SCHEME OF EXAMINATION
COURSE SRUCTURE & SYLLABUS

Choice based Credit System (CBCS)
with
Learning Outcomes based Curriculum Framework (LOCF)

for
M.Sc. (ELECTRONICS) PROGRAMME
(SEMESTER SYSTEM)
(Effective from Academic Year 2020-21)

FACULTY OF SCIENCE

For Approval of Board of Studies in Electronics

Effective from Academic Session JULY 2020

School of Studies in Electronics and Photonics
Pt. Ravishankar Shukla University
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Preamble

The Pt. Ravishankar Shukla University is a pioneer institution that has contributed significantly to the Higher Education system of the Chhattisgarh State by providing equitable access to quality education. It has continuously striven to build a knowledge society by providing inclusive and lifelong education to learners across the state and country.

Keeping pace with the emerging ethos of institutionalizing an outcome-oriented higher education system and enhancing employability of graduates, it has adopted the UGC notified Scheme for development of Learning Outcomes-based Curriculum Framework (LOCF). Such initiatives are required for upgrading academic resources and learning environment, raising the quality of teaching and research across all programmes offered by the University. This is critical for enabling effective participation of the PRSU learners in knowledge production and contribution to the knowledge economy, by equipping the learners with skills relevant for global and national standards.

The objective of any programme at Higher Education Institute is to prepare their students for the society at large. The Pt. Ravishankar Shukla University, Raipur envisions all its programmes in the best interest of their students and in this endeavor it offers a new vision to all its Post-Graduate courses. It imbibes a Learning Outcome-based Curriculum Framework (LOCF) for all its Post Graduate programmes.

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the Postgraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students 'experiences as they engage themselves in the programme of their choice. The Post-Graduate Programmes will prepare the students for both, academia and employability.

Each programme vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programmes also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice and also skills for employability. In short, each programme prepares students for sustainability and life-long learning.

The new curriculum of M.Sc. Electronics offers the Postgraduates a complete package to have an in-depth understanding of basic to advance electronics. They can equip themselves to the fundamentals of electronics to a complete skill set compatible to industry 4.0 standards. The exhaustive curriculum will prepare them to pursue higher education as well compete in the job market.

The Pt. Ravishankar Shukla University, Raipur hopes the LOCF approach of the programme M.Sc. Electronics will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

Scheme of Examination
M.Sc. (Electronics) Programme
(Semester System)

Effective from Academic Session JULY 2020

M.Sc. Electronics is a four semester course spread over the period of two years. Every semester course consists of four theory courses and two laboratory courses ,each theory course carrying weight-age of 100 marks (4 credits) and lab course of 100 marks (2 Credits). However, in the final semester, there will be one project in lieu of one practical.

The School of Studies in Electronics & Photonics, Pt Ravishankar Shukla University, Raipur offers this course on its campus. It is designed to offer in depth knowledge of the subject starting from its basic concepts to the state of art technologies in use today. Students are also provided extensive laboratory training on the course content and the current requirements of industries and R and D. In the final semester every student has to undertake a project. Moreover the course structure intends to inculcate strong laboratory skills so that the student can take up independent projects which will help to be an entrepreneur. The students passed out from the revised course will serve as quality human resource to take up the state of art research work of the Department. This course provides exposure to the students to the technologies in-vogue and trains them to take up projects relevant to the industrial needs, the R& D activities and self-employment opportunities. Advanced papers are offered to the students in the areas of Communications, Photonics, Nano and Opto Electronic Devices, Laser Technology Digital Signal Processing, Embedded Systems, Power Electronics and Microcontrollers. In addition, the course caters to the requirements of providing complete exposure to NET/SET syllabus for Electronics formed by the U.G.C. The student after passing the M.Sc. course has many opportunities of employment, self-employment and higher studies. Department of Higher Education, Govt. of Chhattisgarh has declared Electronics as allied subject of Physics for recruitment of Assistant Professor in colleges. The students may opt for UGC – AICTE approved M.Tech. in Optoelectronics & Laser Technology in the department after M.Sc.

Employment Opportunities: - – Electronics and Telecommunication Industries. – I.T. Industries (India and Abroad). – Process and Manufacturing Industries. – Research and Development Laboratories. – Employment in Academic and Other Govt. Organizations.

Educational Opportunities: - – Higher studies in I.I.T, I.I.Sc., and CERE Pilani. For M.Tech. and Ph.D. – Research in Pt. Ravishankar Shula University or any other University. M.Phil, M.Tech. and Ph.D. – M.Tech. /M.E courses of Various Universities in India and Abroad. –Higher Studies Like M.S. in relevant discipline and Research Opportunities in foreign universities. .

Eligibility Criteria: A student shall be held eligible to the admission to the M.Sc. course provided he/she has passed the B.Sc. examination with Electronics or Physics as one of the core subjects in all the three years. of this University or the degree of any other statutory University recognized as equivalent. A student with Bachelor in Vocation in Renewable Energy Technology & Management degree of the University is also eligible for admission to M.Sc Electronics course.

1. **Introduction to Programme**

The learning outcomes based curriculum framework (LOCF) for M.Sc. Electronics is intended to prepare a curriculum which enables the Postgraduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The framework will assist in maintaining international standards to ensure global competitiveness and facilitate student/graduate mobility after completion of M.Sc. Electronics programme. The framework intends to allow for greater flexibility and innovation in curriculum design and syllabus development, teaching learning process, assessment of student learning levels.

The LOCF for M.Sc. Electronics is prepared on the contours and curricular structure of CBCS provided by the UGC, and may be modified without sacrificing the spirit of CBCS and LOCF.

Programme Duration:

The M.Sc. Electronics programme will be of two years duration. Each year will be called an academic year and will be divided into two semesters. Thus there will be a total of four semesters. Each semester will consist of sixteen weeks.

Learning Outcomes

The key learning outcomes of our course are: knowledge and understanding of the concepts, logical as well as abstract thinking and analytical approach, experimental and computational skills, research methodology, values and positive attitude.

Post Graduates should have developed following qualities

1. Understanding of basic and advanced concepts in Electronics
2. Theoretical and practical skills along with problem solving ability
3. Logical and abstract thinking and analytical approach
4. Ability to apply acquired knowledge and skills to the new and unknown situations in order to develop new theories, experiments and technology
5. Understand the nature in a better way
6. Understand and appreciate the nuances and beauties in science education
7. Tenacity, hardworking and ability to work against odds
8. A new perspective to look at everything from 'Electronics' point of view
9. Get introduced to work environment at industrial scale and at research level
10. Awareness of the impact of Electronics in social, economic and environmental issues

11. Willingness to take up responsibility in study and work; confidence in his/her capabilities; and motivation for life-long learning.

Design of Programme:

The various courses of the programme are designed to include classroom teaching and lectures, laboratory work, project work, viva, seminars and assignments. Twenty percent of the total marks for each course will be awarded through Internal Assessment. Final examinations for two and four credit courses will be of two and three hours duration respectively while examinations for each laboratory-based course will be held over one day of six hours each for two credit courses respectively.

The teaching-learning will involve theory classes (Lectures) of one hour duration, tutorials and practical classes. The curriculum will be delivered through various methods including chalk and talk, PowerPoint presentations, audio, video tools, E-learning/E-content, lab sessions, virtual labs, simulations, optional experiments, field trips/Industry visits, seminars (talks by experts), workshops, projects, models, class discussions and other listed suggestive ways. The assessment broadly will comprise of Internal Assessment (Continuous Evaluation) and End Semester Examination. Each theory paper will be of 100 marks with 20% marks for Internal Assessment and 80% for End Semester examination. The internal Assessment will be through class test, quizzes, assignment, oral presentation and other suggested methods. Each practical paper will be of 100 marks.

Programme Structure:

The programme will consist of six-credit courses and four-credit courses. All six credit courses with practicals will comprise of theory classes (four credits) and practicals (two credits) . For theory or tutorial classes, one credit indicates a one hour lecture per week while for practicals one credit indicates a two-hour session per week. Each practical or tutorial batch will be of 12-15 students.

2. Learning Outcome-based Curriculum Framework in M.Sc.Electronics

The learning outcomes based approach implies that when an academic programme is planned, desirable learning outcomes are identified and considered in formulation of the plans. Course contents, learning activities and assessment types are designed to be consistent with the achievement of desired learning outcomes. The learning outcomes are in terms of knowledge, Professional attitude, work ethics, critical thinking, self-managed learning, adaptability, problem solving skills, communication skills, interpersonal skills and group works. At the end of a particular course/program, assessment is carried out

to determine whether the desired outcomes are being achieved. This outcome assessment provides feedback to ensure that element in the teaching and learning environment are acting in concert to facilitate the nurturing of the desired outcomes. The expected learning outcomes are used as reference points that would help formulate graduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn help not only in curriculum planning and development, but also in delivery and review of academic programmes.

The overall objectives of the learning outcomes based curriculum framework are:

- Help formulate student attributes, qualification descriptors, program learning outcomes and course learning outcomes that are expected to be demonstrated by the holders of qualification.
- Enable prospective students, parents, employers and others to understand the nature and level of learning outcomes or attributes a graduate of a programme should be capable of demonstrating on successful completion of the programme of study.
- Maintain national standards and international comparability of learning outcomes and academic standards to ensure global competitiveness, and to facilitate student/graduate mobility.
- Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning level, and periodic review of programme and academic research.

2.1 **Nature and extent of the Programme in M.Sc. Electronics**

M.Sc. Electronics is a professional program which needs to develop a specialized skill set among the Postgraduates to cater the need of industries. In recent years, Electronics has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries that work in this frontier area are in need of highly skilled and scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the research organizations, academicians and industries. The key areas of study within subject area of Electronics comprise: Semiconductor Devices, Photonics, analog and digital circuit design, optical electronics Microprocessors & Microcontroller systems, Communication techniques, IoT and computation techniques for Electronics, computer coding/programming in high level languages etc.

The Choice- Based Credit System provides a framework within which there is flexibility in the design of courses and their content, simultaneously also providing the student a choice of the courses he/she wishes to study. The courses have assigned credits on the basis of teaching hours, which in turn is linked to course content and structure.

2.2 Aims of Master's Degree Programme in Electronics

The overall aims of the M.Sc. Electronics are:

- Provide students with learning experiences that develop broad knowledge and understanding of key concepts of Electronics and equip students with advanced scientific/technological capabilities for analyzing and tackling the issues and problems in the field of electronics.
- Develop ability in student's to apply knowledge and skills they have acquired to the solution of specific theoretical and applied problems in electronics.
- Develop abilities in students to design and develop innovative solutions for benefits of society, by diligence, leadership, team work and lifelong learning.
- Provide students with skills that enable them to get employment in industries or pursue higher studies or research assignments or turn as entrepreneurs.

3. Postgraduates Attributes in M.Sc. Electronics

Postgraduates Attributes form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Postgraduate Attributes of M.Sc. Electronics are listed below:

PGA1. Scholarship of Knowledge: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PGA2. Critical Thinking: Analyze complex scientific/technological problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PGA3. Problem Solving: Think laterally and originally, conceptualize and solve scientific/technological problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PGA4. Usage of modern tools: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex scientific/technological activities with an Poststanding of the limitations. The proposed course is expected to develop digital literacy among the students for using ICT in different learning situations. The students should be able to equip themselves with in depth programming

PGA5. Collaborative and Multidisciplinary work: Possess knowledge and Post standing of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PGA6. Communication Skills and Team Work: The students are expected to develop effective and confident Communication skill after completion of the course. They will have an ability to work in a team as well as in isolation. Communicate with the scientific/technological community, and with society at large, regarding complex scientific/technological activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PGA7. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously. The proposed course is designed to develop independent, coherent and decisive thoughts among the students that will ultimately develop competency in their lives.

PGA8. Ethical Practices and Social Responsibility: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and a Post standing of responsibility to contribute to the community for sustainable development of society. After completion of the course, the students are expected to develop ethical and social responsibility as well. As a result, the

students will be able to identify ethical issues, avoid unethical behavior such as fabrication, falsification or misrepresentation and misinterpretation of data.

4.0 Qualification Descriptors for Postgraduates in M.Sc. Electronics

A qualification descriptor indicates the generic outcomes and attributes expected for the award of a particular type of qualification. The learning experiences and assessment procedures are expected to be designed to provide every student with the opportunity to achieve the intended programme learning outcomes. The qualification descriptors reflect followings:

1. Disciplinary knowledge and Post standing
2. Skills & Ability
3. Global competencies that all students in different academic fields of study should acquire/attain and demonstrate.

5. Program Learning Outcomes for M.Sc. Electronics

The following program outcomes have been identified for **M.Sc. Electronics**

PLO1	Ability to apply knowledge of mathematics & science in solving electronics related problems
PLO2	Ability to design and conduct electronics experiments, as well as to analyze and interpret data
PLO3	Ability to design and manage electronic systems or processes that conforms to a given specification within ethical and economic constraints
PLO4	Ability to identify, formulate, solve and analyze the problems in various disciplines of electronics
PLO5	Ability to function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility
PLO6	Ability to communicate effectively in term of oral and written communication skills
PLO7	Recognize the need for, and be able to engage in lifelong learning
PLO8	Ability to use techniques, skills and modern technological/scientific/engineering software/tools for professional practices

6.0. M.Sc. (Electronics) Programme Details:

6.1 Programme Objectives (POs):

At the time of completion of the programme the student will able to develop extensive knowledge in various areas of Electronics. Through the stimulus of scholarly progression and intellectual development, this programme aims to equip students with excellence in education and skills, thus enabling the student to pursue a career of his/her choice. By cultivating talents and promoting all round personality development through multi-dimensional education a spirit of self-confidence and self-reliance will be infused in the student. The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individual.

6.2 Programme Specific Outcomes (PSOs):

At the end of the two year programme, the student will understand and be able to explain different branches of Electronics such as Communication Electronics, Optical Electronics, Circuit Design, Control Systems, Electronic Materials and Semiconductor Devices, Microprocessors, Digital Signal Processing, RF & Microwaves. The student will be able to execute a short research project incorporating techniques of Basic and Advanced Electronics under supervision. The student will be equipped to take up a suitable position in industry/academia.

These are given with each course in detail in Section IV.

7. Programme Structure:

The M.Sc. (Electronics) programme is a two-year course divided into four-semester. A student is required to complete 96 credits for the completion of course and the award of degree.

		Semester	*Semester*
Part-I	First Year	Semester I	Semester II
Part-II	Second Year	Semester III	Semester IV

8.0 Courses for Programme M.Sc. Electronics
Semester – I

The following shall be the scheme of examination for the course:

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 101	Paper I : Analog Integrated Electronics and Physics of Electronic Materials	80	20	100	4
ELT 102	Paper II : Digital Design and Applications	80	20	100	4
ELT 103	Paper III : Signals, Mathematical and Computational Methods in Electronics	80	20	100	4
ELT 104	Paper IV : Optical , Quantum and Organic Electronics	80	20	100	4

Code	Practical	Experiment	Viva	Internal	Max	Credits
ELP 105	1. Lab course "A" Analog Electronics"	60	20	20	100	2
ELP 106	2. Lab course "B" Digital Electronics"	60	20	20	100	2
	Total (Theory & Lab)				600	20

Total Marks for Semester I =600 & Credit = 20

Semester – II

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 201	Paper I Network Analysis and Synthesis	80	20	100	4
ELT 202	Paper II Microprocessor and C++ Programming	80	20	100	4

ELT 203	**Paper III Analog and Digital Communication Systems**	**80**	**20**	**100**	**4**
ELT 204	**Paper IV Electromagnetic Plane wave, Transmission lines and Microwave Devices**	**80**	**20**	**100**	**4**

Paper Code	Practical	Experiment	Viva	Internal	Max	Credits
ELP 205	**1. Lab course "C" Analog and Digital Communication Lab**	**60**	**20**	**20**	**100**	**2**
ELP 206	**2. Lab course "D" – 8085 Microprocessor Programming, Study Cards and Interfacing Lab**	**60**	**20**	**20**	**100**	**2**
	Total (Theory & Practical)				**600**	**20**

Total Marks for Semester II=600 & Credits=20

Semester – III

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 301	**Paper I (Code) Advance Microprocessors and Microcontroller (AMM)**	**80**	**20**	**100**	**4**
ELT 302	**Paper II Data Communication, Mobile and Wireless Communication**	**80**	**20**	**100**	**4**
ELT 303	**Paper III Photonics**	**80**	**20**	**100**	**4**
ELT 304	**Paper IV Power Electronics, Information Theory and Coding**	**80**	**20**	**100**	**4**

Code	Practical	Experiment	Viva Voce	Internal	Max	Credits

ELP 305	**Lab course "E" - - Optical Electronics, Transducer and Instrumentation Lab**	**60**	**20**	**20**	**100**	**2**
ELP 306	**2. Lab course "F" – 8086 Microprocessor Programming, Interfacing and "C++" Programming Lab**	**60**	**20**	**20**	**100**	**2**
	Total [Theory & lab]				**600**	**20**

Total Marks for Semester III = 600 & Credits=20

Semester IV

Code	Theory	Marks			Credits
		Theory	Internal	Total	
ELT 401	**Paper I Digital Signal Processing**	**80**	**20**	**100**	**4**
ELT 402	**Paper II (Code EL 402) Optical and Satellite Communication**	**80**	**20**	**100**	**4**
ELT 403	**Paper III (Code EL 403) Automatic Control System and Artificial Neural Network**	**80**	**20**	**100**	**4**
ELT 404	**Paper IV (Code EL 404). Embedded Systems , Microcontrollers and Advanced Instrumentation**	**80**	**20**	**100**	**4**

Code	Practical	Experiment	Viva	Internal	Max	Credits
ELP 405	**1. Lab course "G" - Optical Communication and 8051 Programming Lab**	**60**	**20**	**20**	**100**	**2**

ELP 406	**2. Project & Seminar**	**80**	**20**	**-**	**100**	**2**
	Total [Theory & lab]				**600**	**20**

Total Marks for Semester IV = 600 & Credits=20

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR

SYLLABUS PRESCRIBED FOR THE EXAMINATION OF

M. Sc. Electronics (Semester System)

July - Dec 2020

Semester – I

Electronic devices play a crucial role in today's societies and in the physical sciences where they originated. Contemplating that in just a few decades, technology guiding electrons and photons has emerged that makes possible oral and visual communication between peoples on opposite sides of the planet is truly a triumph of science and technology. Present day information technology is based on the physical properties of semiconductors, in particular the functioning of the transistor. The intension of this paper is to take the students from the principles of quantum mechanics through the quantum theory of metals and semiconductors all the way to how devices are used to perform their duties in electric circuits

ELT 101 Paper 1 - Analog Integrated Electronics and Physics of Electronic Materials
Max. Marks: 80, Min. Marks: 16

Course Objective:

1. To provide basic knowledge and concepts of Semiconductor materials and devices.
2. The students will be able to comprehend the drift and diffusion mode of electrical transport through semiconductor devices.
3. To understand the basic crystal structure and different types of semiconductor materials and physics of semiconductor devices
4. To be able to plot the current voltage characteristics of Diode, Transistors and MOSFETs
5. The student should be able to explain and calculate small signal parameters of semiconductor devices.
6. To develop understanding of Analog Devices starting with ideal Op Amp model and assessing the practical device limitations covering the direct and cascading approach and understand not only linear applications but also design of non-linear applications

Course Outcomes: At the end of the course, a student will be enable to

1. Ability to apply basic concepts of Inorganic and Organic Semiconductor materials for electronic device application in modern electronic industry.
2. Describe the behavior of semiconductor materials
3. Understand and appreciate the synergy between quantum mechanics and semiconductor materials, which will eventually lead to a general framework of concepts applicable across a variety of semiconductor devices.

4. Detailed knowledge of various classifications and applications of **Multistage and Feedback Amplifiers**
5. Explain the concepts of feedback and construct feedback amplifiers and oscillators.
6. Holistic view of the Integrated circuit fabrication
7. Understand the fundamentals and areas of applications for the Integrated Circuits.
8. Analyze important types of integrated circuits of day-to-day requirements.
9. Emphasis on Operational amplifier and its applications such as integrator, differentiator Multivibrator, Schmitt trigger and Triangular wave generator.

Student should be allowed to use Programmable Scientific Calculator in Examination hall

Unit I – Physics of Electronic Materials

Crystal structures, classification of crystals, lattices, reciprocal lattice, Miller indices, amorphous materials. Lattice Vibration and Phonons, Bloch theorem, Phonons, Nearly Free electron theory. Dielectric properties, electronic polarisability, Clausius Mossotti relation, dielectric Constant static and frequency dependent. Introduction to Fermi Dirac and Bose Einstein Statistics.

Semiconductors: Direct and indirect band gap methods to determine the Forbidden gap, mobility and conductivity, intrinsic and extrinsic semiconductor, Impurities, carrier concentration, electrical properties of Ge and Si, experimental methods to study the electrical parameters, Drift and Diffusion, Hall effect, electrons and phonons in semiconductors.

Unit II –Quantum Electronics and Transistor model

Uncertainty principle, Experiments on duality, Schrodinger's equation and its applications to square well potential, square potential barrier (1D).

Infinite array of potential wells, Kronig-Penny model, Barrier penetration, applications to tunnel diode, Josephson effect, Perturbation theory and its applications, Scattering.

Transistor at low frequency - Analysis of a transistor amplifier circuit using h- parameter, Emitter follower, comparison of transistor amplifier configurations, Miller's Theorem and its dual, cascading transistor amplifiers, High Electron Mobility Transistor (HEMT). Basics of Transistor biasing and stabilization

Unit III – Multistage and Feedback Amplifiers Analysis

Transistor at high frequencies, Hybrid – pi model, gain bandwidth product.

Multistage Amplifiers Analysis - Introduction, frequency response of an amplifier, band pass of cascaded stages, Coupling scheme - RC coupled, transformer coupled and direct coupled amplifiers, low frequency response of RC coupled stage, effect of emitter bypass

capacitor on low frequency response, high frequency response of two cascaded CE transistor stages.

Feedback Amplifiers – Basic concept, types of feedback method of analysis of a feedback amplifier.

Unit IV – Operational Amplifier, Characteristics and Applications

Basic operational amplifier and its characteristics, characteristics of ideal and practical operation amplifier, parameters of operational amplifier, measurement of operational amplifier parameters, frequency response of operational amplifier,

Linear and Nonlinear Circuits analysis using operational amplifier - Inverting and Non inverting Amplifiers, Differentiator, Integrator, Voltage to current converter, Instrumentation amplifier, Sine wave Oscillator, Low pass and band – pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator, Log and Antilog amplifiers

Unit V - Integrated Circuit Fabrication and Characteristics

IC fabrication – crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, metallization, bonding, MOS technology and VLSI, scaling of MOS devices, NMOS and CMOS structures and fabrication, Characteristics of MOS transistors and threshold voltage, NMOS and CMOS inverters, Charge-Coupled Device (CCD) – structure, charge storage and transfer, Basics of VLSI design, stick diagrams, Layout design rules.

TEXT BOOKS

1. Physics of Electronic Materials: Principles and Applications Jørgen Rammer Cambridge University Press,
2. Electronic Devices and Circuit Theory, 9th ed. Boylestad & Nashelsky PHI
3. Microelectronics - Jacob Millman, Arvin Grabel, Tata Macgraw-Hill
4. Physics of Semiconductor Devices: Shur PHI
5. A Textbook of Applied Electronics (M.E.) Sedha R S, S. Chand Pub.
6. Physics of Semiconductor Devices: Sze
7. Ramakant A.Gayakwad, 'OP-AMP and Linear IC's', Prentice Hall
8. Introduction to Quantum Mechanics J. Griffiths David Pearson
9. Quantum Mechanics Statistical Mechanics & Solid State Chattopadhyay D. and Rakshit P.C. S Chand & Company
10. Integrated electronics – Analog and digital circuits and systems Jacob Millman, Cristos, C. Halkias, Tata Macgraw-Hill

ELT-102 Paper 2 - Digital Design and Applications

Max. Marks: 80, Min. Marks: 16

Max. Marks: 80, Min. Marks: 16
Student should be allowed to use Programmable Scientific Calculator in Examination hall

Course Objective:

The course offers students to learn how to minimize the Boolean expression by advanced digital design techniques, programmable logic devices; to understand analysis, designing and reduction techniques for combinational and sequential circuits and introduce to the memory organization and programmable logic devices.

Course Outcomes: After successful completion of the course student will be able

1. To learn how to design digital systems, from specification and simulation to construction and debugging.
2. Develop a digital logic and apply it to solve real life problems.
3. Analyze, design and implement combinational and sequential logic circuits.
4. Classify different semiconductor memories.
5. Analyze, design and implement sequential logic circuits.
6. To learn techniques and tools for programmable logic design.
7. To understand the limitations and difficulties in modern digital design, including wiring constraints, high-speed, etc.
8. Understand IC characteristics, digital logic families and able to optimize the logic functions using K-map.
9. Able to design and analyze the shift registers, counters and A/D & D/A converters, digital semiconductor memories and programmable logic devices
10. Through the practical assignments, experience will be achieved from both using tools as well as designing their own system.

Unit I - Basic Logic Circuit

Introduction of basic gates, universal gates, number systems and codes, Boolean algebra, switching characteristics of semiconductor devices, logic gate characteristics - speed of operation, power dissipation , figure of merit, fan in, fan out, noise margin. Logic families - RTL, DTL, TTL, ECL interfacing, ECL and TTL, MOS logic - MOSFET NAND and NOR gates, CMOS inverters, CMOS - NAND and NOR gates, interfacing CMOS and TTL, inter facing CMOS and ECL, comparison of logic families.

Unit II - Combinational Logic Design

Simplification of Boolean algebra using K-map, minterm and maxterm, design of binary adder, subtractor , digital comparator, parity generator/checkers, priority encoder, BCD to 7 - segments decoder, multiplexer , multiplexer tree, demultiplexer and demultiplexer tree.

Unit III - Sequential Circuit Design

Excitation table of flip flops – S - R, J-K, Master-Slave – JK, D and T flip-flops, clocked flip flop design – conversion of one form of flip flop to another type.

Analysis of clocked sequential circuits - State equation, state table, state diagram, state input equations, analysis with - flip flops, JK flip flops and T flip flops.

State reduction and assignment, design procedure – synthesis using D flip flops, JK Flip flops and T flip flops.

Unit IV - Registers, Counters and A/D, D/A converters

Registers - Shift registers, application of shift registers, serial to parallel converter, parallel to serial converter.

Counters - Ring counter, modulo-n-counter, synchronous counter –ripple counter (binary, BCD) and up-down counter, asynchronous counters - ripple counter (binary , BCD) and up-down counter. Other counters – counter with unused states, ring counter, Johnson counter.

A/D, D/A Converters – D/A weighted register type, R/2R ladder type, D/A converter specifications, A/D converters - successive approximation type, parallel comparator, dual slop ADC using voltage to frequency conversion and frequency to time conversion.

Unit V - Memory and Programmable Logic

General Memory Operation; CPU-Memory Connections; ROM: Architecture, Timing, Types: MROM PROM, EPROM, EEPROM, Flash Memory;

RAM: Architecture & Operation of SRAM, DRAM; Memory Expansion; Introduction to Programmable Logic Devices (PLDs): PLA, PAL, GAL, CPLD, FPGA. Analysis and Design of digital circuits using HDL.

TEXT BOOKS

1. T. L. Floyd & R. P. Jain, Digital fundamentals, Pearson Education India, New Delhi.
2. M. Moris Mano, Digital Design, PHI Learning Pvt. Ltd. New Delhi.
3. A. P. Malvino & D. P. Leach, Digital Principals and Applications, Tata McGraw Hill, New Delhi.
4. A. P. Malvino & J. A. Brown, Digital Computer Electronics, Tata McGraw Hill, New Delhi.
5. A. Anand Kumar, Fundamentals of Digital Circuits, PHI Pvt. Ltd. New Delhi.
6. R. J. Tocci & N. S. Widmer, Digital Systems, Pearson Education India, New Delhi.
7. John. M. Yarbough, Digital Logic: Applications and Design, Thomson Brooks/Cole, Boston.
8. John F. Wakerly, Digital Design Principles and Practices, Pearson Education India, New Delhi.
9. M. Moris Mano, Computer System Architecture, PHI Pvt. Ltd. New Delhi.

ELT 103 PAPER 3 – Signals, Mathematical and Computational Methods in Electronics

Max. Marks: 80, Min. Marks: 16

Course Objectives:

1. To improve and summarized the Signals, mathematical and computational techniques among the students.
2. To familiarize the students with the classification of continuous time signals and systems and their analysis
3. To enable the students to understand the concepts of Fourier series and Fourier transform probability theory, and state variable approach
4. To introduce mathematical and computational methods used in Electronics.

Course Outcomes: On completion of this course, student will be able to

1. Use mathematics as a tool for solving/modeling systems in electronics
2. Understand about various types of signals and systems, classify them, analyze them, and perform various operations on them,
3. Understand use of transforms in analysis of signals and system in continuous and discrete time domain.
4. Understand basic concept of probability theory; differentiate between discrete and continuous random variables, Random and Markov processes
5. Able to solve ordinary differential equations using Laplace Transform, special function and numerical methods; numerical differentiation and integration.
6. Understand different techniques for simulation & modeling of electronic circuits

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Student should be allowed to use Programmable Scientific Calculator in Examination hall.

UNIT I - Signal Analysis

Introduction – Classification of signals and systems, some ideal signals, energy signal, Power signals, energy and power spectral densities.
Fourier Series, Complex Fourier Spectrum, The Fourier Transform, Continuous Spectrum, Fourier Transform involving Impulse Function, Properties of Fourier Transform, Fourier Transform of Periodic Functions, Convolution, Sampling Theorem.

UNIT II – Linear Systems and State Variables Techniques

Introduction, System Function (Transfer Function), Distortion less Transmission, Paley-Wiener criterion, Correlation, Autocorrelation

State Variables Techniques - State variable concepts, form of the state equations, time domain and frequency domain solution of state equations, state transition matrix, state equations for networks, state equations from transfer functions.

UNIT- III- Probability and Random Signal Theory

Introduction, set theory, Introduction to Probability, Conditional Probability Statistical Impedance, Baye's Theorem, Random variables, Discrete and Continuous Random Variables, Joint Distributions, Characteristics of Random Variables, Binomial, Poisson and normal Distributions, Uniform and other Distributions, Random and Markov Processes.

UNIT IV - Mathematical Methods

Laplace Transform – Definition, transform of elementary function, properties of Laplace transform, convolution theorem, application to differential equation, simultaneous Linear equations with constant coefficients, unit step and unit impulse function

Special Function - Bessel equations, recurrence formula, expansion for Jo and J1, values of J1/2, generating function for Jn(x), equation reducible to Bessel equation

UNIT V – Computational Methods

Numerical Differentiation and Integration

Finite Differences, Derivatives using Forward, Backward and Central Difference Formulae, Newton-Cote's Quadrature formula, Trapezoidal rule, Simpson's rules, Weddle's rule.

Numerical methods for Solution of Ordinary Differential Equation-Picards Method ,Taylor Series Method , Eulers and Modified Eulers methods, Runge and Runge Kutta Methods , Newton- Raphson Method, Gauss Elimination Method Predictor and Corrector Method.

TEXT BOOKS

1. Communication System- Analog and Digital - R.P.Singh & S.D. Sapre TMH.
2. Signal and System - Nagrath, Sharan and Ranjan. Mcgraw hill Publishing
3. Signal and Systems - Rodger E. Ziemer. Continuous and Discrete 2nd ed.Maxwell Macmillan Int. Edition,
4. Higher Engineering Mathematics - B.S. Grewal, Khanna Publications
5. Numerical Methods - Kandaswami,Thilagavathi and Gunavathi, S.Chand & Co.
6. An introduction to Numerical methods: A MATLAB approach by Abde/Wahab Kharab, Ronald B Guenther
7. Optoelectronics and Photonics Engineering Dutta, Partha S. Springer

ELT 104 Paper 4-Optical, Quantum and Organic Electronics

Max. Marks: 80, Min. Marks: 16

Course Objectives

1. Introduction: how light is generated, outline and need for the laser, scope of course.
2. Interaction of EM Radiation with Matter: two-level system, spectral line-shapes, finite lifetime, Doppler effects, absorption and decay processes, spontaneous and stimulated emission.
3. Amplification Criteria: amplification conditions, Lorentzian line-shapes, Gaussian line-shapes, simple cavity model.

4. laser use of Fabry-Perot, laser gain conditions, laser modes, homogeneous broadening, inhomogeneous broadening, control of modes, examples of lasers.
5. to study light sources, photo-detectors, and organic materials. Laser namely Ruby Laser, He-Ne laser, Ar-ion laser, Co2 laser, Solid State Laser, and Nd-YAG laser.
6. To introduce Plasma, LED and LCD devices.
7. To get acquainted with the Electro-Optic Effect, Acousto-Optic Effect, and Magneto-Optic Effect

Course Outcomes

On completion of this course a student should be able to demonstrate understanding of and be able to solve problems on:

1. absorption and spontaneous and stimulated emission in two level system, the effects of homogeneous and inhomogeneous line broadening, and the conditions for laser amplification,
2. operations of the Fabry-Perot cavity including mode separation and line-widths, laser gain conditions, gain clamping in both homogeneous and inhomogeneous line broadened media,
3. the four-level laser system, the simple homogeneous laser and its output behaviour and optimal operating conditions,
4. spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system,
5. operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types,
6. Develop the ability to understand the working principle of display devices.
7. Comprehend and analyse the light sources and detectors.
8. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance.
9. Understand the basic concept of Organic electronics.

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Unit I - Quantum Electronics

Coherent light sources, basic principle of lasers, laser pumping, stimulated emission, light amplification, threshold condition, Einstein's coefficient, laser rate equations for two, three and four level laser systems, variation of power around threshold, rectangular cavity, open plane resonator, mode locking and Q-switching of lasers.

Unit II - Applications of Quantum Electronics

Types of Lasers - Ruby Laser, He-Ne laser, Ar-ion laser, Co2 laser, Solid State Laser: Host material and its characteristics, doped ions Nd:YAG laser,
Liquid laser: Dye laser, Semiconductor laser

Laser Applications - Laser in manufacturing, laser cutting of material, laser marking, laser transmitter, measurement of distance through Laser

Unit III - Optical Display Devices

Optical Display Devices - LED- Basic principle of operation, radiative recombination process, the spectrum of recombination process, the internal quantum efficiency, double hetrostructure, response time of LED, carrier configuration and modulation bandwidth, edge emitting LED, LED design. Liquid Crystal Display - construction, basic principle of emission, Plasma Display- construction, basic principle of emission

Unit IV - Photo Detectors and Organic Electronics

Photodiodes- General Principles, quantum efficiency, silicon P-N photodiodes, hetrojuncton photodiodes, Schottkey barrier diode, P-I-N photodiodes, avalanche photodiodes, and phototransistors.

Introduction to Organic Electronics, Organic versus Inorganic solids, Molecular materials, Organic Semiconductors, Electronic states in conjugated molecules, Conjugated polymers, Basics of OLED

Unit V - Electro-Optical Devices

Nonlinear Optics: Origin of nonlinearity, susceptibility tensor, phase matching, second harmonic generation, methods of enhancement, frequency mixing processes, nonlinear optical materials.

Electro-Optic Effect - Kerr effect, Pockels effect, Farady effect, Electro-Optic Modulator-Electro-optic phase modulator, electro-optic amplitude modulator, kerr modulator

Acousto-Optic Effect - Raman-Nath and Bragg Diffraction, Raman-Nath acousto optic Modulator, bragg modulator, acousto-optic modulator.

Magneto-Optic Effect - Faradays effect, magneto-optic modulator

TEXT BOOKS

1. Optical Electronics - Ghatak Thyagarajan, University Press
2. Optoelectronics - An Introduction - J.Wilson and J.F.B. Hawkes, PHI Publication.
5. Semiconductor Optoelectronic Devices, 2nd ed. **Bhattacharya PHI**
6. Pope and Swenburg, Electronic Processes in organic crystals and polymers, 2 nd Ed., Oxford
7. Optoelectronics & Photonics Principles and Practices S.O. Kasap Pearson
9. Optical Processes in Solids Mark Fox Oxford Press
10. Optoelectronics and Optical Fiber Sensors A B Maity PHI

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SYLLABUS PRESCRIBED FOR THE EXAMINATION OF
M. Sc. Electronics
Jan-June 2021
Semester-II
Course Code: ELT 201 Paper - I
Course Name: Network Analysis and Synthesis
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Paper 1-Network Analysis and Synthesis

Course Objectives:

1. To equip the students with rigorous theoretical and practical knowledge to analyze and synthesize networks.
2. To analyze the given electronics circuit/network problems using mesh/ loop methods, network theorems and graph theory.
3. To introduce the basic knowledge of network analysis with initial conditions, magnetically coupled circuits, Waveform synthesis and network transfer functions.
4. To analyze the one port, two-port networks.
5. To introduce basic concept of network synthesis.

Course Outcomes:

1. Apply the knowledge of basic circuital law and simplify the network using reduction technique.
2. Analyze the circuit using Kirchoff's law and network theorem.
3. Apply the knowledge of various circuit/network analysis techniques such as mesh analysis, nodal analysis, and network theorems to investigate the given network.
4. Able to solve the networks using graphical approach.
5. Able to analyze the given network by transforming from time domain to S domain.
6. Express the periodic sources using waveform synthesis and analyze the network.
7. Design and analyze one port, two-port networks.
8. Comprehend the basic concepts and synthesis the RL, RC and LC networks using Foster and Cauer forms.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Programmable Scientific Calculator in Examination hall.

2. Special graph paper viz. Polar graph & Semi log graph papers should be provided to the students in the examination hall.

Unit I - Mesh and Node Analysis and Network Theorems

Mesh and Node Analysis - Kirchhoff's laws , Star and Delta conversion, source transformation, mesh and node analysis of electric circuits, response of the network by differential equation and Laplace transform method ,initial conditions in the network.
Network Theorems - Thevenin's theorem, Norton's Theorem, Superposition, Millman theorem, Maximum power transfer theorem, and Reciprocity theorem, Tellegen theorem and Substitutions theorem .

Unit II – Coupled Circuit, Waveform Synthesis and Graph Theory Coupled Circuit – Dot convention and magnetic coupling
Waveform Synthesis – Standard signals, unit step function, ramp function, impulse function, initial and final value of f(t) from F(s), the convolution integral.
Graph Theory - Concept of a network graph, twigs and links, trees, co trees ,formation of incidence matrix ,cut-set matrix, tie-set matrix and loop currents, analysis of networks ,network equilibrium equation ,duality, network transformation

Unit III - Network Function and Frequency Response Plots
Network Function - Network function for one port and two port, the calculation of network functions - ladder networks and general networks, pole and zero of network functions, restrictions on pole and zero locations for driving point functions ,restrictions on pole zero locations ,time domain behavior from the pole and zero plot, stability of active networks.

Frequency Response Plots- Magnitude and Phase plots, Root Loci, Bode Diagrams, Nyquist- Stability Criterion

Unit IV -Two Port Network Analysis
Relationship of two port variable , Z-parameters, Y- parameters, Hybrid parameters, ABCD parameters, conditions of reciprocity and symmetry, inter-relationship between parameter of two port network, different types of interconnections of two port networks.

Unit V- Network Synthesis
Concept, Procedure of Synthesis, Reactive Networks, Properties of Expressions of Driving point Admittances of L-C Networks, Pole-Zero Interpretations in L-C Networks. L-C Networks Synthesis-Foster's Canonic Form (First and Second Foster form), Significance of Elements in the Foster form, Cauer Canonic form of Reactive Networks-First and Second form of Cauer Networks, Applicability of Foster and Cauer forms, R-L & R-C Network Synthesis by Foster form, Identification of foster form , Identification of Admittance, R- L& R-C Network Synthesis by Cauer form, Identification of Admittance Function in Cauer form, Determination of end elements in Foster and Cauer R-L & R-C Networks.

TEXT BOOKS
1. Networks and System - D. Roy Choudhary, New Age International
2. Network Analysis: M.E. Van Valkenburg.PHI
3. Circuit theory (analysis and synthesis) - A. Chakrabarti, Dhanpat Rai and co.
2. Network Synthesis: M.E. Van Valkenburg.PHI

Course Code: ELT 202 Paper II:
Course Name: Microprocessor and C++ Programming
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Course Objectives:

1. To introduce the basic idea about architecture and the working principle of microprocessor 8085.
2. Students will get acquainted with the assembly language programming using the instruction set of microprocessor 8085.
3. To introduce Programmable peripheral interfacing devices such as Programmable keyboard /display interface 8279, Programmable peripheral interface 8255,Programmable interval timer - 8253, Programmable interrupt controller - 8259,Synchronous data communication device - 8251, DMA Controller 8257 with microprocessor 8085.
4. Understand the basic concepts of object-oriented programming with C++.

Course Outcomes

1. Comprehend and analyze architecture of 8085 microprocessor, its addressing modes, and instruction set.
2. Comprehend the memory organization of 8085 microprocessor.
3. Showcase the skill, knowledge and ability of programming using instruction set.
4. Work with microcontroller and interfaces including general purpose input/ output and timers, interrupt controller, DMA controller, Keyboard/display.
5. Comprehend and use peripheral serial communication and the concepts of interrupts in 8085
6. Understand the object oriented programming language C++ and apply the programming skills.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I - Micro-Computer System & 8085 Microprocessor Architecture

Microcomputer System & its operation- Overview of a basic Microcomputer structure and operation, Ideal microprocessor, Microprocessor evolution and types, Microprocessor initiated operation & Bus organization, internal data operation & registers, peripheral initiated operation.

Memory- Memory organization, memory map, memory & instruction fetch, types of memory. Interfacing Devices - Tri-state devices, buffer, decoder, encoder, latch.

Microprocessor Architecture - Introduction to 8085 Microprocessor, pin diagram & its function, bus timing, Demultiplexing of address & data Bus, generation of control signals, microprocessor architecture of 8085, decoding & execution of an instruction, memory interfacing, timing diagram of memory, read & write cycle.

Unit II - Instruction Set & Programming of 8085, Stack & Subroutines

Instruction classification, instruction format, addressing modes, basic instructions and simple programming ,Additional Instructions - DAA, DAD, LHLD.SHLD, PCHL, STC, XCHG,

XTHL and programming, Code Conversion - BCD to Binary, Binary to BCD, Binary to ASCII, ASCII to Binary.

Stack & Subroutines - Concept of stack, PUSH/POP instruction, illustrative example, Concept of subroutines, call & return instruction, conditional call & return instruction, advanced subroutines concept.

Unit III - Counters, Time Delay, Interrupts & Interrupt Controller

Counters and Time Delay -Time delay using one register, Time delay using a register pair, flow chart & program for a hexadecimal counter and modulo 10 counter, delay calculations.

Interrupts - Interrupts of Intel 8085, hardware and software interrupts, vectored/non vectored interrupts, maskable/non- maskable interrupts, Interrupts priority concept, DI,EI, RIM, SIM instructions, pending interrupts.

Programmable Interrupt Controller - Architecture of 8259, initialization command words (ICW's), operational command words (OCW's), 8259 interrupts mode, simple initialization program for 8259.

Unit IV - Data Transfer & Peripheral Interfacing Devices, Co-processor

Format of data transfer, modes of data transfer, microprocessor controlled data transfer, peripheral control data transfer, peripheral I/O instruction, serial I/O lines, SOD and SID.

Programmable Peripheral Interfacing Devices - Programmable keyboard / display interface – 8279, Programmable peripheral interface – 8255, Programmable interval timer – 8253, Programmable Interrupt controller – 8259, Synchronous data communication device – 8251, DMA Controller 8257, RS 232 interface. Numeric co-processor 8087

Unit V- Object Oriented Programming

Principles and Basic concepts, OOPs languages, Application of OOPs, Simple programming in C++, Tokens, expressions and control structures - Tokens, keyword, identifiers and constants, declaration of variables, operators in C++, manipulators, control structure.

Functions in C++ - main function, function references, return references, default arguments and constant arguments. Classes and Objects- C structures revisited, specifying class, C++ program with classes, arrays within Classes, memory allocation of objects, arrays of objects,

returning objects, pointer to members, local classes.

TEXT BOOKS

1. Microprocessor Architecture Programming - Ramesh S. Gaonkar & Application with 8085/8080 Penram Int. Pub2

2. 0000 to 8085: Introduction to Microprocessors for Engineers and Scientists,

2nd ed. Ghosh & Sridhar PHI

3. Fundamentals of Microcomputer & Microprocessor r - B.Ram, Dhanpat Roy Pub.

4. Object Oriented Programming E - Balaguruswamy with C++ Second Edition

5. PROGRAMMING IN C++ P.B.MAHAPATRA, S Chand & Co

Course Code: ELT 203 Paper III
Course Name: -Analog and Digital Communication Systems
(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Aim and objective: This course will help students to get familiarize with core fundamental communication concepts relevant in field of Analog and Digital arena. . It will also help to gain good understanding of application of communications in day to day real world with following objectives:.

1. The fundamentals of basic communication system, types of noise affecting communication system and noise parameters.
2. To help to understand the principle of analog and digital communication. Need of modulation, modulation processes and different analog and digital modulation techniques with generation and detection methods, transmitter, and receiver systems in detail.
3. Need of sampling and different sampling techniques.
4. Generation and detection of pulse modulation techniques and multiplexing.
5. To introduce the knowledge of the Monochrome and Colour Television system.

Learning Outcomes

After successful completion of the course student will be able to

1. Understand different blocks in communication system and how noise affects communication using different parameters.
2. Distinguish between different amplitude modulation schemes with their advantages, disadvantages and applications.
3. Analyze generation and detection of FM signal and comparison between amplitude and angle modulation schemes.
4. Identify different radio receiver circuits and role of AGC.
5. Sample analog signal and recover original
6. Compare and contrast advantages, disadvantages and limitations of analog and digital communication systems
7. Understand the fundamental concepts of television transmitter and receiver systems, the transmission of video signals and importance of television standards to effectively work with broadcasting applications, trouble shooting of television systems.
8. Understand different color television systems used worldwide and its compatibility.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I Radiation and Propagation of Waves - Electromagnetic Radiation –Effect of environment, Propagation of waves –Ground Wave and Sky-wave Propagation – The ionosphere – Space waves – Tropospheric scatter propagation – Extraterrestrial communications

Introduction to Communication Systems -Block diagram of communication system –

Transmitter, Receiver, Modulation, Bandwidth requirements

Noise - Source of Noise, External Noise –Atmospheric Noise, Extra Terrestrial Noise, Industrial Noise, Internal Noise-Shot Noise, Resister or Johnson Noise ,Calculation of noise in Linear Systems, Noise Bandwidth, Power, Noise Temperature, Noise in Two Port Networks, Noise Figure, Cascaded stages, Measurement of Noise Figure, Signal in presence of Noise, Narrowband Noise.

Unit II – Amplitude Modulation System

Amplitude Modulation - Frequency spectrum of AM wave, Representation of AM wave, Power relation in AM wave, Single side band techniques – Suppression of carrier, suppression of side bands, vestigial side band,

Transmitters - Classification of radio transmitter, AM radio transmitter, Generation of AM -Transistor as AM Generator, balanced modulator, filter method, phase shift method, third method.

Receivers – Classification of radio receiver, basic function of AM receiver, tuned radio frequency receiver, super heterodyne receiver, AM demodulation – RC demodulator, square law demodulator. Noise in Amplitude Modulated Systems, Comparison of various AM systems,

Unit III – Angle Modulation System

Angle Modulation – Frequency modulation, analysis of FM waveform, frequency spectrum, Bessel function, Narrowband FM and Wide Band FM, Phase modulation

FM Modulators and Transmitters - Method of frequency modulation – Direct method – reactance modulator (FET and varactor diode method), Indirect Method, pre-emphasis and de-emphasis

FM Demodulators and Receivers – Super heterodyne FM receiver – block diagram, amplitude limiter, FM demodulator –phase discriminator, ratio detector, PLL demodulator. Comparison of AM, FM and PM, , frequency division multiplexing(FDM).

Unit IV - Pulse Modulation System

Pulse Amplitude Modulation - Natural Sampling, flat top sampling, equalization signal recovery to holding, PAM modulator and demodulator. Pulse time modulation (PTM)-Generation of PTM signals, PTM modulator and Demodulator, time division multiplexing (TDM).

Pulse Code Modulation- Quantization of signals, quantization error, pulse code modulation (PCM), companding, Bandwidth of PCM System, Noise in PCM System, Differential pulse code modulation, Delta modulation, Adaptive Delta modulation.

Digital Modulation Techniques - Introduction, Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Shift Keying (QASK) and Binary Frequency Shift Keying (BFSK).

Unit V – Monochrome and Colour Television

Elements of a TV System - Concept of Picture and sound transmission and reception, Flicker, Composite Video Signal, signal transmission and Channel bandwidth, Monochrome picture tube, Television Camera tube - Vidicon and CCD. Monochrome TV transmitter and receiver (Block Diagram), Essentials of Colour TV - Three Colour theory, Luminance, Hue

and saturation, Triniton Colour Picture tube, Block diagram of Colour TV transmitter and receiver, PAL Colour TV System. CCTV, HDTV, CATV and DTH, Concepts of Home Theatre

TEXT BOOKS

1. Principles of Communication Systems - Taub & Schilling, TMH
2. Principles of Communication Systems - George Kennedy, TMH
3, Communication System- Analog and Digital - R.P.Singh & S.D. Sapre TMH
4. Radio Engineering - G. K. Mithal G.K. Pub.
5. Monochrome and Colour Television - R.L. Gulati, New Age International, Wiley Eastern Ltd. New Delhi.
8. Advanced Electronic Communication Systems: Tomasi PHI
9. Television Engineering – A.M. Dhake, TMH
10. Electronic communication, Roddy and Coolen, PHI, New Delhi,

Course Code: ELT 204 Paper IV
Course Name: Electromagnetic Plane Wave, Transmission Lines and Microwave Devices

(Credits: Theory-04, Practicals-02)
Max. Marks: 80, Min. Marks: 16

Aim and objective

1. To introduce the basic concepts of electromagnetic plane wave, transmission lines and antennas
2. To teach different types of waveguide, components and understand the distribution of electromagnetic fields within waveguides using Maxwell's equations.
3. To understand the importance of microwave components, circuits and applications.
4. To comprehend operational principles of microwave sources and to characterize microwave networks.
3. To design and analyze various passive and active microwave devices and circuits.

Learning Outcomes

1. Understand the uniform plane wave, its reflection and propagation in free space, lossless and lossy dielectric
2. Obtain solutions to transmission line equations with characteristic impedance, input impedance and propagation constant.
2. Able to solve the numerical problems of lossy, lossless and distortion less transmission line.
3. Design and interpret the impedance matching transmission line sections using single stub, double stub and LC sections using Smith Chart.
5. Analyze the field components of different waveguides and planar transmission lines based on various modes of E and H field.
6. Understand the working principle of operation of microwave sources like Klystron, Magnetron and microwave measurement techniques
7. Developed understanding of Microwave semiconducting and avalanche transit time devices.

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

UNIT I - Electromagnetic Plane Wave

Electromagnetic Plane Wave - Electron motion in electric field , electron motion in magnetic field , electron motion in electromagnetic field, electric and magnetic wave equations, Maxwell equation, Poynting theorem, uniform plane wave and reflection, uniform plane wave propagation in free space and lossless dielectric, plane wave propagation in lossy media, Ionospheric propagation, conductors and dielectrics, skin depth, polarization, phase velocity and group velocity.

UNIT II - Transmission Lines and Antennas

Transmission Line - Basic equation , reflection and transmission coefficient , standing wave and standing wave ratio , line impedance and admittance, Determination of characteristics impedance, Fundamental of Smith Chart, Impedance Matching: Single and Double Stub Matching, microwave Coaxial Connectors.

Antennas – The Radiation mechanism, Current and Voltage distribution, Antennas gain, Antenna resistance, Bandwidth, Beam width and Polarization, effects of Antenna height, Dipole arrays, Folded dipole. Microwave Antennas - Parabolic reflector, Horn and Lens antenna, Special purpose antennas - Yagi, Log periodic and Loop antennas.

Radar– block diagram of Radar, frequencies and power used, Radar range equation.

UNIT III – Microwave Waveguides and Components

Waveguides - Rectangular Wave guide **–** TE and TM modes , power transmission, excitation in rectangular wave guide , circular wave guides – TE,TM and TEM mode, **Microwave Components** - Waveguide Tee - E-plane tee, H-plane tee, Hybrid tee, scattering parameters (s-matrix), circulators, isolators , directional couplers.

UNIT IV – Microwave Sources and Measurements

Microwave Sources - Reflex Klystron - principle of operation of velocity modulation, power output and efficiency, electronic admittance, Cylindrical Magnetron – principle of operation, equation of electron motions, cyclotron angular frequency , power output and efficiency.

Microwave measurement techniques, - Microwave bench, precautions, power measurement, bolometric method, attenuation, VSWR, impedance, frequency and Q of the cavity, standing wave measurements, impedance measurement, cavity resonator, dielectric measurements.

UNIT V - Microwave Semiconducting and Avalanche Transit -Time Devices

Microwave Semiconducting Devices

Microwave Transistor **–** Microwave Bipolar Transistor – principle and amplification phenomenon, power frequency limitation, Microwave Tunnel Diode **–** principle and characteristics of microwave tunnel diodes, JFET operation and characteristics. Microwave integrated circuit design, introduction, hybrid microwave integrated circuits (HMIC),

monolithic microwave integrated circuit (MMIC), MIC materials, substrate material, conductor material, dielectric materials, resistive films, types of MIC'S, microwave monolithic integrated circuits (MMIC'S).
Transferred Electron Devices **–** Gunn Effect Diodes, GaAs diode Ridley Watkins Hilsum (RWH) theory – Differential negative resistance
Avalanche Transit -Time Devices - Read Diode - Avalanche multiplication, carrier current and external current, output power and quality factor. IMPATT Diodes and TRAPATT Diodes- Principles of operation, power output and efficiency

TEXT BOOKS

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI Pub
2. Microwave Engineering – Annapurna Das, Sisir K. Das, Tata Mc Graw Hill.
3. Microwave and Radar Engineering - M. Kulkarni, Umesh Publication
4. Electronic Communication Systems - George Kennedy, 3rd Edition TMH
5. Introduction to electrodynamics by David J. Griffithe , PHI
6. Elements of engineering electromagnetics by Narayaaa Rao, PHI

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M. Sc. Electronics

July-Dec 2021

Semester III

ELT 301 Paper - 1 Advance Microprocessors and Microcontroller (AMM)

Aim and objective

1. To introduce the architectures of 16 bit microprocessors, assembly language programming and interfacing with commonly used peripheral devices.
2. To familiarize the students with architecture of 8051 microcontroller, assembly language programming in 8051 microcontroller.
3. To design the interfacing of peripherals with the 8051 microcontroller

Learning Outcomes

1. Comprehend and analyze the architectures of 16 bit microprocessors and 8 bit microcontroller
2. Understand and implement the assembly language programming of 8086 microprocessor and 8051 microcontroller
3. Comprehend the memory organization of 8086 microprocessor and 8051 microcontroller
4. Showcase the skill, knowledge and ability of programming using instruction set of 8086 microprocessor and 8051 microcontroller

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non-Programmable Scientific Calculator in Examination hall

UNIT I *16-bit microprocessors*

8086 internal architecture; memory organization, 8086 basic configurations: minimum mode, maximum mode, 8284 clock generator, 8288 bus controller, system bus timings for minimum and maximum modes. Introduction to 8088, 80186, 80286, 80386, 80486

UNIT II *Programming of 8086*

8086 addressing modes, Instruction formats, instruction set: data transfer instructions, arithmetic instructions: binary, packed and unpacked arithmetic; branch instructions: conditional and unconditional branch instructions; loop instructions, flag manipulation instructions, shift and rotate instructions, byte and string; assembler directives; programming examples.

UNIT III *Interfacing*

Basic interfacing concepts; Interfacing memories: I/O mapped I/O, memory mapped I/O, 8086 memory interface, I/O operations: programmed I/O, Interrupt I/O, Direct memory access, Programming and interfacing of peripheral devices: programmable peripheral interface (8255), Interrupt controller (8259), DMA controller (8257); Co-processor (8087): architecture, data types, and interfacing.

UNIT IV *Microcontroller 8051*

8051 architecture: oscillator and clock, PC and data pointers, CPU registers, flags, and PSW; internal RAM; stack and stack pointer, SFRs, internal ROM, I/O ports; external memory; Counters and timers: timer counter interrupts, timing, timer modes of operation, counting, Serial Data I/O: serial data interrupts, data transmission, data reception, serial data transmission modes, Interrupts: timer flag interrupt, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations, software generated interrupts.

UNIT V *Programming of Microcontroller 8051*

Instruction set: Moving data: addressing modes, external data moves, code memory read-only data moves, push and pop opcodes; Logical operations: byte and bit level logical operations, rotate and swap operations; Arithmetic operations: flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic; Jump and call instructions: jump and call program range, jumps, calls and subroutines, interrupts and returns; simple programming examples.

TEXT BOOKS

1. Yu Cheng Liu, Glenn A. Gibson, **Microcomputer systems: The 8086/8088 family architecture**, **programming and design**, Prentice Hall of India, New Delhi.

2. Douglas V. Hall, **Microprocessors and interfacing**, Tata McGraw-Hill Company Limited, New Delhi.

3. Bhupinder Singh Chabra, **The Intel 8086/8088 microprocessor architecture programming design and interfacing**, Dhanpat Rai Publishing Company Limited, New Delhi.

4. Ramesh S. Gaonkar, **Microprocessor architecture, programming and application with 8085/8080A**, Wiley Eastern Limited, New York.

5. Kenneth J. Ayala, **The 8051 Microcontroller architecture, programming, and applications**, Penram International Publishing, India.

6. Barry B. Brey, **The Intel Microprocessors 8086/8088, 80186,80286, 80386 and 80486 Architecture, programming and interfacing,** Prentice Hall of India, New Delhi.

7. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, S.K. Shah, **Microprocessors and Interfacing 8086,8051,8096 and advanced processors,** Oxford university press.

ELT 302 Paper 2-Data Communications, Mobile and Wireless Communication

Aim and objective

1. This paper aims to learn the basics of Data Communication, Mobile, and Wireless Communication.
2. To introduce analysis and design of computer and communication networks.
3. To understand the network layered architecture and the protocol stack.
4. To understand the concept of mobile and broadcast systems, cellular systems, GSM models and satellite systems
5. To understand the infrastructure and ad-hoc networks, GPRS, Bluetooth, 3G technologies like UMTS, and mobile network and transport layers protocols.

Learning Outcomes

The student will be able to

1. Understand the types of communication modes, switching circuits, Network protocols and detailed knowledge of the network topology.
2. Describe the phases of planning and design of mobile wireless networks
3. Know modern multiple access schemes, the concept of frequency reuse, channel assignment strategies and estimate trucking and GOS.
4. Understand GSM, CDMA concepts, architecture, frame structure, system capacity
5. Understand evolution of mobile communication generations 2G, 2.5G, and 3G with their characteristics and limitations.
6. Understand emerging technologies required for fourth generation mobile system such as SDR, MIMO etc.
7. Students will also able to build the basic concepts and ideas need to realize the working of 3G, Bluetooth, GPRS, and various network protocols.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Data Communication

Data Signal, Signaling & Data Transmission Media, Communication Mode-Half Duplex/Full Duplex, Data Communication System-Synchronous/Asynchronous Transmission, Serial/Parallel Data, Switching & Multiplexing-Circuit Switching, Message Switching, Packet Switching, Network Topology-Bus/Star/Ring/Mesh Topology, LAN, OSI Reference Model, Network Protocol(TCP/IP).

Unit II- Introduction to Mobile and Wireless Devices

Mobile and wireless devices, history, applications wireless transmission, frequencies for radio transmission, regulations, signals, antennas, signal propagation, multiplexing, modulation, wireless LANs and wireless WANs, spread spectrum, FHSS and DSSS spread spectrum technology, cellular systems, medium access control, specialized MAC.

Unit III- Telecommunications and Broadcast Systems
GSM, mobile services, system architecture, GSM subsystems, GSM communication frame, localization and calling, handover, security, new data services, satellite systems applications, GEO, LEO. MEO, routing, localization, broadcast systems, cyclic repletion of data.

Unit IV- Wireless Networks and others 3G Technologies
Wireless LAN, infrared v/s radio transmission, infrastructure and adhoc networks, IEEE 802.11, architecture (details of protocol not required), DFWMAC schemes, MAC frames, MAC management, roaming, HIPERLAN (just basics, frame and protocol details not required), Bluetooth, applications, physical layer, modes MAC layer, packet format, networking security, link management, brief discussions (frame details and protocols not required) on GPRS, DECT, TETRA, UMTS, IMT-2000, CDPD.

Unit V- Mobile Network and Transport Layers
Mobile network layer, requirements, entities, IP packet delivery, agent advertisement and discovery, registration, encapsulation and tunneling, optimization, messages, reverse tunneling, IPv6, DHCP, Mobile IP, DHCP, ad-hoc networks, mobile transport layer, traditional TCP, indirect TCP, snooping TCP, mobile TCP, fast transmit/fast recovery, transmission/time out freezing, selective retransmission, transaction oriented TCP.

TEXT BOOKS
1. Data Communication & Networking - Behrouz A Foruzon.
2. Wireless communications and networking" William Stallings, PHI
3. Data and Computer Communications – By William Stalling., 7th Ed., PHI
4. Mobile communications"-by Johan schiller, PEA, 2nd ED
5. Mobile and personal communications systems and services" Rajpandya, PHI
6. Computer Networks - Tanenbaum, PHI.
7 Data Communications and Distributed Networks, 3rd ed. Black PHI
8 Computer Networks: Protocols, Standards and Interfaces, 2nd ed. Black PHI

ELT 303 Photonics

Aim and objective

1. To understand photonic devices which have emerged as the key technology for optical communications, environmental sensing, and biomedical diagnostics in the life sciences, energy-efficient lighting, and solar energy harvesting.
2. To understand light as an electromagnetic wave and various Interaction between a photon and electron and its relevance to laser and various other optoelectronic devices.
3. To understand optical radiation, radiometry & photometry, photovoltaic devices. Advanced photonics phenomena like Raman scattering, photorefractive effect, Photothermal deflection effect, and Ultra-fast phenomena
4. To understand Solar Photovoltaic Technology and its generations.
5. To understand the Nonlinear optical processes

Course Learning Outcomes At the end of this course, students will be able to

1. Describe the optics and simple optical systems.

2. Understand the concept of light as a wave and the relevance of this to optical effects such as interference and diffraction and hence to lasers and optical fibers.
3. Understand the area of silicon photonics which is an upcoming area of photonic integration with Electronics.
4. understand nonlinear optical processes and their applications
5. to understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses.
6. to understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations.
7. to know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it
8. Understand the concept, functioning and design of most photonic devices in use.

Max. Marks: 80, Min. Marks: 16
Student should be allowed to use Programmable Scientific Calculator in Examination hall

Unit I- Theory of Light, Light as Electromagnetic wave, Polarization of Light, Principle of superposition, Interference, Diffraction, Scattering, Photon nature of light, Light wave in homogeneous medium, Plane Electromagnetic Wave, Maxwell's Wave equation and Diverging Waves.
Basics of LED, and flexible display devices. Thin film deposition and characterization Techniques: XRD, TEM, SEM, EDX, Thin film active and passive devices,

Unit II -
Guide Wave Integrated Optic Devices: Planar and channel waveguides, Waveguide platforms on various materials and their fabrication techniques. Waveguide directional couplers, tapered waveguides and Y-junction splitters/combiners, Ring resonators, Mach-Zehnder interferometers/modulators. Sagnac interferometer/gyroscope. Coupling in and out of Photonic Integrated Circuits: Optical mode converters, prism and grating couplers. Wavelength-division multiplexing components: Mulitplexers, Demultiplexers, Multimode interferometers, Arrayed waveguide gratings.

Unit III - Solar Photovoltaics: Solar cell materials and their properties. Solar cell research: technology (silicon, organic, Dye sensitized, peroviakites), applications and limitations.Characterization and analysis: ideal cell under illumination- solar cell parameters,optical losses; electrical losses, surface recombination velocity, quantum efficiency - measurements of solar cell parameters; I-V curve & L-I-V characteristics, internal quantum yield measurements – effects of series and parallel resistance and temperature - loss analysis. Solar photovoltaic(PV) modules from solar cells, series and parallel connections, design and structure of PV modules.

Unit IV- Non Linear Optical processes
Introduction, Second Harmonic Generation,, susceptibility tensor, phase matching, propagation of EMW through second order nonlinear media, experimental technique in study second order non linearity Self Focussing and Defocussing, Optical Parametric

Interactions, Chirped pulse amplifier, parametric oscillations, Optical Mixing, Four Wave Mixing, Multiphoton Absorption.

Unit V -Advances in Photonics and photonic Materials

Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc. Low dimensional semiconductor devices – quantum wells, quantum wires, quantum dots **Silicon Photonics:** Motivation towards silicon photonics, Silicon on Insulator (SOI) waveguides or nanowires .Optical fiber to silicon waveguide: edge, grating, evanescent coupling, spot-size converters. III-V integration with silicon photonics. Photonic modulators: electro-optical and thermo-optical effects.

Raman Scattering, Photrefractive effect, Photothermal Deflection effect, Photorefraction in diffusing medium, Squeezed state, Optical Solitons, Optical Bistability, Optical interconnect, Photonic switches, Optical Computers, Ultrafast phenomena

TEXT BOOKS

1. Optical Electronics - Ghatak Thyagarajan, University Press
2. Optoelectronics An Introduction: Wilson & Hawkes PHI
3. Optoelectronics & Photonics S.O.Kasap, Pearson
4. Optoelectronics Devices & Systems - S.C. Gupta, PHI Publication
5. Photonics Sasi Kumar PHI

ELT 304 Paper 4- Power Electronics, Information Theory and Coding

Course Objectives

1. To introduce the students with the working of thyristor family.
2. To introduce the controlled rectifiers, AC Voltage Controllers, DC Choppers, inverters, UPS, AC motor, DC motor, and power conditioners.
3. To acquaint students with the basics of probability, information and its properties
4. To familiarize students with different channel models and their capacity
5. To teach different types of source and channel coding techniques

Course Outcomes

1. Able to understand the vital requirement of solid-state power electronics components.
2. Get acquainted with the working of thyristors, their characteristics and applications.
3. Learned about the working of the controlled rectifiers, AC Voltage Controllers, DC Choppers, Inverters, UPS, AC motor, DC motor, and power conditioners.
4. Comprehend and analyze the basics of probability, information and its properties
5. Examine different types of channels and determine their capacity
6. Understand the requirement of Shannon-Fano-Coding, Huffman Coding, Error-Control Coding.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination Hall

Unit I- Thyristors, Controlled Rectifiers and Commutation Techniques

Thyristors – Thyristor Characteristics, Two- transistor model of Thyristor, Turn ON and Turn OFF of Thyristor, di/dt protection, dv/dt protection, Type of Thyristors, Series operation and Parallel operation of Thyristors, Thyristor Firing Circuits, Unijunction Transistor. Controlled Rectifiers – Single Phase semiconverter with RL load, Single Phase full converter with RL load

Thyristor Commutation Techniques – Natural Commutation, Forced Commutation, Self Commutation, Complementary Commutation, External Pulse Commutation,

Unit II- AC Voltage Controllers, DC Choppers and Inverters

AC Voltage Controllers –Introduction, Principle of ON-OFF control, Principle of Phase control, Single Phase bi-directional controllers with inductive loads, Cycloconverters.

C Choppers – Principle of operation, Classification of Choppers – Class A, Class B, Class C, Class D and Class E Choppers.

Inverters-Introduction, classification of Invertors, Single phase, full bridge Voltage source inverter with RL load,

Unit III- Power Drives- DC Motor and AC Motor

DC Motor – Basic Characteristics, Speed control of DC motors – Armature voltage, Armature Resistance and Field flux controls, Solid state speed control of DC motor – Single Phase half wave converter, Single phase full wave converter.

AC Motor (Induction Motor) – Construction & Principle, Speed control of Induction motor – Stator voltage, Stator frequency, Pole changing, Rotor resistance and Slip power recovery control, Basic Construction and principle of Stepper motor

Unit IV – Power conditioners:

EMI/ RFI filter, CVT, Voltage regulators, Solid state regulators, UPS online & OFF line, reliability of UPS system. Batteries used for UPS, Important terms related to the UPS System & comparison of UPS system.

Applications of Power Electronics: Electronic ballast, Power factor correction, Induction heating, Dielectric heating.

Unit V – Information Theory : Introduction, Unit of Information, Entropy, Rate of Information, Joint Entropy and Conditional Entropy, Mutual Information, Channel Capacity-noise-free channel, symmetric channel, Binary Symmetric channel & cascaded channel, Shannon's Theorem, Continuous Channel, Capacity of a Gaussian Channel: Shannon Hartley Theorem, Bandwidth S/N Trade-off.

Coding – Introduction, Coding Efficiency, Shannon-Fano Coding, Huffman Coding, Error-Control Coding, Block Codes, Convolution Codes.

TEXT BOOKS

1. Power Electronics - Muhammad H. Rashid, Prentice Hall of India, Second Edition, New Delhi
2. Power Electronics - A.K. Gupta & L.N. Singh, Dhanpat Rai Publishing Company, 1st Edition
3. Power Electronics - J. Asger, PHI Publication.
4. Communication System - R.P.Singh & S.D. Sapre TMH Analog and Digital

5. Power Electronics - R.M. Jalnekar & N.B. Pasalkar
6. Pspice Simulation of Power Electronic Circuits: Raymond Ramshaw
8. Communication Systems-Simon Haykin, John Wiley & sons, NY, 4th Edition
9. Information theory- F.M Reza, McGraw Hill
10. A Text book of Electrical Technology (Volume –II) - B. L. Thereja & A K Theraja, S Chand & Co. Ltd (2006)
11. Principles of Electrical Machines- V K Mehta & Mehta,S Chand & Co. Ltd (2006)
12. Elecrtrical Machines – A Hussain, Dhanpat Rai & Co

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
SYLLABUS PRESCRIBED FOR THE EXAMINATION OF
M. Sc. Electronics
Semester-4
(Jan-June 2022)

ELT 401 Paper 1 -Digital Signal Processing

ELT-401 Paper - I: Digital Signal Processing

Aim and objective

1. To learn and understand the impact of digital signal processing (DSP).
2. Analyze the concepts of discrete time signals and systems in time and frequency domain with corresponding transformations.
3. To introduce the diverse structures for realizing FIR and IIR digital filters.
4. To introduce the digital of IIR, FIR filters with given specifications.
5. To understand the application of DSP in Speech analysis.

Learning Outcomes

1. Comprehend, classify and analyze the discrete time signals and systems, also transform the time domain signals to frequency domain for analyzing system response
2. Able to understand and simplify DTFT,DFS, DFT and FFT computations .
3. Comprehend the various mapping techniques for IIR filter design and their digitization.
4. Able to design FIR digital filters.
5. Able to realize digital filters using delay elements, summer, etc.
6. Able to analyze and exploit the speech signal processing applications

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Discrete Time Signals, Systems and Z-Transform

Discrete Time Signals, Systems-An introduction to analog signal processing, Discrete time signals & systems- discrete time signals (sequences), Linear shift, Invariant systems, Stability & Casuality, linear constant coefficient Differential equations, Frequency domain representation of discrete time systems & signals, Sampling of continuous time signals.
Z-Transform- Introduction, Z-transforms (of finite length sequences, Right sided, left sided & two sided sequences) Inverse Z-transform, Z-transform theorems & properties – Region of convergence of rational Z-transform, Linearity, Shift of a sequence, multiplication by an exponential sequence, Initial value theorem, Convolution of sequences, system functions.

Unit II-Discrete Fourier Transform
Discrete time fourier transform (DTFT), Representation of periodic sequence - Discrete Fourier series(DFS), Properties of the Discrete Fourier series- Linearity, Shift of a sequence, symmetry properties, periodic convolution; Fourier representation of finite duration sequences- The Discrete Fourier transform(DFT), Properties of discrete Fourier transform - Linearity, Circular shift of a sequence, Symmetry Properties, Circular convolution, Linear Convolution using the Discrete Fourier Transform.

Unit III- Fast Fourier Transform and Network Structures
Fast Fourier Transform (FFT), Inverse DFT, Radix FFT.
Signal Flow Graph Representation of Digital Network, Matrix Representation of digital Networks, Basic network structures for IIR systems (Direct form, cascaded form, and parallel form) Transposed forms, Basic network structures for FIR systems (direct form, cascaded form).

Unit IV- Digital IIR filter
Digital filter design techniques- design of IIR digital filters from analog filters, impulse invariance, Bilinear Transformation, Design examples: Analog-Digital Transformation – Digital Butterworth Filters (impulse invariance, bilinear transformation), Digital Chebyshev filters (impulse invariance, bilinear transformation), Comparison of IIR and FIR Digital Filters.

Unit V- Digital FIR filter
Finite impulse response (FIR) Filter Design, Rectangular, Triangular, Hanning, Hamming, Blackman and Kaiser Window, Linear phase and Optimal Filter .
Application Digital Signal Processing-speech processing, speech analysis- short term Fourier analysis, cepstral analysis & linear predictive analysis, speech coding, channel vocoder

TEXT BOOKS
1. Digital Signal Processing - A.V. Oppenheim & Schafer. PHI
2. Discrete Time Signal Processing - A.V. Oppenheim & Schafer. PHI
3. Digital Signal Processing - Johny Jonson, Pearson PHI
4. Digital Signal Processing - Proakis
5. Digital Signal Processing -Vallavaraj, Salivahanan, Ghanapriya, THM

ELT 402 Paper 2-Optical Communication and Satellite Communication
This course enables the students to:

1. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
2. Fabrication process of fiber optic cables
3. Design optical fiber communication links using appropriate optical fibers light sources, detectors.
4. To learn the basic elements of optical fibre transmission link, fiberglass modes configurations and structures
5. To understand different kinds of losses, signal attenuation in optical fibres & other dispersion factor.
6. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance
7. To provide an in-depth understanding of different concepts used in a satellite communication system

Learning Outcomes: The course enables the students to

1. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
2. Understand the types and fabrication process of fiber optic cable, calculation of losses during transmission in fiber, optical source, and detector require for optical communication.
3. Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.
4. Explore concept of designing and operating principles of modern optical systems and networks
5. Learn about some passive and active components required for optical communication
6. Students will be able to design Satellite Link, calculate the satellite's Look Angles and Antenna parameters like Gain, Resistance, Bandwidth, Beam-width. Explain and analyzes link budget of satellite signal for proper communication
7. Use the different application of satellite communication

Max. Marks: 80, Min. Marks: 16
1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I-Optical Fibers Optical fiber theory and applications, ages and disadvantages, parameters and types of optical fibers, Propagation of light through optical fiber ,single mode step index fiber, multimode step index fibers, multimode graded index fibers, Comparison of Three types of Optical fibers, Acceptance angle and acceptance cone, Numerical Aperture, , construction of optical fiber cables,
Transmission Characteristics of Optical Fiber: Attenuation in Optical Fibers, loss mechanisms - absorption and Rayleigh scattering, Radiation losses, Wavelength dispersion, intermodal and intramodal, Bending losses, Coupling losses: misalignment and mismatch losses

Unit II- Principle of Optical Communication

Optical Fiber Communication System Block Diagram

Optical sources: Heterojunction LED, Edge emitting LEDs, Injection Laser LEDs

Light Detectors: PIN Diode and Avalanche Photodiode, Structure of In, GaAs APDs Characteristics of Light Detectors, Connector types and splices, Optical Fiber System Link Budget, Optical fiber manufacturing processes. Optical fiber testing and parameter (cut off Wavelength, loss per unit length, numerical aperture, bending loss, connector/spliceloss) measurement

Unit III- Optical Fiber Communication Systems and Applications

Typical Fiber Optic Communication System, Optical Transmitter, Optical Receiver, Optical Repeaters, Optical Amplifiers, semiconductor optical amplifiers, EDFA, Raman Amplifier. Basic idea of WDM and DWDM systems, System Architecture: Point to point link, Distributed Network, AN Fiber Optic Sensors in Health care, Optical Computing, Optical Logic Gates

Unit IV-Satellite Communication - I

Satellite Communication – Introduction, Kepler's laws, orbit, Power systems, Satellite Frequency Allocations and Band Spectrum, Elements of a Satellite Communication System, Active and Passive Satellites, Modem and Codec, Communication Satellite Link Design – General Link Design Equations, Effective Isolated Radiated Power (EIRP), System Noise Temperature, C/N and G/T ratio, Atmospheric and Ionosphere Effects on Link Design, Uplink Design, Complete Link Design, Interference Effects on complete link design, Earth Station parameters.

Unit V- Satellite Communication - II

Satellite orbits – synchronous orbit, orbital parameters, Satellite location with respect to the earth, Look Angles, Earth coverage and Slant range. Satellite Transponder model, Satellite RF Front End, Satellite Carrier Processing, Antenna – Antenna parameters, Gain, Resistance, Bandwidth, Beam-width and polarization, Parabolic antenna, Application of Satellite Communication in Television - Direct Home Broadcast, Telephone services and Data Communication.

TEXT BOOKS

1. Optical Fiber Communication -G. Keiser, Mc. Graw Hill
2. Fiber Optics Communication -D. C. Agrawal
3. Satellite Communication -D.C. Agrawal, Khanna Pub.
4. Satellite Communication -R.M. Gagliardi
5. Fundamentals of Optical Fibre Communication: Satish Kumar PHI
6. Optical fibre and Laser Anuradha De New Age International Publishers
7. Optical Fiber Communication: V.S.Bagad Technical Publications
8. Optical Fiber Communications', John Senior: PHI.
9 Electronic communications, Roddy and Coolen, PHI, New Delhi,

ELT 403 Paper 3- Automatic Control System and Artificial Neural Network

Aim and objective

1. To understand the use of transfer function models for the analysis of physical systems and to introduce the components of control system.
2. To provide adequate knowledge in the time response of systems and steady state error analysis along with the understanding of closed loop and open loop in frequency domain.
3. To understand the concept of feedback controllers
4. To introduce state variable representation of physical systems and study the effect of state feedback
5. To summarize basic learning laws and architectures of neural networks.
6. To describe supervised and unsupervised learning laws of Neural Networks.
7. To introduce single-layered- feed-forward and multi-layered feed-forward neural network, multi-layered perceptions model with the back-propagation algorithm

Learning Outcomes

1. Differentiate real-time applications as open loop or closed loop systems.
2. Analyze the system from the transfer function.
3. Design of controllers and find the stability of these control systems.
4. Ability to compute steady state and transient response of the different order of the system and also to analyze its error coefficients.
5. Analyze the frequency domain response of the control systems.
6. Apply various control systems concepts to analyze and find the stability of control systems.
7. Analyze the controllability and observability of the system in state modeling.
8. Ability to translate biological motivations into various characteristics of artificial neural networks
9. To comprehend and analyze basic learning laws of neural networks and activation functions
10. To learn supervised and unsupervised learning algorithms .

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination Hall

2. Special graph paper viz. Polar graph & Semi log graph papers should be provided to the students in the examination hall.

Unit I - Fundamental of Control System

Basic Definition, Classification of Control System, Open Loop & Closed loops System, Effect of feedback on System response, Impulse Response & Transfer Function, Block diagram, Block Diagram Reduction Techniques. Signal Flow Graph-Basic Definition in SFG, Rule for SFG, Properties of SFG, Masons Gain Formula.

Unit II -Time Domain analysis and Stability of Linear Control System

Time Response of Continuous Data system, test Signal ,Steady State Errors and error constants, Unit Step response, Time Domain specifications, time Response of first order

System, Transient Response of Prototype second order System, effect of adding a zero to the system, Stability of Linear Control System-Absolute Stability, Relative Stability, Routh-Hurwitz Criterion-Ruth Tabulation, Special Cases.

Unit III- Frequency Domain Analysis and Frequency Response Plots

Frequency Domain Analysis - Frequency Response of closed loop control System, Frequency Domain Specifications of prototype Second Order System, Nyquist Stability Criterion and plot, Root Loci- basic properties, Relative Stability-Gain Margin & Phase Margin, Correlation Between Time & Frequency response, Polar Plot, Bode Plot.

Unit IV-State Variable Analysis and Controllors

State Variable Analysis and Design – Concept of state variables, state model, state model for linear continuous time system, diagonalization, solution of state equations, concept of controllability and observability, PID Controller, Theory of lag, lead and lag-lead compensators.

Unit V- Artificial Neural Network

Introduction to ANS Technology-Models of a neuron, neural networks, viewed as directed graph, feedback from neurons to ANS, **Learning and training**- Hebbian, memory based, competitive, error-correction and learning. **Assignment problem** supervised and unsupervised learning. **Network architectures-Single layered**- feed forward networks, multi-layered feed forward networks, Activation and Synaptic Dynamic. **Stability and convergence-** single layered perception - least mean square algorithm, multilayered perceptions - backpropogation algorithm

TEXT BOOKS

1. Control systems Theory & Application - Samarajit Ghosh (Pearson Edu)
2. Control System Engineering - B.C.Kuo(PHI)
3. Control Systems Engineering - I.J. Nagrath, M. Gopal
4. Artificial Neural networks - B. Yagna Narayan
5. Neural Computing -Philips D. Wasserman
Theory and practice -Vannostrand Reinhold

ELT 404 Paper 4 – Embedded Systems, Microcontrollers and Advanced Instrumentation

Course objective

1. To develop ability to understand microcontroller
2. To introduce the architectures of embedded systems, PIC microcontrollers, FPGA and ARM processor
3. To familiarize the students with fundamentals of the IoT
4. To introduce the basic concept of electronic instrumentation and measurement
5. To familiarize the students with transducer, Digital Storage Oscilloscope, Spectrum analysers and different types of sensors
5. To introduce the basics of biomedical instrumentation and measurement

Learning Outcomes

1. Understand the requirement of the embedded system, ARM processor, and IoT
2. Understand general-purpose processing and principles of PIC microcontrollers, FPGA and ARM processor
3. Developed the ability to work with different types of sensors
4. Understand working of basic electronics instrumentation and develop the ability to handle instrument like digital multimeter, Digital Storage Oscilloscope, Spectrum analysers, and impedance analysers.
5. Understand functioning of biomedical Electronic Instrumentation like electrocardiography, plethysmography.

Max. Marks: 80, Min. Marks: 16

1. Student should be allowed to use Non Programmable Scientific Calculator in Examination hall

Unit I- Introduction to Embedded systems:

Introduction, Application Areas, Categories of embedded systems, Overview of embedded systems architecture, Specialties of embedded systems, challenges and issues in embedded software development Recent Trends, hardware architecture, Software architecture, core platform development, boot sequence, development/testing tools.

Fundamentals of Internet of Things (IoT) for communication and Cloud Computing.

Unit – II

FPGA Architecture Introduction to Programmable logic, Basic Components of FPGA (LUT, CLB, Switch Matrix, IOB), Basic FPGA Architecture

PIC Microcontrollers – Introduction to PIC 16C6x/7x family microcontrollers, Architecture, Registers, Register File Structure, Addressing Modes, Instruction set. Interrupt Structure, Timers, Counters, I/O Port Concepts, Peripheral Interfacing and Applications,

Basics of ARM Architecture: Introduction to ARM microprocessor and its features, Architecture, Programming model.

CISC and RISC architecture comparison, advantages of RISC, Power saving methods

Unit III

Concept of Measurement & Transducers

Basic concept of Measurement, Performance & Static Characteristics, Error in Measurement, Types of Errors-Gross, Systematic & Random,

Fundamental Concept Transducers – Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Measurement of displacement, velocity, acceleration, force, torque, strain, temperature, pressure, flow, humidity, thickness, pH. Measuring Equipment – Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/time, phase,

Unit IV- Instrumentation Electronics

Instrumentation Amplifiers, Basic Characteristics, D.C. Amplifiers, Isolation Amplifiers, Feedback Transducers system, feedback Fundamentals, Inverse Transducers, Temperature Balance System. Digital Multimeters, CRO, Digital Storage Oscilloscope, Spectrum Analyzer., Impedance analyzer

Advanced Instrumentation Systems

Semiconductor sensors; smart sensors; micro sensors; IR radiation sensors; ultrasonic sensors; fibre optic sensors; chemical sensors; bio sensors; thermometry and thermography; nano instrumentation; environmental pollution monitoring;

Unit V-Biomedical Electronic Instrumentation and Measurements

Introduction to biomedical instrumentation, sources of bioelectric potentials, electrodes- electrode theory, biopotential electrodes, biochemical transducers, cardiovascular measurements- electrocardiography, measurement of blood pressure, blood flow and heart sound, plethysmography, the elements of intensive care monitoring; calibration and reparability of patient monitoring equipment, pace makers. MEMS and its applications Sensors for IoT applications.

TEXT BOOKS

1. Embedded systems - Raj Kamal, TMH
2. Embedded/Real Time Systems – Dr.K.V.K.K.Prasad, dreamtech Press.
3. FPGA based System design by Wayne Wolf
4. 2. Digital Systems Design With FPGAs And CPLDs By Ian Grout, Elsevier(2008)
5. Unleash the System On Chip Using FPGAs and Handel C By Rajanish K. Kamat, Santosh A. Shinde, Vinod G Shelake, Springer (2010)
6. Design with PIC Microcontrollers – John B.Peatman, Pearson Education Asia
7. PIC Microcontrollers: An Introduction to Microelectronics, Martin P. Bates, Elsevier.
8. D.V.S. Murti, **Transducers and Instrumentation**, PHI Learning Pvt Ltd, New Delhi.
9. Douglas A. Skoog, F. james Holler, and Stanley R. Crouch, **Instrumental Analysis**, CENGAGE Learning, Indian Edition.
7. Internet of Things (IoT) – Jeeva Jose, Khanna Publishers, Delhi

BOOK FOR REFERENCE:

1. Intel Embedded Microcontrollers and Processors Vol. I

ELP 105 LAB COURSE "A"- ANALOG ELECTRONICS LAB

M.Sc. Electronics

July-Dec 2020

Semester I

Course Objective:

1. To illustrate the students different electronic circuit and their application in practice.
2. To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
3. To evaluate the use of computer-based analysis tools to review performance of Semiconductor device circuit.

At the end of this course, students will be able to

1. Understand the non-ideal behavior by parameter measurement of Op-amp.
2. Design application-oriented circuits using Op-amp ICs.
3. Generate square wave using different modes of 555 timer IC.
4. Study of Hall effect and four probe methods.
5. Prepare the technical report on the experiments carried.

Course outcomes:

1. Identify relevant information to supplement to the Analog Electronic Circuits
2. Set up testing strategies and select proper instruments to evaluate performance characteristics of electronic circuit.
3. Choose testing and experimental procedures on different types of electronic circuit and analyze their operation different operating conditions.
4. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory.
5. Practice different types of wiring and instruments connections keeping in mind technical, Economical, safety issues.
6. Prepare professional quality textual and graphical presentations of laboratory data and Computational results, incorporating accepted data analysis and synthesis methods, Mathematical software and word-processing tools.

Max. Marks: 100, Min. Marks: 20

1. Study of op-amp characteristics: CMRR and Slew rate.
2. Designing of an amplifier of given gain for an inverting and non-inverting configuration using an opamp.
3. Designing of analog adder and subtractor circuit.
4. Designing of an integrator using op-amp for a given specification and study its frequency response.
5. Designing of a differentiator using op-amp for a given specification and study its frequency response.
6. Designing of a First Order Low-pass filter using op-amp.
7. Designing of a First Order High-pass filter using op-amp.
8. Designing of a RC Phase Shift Oscillator using op-amp.
9. Study of IC 555 as an astable multivibrator.
10. Study of IC 555 as monostable multivibrator.

11. Designing of Fixed voltage power supply using IC regulators using 78 series and 79 series.
12. To study the Astable and Monostable Multivibrator using IC741.
13. To study the RC Phase Shift Oscillator by determining its frequency of oscillation and Compare calculated and observed frequency.
14. To study the Schmitt Trigger using transistor and IC7413 by observing the output Waveform.
15. To study the Colpit Oscillator, determine its frequency of oscillation and compare the Calculated and observed frequency.
16. To study the Negative Feedback Amplifier by measuring closed loop gain and gain bandwidth product.
17. Calculation of barrier height and ideality factor at room temperature (for Si and GaAs devices) from the *I-V* characteristics.
18. Calculation of diode parameters at varying frequency from the *C-V* characteristics.
19. Calculation of semiconductor conductivity type and carrier concentration using Hall Effect.
20. Calculation of semiconductor resistivity and band gap using Four-Probe method.
21. Calculation of carrier mobility and drift velocity using an experimental setup.
22. Verification of following network theorems (1) Superposition (2) Thevenin`s (3) Nortan`s theorem.
23. To study and plot the MOSFET characteristics.
24. To study the Active Band pass filter and calculate its (1) Bandwidth: - Lower cutoff & upper cutoff frequency. (2) Quality factor.
25. Construct a Wein Bridge Oscillator and determine its frequency of oscillation and compare calculated and observed frequency.
26. To study the Active Low pass filter and to evaluate: -(1) Cutoff frequency, (2) Band pass gain, and (3) Plot the frequency response.
27. To study the Clipping circuits as positive and negative logic.
28. To study the Clamping circuits as positive and negative logic.
29. To Study the phototransistor characteristics.
30. To study the comparison of Schmitt trigger and phototransistor.
31. Verification of the Maximum Power Transfer theorem.
32. . To study the characteristics of JFET (Junction field effect transistor) in common source configuration & evaluate— 1. AC drain resistance, 2. Amplification factor and 3. Drain Resistance.
33. To study the operation of Class B Amplifier.
34. To study the Z parameter of a passive Two Port Network.

35. To study the Op – Amp as voltage to current converter.
36. To study of characteristics of NPN transistor in common emitter configuration and evaluate— 1. Input resistance, 2. Output resistance and 3.Current gain.
37. To study the Active High pass filter and to evaluate:--
    a. Low cutoff frequency, (2) Bandpass gain, and (3) Plot the frequency response.
38. To study, identify and testing the electronic components using Physical and electronic equipments (CRO, Digital Multi Meter).
39. To study the Clipping and Clamping circuits as positive and negative logic using expEYES-17 kit.
40. To study transfer characteristic and functional verification of a Weighted Resistor D/A Converter.
41. To study transfer characteristic and functional verification of a Integrated D/A Converter.
42. To study transfer characteristic and functional verification of a Ladder Network D/A Converter.
43. To study and testing the working of a counter A/D converter.
44. To study and testing the working of a monolithic A/D converter.
45. To study and analysis of comparator operational amplifier.
46. To study of operational amplifier as Integrator and Differentiator.
47. To study of operational amplifier as Square Wave Generator.
48. To study and observe buffer operational amplifier.
49. To study and observe operational amplifier as Adder and Subtractor.

Note : Each student has to perform at least fifteen experiments. The teacher in-charge may add or delete experiments as per the availability of the equipment and need of the course.

Reference Books

1 .Laboratory Experiments and PSPICE Simulations in Analog Electronics Maheshwari & Anand PHI
2 Laboratory Manual for Operational Amplifiers and Linear ICs, 2nd ed. Bell PHI
3. Student Reference Manual for Electronics Instrumentation Lab Wolf & Smith PHI

4. ELECTRONIC LAB PRIMER By B. Sasikala, S. Poorna Chandra S.Chand Pub

ELP 106 LAB COURSE "B"- DIGITAL ELECTRONICS LAB
M.Sc. Electronics
July -Dec 2020
Semester I

Course Objectives

- To know the concepts of Combinational and sequential circuits.
- To understand the concepts of flipflops, registers and counters

Course Outcomes:

CO1 Learn the basics of gates.
CO2 Construct basic combinational circuits and verify their functionalities
CO3 Apply the design procedures to design basic sequential circuits
CO4 Learn about counters CO5 Learn about Shift registers
CO6 To understand the basic digital circuits and to verify their operation
Max. Marks: 100, Min. Marks: 20

List of Experiments: -

1. Verify the following Boolean expressions--

   i) A + A'B = A +B ii) AB + AB' = A

   iii) AB + A'C + BC = AB + A'C iv) AB + A'C = (A + C)(A' + B).

2. To study the operation of 4 bit binary full adder and subtractor (IC 7483) having input and output carry bits. Add and subtract any two binary numbers of four bits.

3. To study the characteristics of C-MOS integrated circuits, verify the operation of C-MOS Inverter/NAND gate ICs and study the voltage level of C-MOS for proper ON/OFF (logic 1 or logic 0) condition.

4. To study the interfacing of C-MOS to TTL IC's and vice-versa. Different TTL logic gates and C-MOS logic gates with pull up resistance are provided for interfacing.

5. To study the master slave J-K flip-flop and verify truth table.

6. To study R-S/D/T flip-flops using NAND ICs and verify truth table.

7. To study the operation of shift register as serial in parallel and parallel in serial mode.

8. To study the operation of shift register as parallel in parallel and serial in serial mode.

9. To study write/read operation of digital data into semiconductor memory using IC 7489. Store and retrieve some set of data. (RAM)

10. To study the operation and application of a modern LSI D/A converter. Parallel binary Inputs from switches are applied to DAC, which in turn converts the binary number into a proportional output voltage.

11. To study the operation of modulo-n-counter as MOD 3 & MOD 4 and verify the Truth Table.

12. To study the operation of modulo-n-counter as MOD 8 & MOD 9 and verify the Truth Table.

13. To study the operation of a Presetable Divide by N Counter and verify its truth table.

14. To study the operation of Multiplexer IC having 16: 1 channels.

15. To study the operation of Demultiplexer IC having 1:16 channels and 4 select inputs.

16. To study the operation of BCD Up-Down Counter.

17. To study the operation of Memory programming with seven segment display.

18. To study the operation of comparison of JK flip-flops and verify the difference with Timing diagram.

19. To study and verify the truth table of Parity Generator and Checker.

20. Verification of operation of IC 74190 as mod- N programmable counter.

21. To study the Binary to BCD converter.

22. To study the BCD to Decimal converter.

23. To study the Binary to Gray code converter and Gray to Binary code converter.

24. To study the 4- bit Synchronous binary up/down counter.

25. To study the 4- bit Asynchronous binary up/down counter.

Any other experiment of equal standard relevant to syllabus can also be set.

Note: -Students have to perform at least 15 experiments from the above list.

Books:

1. Laboratory Manual for Operational Amplifiers and Linear ICs, 2nd ed. **Bell PHI**

2. Student Reference Manual for Electronics Instrumentation Lab Wolf & Smith **PHI**

ELP 205 LAB COURSE "C"- ANALOG AND DIGITAL COMMUNICATION LAB
M.Sc. Electronics
Jan-June 2021
Semester II

Max. Marks: 100, Min. Marks: 20

Course Learning Outcomes: At the end of this course, students will be able to

1. **Familiarize the students with basic analog & digital communication systems. Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation, pulse modulation, PCM etc**
2. **Understand the functioning of various analog and digital communication techniques**
3. **Calculate the performance parameters involved in electronic communication systems**
4. **Prepare the technical report on the experiments carried.**

Course Outcomes

After studying this course the students shall be able to:

1. Design analog modulation circuits as amplitude and frequency modulation.
2. Design various pulse modulation techniques as PAM, PPM, PWM.
3. Design the circuit to sample an analog signal.
4. Use of different modulation and demodulation techniques used in analog communication
5. Identify and solve basic communication problems
6. Analyze transmitter and receiver circuits
7. Compare and contrast design issues, advantages, disadvantages and limitations of analog communication systems

List of Experiments :-

Analog Communication

1. To Generate the DSB-SC Modulated wave and to Observe the Phase Reversal at the Zero Crossing of the Modulating Signal [MOD-13]
2. To study the operation of balanced modulator DSBSC using IC 1496.
3. To study the phase modulation using IC 2206 and calculate the modulation index.
4. To study amplitude modulation and demodulation and construct and AM generator and a diode detector and observe its operations under various conditions.

5. To demonstrate (i) use of 4046 PLL as an FM modulator. (ii) Use of 4046 PLL IC as an FM demodulator

Digital communication-

1. Study of signal sampling and reconstruction techniques and to verify Nyquist criteria and tracing.
2. To Generate the SSB-SC Modulation and Demodulation
3. To Generate Pulse Amplitude Modulated (PAM) Signal and Demodulate it
4. To generate Pulse Width Modulated (PWM/PTM/PLM/PDM) Signal and Demodulate it.
5. To Generate the DSB-SC Modulated wave and to Observe the Phase Reversal at the Zero Crossing of the Modulating Signal
6. To Generate Pulse Position Modulated (PPM) Signal and Demodulate it
7. Study of TDM pulse amplitude modulation and demodulation.
8. Study of pulse code modulation and demodulation techniques.
9. Study of delta and adaptive-delta modulation methods.
10. Study of Phase Shift Keying Modulation and Demodulation Technique.
11. Study of Amplitude Shift Keying Modulation and Demodulation Technique.
12. Study of Frequency Division Multiplexing and Demultiplexing.
13. Study of Frequency Shift Keying (FSK) modulation.
14. Study of DPSK modulation.

Miscellaneous

1. To study the characteristics and testing methods if TT attenuators.
2. To study the Carrier Wave (CW) operation of Klystron tube and determine its operating frequency.
3. To study the Square Wave operation of Klystron tube and determine its operating frequency.
4. To study the modes of Klystron tube.
5. To determine the frequency and wavelength of rectangular waveguide, working on TE10 mode.

6. 10. To determine the standing wave ratio (SWR) of Klystron tube.
7. 11. To determine the Reflection Coefficient of Klystron tube.

Any other experiment of equal standard relevant to syllabus can also be set.
Note: -Students have to perform at least 10 experiments from the above list.

Books: Laboratory Experiments and PSPICE Simulations in Analog Electronics Maheshwari & Anand PHI

ELP 206 LAB COURSE "D"- 8085 MICROPROCESSOR PROGRAMMING, STUDY CARDS AND INTERFACING LAB

M.Sc. Electronics
Jan-June 2021
Semester II

At the end of this course, Students will be able to

1. Simple programs to understand the instruction set of 8085 microprocessors.
2. Simple programs to understand the study cards.
3. Interface various I/O devices with microprocessor and microcontroller.
4. Prepare the technical report on the experiments carried.

Max. Marks: 100, Min. Marks: 20

List of Experiments:-

1. Program of 8085 to add 8-bit numbers from memory & display result to C060H memory location & carry in C061 H.

2. Program of 8085 of 8085 to transfer the data of 16 consecutive locations into other 16 Consecutive locations in forward order and vice versa

3. Program of 8085 to search the memory location that contained 05 H data in a string of length of 16 byte and display it to memory location to C060 H.

4. Program of 8085 to search number of 05 H data in a string of length of 16 byte and display it to memory location to C060 H.

5. Program of 8085 to multiply two 8-bit numbers.

6. Program of 8085 to divide two 8-bit numbers.

7. Program of 8085 to solve a Boolean Equation which rep. Combinational logic as follows:-
X= A' (B+C). D' + A.B. (D+C), A.B.C. & D are four independent variables.

8. Program of 8085 to convert BCD into its equivalent binary number.

9. Program of 8085 to convert Binary number into its equivalent unpacked BCD number.

10. Program of 8085 to count the number of Zeros, positive and negative number in a series of 16 bytes.

11. Program of 8085 to convert Binary number into its equivalent ASCII number.

12. Program of 8085 to convert ASCII into its equivalent binary number.

13. Program of 8085 to find the largest and smallest number in a data array.

14. Program of 8085 to arrange the data array in ascending and descending order.

15. Program of 8085 to add a series of data of 16 consecutive memory location and display the result in C060 H and carry in C061 H memory location using subroutine.

16. Program of 8085 to subtract two 8-bit data from memory location using 2's complement method and display the result in C060 H and borrow in C061 H.

Note: -Students have to perform at least 15 Programs of 8085 from the above list.

*** STUDY OF 8255 CARD ***

1. Program 8255 in mode-O; i.e. simples I/O mode Program Port-A, Port-B, Port-C in O/P mode, transmit data from keyboard to all the ports.

2. Repeat program no.(1), with all ports in I/P mode. Store data to M.P.U.'s registers

3. Program 8255 in B.S.R. mode. Set port-C in O/P mode Using appropriate delay set/reset PC.

4. Program 8255 in mode-1; i.e. strobe I/O mode Program Port-A, Port-B is in mode-1 and Port-A is in O/P mode and Port-B is in I/P mode and Port-C is used in control signal.

5. Program 8255 in mode 0 i.e. simple I/O mode. Program Port A in I/P mode and Prot B in output mode.

6. Program 8255 in mode 0 i.e. simple I/O mode/ Program Port B in I/P mode and Port A in output mode.

7. Program 8255 in mode 0 i.e. simple I/O mode. Program Port A in I/P mode, Port B in input mode. Read data from Port A&B, add it & display

*** STUDY OF 8253 CARD ***

8. Program 8253 in mode-0 i.e. interrupts on terminal count. Select counter c; Read/load lower 8-bits & then higher bits. Draw and explain the function of Gate, Out & Clock Signals.
9. Program 8253 in mode 1. Draw and explain the function of GATE, OUT and CLOCK Signals.
10. Program 8253 in mode 2. Draw and explain the function of GATE OUT and CLOCK Signals.
11. Program 8253 in mode 3 to generate square wave. Draw and explain the function of GATE, OUT and CLOCK Signals.

*** STUDY OF LBDR CARD ***

12. Study of Buffer IC-74L8245 on L.B.D.R. Card using 8085 M.P.U. kit.
13. Study of Latch IC-74L8245 on L.B.D.R. Card using 8085 M.P.U. kit.
14. Study of LBDR as 2 & 4 decoder.
15. To access memory locations (RAM) specified by generation control signals on L.B.D.R. card using 8085 M.P.U.

*** STUDY OF 8259 CARD ***

16. Study of master 8259 in stand-alone mode. Generate and interrupt request-using 8259 and display the respective interrupt in address field.
17. Study of 8259 in cascaded mode i.e. in 8259 as master and the other as slave. Generate an interrupt request using 8259 and display the respective interrupt in address field.

*** STUDY OF 8251 CARD ***

18. Interface 8251 with 8085 M.P.U. and program it in asynchronous transmitter mode, use 8251 Group A.
19. Interface 8251 with 8085 M.P.U. and program it in asynchronous receiver mode, use 8251 Group A.
20. Interface 8251 with 8085 M.P.U. and program it in synchronous transmitter mode, use 8251 Group A.

21. Interface 8251 with 8085 M.P.U. and program 8251 Group A is in synchronous transmitter mode and 8251 B is in synchronous receiver mode.

***STUDY OF 8237/57 CARD ***

22. Interface 8237 IC with 8085 M.P.U. memory to I/O transfer (Read Mode)

23. Interface 8237 IC with 8085 M.P.U. and Study memory to I/O transfer in block transfer mode (write mode).

24. Interface 8237 IC with 8085 M.P.U. and study I/O to memory transfer in single transfer mode (write mode)

25. Interface 8237 IC with 8085 M.P.U. and study I/O to memory transfer. In this mode data stored at 4150H to 415AH

Note: -Students have to perform at least 5 Study Cards from the above list.
PIO Card

***STUDY OF DAC CARDS ***

26. Program to demonstrate DAC as positive going staircase (or ramp) generator.
27. Program to demonstrate DAC as triangular wave generator.
28. Program to demonstrate DAC as exponential binary staircase generator.
29. Program to demonstrate DAC as R-C charging and discharging waveform.

***STUDY OF DYNA THUMBWHEEL CARDS ***

30. To study interfacing of Thumbwheel with microprocessor based system as Dyna-85.

***STUDY OF SERIAL DISPLAY INTERFACE CARDS ***

31. To study interfacing of Serial Display Interface Card with microprocessor based system as Dyna-85.

Note: -Students have to perform at least 2 PIO Cards from the above list

Any other experiment of equal standard relevant to syllabus can also be set.

ELP 305 LAB COURSE "E"- OPTICAL ELECTRONICS AND PHOTONICS
M.Sc Electronics
July-Dec 2021
Semester III

Max. Marks: 100, Min. Marks: 20

Course Objectives: Students will try to learn:

1. .To learn the basic elements of optical fibre transmission link, fiberglass modes configuration s and structures
2. To understand different kinds of losses, signal attenuation in optical fibres & other dispersion factor.
3. To learn various optical sources, LED/LASER structures, receivers (PIN, APD), and noise performance.

Course Outcomes: At the end of this course, students will be able to

1. Perform experiments based on the phenomenon of light/photons.
2. Measure the parameters such as wavelength, resolving power, numerical aperture etc. using the appropriate photonic/optical technique.
3. Prepare the technical report on the experiments carried.
4. Apply the fundamental principles of optics and light wave to design optical fiber communication systems.
5. Differentiate losses in optical fiber link and state transmission characteristics of optical fiber.
6. Design optical fiber communication links using appropriate optical fibers light sources, detectors.

List of Experiments: -

1- Laser Diode Intensity Modulation And Demodulation

To calculate the diameter of a pinhole using Laser.

2- To observe the diffraction pattern and calculate the slit width using single slit.

3- To determine the Grating pitch of transmission Grating.

4- To study the output characteristic of Phototransistor.

5- To study the I-V characteristic of Photodiode.

6- To study the characteristic of LED.

7- To determine the I-V characteristics of PV module with varying radiation and temperature level.

8- To determine the P-V characteristics of PV module with varying radiation and temperature level.

9- To determine the I-V and P-V characteristics of series combination of PV module.

10- To determine the I-V and P-V characteristics of parallel combination of PV module.

11- To show the effect of variation in tilt angle on PV module power.

12- To study the V-I characteristics of DIAC with positive and negative biasing.

13- To study the Optical transducer in Optically Controlled Switching System.

14 To study the Optical transducer characteristics of photovoltaic cell.

15- To study the Optical transducer characteristics of photoconductive cell.

16- To study the Optical transducer characteristics of filament Lamp.

17- To study the characteristics of phototransistor.

18- To study the characteristics of PIN photodiode.

19- To study the effect of variation in tilt angle on PV module power.

20- To determine the Planck's constant.

21- To study the I-V characteristic of LED using expEYES-17 kit.

22- To study the characteristic of LDR using expEYES-17 kit.

23- To calculate velocity of sound using expEYES-17 kit.

For Optional Paper Instrumentation Lab

Transducer control system Trainer kit

1. To study the characteristics of a 3 wire RTD and to observe the change in resistance as Temperature increases (Wheatstone bridge).
2. To study the application of 2 wire RTD in a potentiometer circuit.
3. To study the application of 3 wires RTD in a Wheatstone bridge circuit.
4. To study the characteristics of thermocouple and observe the change in output voltage with the change in temperature.

5. To study semiconductor diode as a temperature sensor.

6. To study transistor as a temperature sensor.

7. To study the application of thermistor in a DC whetstones bridge circuit.

8. To study the application of thermistor in a non- inverting Op – Amp circuit.

Thyristor Application trainer

1. To study & plot the SCR characteristics.

2. To study & plot the UJT characteristics.

3. To study & plot the DIAC characteristics.

4. To study & plot the TRIAC characteristics.

Virtual Instrumentation Using National Instrument LabView Software

1. Design a Virtual Instrument of Half adder digital circuit using LabView.

2. Design a Virtual Instrument of Full adder digital circuit using LabView.

3. Design a Virtual Instrument of Half subtractor digital circuit using LabView.

4. Design a Virtual Instrument of Full subtractor digital circuit using LabView.

5. Design a Virtual Instrument. to find maximum & minimum amplitude of given waveform using LabView.

6. Design a Virtual Instrument to convert Analog waveform to Digital waveform using LabView.

7. Design a Virtual Instrument to generate multitone waveform (sine & square) using LabView.

8. Design a Virtual Instrument to convert Celcius into equivalent Fahrenheit using LabView.

ELP 306 LAB Course "F"- 8086 MICROPROCESSOR PROGRAMMING INTERFACING AND "C" PROGRAMMING LAB

M.Sc Electronics
July-Dec 2021
Semester III

Max. Marks: 100, Min. Marks: 20

List of Experiments:-

8086 ASSEMBLY LANGUAGE PROGRAMMING

1. Write a program to transfer an 8-bit data from register to C060H memory location.
2. Write a program to transfer an 16-bit data from register to C060H memory location.
3. Write a program to add two 8-bit data and result is stored in C060H.
4. Write a program to add two 16-bit data and result is stored in C060H.
5. Write a program to subtract two 8-bit data and result is stored in C060H.
6. Write a program to subtract two 16-bit data and result is stored in C060H.
7. Write a program to multiply two 8-bit data and result is stored in C060H.
8. Write a program to multiply two 16-bit data and result is stored in C060H.
9. Write a program to divide 16-bit data by 8-bit and result is stored in C060H.
10. Write a program to divide 32-bit data by 16-bit and result is stored in C060H.

*** STUDY OF 8255 CARD ***

Study the Interfacing of 8255 Study card with 8086 Microprocessor.

*** STUDY OF 8259 CARD ***

Study the Interfacing of 8259 Study card with 8086 Microprocessor.

List of C Programming

1. Write a program to calculate the roots of quadratic equation Ax2+Bx+C=0.
2. Write a program to calculate the average of a set of n numbers including zero and negative numbers.

3. Write a program to sort an array element in ascending order using bubble sort technique.

4. Write a program to sort and array element in descending order using bubble sort technique.

5. Write a program to plot a sin (X).

6. Write a program to read and print a single dimension array A and B each having 10 elements write a program that prints out an array C having elements, which are sum of the elements of array A and B.

7. Write a program to find a row sum and column sum of a given matrix and built a new matrix with the help of row sum and column sum and previous matrix.

8. Write a program to read and print two-dimensional matrix of order nxm. Find the sum of diagonals.

9. Write a program that calculate and prints out the maximum and minimum of array.

10. Write a program for sorting names in alphabetical order.

11. Write a program to plot and exponential series.

12. Write a program to print the terms in the exponential series, till the term is equal to 0.00001 also compute the exponential series of x,

    ex=1+x+x2/2!+x3/3!+…….+0.00001.

13. Write a program for matrix multiplication.

14. Write a program for matrix addition.

15. Write a program for the operation of (a) addition (b) subtraction (c) multiplication (d) Division, using switch command

16. Write a program to find the factorial of a given number and Fibonacci series using switch command

17. Write a program to find the sum of natural numbers using function

Any other experiment of equal standard relevant to syllabus can also be set

ELP 405 LAB COURSE "G"- OPTICAL COMMUNICATION AND 8051 PROGRAMMING LAB

M.Sc. Electronics
Jan-June 2022
Semester IV

Max. Marks: 100, Min. Marks: 20

List of Experiments: -

Fiber Optics Communication kit

1. Study of setting up a fiber Optic Analog Link.
2. Study of setting up a fiber Optic Digital Link.
3. Study of Losses in Optical Fiber.
4. Measurement of Numerical aperture of a optical fiber.
5. Study of Manchester Coding & Decoding of optical signal.
6. Study of Time Division Demultiplexing through fiber optic link –B .
7. Measurement of Bit Error Rate of an optical signal through fiber optic link -B.
8. Study of Eye Pattern of fiber through fiber optic ling –B.
9. Forming PC to PC Communication Link using Optical Fiber & RS-232Interface.

ExpEYES-17 Kit:

11. To Study and Analyze the Half wave Rectifier (HWR) using ExpEYES-17 Kit.
12. To Study and Analyze the Full wave Rectifier (FWR) using ExpEYES-17 Kit.
13. To Study and Analyze the Clipper circuit using ExpEYES-17 Kit.
14. To Study and Analyze the Clamper circuit using ExpEYES-17 Kit.
15. To Study and Analyze the Op-Amp as Inverting Amplifier using ExpEYES-17 Kit.
16. To Study and Analyze the Op-Amp as Non-inverting Amplifier using ExpEYES-17 I(it.

8051 Programming: -

Any 10 Basic programming in 8051 Microcontroller

General Programming Practical of 8051

1. Write a program to find the addition of two 8- Bit Numbers.
2. Write a Program to subtract Two 8 – Bit Numbers.
3. Write a Program to find Multiplication of Two 8- Bit Numbers.
4. Write a Program to find Division of Two 8- Bit Numbers.
5. Write a Program to find the Factorial of a given numbers.

6. Write a Program to transfer the Data block in Forward order.

7. Write a Program to transfer Data Block in Reverse order.

8. Write a Program to find Addition of Series of numbers.

9. Write a program for searching no. of (05H) in a given Memory Location.

10. Write a Program to find out no. of Even & Odd no. in a given Data Series.

11. Write a Program to count Zero, Positive, Negative no. in a given Data Series.

12. Write a program to count the numbers which are divisible by 3 in a given

Data Series

13. Write a Program to find the largest number in a given Data Series.

14. Write a Program to find the smallest number in a given Data Series.

15. Write a Program to arrange the Data in ascending order.

16. Write a Program to arrange the Data in descending order.

17. Write a program to convert Binary Number to BCD Number.

18. Write a program to convert Binary Number to ASCII Number

Interfacing Practical of 8051

1. To Study & Analyze the Interfacing of 16×2 LCD.

2. To Study & Analyze the Interfacing of 5×7 LED Matrix.

3. To Study & Analyze the Interfacing of Seven Segment Display.

4. To Study & Analyze the Interfacing of ADC & DAC Module.

5. To Study & Analyze the Interfacing of DC Motor.

6. To Study & Analyze the Interfacing of Stepper Motor.

7. To Study & Analyze the Interfacing of LEDs.

Any other experiment of equal standard relevant to syllabus can also be set.

ELP 406 Project & Seminar

Course Learning Objectives The course is designed to facilitate the student to acquire special/advanced knowledge, such as supplement study/support study/ solving / analyzing /exploring a real life situation / difficult problem into a project work. The candidate studies this course on his own with an advisory support by a teacher/faculty member.

Course Learning Outcomes: At the end of this course, Students will be able to

1. Survey and study of published literature on the assigned topic

2. Working out a preliminary Approach to the Problem relating to the assigned topic
3. Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility
4. Preparing a Written Report on the Study conducted for presentation to the Department Final Seminar, as oral Presentation before a departmental committee

Max. Marks: 100, Min. Marks: 20

Project

This course provides quality education to students on professional grounds. Apart from classroom lectures and Practical's, the students are also required to undertake a project in the fourth semester. This provides them with an opportunity to interact with the industry. Seminars are organized where eminent professionals from various organizations are invited.

Syllabus Contents The objective of Dissertation/Project Work is to enable the student to take up investigative study in the broad field of Electronics, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor.

Execution and documentation of a project on a specific topic with one of the following aspects

o Part of ongoing research projects in the department
o Developmental work related to industry requirements
o State of the art new technological studies
o Theoretical and experimental studies
o Development of prototypes in the finished product form
o Technical Writing and Project Documentation
o Presentation and Appreciation.

Contents:

1. Identification of research problem
2. Survey of literature
3. Formulation of hypothesis, design and methodology
4. Analysis of data and interpretation of results
5. Discussion and conclusion
6. Writing a project report

Note: Project work will involve investigative work and the student will have to do this in the time after their regular theory and practical classes. The final evaluation of the project work will be through a committee involving internal and external examiners. Guidelines provided by University for executing and evaluation of project work will be final.

Seminar

Each student shall present a seminar in the Fourth semester on a topic relevant to Electronics for about 30 minutes. The topic should not be a replica of what is contained in the syllabus. The topic shall be approved by the Seminar Evaluation Committee of the

Department. The committee shall evaluate the presentation of students. A seminar report in the prescribed form shall be submitted to the department after the approval from the committee.

The topics of current relevance covering following aspects should be chosen

- o Collection of reference material
- o Assimilation of concepts and preparing document
- o Communication skills
- o Presentation styles and use of projection aids
- o Appraisal and evaluation of delivered seminars

M. Tech in Optoelectronics and Laser Technology

SCHEME OF EXAMINATION, COURSE STRUCTURE
& SYLLABUS

M.Tech. in Optoelectronics & Laser Technology

Choice based Credit System (CBCS)

with

Learning Outcomes based Curriculum Framework (LOCF)

FACULTY OF SCIENCE

Approved by Joint Board of Studies in Electronics & Physics

EFFECTIVE FROM ACADEMIC SESSION

JULY – 2020

Joint Program of
School of Studies in
Electronics and Photonics
&
School of Studies in
Physics and Astro-Physics

Pt. Ravishankar Shukla University
Raipur (C.G.) 492010
WEBSITE: www. prsu.ac.in

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

School of Studies in Electronics and Photonics &
School of Studies in Physics and Astro-Physics

SCHEME & SYLLABUS

M. Tech in Optoelectronics and Laser Technology
(UGC & AICTE Approved)

SESSION – 2020-2021

Programme Objectives: The Master of Technology (M.Tech.) program in Optoelectronics and Laser Technology is designed to prepare students for technically demanding careers in industry as well as for post-master's graduate studies in photonics or related fields. The program is designed to equip motivated students who are willing to contribute to R&D activity towards the advancement of Optoelectronics technology. They shall (i) Engage in professional practice to promote the development of innovative systems and optimized solutions for Optoelectronics technologies in real life applications, (ii) Adapt to different roles and responsibilities in multidisciplinary working environment by respecting professionalism and ethical practices within an institution/organization at national and international levels, (iii) Enhancing skills and adopt existing and emerging technologies for innovations, professional excellence and research activity.

It requires students to build depth in a photonics specialization selected from areas such as lasers and applications, photonics materials and devices, and fiber optics and optical communications. It has a practicum requirement that is satisfied by doing a Minor Project and Industrial training and taking two project-intensive courses Dissertation Phase –I and Phase-II.

The main goal of the master degree program is to prepare professionals with a high level of expertise in cutting-edge photonics technologies and being able to innovate using them, with a practical vision, providing sustainable solutions in different environments, having the proper tools to get involved in an industry demanding experts on those technologies, for creating starts-up or researching in that field.

Optoelectronics & Laser Technology is a highly interdisciplinary Masters programme concerned with fundamental physics of light and optical components as well as a wide range of applications which are essential to our high-tech society, for example our ability to communicate using IT technology.

The field of photonics covers all technical applications of light over the entire spectrum from ultraviolet through visible to near, mid, and far infrared light—and from lasers in CD players through the development of new, energy-saving light sources to integrated light wave circuits and optical fibers. Moreover, photonics plays an increasing role in biology and

medicine, for instance in connection with food control or medical therapy, measurement methods for efficiency improvement of wind farms, and technologies capable of measuring the efficiency of combustion processes or carbon dioxide levels in the atmosphere.

This master program aims at giving an extensive two-year teaching program from fundamentals to advanced research topics in Photonics and its interdisciplinary applications. Master students benefiting from this program will be able to work on today's new challenges in their academic or applied research carriers: understanding and control matter and optical phenomena at the ultimate nanometric scale, providing new imaging tools for the most complex biological processes from cells and tissues to clinical applications, bringing original tools in line with future optical devices.
It is worth-mentioning that in our country the number of postgraduate programmes on modern optics is a few, and in Chhattisgarh state, none of institutes and universities has M.Tech programme in Optoelectronics and Laser Technology. It is one of the programme in the country where Organic Electronics course was introduced after IIT, Kanpur This M.Tech. program is approved and supported by University Grants commission, New Delhi under its innovative Programme for Teaching and Research in Interdisciplinary and Emerging Areas and All India Council for Technical Education.

The interdisciplinary M. Tech Programme in Opto-Electronics and Laser Technology at PRSU, Raipur is offered jointly by S.O.S. in Electronics & Photonics and S.o.S. in Physics & Astro Physics, which has been running since 2008.. The main objective of the Programme is to generate trained professionals in the broad area of Opto-Electronics, Optical Communication and laser Technology with a strong background of engineering and science. Students who graduated in earlier batches are immensely contributing to growth of various industries and R&D organizations involved in the area of telecommunication, optical communication & networks, semiconductor technology, fiber integrated optics, Opto-Electronics, software etc.

Pt. Ravishankar Shukla University is one of the few Universities/ Institutions in India that have facilities for R & D activities and man Power training in Photonics and related areas. The department have collaboration with premier R & D institutes of national importance and students have an opportunity for one year project at BARC, Mumbai, RRCAT- Indore, CSIO-Chandigarh, CEERI –Pilani, IIT Mumbai, ISRO, RRI -Bangalore, PRL- Ahmadabad, IICT Hyderabad, , Raman Research Institute, Bangalore NPL New Delhi and other research centers of National & International reputation. They are getting placement in multinational companies, Industries, Academics and other private and Govt. Organizations.

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M. Tech in Optoelectronics and Laser Technology

1. Course Aim : The aim of the course is to train postgraduates with advanced knowledge and understanding of optoelectronics with higher order critical, analytical, problem solving and research skills; ability to think rigorously and independently, to meet higher level expectations of academia and research with sufficient transferrable skills.

2. Course Objectives : The course objectives of M.Tech. in Optoelectronics & laser Technology are to:

1. Impart higher level knowledge and understanding of optoelectronics & laser technology
2. Apply the principles of optoelectronics for newer applications
3. Enable students to analyse mathematical models of physical systems for enhancement of system performance and arrive at limitations of physical systems
4. Enhance students' ability to develop mathematical models of defined physical systems
5. Prepare students to evaluate the soundness of concepts proposed
6. Hone students' skills to pursue physics as a teaching and research career
7. Train students in team work and in lifelong learning for continuous professional development

	COURSE DESCRIPTION	
	Course Objectives:	▪ understanding basic laws and phenomena in the area of Optoelectronics and Lasers ▪ theoretical and practical preparation of students to acquire and apply knowledge and skills in Optoelectronics and Lasers ▪ Conducting experiments in laboratory and industrial environment.
	Learning outcomes: On successful completion of this course, student should be able to	1. explain fundamental physical and technical base of Optoelectronic systems, 2. describe basic laws and phenomena that define behaviour of optoelectronic systems, 3. analyse various premises, approaches procedures and results related to optoelectronic systems, 4. use optical fibre equipment, and data transfer using optical fiber. 5. conduct experiments and measurements in laboratory and on real components, devices and equipment of optoelectronic systems, 6. interpret the acquired data and measured

		results, 7. describe development and application of optoelectronic systems 8. take part in team work and be able to independently present various professional materials. 9. Understand fundamental properties of light and operation principles of basic optical components. 10. Demonstrate a mastery of basic mechanisms of light generation (including lasers) through detailed understanding and analysis of operation principles, characteristics, design architectures and trade-offs of semiconductor lasers. 11. Understand and compare operation principles, characteristics, design architectures and trade-offs of optical detectors and modulators of light. 12. Understand basic system design of fiber optic communication link and fundamental theory of fiber optics. 13. Hands-on testing, measurement and development of optical systems in a range of areas spanning the course

3. Program outcomes for M.Tech program suggested by NBA

PO1. Engineering knowledge: Apply the knowledge of mathematics, science,engineering fundamentals, and an engineering specialization to thesolution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, research literature, and analyzecomplex Engineering problems reaching substantiated conclusions usingfirst principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-basedknowledge and Research methods including design of experiments,analysis and interpretation of data, and Synthesis of the information toprovide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques,resources, and

Modern engineering and IT tools including prediction andmodeling to complex engineering activities with an understanding of thelimitations.

PO6. The engineer and society: Apply reasoning informed by the contextualknowledge to Assess societal, health, safety, legal and cultural issues andthe consequent responsibilities relevant to the professional engineeringpractice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics andresponsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as amember or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineeringactivities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledgeunderstanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manageprojects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation andability to engage in independent and life-long learning in the broadestcontext of technological change.

4. Intended Learning Outcomes of the Course

The intended learning outcomes are listed under four headings:

1. Knowledge and Understanding,
2. Cognitive Skills
3. Practical Skills and
4. Capability/ Transferable Skills.

1 **Knowledge and Understanding** After undergoing this course, a student will be able to:

KU1: Describe the functioning of lasers and optoelectronic devices
KU2: Explain working of a fiber optic communication system
KU3: Acquire a knowledge of optical networks
KU4: Select appropriate tools of nano-optics for desired applications

2 **Cognitive Skills** After undergoing this course, a student will be able to:

CS1: Explore new materials for optoelectronic applications
CS2: Design and simulate fiber optic communication systems
CS3: Design and characterize optical networks
CS4: Apply the techniques for optical engineering to fabricate novel devices

3 **Practical Skills** After undergoing this course, a student will be able to:
PS1: Perform measurements related to lasers and fiber optic communication system
PS2: Conduct experiments with a variety of scientific equipment with minimum guidance
PS3: Design PC based instrumentation
PS4: Use Scilab/MATLAB /MOEMS Software
4 **Capability /Transferable Skills** After undergoing the course, a student will be able to
TS1: Communicate and present ideas clearly and concisely
TS2: Perform under constraints to meet the desired objectives
TS3: Build, work and lead teams effectively
TS4: Adopt a reflective approach to personal development and embrace the philosophy of continual professional development

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

SYLLABUS

M. Tech. in Optoelectronics and Laser Technology

SEMESTER – I

JULY – DECEMBER, 2020

Course Code	Subject	Core/Elective	Marks			Credits
			Theory	Internal	Total	
OE-11	Modern Optics	C	80	20	100	4
OE-12	Laser Technology	C	80	20	100	4
OE-13	Optoelectronics	C	80	20	100	4
OE-14	Optical Communication	C	80	20	100	4
OE-15	Seminar	C	-	-	50	1
OE-16	Comprehensive Viva voce	C	-	-	Grade	
OE-17	Photonics Lab-I	C	External	Internal	150	3
			120	30		
OE-18	Quantum Optics	E	80	20	100	3
Total for Semester-I					700	23

M. Tech in Optoelectronics and Laser Technology

SEMESTER – II

JANUARY - JUNE, 2021

Course Code	Subject	Core/ Elective	Marks			Credits
			Theory	Internal	Total	
OE-21	Physics of Advanced Materials	C	80	20	100	4
OE-22	Fiber Optics & Laser Instrumentation and Solar Photovoltaic Technologies	C	80	20	100	4
OE-23	Optical Networks	C	80	20	100	4
OE-24	Advance Optical Communication	C	80	20	100	4
OE-25	Seminar		-	-	50	1
OE-26	Comprehensive Viva Voce		-	-	Grade	
OE-27	Photonics Lab-II	C	External	Internal	150	3
			120	30		
OE 28	Theory-V	E	80	20	100	3
Total for Semester-II					**700**	**23**

Semester III
JULY – DECEMBER, 2021

Course Code	Subject	Core/Elective	Marks	Credits
OE-32	**Major Project Phase -I**	**C**	**400**	**18**

Semester IV

JANUARY - JUNE, 2022

Course Code	Subject	Marks	Credits
OE-41	**Major Project Phase -II**	400	18
OE-42	Comprehensive Viva- Voce	GRADE	
TOTAL CREDITS ALL SEMESTERS		**2200**	**82**

M. Tech in Optoelectronics and Laser Technology

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)
SYLLABUS

SEMESTER – I
July-Dec. 2020

Course Code: OE-11
Course Title: MODERN OPTICS
Credits: 4

OE-11-MODERN OPTICS

Course Objectives :

1. To learn the basic phenomena in Optics.
2. To help the student to develop a thorough understanding of the underlying physical principles of various modern optical phenomena and their applications.

OBJECTIVE:

Course Outcomes :

On successful completion of this course, students should be able to:

1. explain the propagation of light in conducting and non-conducting media (understand level)
2. understand reflection/transmission behaviour of light interacting with a dielectric interface (under (understand level)
3. analyze the polarization state of a beam of light (analyze level)
4. use the principles of wave motion and superposition to explain the physics of polarization, dispersion, interference and diffraction. (apply level)
5. describe the operation of optical devices, including, polarisers, retarders, modulators, inteferometers, difraction gratings. (understand level)
6. have an understanding of light coherence, the coherent properties of light from various sources, and the measurement of degrees of coherence (understand level)
7. use Fourier transform theory to predict and interpret imaging under various Fourier transform filtering conditions.(apply level)

Unit I

Classification of optical processes, optical coefficients, complex refractive index and dielectric constant.

Optical materials : Crystalline insulators and semiconductor, glasses, metal, molecular materials, doped glass and insulator characteristics, Optical Physics in the Solid state, crystal

symmetry, electronics bands, vibronic band, the density of state, delocalized states and collective excitation

Light propagation: Propagation of light in dense optical medium, Atomic oscillator, vibration oscillator, free electron oscillation, the Kramers – Kronig relationship, Dispersion, Optical anisotropy, birefringence. Matrix representation of polarization, Jones vector, Jones matrices, Jones calculus, orthogonal polarization. Reflection and refraction at a plane boundary, fresnel's equations.

Unit II

Excitons : Basic concept, free excitons in external electric and magnetic fields, Free Excitons at light densities, Frenkel excitons.

Luminescence: Light emission in solids, Interband luminescence, Direct and indirect gap materials, photoluminescence : Excitation and relaxation, degeneracy Photoluminescence spectroscopy.

Electroluminescence: General Principles of electroluminescence, light emitting diodes, diode laser.

Unit III

Electromagnetism in dielectrics, Electromagnetism fields and Maxwell equation.

Electromagnetism waves, Quantum theory of radiative absorption and emission. Einstein coefficients, Quantum transition rates, selection rules. Basic concept of phonons, Polaritons and polarons.

Laser Plasma Interaction: Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.

Unit IV

Nonlinear optics : Non linear optics : Physical origin of optical nonlinearities, Non resonant and resonant nonlinearities, second order nonlinearities, Non liner frequency mixing, Crystal symmetry, Phase matching, Third order non linear media. Harmonic generation, mixing and parametric effects. multiphonon processes Two-photon absorption, saturated absorption, Spectroscopy Rayleigh, and Raman scattering. Stimulated Raman effect, Hyper Raman effect, Coherent Antistoke Raman scattering Self-focusing and self-phase modulation. Self-induced transparency. Solitons.

Unit V

Optical Design, Fourier Optics & Holography : Revision of geometrical optics. Fourier transforms. impulse response transfer function. Scalar diffraction, spatial and temporal

coherence.

Holography: Image forming systems, The wavefront reconstruction process: Inline hologram, the off axis hologram, Fourier hologram, the lens less Fourier hologram. The reconstructed image: Image of a point, image magnification, orthoscopic and pseudoscopic images, effect of source size and spectral bandwidth. Thin hologram, volume hologram, volume transmission hologram and volume refraction holograms. Materials for recording holograms, holograms for displays, colour holography, holographic optical elements. Holographic interferometry: Real time holographic interferometry, double exposure holographic interferometry image hologram, Image forming systems, coherent and incoherent imaging. Spatial filtering. Holography (Fresnel, Fraunhofer, Fourier). Holographic techniques and applications. Fourier transforming property of thin lens.

REFERENCE BOOKS

1. Optical Electronics, A. Yariv Saunders
2. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.K. 3.Essentials of Optoelectronics, A. Rogers (Chapman Hall) 4.Optical Properties of Solids Mark Fox
3. Jasprit Singh, Semi conductor Optoelectronics, McGraw Hill, 1995
4. P. Hariharan, Optical holography, (Cambridge University Press, 1984)

Course Code: OE-12
Course Title: LASER TECHNOLOGY
Credits: 4

OE-12 -LASER TECHNOLOGY

Course Ojectives:

1. To study the principle, construction and working of different lasers.
2. To provide a deeper knowledge about the theory, working and applications of lasers.

Course Outcomes :

On successful completion of the course, the student will be able to:

1. describe Einstein's treatment of absorption and emission of radiation (understand level)
2. describe the conditions required for laser action(understand level)
3. describe laser media with rate equations and solve them(evaluate level)
4. predict the stability of laser cavity (apply level)
5. identify the behavior and functionality of different lasers(analyze level)
6. identify a laser for a particular application(analyze level)
7. review the safety requirements of lasers(understand level)

Unit I

Einstein Coefficients and Light Amplification

Introduction: The Einstein's coefficients, Quantum Theory for the Evaluation of the Transition Rates and Einstein Coefficients, Interaction with radiation having a broad spectrum, Introduction of a near monochromatic wave with an atom having a broad frequency response, More accurate solution for the two level system, Line broadening mechanisms, Saturation Behavior of homogeneously and homogeneously broadening transitions.

Unit II

Laser Rate Equations : Introduction, The three Level System, The Four level System, Variation of Laser Power around Threshold, Optimum Output coupling. Laser spiking.

Semi classical Theory of Laser: Introduction, Cavity Modes, Polarization of cavity medium : First order & Higher order theory.

Unit III

Optical Resonators: Introduction, modes of a rectangular cavity and the open planar resonator, The Quality factor, the ultimate line width of the laser, Transverse and longitudinal mode selection switching. Mode locking in Lasers Co focal Resonator system, Planar resonators,

General Spherical Resonator.

Optical Pumping: Laser pumping requirement and techniques, Optical Pumping and Electrical discharge pumping. Introduction of Flash Lamp, Optically and diode pumped solid state lasers.

Unit IV

Properties of Laser Beams and laser Structures

Coherence properties of Laser Light : Temporal Coherence, Spatial Coherence, Directionality

Semiconductor: Interaction of photons with electrons and holes in semiconductors. Optical joint density of states, Structure and properties, operating principle, Threshold condition, Power output.

Heterojunction Laser: Principle and structure, Losses in heterostructure laser, Heterostructure laser materials.

Distributed feedback lasers: Principle of working, Coupled mode theory.

Quantum well laser, Gain in quantum well lasers, Multiquantum well lasers, Strained quantum well laser, Vertical cavity surface emitting lasers.

Free Electron Lasers: Basic Concepts.

Unit V

Types and Some important applications of laser:

Properties of solid state laser materials, Ruby, Nd:YAG lasers, Er:lasers, Ti: Saphire laser, Excimer lasers. Gas dynamic CO_2 lasers, High Power Laser. Laser induced fusion: Introduction, The fusion process, laser energy requirements. The laser induced Fusion Reactors.

Lasers in Science: Harmonic Generation, Stimulated Raman Emission, Self-focusing, Lasers in Chemistry, Rotation of the Earth, Lasers in isotope Separation. Laser in light detection and ranging (LIDAR)

TEXT BOOKS

1. Lasers Theory and Applications : K. Thyagrajan and A.K. Ghatak, Macmillan Publication
2. Laser Fundmentals - Willaim T Selfvast, Cambridge Univ-Press, 2nd edn (2008). (Text)
3. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
4. Laser Physics, P W Milonni and J H Eberly, John Wiley and Sons, 2010
5. Lasers - Anthony E Siegman, University Science Books, USA, 1986
6. Essentials of Optoelectronic, A Rogers (Chapman Hall), 0-412-40890-2

REFERENCE BOOKS

1. Fowles G.R., Introduction to Modem Optics, 2nd Edition, Holt, Rienhart and Winston
2. Lasers and nonlinear optics, BB Laud, Wiley Eastern, 3rd edition (2004)
3. Optical Electronics – A Yariv (4th Ed. Saunders College Pub. (1991).

4. Principles of lasers - Svelto and DC Hanna, 4th edn, Plenum Press (1998)
5. Solid State Laser Engineering - Koechonar (Springer Verlag. 1991
6. Lasers, principles, types and applications-K R Nambiar, New Age International, Delhi (2004)
7. Free Electron Lasers by T.C. Marshall

Course Code: OE-13
Course Title: OPTOELECTRONICS
Credits: 4

OE-13- OPTOELECTRONICS

COURSE OBJECTIVE::

1. To give a deeper understanding of the fundamental theories, fabrication, integration, characterization and applications of novel optoelectronic devices.
2. To introduce the theory, working and applications of various optoelectronic devices.

Course Outcomes :On successful completion of the course the students will be able to
1.recall the properties of Photons and Electrons and recognise their applications in optoelectronic devices. (Remember level)
2.classify LED and laser diode structures and their applications (Understand level)
3.differentiate the types of optical modulators and their applications (Analyze level)
4.categorise different luminescence mechanisms involved in the modern display devices (Analyze level)
5.compare the modes of operations and characteristics of different optoelectronic detectors. (Evaluate level)

Unit I

Optical process in Semiconductors

Electron hole pair formation and recombination, absorption in semiconductor, effect of electric field on Absorption, Franz-keldysh and stark effects, Absorption in Quantum wells and Quantum confined stark effect, relation between Absorption and emission spectra, Stokes shift in optical transition, Deep level transitions, Measurement of absorption and luminescence Spectra, Time resolved Photoluminescence.

Unit II

Materials Growth & Fabrication Growth of optoelectronics materials by MBE, MOCVD, Plasma CVD, photochemical deposition. Epitaxy, interfaces and junctions (advantages/disadvantages of growth methods on interface quality, interdiffusion and doping. Quantum wells and band gap engineering

Equipments for Thin Film Deposition: Working principle of Vacuum Coating Unit , Spin Coating Unit, Dip coating unit, Basics of Ellipsometer and Spray pyrolysis apparatus and their specifications and features.

Unit III

Organic Electronics

Molecular materials, Electronic state in conjugated molecules, Optical spectra of molecules,

Electronic vibration transitions, the Franck Condon principle hydrocarbons, conjugated polymer, Conductivity and Mobility of nearly-fee Charge Carriers, Charge Carriers in Organic Semiconductors: Polarons, Shallow Traps and Deep Traps, Generation of Charge Carriers and Charge Transport: Experimental Methods. The TOF Method: Gaussian Transport. Space-Charge Limited Currents. Band or Hopping Conductivity, Electric-field Dependence, Charge Transport in Disordered Organic Semiconductors. The Bassler Model

Unit IV

Organic Optoelectronic Devices:

Organic Light-Emitting Diodes (OLEDs). The Principle of the OLED, Multilayer OLEDs. Structure, Fundamental processes Efficiency, Characterization of OLEDs

Organic photovoltaic diodes (OPVDs): Fundamental process, Exciton absorption, Exciton dissociation, Charge collection characterization of OPVDs, Relevant performance parameters.

Unit V

Introduction to Semiconductor Device Simulation: Need of Simulation, Process Simulation, Device Simulation device simulation sequence, hierarchy of transport models, DD Model, Relationship between various transport regimes and significant length-scales.

Numerical Solution Methods - finite difference scheme, discretization of Poisson's and current continuity equations.

TEXT BOOKS

1. Organic Molecular Solids Markus Schwoerer (Author), Hans Christoph Wolf, Wiley-VCH; 1 edition (March 27, 2007)
2. Semiconductor Devices Modeling and Technology" by Nandita Das Gupta and Amitava Das Gupta, Prentice Hall of India Pvt.Ltd.
3. Fibre Optics and Opto-electronics, R P Khare (Oxford University Press, 2004)
4. Computational Electronics :Dragica Vasileska and Stephen M. Goodnick, CRC Press
5. Semiconductor Optoelectronics Devices: Pallabh Bhattacharya. Pearson Education
6. Optical Electronics, A. Yariv Saunders.
7. Optical Electronics, Ghatak & Thyagarajan, Cambridge U.P. 0-521-31408-9
8. Essentials of Electronic & Optoelectronics properties of semiconductor, Jasprit Singh, Cambridge University Press

REFERENCE BOOKS

1. Organic Electronics: Materials, Manufacturing, and Applications Hagen Klauk Wiley-VCH; 1 edition
2. Hand book of thin film technology, by L. I. Maissel and R. Glang
3. Thin film phenomena, By K. L. Chopra

4. Opto electronics -An introduction - J Wilson and J F B J iS Hawkers.(Prentice-Hall India, 1996)
5. Optical fibre communication - J M Senior (Prentice Hall India (1994)
6. Optical fibre communication systems - J Gowar (Prentice Hall 1995)
7. Introduction to optical electronics - J Palais (Prentice Hall, 1988)
8. Semiconductor opto electronics - J asprit Singh (McGraW-Hill, Inc, 1995)
9. Opto electronics-Thyagaraj an and Ghatak, Cambridge Uni, Press (1997)

Course Code: OE-14
Course Title: OPTICAL COMMUNICATION
Credits: 4

OE-14- OPTICAL COMMUNICATION

Course Objectives :

1. To enable the students to understand the principles and design considerations of different optical communication systems.
2. To provide basic understanding and knowledge about various types of optical fiber communication systems**.**
3. To equip students with understanding of Optical fiber communication systems, their analysis and design. Issues in advanced DWDM system, Impairments in optical system, etc.

Course Outcomes: On successful completion of this course students should be able to

1. describe the properties and advantages of optical guided communication (knowledge level)
2. identify the various components of optical fiber communication system (understand level)
3. describe the operation of optical receivers including the types of preamplifiers (understand level)
4. classify various multiplexing schemes and operation principles of wavelength division multiplexing (understand level)
5. distinguish semiconductor optical amplifier and erbium doped fiber amplifier and calculate its gain and power conversion efficiency (understand level)
6. describe various optical network topologies and its performance (understand level)
7. design and prepare optical power loss/gain budget with various line coding(application level)

Unit I

Need for fiber optic Communication, evolution of light wave systems and its components. Optical Fiber **–** their classification, essentials of electromagnetic theory – total internal reflection, Goos Hanchen shifts Dispersion in Single mode fiber, fiber losses, Non liner optical effects and polarization effect. Analysis of Optical fiber waveguides, electromagnetic mode. Theory for optical propagation attenuation and single distortion in optical waveguide. Characteristic equation of step-index fiber, modes and their cut-off frequencies, single-mode fibers, weakly guiding fibers, linearly polarized modes, power distribution. Graded-index fibers- WKB and other analysis, propagation constant, leaky modes, power profiles, dispersions – material, modal & waveguide, impulse response.

Unit II

Physics and Technology of Optical Fiber

Passive photonic components: FO cables, Splices, Connectors, Couplers, Optical filter, Isolator,

Circulator and Attenuator, switches.

Fabrication of optical fibers: MOCVD, OVD, VAD, PCVD; measurement of RI, attenuation. Etc. Fiber devices, fiber Bragg gratings, long period gratings, fiber amplifiers and lasers. Application of optical fibers in science, industry, medicine and defense.

Unit III

Optical fiber systems, modulation schemes, Digital and analog fiber communication system, system design consideration, fiber choice, wavelength conversion, switching and cross connect Semiconductor Optical amplifier (SOA), characteristics, advantages and drawback of SOA, Raman amplifier, erbium doped fiber amplifier, gain and noise in EDFA, Brillion fiber amplifier, wideband Hybrid amplifier, noise characteristic, amplifier spontaneous emission, noise amplifier, noise figure, Cumulative and effective noise figure, Noise impairments, amplifier applications.

Unit IV

Optical Transmitters and Receivers : Basic concepts, Light emitting diodes, Semiconductor laser, characteristics, Transmitter design, Optical Receivers; Basic concepts, P-n and pin photo detector. Avalanche photo detector MSM photo detector, Receiver design, Receiver noise, Receiver sensitivity, Sensitivity degradation, performance.

Electro-optic effect, electro optic retardation. Phase and amplitude modulators, transverse electro optic modulators, Acousto-optic effect, Raman-Nath and Bragg regime, acousto-optic modulators, magneto optic effects.

Unit V

Optical Multiplexing Techniques

Wavelength division multiplexing (WDM): Multiplexing Technique, Topologies and architectures, Wavelength shifting and reverse, Switching WDM demultiplexer, optical Add/drop multiplexer. Dense wavelength division multiplexing (DWDM): System consideration, Multiplexer and demultiplexers, fiber amplifier for DWDM, SONET/SDH Transmission, Modulation formats, NRZ and RZ signaling, DPSK system modeling and impairments.

REFERENCES

1 Optical Fibre Communication - G Keiser, McGraw Hill(4th Ed), 2006
2 OpticalFibre Communications - JM Senior(Prentice Hall India 1994)
3 Fibre Optic Communication - CAgarwa1(Wheeler, 1993)
4 OpticalFibre Communication Systems- J Gowar(Prentice Hall, 1995).
5. Fibre Optic Communication -J Palais (Prentice Hall International 1988).
6 Optical networks: A practical perspective Kumar N Sivarajan and Rajeev Ramaswami, MarcourtAsia, 2010

Course Code: OE-15
Course Title: SEMINAR
Credits: 1

Course Objectives: Expertise in understanding research topics in photonics and improving skills such as imparting knowledge and presentation.The seminar should be on a topic of current research. Students have to submit a detailed report and they have to make a presentation of 45 minutes-duration before the seminar committee.

Course outcomes :

1. Presentation Skills

1. In terms of content, students will be able to show competence in identifying relevant information, defining and explaining topics under discussion.
2. They will demonstrate depth of understanding, use primary and secondary sources; they will demonstrate complexity, insight, cogency, independent thought, relevance, and persuasiveness.
3. They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

2. **Discussion Skills**

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion to reach a shared understanding, speak with or without notes, show depth of understanding, demonstrate breadth of reading, use primary and secondary sources, show independence and flexibility of thought, help discussions to move forward, show intellectual leadership and effective time management.

3. Listening Skills

1. Students will demonstrate that they have paid close attention to what others say and can respond constructively.
2. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants.

4. **Argumentative Skills and Critical Thinking**

1. Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.
2. Students will be able to demonstrate use of appropriate methodologies, test the strength

of their thesis statement, show insight into a topic, appropriate signposting, and clarity of purpose.

3. They will also demonstrate problem-solving skills and apply theoretical knowledge.

5. Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Course Code: OE -16

Course Title: Comprehensive Viva voce

Credits: GRADE

Comprehensive Viva-Voce

A comprehensive viva -voce will be held immediately after the end of Semester. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are as follows.

Course Objetive: The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering acquired over 4 years of study in the undergraduate program .

Course outcomes: Viva will be conducted at the end of 1st,2nd and 4th semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their M.Tech programme. In doing so, the main objective of this course is to prepare the students to face interview both in the academic and the industrial sector.

RANGE	QUALITATIVE_ASSESSMENT/GRADE	
91% - 100%	O	Outstanding
81% - 90%	A	Very Good
71% - 80%	B	Good
61% - 70%	C	Fair
50% - 60%	D	Pass

Below 50%	F	Failure

OE-17- Photonics Lab- I

AIM: Laboratory experience.

OBJECTIVE: To empower the students with hands-on experience and to provide practical knowledge about Optoelectronic sources, detectors, devices, optical fibers and Laser.

Course Outcomes: Students will have achieved the ability to:

1. Understand the behaviour of electronic and photonics components and perform analysis and design of bias circuits for diodes, transistors etc.
2. Set up testing strategies and select proper instruments to evaluate performance characteristics of photonic circuit.
3. Choosing testing and experimental procedures on different types of photonic circuit and analyse their operation different operating conditions.
4. To apply the most commonly used simulation tools in photonics applications.
5. To use laboratory test equipment useful in photonics applications.
6. To design and develop full opto-electronic systems by using the photonics-related components and technologies studied along the master.
7. To design and develop the required test and measurements procedures to evaluate the working operation of an optoelectronic system.
8. To apply the knowledge within the photonic engineering field in a real-life environment both at component and at system level.
9. To work effectively in a multidisciplinary group in the photonic field with the ability to react to technical and operative difficulties in a technological project.

Experiments are to be performed in the Advance Photonics Laboratory of S. O.S. in Electronics & Photonics

L 1 Fiber Optics Lab:

1. Study of setting up a Optic Analog Link.
2. Study of setting up a fiber Optic Digital Link.
3. Study of Losses in Optical Fiber.
4. Measurement of Numerical aperture of a optical fiber.
5. Study of Manchester Coding & Decoding of optical Signal.
6. Study of Time Division Demultiplexing through fiber optic link – B.
7. Measurement of Bit Error Rate of an optical signal through fiber optic link – B.
8. Study of Eye Pattern of fiber through fiber optic ling – B.
9. Forming PC to PC Communication Link-using Optical Fiber & RS – 232 Interface.

L 2 – Laser Lab:

1. Study of Diode Laser characteristic.
2. Construction of laser beam expander.

3. Measurement of screw parameter.
4. Measurement of electro-optic coefficient.
5. Magneto-optic effect (Faraday Rotation)
6. High voltage sensor based on electro-optic effect.
7. Molecular Weight Measurement.
8. Holography.

The students are required to perform 5 programs using MATLAB platform

Course Code: OE-18
Course Title: Quantum Optics
Credits: 4

OE 18 Quantum Optics

Course Objectives :

1. To provide knowledge on the evolution of Quantum optics and its impact in technological applications.
2. To introduce the basic concepts and theory of Quantum Optics.

Course Outcomes

After taking this course, the student will be able to :

1. Discuss the basic theory of nonlinear optics including sum and difference frequency generation (understand level)
2. Analyze the origin of optical bistability and its implications (analyze level)
3. Examine different mathematical transforms used in optical signal processing and compute the transforms of given functions (Analyze level)
4. Construct spatial filtering geometries based on the Fourier transform property of lens (Apply level)
5. Analyze the role of various light modulators in signal processing (Analyze level)
6. Describe the basic concepts of optical computing and optical neural networks and their practical implementation (Understand level)

Unit-I

Introduction: What is quantum optics, A brief history of quantum optics

Classical optics Maxwell's equations and electromagnetic waves ,Electromagnetic fields ,Maxwell's equations ,Electromagnetic waves , Polarization , Diffraction and interference

Unit-II

Formalism of quantum mechanics , The Schr¨ odinger equation,Properties of wave functions m, Measurements and expectation values, the uncertainty principle, The Stern–Gerlach experiment ,The band theory of solids

Unit III

Radiative transitions in atoms, Einstein coefficients, Radiative transition rates , Selection rules

Photon statistics : Introduction, Photon-counting statistics, Coherent light, Classification of light by photon statistics.

Coherent states and squeezed light , Light waves as classical harmonic oscillators , Light as a quantum harmonic oscillator , Coherent states , Squeezed states , Detection of squeezed light .

Unit IV

Quantum information processing, Quantum cryptography, Classical cryptography , Basic principles of quantum cryptography Quantum key distribution according to the BB84 protocol , System errors and identity verification , Error correction , Identity verification , Practical demonstrations of quantum cryptography ,Quantum cryptography in optical fibres .

Unit V

Quantum computing

Introduction , Quantum bits (qubits) ,The concept of qubit, Quantum logic gates and circuits , Preliminary concepts Single-qubit gates , Two-qubit gates , Practical implementations of qubit operations optical realization of some quantum gates.

Reference Books:

1. Quantum Optics by M. Fox, Oxford Master series in Atomic, Optical and Laser physics
2. Introductory Quantum Optics by C.C. Gerry and P.L. Knight, Cambridge University Press
3. Quantum Optics by M.O. Scully and M.S. Zubairy, Cambridge University Press
4. Quantum Theory of Light by R. Loudon, Oxford science publication

PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR (C.G.)

SYLLABUS
M. Tech in Optoelectronics and Laser Technology

SEMESTER – 2
JANUARY – JUNE, 2021

Course Code: OE-21
Course Title: PHYSICS OF ADVANCED MATERIALS
Credits: 4

Course objectives

1. Use the fundamental science and engineering principles relevant to materials that include the relationships between nano/microstructure, characterization, properties, processing, performance and design of materials.
2. Use their knowledge of the significance of research, the value of continued learning and environmental/social issues surrounding materials.
3. Use the technical and communication skills developed in the program as a foundation for careers in engineering, research and development, the pursuit of advanced education and other professional careers.

Course outcomes

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

OE-21- PHYSICS OF ADVANCED MATERIALS

UNIT I

Nano Particles and Nano Structured Materials:

Properties of Individual Nano-Particle: metal nanoparticles, geometric and electronic structure, magnetic clusters, Semiconductor nanoparticles, optical properties, rare gas and molecular clusters, methods of synthesis of nanoparticles. Carbon nanostructure, C60 carbon nanotube and application.

Bulk nano structured materials: Solid disordered nanostructures, methods of synthesis,

properties, metal nano-cluster composite glasses, porous silicon; Nano structured crystals.

UNIT II

Quantum Nanostructures and Nano-Machines/Devices:

Quantum wells, wires and dots, preparation, size & dimensionality effects, excitons, single electron tunneling, applications of quantum nanostructure. Super conductivity. Self-assembly, process of self-assembly, semiconductor islands, monolayers. Catalysis, surface area of nanoparticles, porous, and colloidal materials.

Nanomachines and Devices: Microelectromechanical system (MEMSs), Nanoelectromechanical system (NEMSs), Photonic nano & micro circuits, nano and micro fluidics. Application of NEMS and MEMS in Rf, Microfluilds, Optics, BioScience, and Precious Manufacturing.

UNIT- III

Solid state lasers: Material requirement for solid state lasers, Activator ions and centers, Material design parameters for semiconductor laser diode, choosing alloy composition and thickness, making ohmic contracts, Other III-V heterojunction laser materials. Introduction to organic laser. Material selection for light emitting diodes.

Electrical, Optical and Thermal properties of III-V and II-VI semiconductors required for optoelectronics devices for visible and IR range.

Electroluminescent materials: Inorganic electroluminescence, AC powder EL, ACTFEL device, EL characteristics, EL excitation mechanism. Electroluminescence in Organic solids, Material useful for organic thin film EL devices, polymeric material for EL. LED Technologies for Light Emission and Displays. QLED.

UNIT IV

Characterization of Materials: Introduction to emission and absorption spectroscopy: Nature of electromagnetic radiation, electromagnetic spectrum, atomic, molecular, vibrational and X-ray energy levels Basics of UV-VIS spectroscopy: Radiation sources, wavelength selection, Cells and sampling devices, Detectors, Basic ideal of IR spectrometry: Correlation of Infrared spectra with Molecular Structure.

Fundamental of X-ray diffraction, Powder diffraction method, Quantitative determination of phases; Structure analysis. EDAX, Lithography (top down and bottom up), Contact preparation of thin films for device fabrication.

Epitaxial thin film techniques : Liquid phase epitaxy, vapour phase epitaxy, Metal Organic chemical vapour deposition, Atomic layer epitaxy.

UNIT V

Experimental Techniques: High resolution X ray diffraction, Double Crystal diffraction, Drift mobility and Hall mobility, Hall effect for Carrier density and Hall mobility, Photoluminescence (PL) and Excitation Photoluminescence (PLE) Optical pump probe experiments.

Basic idea of Microscopic Techniques: Optical microscope, Scanning Electron Microscope (SEM), Transmission Electron microscope (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Thickness measurement – Gravimetric method, Basics of Ellipsometry: Optical parameter measurements (n and k).

TEXTS BOOKS

1. Nanotechnology by Charles P. Poole Jr. and Frank J. Owens (Willey Inter. Science pub 2003).
2. Nanostructures and Nanomaterials – Synthesis properties and Applications by Guozhong Cao (Empirical College Press World Scientific Pub. 2004).
3. Physics of Semiconductor Devices by S. M. Sze(Willey Int., 1981)
4. Instrumental methods of analysis, H. H. Willard, L. L. Merritt, J A Dean, F A Sellte, CBs Publishers New Delhi 1996.

REFERENCE BOOKS

1. Scanning Electron Microscopy : OOtley
2. Handbook of Electroluminescent Materials Ed. D. R. Vij Inst of Physics, Bristol and Philadelphia
3. Electronic and Optoelectronic properties of Semiconductor, Jaspreet Singh, Cambridge University Press
4. H. Baltes, O. Brand, Enabling Technology for MEMS and Nanodevices, Wiley, New York, 2004

Course Code: OE-21
Course Title: FIBER OPTICS , LASER INSTRUMENTATION AND SOLAR PHOTOVOLTAIC TECHNOLOGIES
Credits: 4

OE-22- FIBER OPTICS LASER INSTRUMENTATION AND SOLAR PHOTOVOLTAIC TECHNOLOGIES

Course Objectives :

1. To introduce students the fundamental theories and technological aspects of power generation using solar photovoltaic technology**.**
2. To learn theory, working and applications of solar cells.

Course Outcomes: At the end of the course the student should be able to

1. explain the theory of propagation of light in an optical fiber (Understand level)
2. analyze the formation of modes in a planar optical wave guide (Analyze level)
3. examine single mode and multimode optical fibers and classify optical fibers based on their refractive index profiles (Analyze level)
4. compare the loss mechanisms in optical fibers and to compute various losses (Analyze level) 5. distinguish between different techniques to provide optical connections in fibers (Analyze level)
5. summarize the functioning of optical fiber sensors that use amplitude, phase, frequency and polarization type modulation schemes (Evaluate level)
6. analyze the different nonlinear processes associated with light-matter interaction. (Analyze level)
7. Identify lasers with appropriate wavelength for various applications (Understand level)
8. to understand the role of solar energy in the context of regional and global energy system, its economic, social and environmental connotations, and the impact of technology on a local and global context.
9. to understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses.
10. to understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations.
11. to know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it

Unit I

OPTICAL FIBER AND THEIR PROPERTIES

Principle of light propagation through a fiber – Different types of fiber and their properties –

Fiber materials and their characteristics – Transmission characteristic of fibers – absorption losses – scattering losses – Dispersion – measurement of optical fibers – optical sources – Optical detectors. Dispersion shifted Fiber Technologies.

Unit II

FIBER OPTIC SENSORS IN MEASUREMENTS

Fiber optic instrumentation system – Fiber optic sensors, Different types of modulators, Applicationin instrumentation, Interferometric method of length Measurement, Measurement of pressure, temperature, current, voltage, liquid level and strain. Magnetic and electric field sensors based on the characteristics like intensity, phase, polarization, frequency and wavelength of light wave , Plasmonic nano-sensors.

Laser Plasma Interaction: Basic concepts and two-fluid description of plasmas, electromagnetic wave propagation in plasmas.

Unit III

LASERS IN MEASUREMENTS AND TESTING

Laser for measurement of distance, velocity, acceleration, current, voltage, and atmospheric effect, Laser application in Spatial Frequency filtering. surface topology & optical component testing, beam modulation telemetry, laser Doppler velocimetry, surface velocity measurement using speckle patterns, measurements of rate and rotation using laser gyroscope.

Holography: Basic principle, methods; Holographic interferometry and applications; Holography for non–destructive testing – Holographic components. The wavefront reconstruction process: Inline hologram, the off axis hologram, Fourier hologram, the lens less Fourier hologram, image hologram.

Unit IV

Lasers in Industry – Laser material processing: Laser matter interactions, mode of coupling energy from beam to the material. CW and pulsed heating and the resulting effect. Thermal processing of materials with lasers, Application in material processing, Laser Welding, Hole Drilling, Laser cutting, Laser Tracking, heat treatment, glazing, alloying, cladding, hardening of surfaces, semiconductor annealing and trimming.

BioMedical Application of Lasers: Medical applications of lasers; laser and tissue interaction – Laser instrument of surgery. Laser light scattering, application in biomedicine. Light transport in tissue.

Photochemical, photothermal, photomechanical effects and their therapeutic applications. Optical imaging and diagnosis. Biomedical Instruments.

Unit V

Solar Photovoltaic Technologies

Generation of Photo voltage, Light Generated current,, I-V equation, Solar Cell Characteristics, parameters of solar cells, Relation of Voc and Eg

Design of solar cells: Upper limit of cell parameters, Losses in Solar Cell, Design for High Isc, Voc and FF Analytical Techniques: Solar Simulator-IV measurement, Quantum efficiency measurement, Minority carrier lifetime & diffusion length measurement.

TEXT BOOKs

1. Optical fiber communication-G Keiser ,McGraw Hill Education; Fifth edition (2017)
2. Introduction to fiber optics , Ajoy Ghatak and K. Thyagarajan, Cambridge Univ Press (2017)
3. Optical Fiber Communications: Principles and Practice, John M Senior, Pearson Education India, 3rd edition (2010)
4. Fundamentals Of Fibre Optics In Telecommunication And Sensor Systems, B P Pal, new age publishers (1992)
5. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, 2nd Edition Prentice Hall of India, 2011.
6. Understanding fiber optics, J Hecht, Laser Light Press, 5 edition (2016)
7. John F Ready, Industrial application of lasers. Academic press 1978
8. John Crisp, Introduction to Fibre Optics , an imprint of Elsevier Science 1996
9. Understanding Fiber Optics, 4th or 5th edition; Jeff Hech; Prentice Hall Publishers
10. Optical Fiber Communication Principles and Systems, A. Selvarajan, S. Kar and T. Srinivas TMH

REFERENCE BOOK

1. Fiber Optic Communication System, G. P. Agarwal, Willey Eastern
2. Laser Material processing by W.M. Steen
3. Industrial Laser and their applications, John and Harry, McGraw Hill
4. M.L. Wolbarshi, Ed. Laser Applications in Medicine & Biology, Vol.1, 2 & 3 (Plenum, New York, 1971,74,77)
5. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice- Hall Inc, Englewood Cliffs, NJ, USA

JANUARY – JUNE, 2021

Course Code: OE-23
Course Title: OPTICAL NETWORKS
Credits: 4

OE-23- OPTICAL NETWORKS

Course Objectives:

The main objectives of the course are to:

1. Familiarize students with the optical network evolution, from the point-to-point link to the intelligent transport
2. Introduce the main elements and components of the all-optical networking solution
3. Explore the capabilities and limitations of the optical network
4. Expose students to recent research articles on various optical networking issues

Course Outcomes

After completion of the course students are expected to be able to:

1. Identify the three generations of optical networking evolution
2. Name the all-important technological issues that affect how optical networks are implemented Comprehend the potentialities and limitations of optical networks
3. Underline how these networks fit in the more classical communication networks based on electronic time division
4. Compare the performance of optical networks via computer discrete-event simulation
5. Review current optical networking trends like optical packet, burst or label switching from research articles

Unit I

WDM Technology and Issue in WDM Optical networks: Introduction – Optical networks – WDM – WDM optical network evolution- Enabling Technology for WDM optical networks – WDM optical network architecture – Issue in Wavelength routed networks – Next generation optical Internet networks, The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Unit II

Wavelength Routing Algorithms : Introduction – Classification of RWA algorithms – Fairness and Admission control – Distributed control protocols – Permutation routing and Wavelength requirements Wavelength Rerouting algorithms : Introduction – benefits of wavelength routing – Issue in Wavelength routing – Light path Migration – Rerouting schemes – Algorithm AG – Algorithm MWPG – Rerouting in WDM networks with Sparse Wavelength conversion – Rerouting in Multifiber networks – Rerouting in Multifiber Unidirectional ring Networks .

Unit III

Wavelength Convertible networks : Introduction - need for Wavelength converters – Wavelength convertible switch architecture – routing in convertible networks – Performance evaluation of convertible networks – Networks with Sparse Wavelength conversion – Converter placement problem – Converter allocation problem.

Unit IV

Virtual topology Design: Introduction – Virtual Topology design problem – Virtual topology sub problems – Virtual topology design Heuristics – Regular virtual topology design – predetermined virtual topology and lightpath routes – Design of multi fiber networks.

Virtual Topology Reconfiguration: Introduction – Need for virtual topology reconfiguration – Reconfiguration due to Traffic changes – reconfiguration for fault restoration.

Unit V

Network Survivability and provisioning: Failures and Recovery – Restoration schemes – Multiplexing techniques – Distributed control protocols. Optical Multicast routing – Next generation optical internet network.

JANUARY – JUNE, 2021

TEXT BOOKS

1. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks : Concepts, Design and Algorithms ", Prentice Hall India 2002.

2. Rajiv Ramasami and Kumar N. Sivarajan, " Optical networks : A Practical Perspective", A Harcourt publishers international company 2000.

Course Code: OE-24
Course Title: ADVANCED OPTICAL COMMUNICATION
Credits: 4

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion, SM fibers.
- To learn the various optical sources, materials and fiber splicing
- To learn the fiber optical receivers and noise performance in photo detector.
- To learn link budget, WDM, solitons and SONET/SDH network.

Course Outcomes:

CO1: Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.

CO2: Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers CO3: Describe the principles of optical sources and power launching-coupling methods.

CO4: Compare the characteristics of fiber optic receivers

CO5: Design a fiber optic link based on budgets

CO6: To assess the different techniques to improve the capacity of the system

OE-24-ADVANCED OPTICAL COMMUNICATION

Unit I

Introduction to optical components – optical amplifiers – types – issue in optical amplifiers – photonic switching – Cross connect – Wavelength conversion – Multiplexer – Demultiplexer, Filters– tunable filters, Photonic Crystal Fibers : Introduction, Guiding mechanism, modified total internal reflection and photonic bandgap guidance, properties and applications, introduction to OICs and its applications.

Unit II:

First Generation Optical Networks

SONET/SDH – multiplexing , element of a SONET/SDH infrastructure - SONET/SDH physical layer, Computer interconnects – ESCON, Fiber channel, HIPPI , Metropolitan area networks – FDDI, ATM, Layered Architecture - SONET/SDH layers – Second generation optical network layers.

Unit III

DWDM: Networks, Devices, and Technology :Fundamentals of DWDM Technology, Architecture and components, Working of DWDM, Topologies and Protection Schemes for DWDM, IP over DWDM Networks, Ethernet switching over DWDM, OTN (Optical Transport Networking), Capacity expansion and Flexibility in DWDM, Future of DWDM, Survivability in DWDM Networks.

Unit IV

OTDM Technology

Important issues of OTDM – optical solitons. Optical pulse compression – fiber grating compressor soliton effect compressor. Modulation instability, fundamental and higher-order

solitons, soliton lasers, soliton-based communication systems, fiber loss, frequency chirp, soliton interaction, design aspects, higher-order nonlinear effects. Broadcast OTDM networks, bit interleaving and packet interleaving, optical AND gates, nonlinear optical loop mirrors, terahertz optical asymmetric demultiplexer, switch based networks. Applications of solitons.

Unit -V

FTH and PON Technology

Proposed architecture and issues of Fiber to the home (FTH) – Passive Optical Network (PON), Near space communication – open air optical communication. Inter satellite link hops (ISL). Introduction to all optical networks (AON), Military, Civil, consumer and industrial applications.

TEXT BOOKS :

1. Rajiv Ramaswami and Kumar N. Sivrajan, " Optical networks – A practical perspective", A Harcourt Publishers International Company 2000
2. R. G. Junsperger, " Integrated Optics – Theory and Technology, Springer Series in Optical Sciences", 3rd Edition 1991
3. Gerd Keiser, " Optical Fiber Communications" ,McGraw Hill International Edition 191
4. G. P. Aggarwal," Non Linear Optics", Academic Press.
5. Stamations V. Kartalopoulos, "Understanding SONET/ SDH and ATM Communication network for Next Millennium", PHI 2000.
6. C. Sivaram and mohan Gurusamy, " WDM Optical Networks : Concepts, Design and Algorithms" PHI India 2002.

REFERENCE BOOKS:

1. DWDM: Networks, Devices, and Technology 1st Edition, by "Stamatios, V. Kartalopoulos"
2. Broadband Networking ATM, Adh and SONET, " Mike Sexton, Andy Reid"
3. F. Poli, A. Cucinotta and S. Selleri : Photonic crystal fiber properties and application, Springer, 2007

OE-27- PHOTONICS LAB –II

The Photonics Laboratory is a mandatory course for students aiming to use the experimental facilities of the photonics group. It provides students a hands - on experience with sophisticated instruments under the mentorship of senior students. The experiments are designed carefully to motivate the students towards design, analysis and interpretation. This lab enables scholars to deal with difficulties encountered and precautions to be taken while performing experiments and hence serves as a preparatory course for their research.

Course Outcomes

1. Acquire a theoretical knowledge base in photonics related areas of physics (Optics, Electrodynamics, Physics of Semiconductors, Quantum Mechanics)
2. Develop understanding of application of fundamental laws of physics in such engineering areas as telecommunications, optoelectronics, nano and microfabrication, growth techniques
3. Learn fundamentals of computerized modeling of diverse optical and photonics systems and gain working experience with standard computational tools used in industry.
4. Acquire essential laboratory skills in designing experiments, assembling standard optical tools for optical experimentation, carrying out measurements with customary optical instruments and analyzing acquired data
5. Become familiar with economics and management of photonics related engineering projects
6. Learn to communicate scientific and engineering ideas both orally and in written form
7. Acquire experience working in industrial or research lab settings as a part of a team

Experiments are to be performed in the Advance Photonics Laboratory of S.O.S. in Electronics & Photonics

EXPERIMENTS

1. To calculate the wavelength of Laser using Michelson interferometer.
2. To determine the size of tiny particles using Laser.
3. To determine the grating pitch of transmission grating.
4. To determine the wavelength of a Laser using meter scale ruling.
5. To find the refractive index of glass (transparent materials) by measuring Brewster angle.
6. To determine the bending losses that occurs in a multimode fiber when it is bent along various radii.
7. To determine the absorption coefficient of transparent materials (glass slide).
8. To study the variation of splice losses due to transverse offset, angular tilt and longitudinal separation.
9. To observe the refraction of light in liquid and to calculate its refractive index.
10. To study the wavelength dependence of attenuation in the given optical fiber.
11. To determine insertion loss of each channel of WDM mux, loss uniformity and optical cross talk in channels.
12. To setup optical Add/Drop multiplexer (OADM) using fiber Bragg grating .
13. To setup the WDM link with the given components and determine the total loss for each wavelength.
14. To find the refractive index of transparent Bar using diode Laser.
15. To observe the absorption of Laser light when various colors are introduced in its path.
16. Preparation of thin films with the help of Dip Coating Unit and resistance/ impedance measurement using Source measuring unit.
17. Preparation of thin films with the help of Spray pyrolysis method and resistance/ impedance measurement using Source measuring unit.

18. Preparation of thin films with the help of Spin Coating Unit and optical constant measurement using ellipsometer .

Note: Students have to perform at least 15 experiments

OE 28 Theory-V

The motivation for the course is to make the students understand the fundamentals and physics of photonic materials, devices and nano photonics, as well as nano-photonic devices. **The student may elect one from OE 28 [A] or OR 28 [B].**

Course Code: OE-28[A]
Course Title: PHOTONICS MATERIALS AND DEVICES
Credits: 4

This course covers the theory, design, fabrication and applications of photonic materials and devices. After a survey of optical materials design for semiconductors, dielectrics and polymers, the course examines ray optics, electromagnetic optics and guided wave optics; physics of light-matter interactions; and device design principles of LEDs, lasers, photodetectors, modulators, fiber and waveguide interconnects, optical filters, and photonic crystals. Device processing topics include crystal growth, substrate engineering, thin film deposition, etching and process integration for dielectric, silicon and compound semiconductor materials. The course also covers microphotonic integrated circuits and applications in telecom/datacom systems.

Course Objectives:

1. Photonics is the technology of this century and this course aims to develop an interest and awareness about Photonics in the students.
2. To learn the fundamentals of Lasers and its applications, optical fiber technology, holography and nanophotonics.
3. analyze transmission properties of optical guides
4. describe the mechanisms contributing to signal degradation in optical transmission links
5. describe the performance characteristics of active components, including fiber amplifiers, laser diode, light emitting diode, and photodetector
6. evaluate spectral characteristics of passive components, such as grating and coupler using coupled-mode theory
7. design optical guides and passive guided-wave components with prescribed transmission characteristics

Course Outcomes:

1. Acquire a theoretical knowledge base in photonics related areas of physics (Optics, Electrodynamics, Physics of Semiconductors, Quantum Mechanics)
2. Develop understanding of application of fundamental laws of physics in such engineering areas as telecommunications, optoelectronics, nano and microfabrication, growth techniques

3. Learn fundamentals of computerized modeling of diverse optical and photonics systems and gain working experience with standard computational tools used in industry.
4. Acquire essential laboratory skills in designing experiments, assembling standard optical tools for optical experimentation, carrying out measurements with customary optical instruments and analyzing acquired data
5. Become familiar with economics and management of photonics related engineering projects
6. Learn to communicate scientific and engineering ideas both orally and in written form
7. Acquire experience working in industrial or research lab settings as a part of a team.

OE 28[A] PHOTONICS MATERIALS AND DEVICES

Course Objectives:

1. Acquire a theoretical knowledge base in photonics related areas of physics
2. Learn the fundamental principles of photonics and light-matter interactions,
3. Develop the ability to formulate problems related to photonic structures/processes and analyze them, and
4. Understand processes that help to manipulate the fundamental properties of light.

Course Outcomes : Students should be able to do the following upon completion of this module:

1. Be able to analyze the properties of materials and associated technologies and make judicious choice of the appropriate material/technology for a given application
2. To have a grasp of the state-of-the-art materials and technologies relevant for current and emerging topics in optics and photonics.
3. Explain working principles of basic photonic devices,
4. Make simple calculations to quantify performances of various photonic devices,
5. Choose appropriate photonic devices for achieving certain system requirements,
6. Tell technological limits of several photonic devices such as solar cells, displays, LED bulbs, and describe potential solutions to those problems.

UNIT I

Materials for nonlinear optics, preparation and characterization, evaluations of second order and third order nonlinear coefficients, 3 wave and 4 wave mixing in uniaxial and biaxial crystals.

UNIT II

Frequency up and Frequency down conversions, Photorefractive materials, phase conjugation and its applications.

UNIT III

AO Phenomenon, Raman-Nath and Bragg modulators, deflectors, spectrum analyser devices

based on EO and MO effects.

UNIT IV

EL and POS devices, fluoride glass based fibres and their applications, optical fibre based signal processing.

UNIT V

Optical Integrated Circuits, architecture fabrication and applications, CD read/write mechanism, memory storage, information storage and retrivel using holography.

REFERENCE BOOKS

l. Optoelectronic devices and systems, SC Gupta, Prentice Hall India (2005) (Text)
2. Handbook of Nonlinear optical crystals - Dmtriev (Springer Verlag), 2003
3. Optical Electronics - Thyagaraj an and Ghatak W (Cambridge University Press), 1997

Course Code: OE-28[B]
Course Title: NANOPHOTONICS
Credits: 4

[OE 28 B] NANOPHOTONICS

Course Objectives : This advanced topical course shall introduce the basic principles, applications and latest advances in the area of nanophotonics. Student shall have a clear view about this excited new area and ready to contribute to the advances of photonic technology for a broad area of applications, from telecommunication/data communications to solid state display, energy and sensing technologies. Students shall have an opportunity to get the latest update on this new field from the seminars offered by the experts in this area. The main objectives are :

1. To introduce the students to fields of confinement of matter and light matter interaction at the nanoscale and its applications.
2. To learn fundamentals of nanotechnology and its applications in Photonics.

Course Outcomes :

After completing this course students will be able to:

1. Learn about the background on Nanophotonics
2. Understand the synthesis of nanomaterials and their application and the impact of nanomaterials on environment

3. Apply their learned knowledge to develop Nanomaterial's.

UNIT I

Foundations for Nanophotonics

Confinement of Photons and Electrons, Propagation Through a Classically Forbidden Zone: Tunneling, Localization Under a' Periodic Potential: Bandgap, Cooperative Effects for Photons and Electrons, Nanoscale Optical Interactions, Axial and Lateral Nanoscopic Localization, Nanoscale Confinement of Electronic Interactions, Quantum Confinement Effects, Nanoscopic Interaction Dynamics, Nanoscale Electronic Energy Transfer.
Near-Field Interaction and Microscopy : Near-Field Optics, Modeling of Near-Field Nanoscopic Interactions, Near-Field Microscopy, Aperture less Near-Field Spectroscopy and Microscopy, Nanoscale Enhancement of Optical Interactions, Time- and Space-Resolved Studies of Nanoscale Dynamics.

UNIT II

Quantum-Confined Materials : Quantum Wells, Quantum Wires, Quantum Dots Quantum Rings, Manifestations of Quantum Confinement, Optical Properties, Quantum-Confined Stark Effect, Dielectric Confinement Effect, Single-Molecule Spectroscopy, Quantum-Confined Structures as Lasing Media, Metallic Nanoparticles and Nanorods, Metallic Nanoshells Applications of Metallic Nano structures.
Growth and Characterization of Nanomaterials : Growth Methods for Nano materials, Epitaxial Growth, Laser-Assisted Vapor Deposition (LAND) Nano chemistry, Characterization of Nano materials, X-Ray Characterization, Transmission Electron Microscopy (TEM) Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM).

UNIT III

Nanostructured Molecular Architectures :Non covalent Interactions, Nanostructured Polymeric Media, Molecular Machines, Dendrimers, Supramolecular Structures, Monolayer and Multilayer Molecular Assemblies.
Photonic Crystals : Basics Concepts, Theoretical Modelling of Photonic Crystals, Features of Photonic Crystals, Methods of Fabrication, Photonic Crystal Optical Circuitry Nonlinear Photonic Crystals, Photonic Crystal Fibers (PCF), Photonic Crystals and Optical Communications, Photonic Crystal Sensors.

UNIT IV

Nanocomposites ,Nanocomposites as Photonic Media, Nanocomposite Waveguides, Random Lasers: Laser Paints, Local Field Enhancement, Multiphasic Nanocomposites, Nanocomposites for Optoelectronics.

Industrial nanophotonics: Nanolithography, Nanosphere Lithography, Dip-Pen Nanolithography, Nanoimprint Lithography, Nanoparticle Coatings, Sunscreen Nanoparticles, Self-Cleaning Glass Fluorescent Quantum Dots, Nano barcodes.

UNIT-V

Bio N ano photonics and nanomedicine :Bioderived Materials, Bioinspired Materials Bio templates, Bacteria as Biosynthesizers, Near-Field Bio imaging, Nanoparticles for Optical Diagnostics and Targeted Therapy, Semiconductor Quantum Dots for Bio imaging Bio sensing, Nano clinics for Optical Diagnostics and Targeted Therapy, Nanoclinic Gene Delivery Nano clinics for Photodynamic Therapy.

REFERENCE BOOKS

Nanophotonics : P N Prasad, Wiley Interscience (2003) (Text)

Biophotonics: P N Prasad, Wiley Publications (2004)

L. Novotny and B. Hecht, Principles of Nano-optics, Second Edition, Cambridge University Press, 2012

Comprehensive Viva-Voce

A comprehensive viva -voce will be held immediately after the end of Semester I, II and IV. The Comprehensive Viva- Voce is intended to assess the student's understanding of various subjects he has studied during the M.Tech. course of study. The Viva-Voce would be conducted by a Board of Examiners consisting of the Head, Course Coordinator and all concerned Faculty Members of the both Electronics and Physics department. The Comprehensive Viva- Voce is evaluated on the basis of Grade. A candidate has to secure a minimum Grade to be declared successful. If he fails to obtain the minimum Grade, he has to reappear for the viva-voce during the next examination. The Grades are as follows.

RANGE	**QUALITATIVE_ASSESSMENT/GRADE**	
91% - 100%	O	Outstanding
81% - 90%	A	Very Good
71% - 80%	B	Good
61% - 70%	C	Fair
50% - 60%	D	Pass
Below 50%	F	Failure

M. Tech in Optoelectronics and Laser Technology

SEMESTER III (July – December, 2021)

Course Code: OE

Course Title: Major Project Phase- I

Credits: 16

Major Project Phase - I

AIM: To enable students to develop deep knowledge, understanding, capabilities and attitudes in Photonics. It should improve their subject knowledge level, experimental and report making skills. It should also enhance aptitude for research and assist career growth.

OBJECTIVE: Each student has to submit a first level of report of the M.Tech project that they are undergoing at the end of the 3rd semester.

Student Outcomes

The Master of Technology in optoelectroics & laser Technology is comprised of rigorous coursework followed by a full year of research project in two phases.

In addition to communication, team work and research skills, each student will attain at least the following learning outcomes from this degree course:

- Demonstrate a depth of knowledge of Photonics
- Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in high impact factor journals, conference proceedings, and patents.
- Demonstrate knowledge of contemporary issues in their chosen field of research.
- Demonstrate an ability to present and defend their research work to a panel of experts.

Project Work Scheme

Project evaluation shall be done at the end of III and IV semesters and the students will have to submit a dissertation on his / her project work as per the Regulation for M.Tech. The problem may be selected form an appropriate Industry or Institution. The candidate is expected to work under the guidance of a project guide for at least for a period as decided. In case the project work is taken up in an external Industry/Institution, the project shall have two guides: one in the participating organization (Industry/Institution) who is the external guide and the other shall be one of the faculty members form Department who is the internal guide. The dissertation should be submitted within tow calendar years form the starting date of the third semester, Six copies of the dissertation have to be submitted to the M.Tech. Course Coordinator. These copies shall be distributed to the External examiner, Internal Examiner, Project guide (Faculty), Department Library and University Library and the Candidate.

Evaluation of Project Work

The project evaluation committee shall be responsible for the project work evaluation The project evaluation committee as per M.Tech. Regulation. The project guide (faculty from department) shall be the internal examiner. The external examiner shall be a technical expert in the concerned subject form any organization other than that of the project guide and is selected form the panel of experts submitted by the Course Coordinator. The dissertation shall be evaluated by the external examiner.

Three bound copies along with a soft copy of the dissertation shall be submitted to the Head of the Department/Coordinator within the last date prescribed by the Department / School for the purpose. The project work shall be evaluated through presentations and viva voce. The grade/marks shall be given to the students according to the level and quality of work and presentation/documentation.

SEMESTER IV (January – June, 2022)

Major Project Phase- II

Course Code: OE

Course Title: Major Project Phase- II

Credits: 16

AIM: To enable the students to develop deep knowledge, understanding, capabilities and attitudes in Photonics. It should improve their subject knowledge level, experimental and report making skills. It should also enhance aptitude for research and assist career growth.

OBJECTIVE: At the end of 4th semester, each student has to submit a dissertation consisting of the work they have done and findings obtained during their project.