REFERENCE BOOKS :	
1.	Quantum Mechanics - V. K. Thankappan, New Age International Publication,2003.
2.	Principle of Quantum Mechanics - R. Shankar, Plenum US Publication, 1994.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	3	3	0	1	3	1	2	1	3	1
CO2	3	3	0	1	3	1	2	1	3	1
CO3	2	2	0	2	3	1	2	1	3	1
CO4	3	3	0	1	3	1	2	1	3	1
CO5	2	2	0	3	3	1	2	1	3	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH305A			MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)	L	T	P	C
				4	0	0	4
C	P	A		L	T	P	H
3	0.75	0.25		4	0	0	4

PREREQUISITE: Basic knowledge on electronics

On the successful completion of the course, students will be able to

Course Outcome		Domain	Level
CO1	***Acquire*** knowledge and ***get*** introduced to the field of Microsystems.	**Cognitive**	Knowledge, Analyze
CO2	***Learn*** new materials, science and technology for Microsystems and its applications	**Cognitive**	Knowledge, Comprehension
CO3	***Describe*** MEMS fabrication technologies	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Analyse*** Microsystems technology for technical feasibility as well as practicality.	**Cognitive**	Knowledge
CO5	***Acquire*** knowledge and ***understand*** the state-of-art micromachining and packaging technologies.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Overview of MEMS and Microsystems**	**12**

Emergence – devices and application, MEMS and Microsystems - typical MEMS and Microsystem Products-Evolution of micro fabrication - Microsystem and microelectronics - Microsystem and Miniaturization. MEMS with micro actuator - Microgrippers - Micromotors - Microvalves - Micro pumps - Micro accelerometers.

UNIT - II :	**Scaling laws and materials for MEMS**	**12**

Scaling: Introduction to scaling - Scaling in geometry - rigid body dynamics - Electrostatic Forces, Electromagnetic, Electricity, Fluid mechanics - Scaling in Heat transfer – Materials: Substrates and Wafers - Active substrate materials - Silicon as a substrate material - Silicon Compounds - Silicon

piezo resistor - Gallium Arsenide - Quartz - piezoelectric crystals - polymers - Packing materials.		
UNIT - III :	**Microsystem Fabrication Process**	**12**
X-ray Introduction - Photolithography - Ion implantation - Oxidation - Diffusion - Chemical Vapour Deposition - Physical Vapour Deposition (sputtering) - Deposition by epitaxy – Etching - Microstereo lithography.		
UNIT - IV :	**Micro Manufacturing**	**12**
Bulk micro manufacturing – isotropic and Anisotropic etching - wet etching - Etch stop - dry etching - comparison, Surface micro machining -general description - process - mechanical problems associated with surface micromachining, The LIGA process - general description-substrate and photoresists-electroplating-SLIGA.		
UNIT - V :	**Microsystem Design and Packaging**	**12**
Microsystem Design: Introduction - Design consideration - Mechanical Design Using Finite Elements Method - design, simulation and layout of MEMS devices using CAD tools. Microsystem Packaging: Microsystem Packaging - Interfaces in Microsystem packaging - Essential Packaging Technologies.		

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	0	0	60

TEXT BOOKS:

1.	MEMS and Microsystems Design and Manufacture - Hsu & Tai Ran, Tata McGraw Hill, 2000.
2.	MEMS and MOEMS Technology and Applications - Ri-Choudhury & Prosenjit, SPIE, 2000.

REFERENCE BOOKS :

1.	MEMS: Introduction and Fundamentals - Mohamed Goad-el-Hak, CRC Press, 2005.
2.	Smart Material Systems and MEMS: Design and Development Methodologies - Vijay K. Vardan, K. J. Vinoy, S. Gopalakrishnan, John Wiley & Sons, 2011.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	1	2	2	2	3	2	3	2	0	1
CO2	1	2	2	2	3	2	3	2	0	1
CO3	1	2	3	2	3	2	3	2	0	1
CO4	1	2	3	2	3	2	3	2	0	1
CO5	1	2	3	2	3	2	3	2	0	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH305B			SOLAR THERMAL AND PHOTOVOLTAIC TECHNOLOGY	L	T	P	C
				4	0	0	4
C	P	A		L	T	P	H
3	0.75	0.25		4	0	0	4

PREREQUISITE: Basic knowledge on energy sources.

On the successful completion of the course, students will be able to

	Course Outcome	Domain	Level
CO1	***Explain*** the principles that underlie the ability to various natural phenomena to deliver solar energy.	**Cognitive**	Knowledge, Analyze
CO2	***Outline*** the technologies that are used to harness the power of solar energy for various applications.	**Cognitive**	Knowledge, Comprehension
CO3	***Evaluate*** the choice of solar collector for a given application.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Understand*** the potential impact of solar thermal systems and ***apply*** knowledge for design of solar thermal systems.	**Cognitive**	Knowledge
CO5	***Understand*** the working principle of solar photovoltaic cell and ***analyse*** the performance of the device.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Energy Resources and Solar Spectrum**	**12**

World energy resources - Indian energy scenario - Environmental aspects of energy utilization. Renewable energy resources and their importance - Global solar resources. Solar spectrum – Electromagnetic spectrum, basic laws of radiation. Physics of the Sun - Energy balance of the earth, energy flux, solar constant for earth.

UNIT - II :	**Solar Applications**	**12**

Solar water heaters - solar space conditioning systems - Solar Cooking – Distillation - Desalination - Solar Ponds – Solar Passive Architecture – Solar Drying – Solar Chimney - Solar electricity - solar lighting.

UNIT - III :	**Solar Collectors**	**12**

Concentrating and non-concentrating solar collectors - design, structure, operation and performance - parabolic trough collectors - flat plate collectors - evacuated tube collectors - Application of non-concentrating collectors (low temperature solar thermal plants for space heating and cooling, drying, seawater desalination) and concentrating collectors (process heat production and power generation).

UNIT - IV :	**Solar Thermal Energy Conversion**	**12**

Green house effect - Fundamentals of solar collectors as devices to convert solar energy to heat - Thermal design of receivers - Thermal Energy Storage Systems - Solar heating systems with and without heat storage - solar thermal power generation.

UNIT - V :	**Solar Photovoltaic Energy Conversion**	**12**

Solar photovoltaic energy conversion - Principles - Physics and operation of solar cells. Classification of solar PV systems, Solar cell energy conversion efficiency, I-V characteristics, effect of variation of solar insolation and temperature, losses. Solar PV power plants.

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	0	0	60

TEXT BOOKS:

1. Solar Energy: Principles of Thermal Collection and Storage - Sukhatme, Tata McGraw Hill,

	New York, 2008.
2.	Thin Film Phenomena - K. L. Chopra, Tata McGraw Hill Book Company, New York, 1969.
REFERENCE BOOKS :	
1.	Hand Book of Thin Films - Hari Singh Nalwa, Academic Press, 2002.
2.	Physics of Thin Films - L. Eckertova. Plenum Press, New York , 1977.
3.	Material Science of Thin Films - Milton Ohring, Academic Press, 2002.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	1	2	3	1	3	3	3	3	0	0
CO2	1	2	3	1	3	3	3	3	0	0
CO3	1	2	3	1	3	3	3	3	0	0
CO4	1	2	3	1	3	3	3	3	0	0
CO5	1	2	3	1	3	3	3	3	0	0

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation

YPH305C			INDUSTRIAL ELECTRONICS	L	T	P	C
				4	0	0	4
C	P	A		L	T	P	H
3	0.75	0.25		4	0	0	4

PREREQUISITE: Basic knowledge on electronics.

On the successful completion of the course, students will be able to

	Course Outcome	Domain	Level
CO1	***Understand*** different types of power electronic devices and their switching.	**Cognitive**	Knowledge, Analyze
CO2	***Study*** the operation of circuits used in power electronic devices.	**Cognitive**	Knowledge, Comprehension
CO3	***Know*** the industrial applications of power electronic devices.	**Cognitive, Psychomotor**	Knowledge, Analysis, Set
CO4	***Know*** the basics of transducers and sensors and types of sensors used for Robotics.	**Cognitive**	Knowledge
CO5	***Understand*** the working principle of ECG, EEG & EMG and general biomedical imaging techniques.	**Cognitive**	Perception, Knowledge

UNIT - I :	**Power Electronic Devices**	**12**

Study of switching devices: Silicon controlled rectifiers (SCR) – Unijunction transistors (UJT) Bipolar junction transistor (BJT) – Diode for alternating current (DIAC) – Triode for alternating current (TRIAC) - Insulated gate bipolar junction transistor (IGBT) - triggering and commutation circuit for SCR - introduction to driver and snuber circuit.

UNIT - II :	Power Electronic Circuits and Controls	12
Converters: Chopper – Cyclo converters – Matrix converters; Rectifiers: Single-phase half-wave rectifiers – Single-phase full-wave rectifiers; Inverters: Single-phase inverters – Three-phase inverters – Multilevel inverters – Line-commutated inverters.		
UNIT - III :	**Applications of Power Electronic Devices**	**12**
SCR DC drives – Power electronic converter – Position sensing – Types and operation of Step Motors: Variable reluctance step motor – Drive circuits for variable reluctance step motors – Permanent magnet step motor – Control of step motor; Uninterruptible power supplies (UPS): UPS functions – Static UPS topologies – Rotary UPS.		
UNIT - IV :	**Sensors in Robotics**	**12**
Introduction of transducers and sensors – Types of sensors in robotics: Tactile sensors–Proximity and range sensors – Miscellaneous sensors and sensor based systems – Uses of sensors in robotics – Machine vision: Introduction to machine vision – Sensing and digitizing function.		
UNIT - V :	**Concepts of Medical Electronics**	**12**
Bioelectric signals and electrodes: Electrocardiogram (ECG) – Electroencephalogram (EEG) – Electromyogram (EMG); Electrode-tissue interface; Electrodes for ECG – Electrodes for EEG – Electrodes for EMG – Electrical conductivity of electrode jellies and creams; Biomedical imaging system: Principle and Working of – X-ray machine, Computed tomography (CT) and Magnetic resonance imaging (MRI).		

LECTURE	TUTORIAL	PRACTICAL	TOTAL
60	0	0	60

TEXT BOOKS:

1. Industrial Electronics – Circuits, Instruments, and Control Techniques - Terry Bartelt, Cengage Learning India Pvt. Ltd, New Delhi, 2009.
2. Handbook of Biomedical Instrumentation, R.S. Khandpur, Tata McGraw-Hill Publishing Company Ltd, New Delhi, Second edition: 2003.

REFERENCE BOOKS :

1. Modern Industrial Electronics - Timothy J. Maloney, Prentice Hall, New Jersy, 1996.
2. Electronic Devices and Circuits - Anil K. Maini, Varsha Agrawal, Wiley India Pvt. Ltd., New Delhi, 2009.
3. Biomedical Instrumentation - M. Arumugam, Anuradha Publications, Chennai, 2006.

Mapping of Course Outcomes (CO) with Programme Outcomes (PO):

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO9	PSO10
CO1	1	2	3	2	3	3	3	3	0	1
CO2	1	2	3	2	3	3	3	3	0	1
CO3	1	2	3	2	3	3	3	3	0	1
CO4	1	2	3	2	3	3	3	3	0	1
CO5	1	2	3	2	3	3	3	3	0	1

3–High Relation, 2–Medium Relation, 1–Low Relation, 0–No Relation