SCHEME OF EXAMINATION

&

COURSE STRUCTURE AND SYLLABUS

M.Phil. (ELECTRONICS)

PROGRAMME

FACULTY OF SCIENCE

Approved by Board of Studies in Electronics

Effective from Academic Session JULY 2019

School of Studies in Electronics and Photonics
Pt. Ravishankar Shukla University
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PT. RAVISHANKAR SHUKLA UNIVERSITY, RAIPUR
SCHEME OF EXAMINATION & SYLLABUS PRESCRIBED FOR THE EXAMINATION OF

M.Phil in Electronics Programme
SESSION 2019-2020

1. Objective of the course:

- To provide academic progression to students obtaining M.Sc. degree willing to pursue an academic career
- To provide academic progression to professionals engaged in academic fields
- To provide a bridge course for an M.Sc. student so as to encourage him / her for research.
- To introduce emerging areas as discourses of study for promoting academic activities and research in related fields.

2. **Course Methodology:** A detailed treatment of each topic will be presented in class but a major portion of each class session will involve interaction and discussion. It is essential, therefore, that each student has a reading of the topic to be taken up in a class prior to attending the session. Written / presentation assignments will explore the issues and their logical consequences. Programming assignments will offer both programming experience and an opportunity to experiment with ideas. Dissertation work will involve students individually carry out a detail study on a topic and implement a related system.

Scheme of Examination :

The Master of Philosophy (M.Phil.) in Electronics is a full time course for one year after completion of M.Sc. in Electronics, Electronic Science, Physics, Instrumentation. Admission to M.Phil (Electronics) programme will be done through entrance examination. The course structure will contain three theory papers, seminar (two) and dissertation as outlined below:

S.No.	Theory paper	Marks
1.	Paper I : Research Methodology , Quantitative Methods and Computer applications	100
2.	Paper II - Photonics, Advanced Concepts in Solar Cell Technologies and Nano Science and Technology	100
3.	Paper III : Digital Image Signal Processing	100
4.	Seminar - Seminar based on theory paper (Best two out of three)	50
5.	Dissertation –(a) Final Seminar based on Dissertation (b) Dissertation Script evaluation (c) Viva – Voce	50 75 25
Grand Total		**500**

Paper I

Research Methodology, Quantitative Methods & Computer Applications

Unit I - Introduction and Design of research

Meaning, objective and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative Vs quantitative research methodology, field studies, field experiments Vs laboratory experiments, research design in social and physical sciences.

Unit II - Data Analysis

Procedure for testing of Hypothesis, the null hypothesis, determining level of significance , type I and type II errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two way, Chi square test and its application, students 'T' distribution, non parametric statistical techniques, binomial test, Correlation and regression analysis- discriminate analysis- factor analysis- cluster analysis, measures of relationship.

Unit III – Solar PV fundamentals and Emerging Solar Cell Technologies

P-N junction under illumination: 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, Shockley-Queisser limit.

Analytical Techniques: Solar Simulator-IV measurement, Quantum efficiency measurement, Minority carrier lifetime & diffusion length measurement.

Thin film solar cell technologies,: amorphous Si solar cells, CdTe solar cells,Quantum Dot Solar Cells, Dye Sensitized Solar cells, Perovskite Solar Cells, Present status of different PV technologies,

Unit IV – Molecular Devices and Semiconductor Device Simulation

Molecular Devices: Operation fundamentals of organic LEDs, Organic FETs and Organic solar cells, Basic physics underlying device operation, Fundamental benefits and limitations of the organic materials

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.

Unit V - Image Fundamentals –

Digital Image representation, fundamental steps in Digital Image processing, image acquisition, storage, processing, communication & display, Simple image model, sampling and quantization, some basic relationships between pixels: Neighbors of a pixel, connectivity, labeling of connected Components, Relations, distance Measures.

Image Transforms

Introduction to Fourier Transform, The Discrete Fourier Transform, some properties of two dimensional Fourier transform: Separability, translation, periodicity & conjugate symmetry, rotation, distributive and scaling, average value, convolution and correlation, sampling. The Fast Fourier Transform: FFT algorithm, number of operations, the inverse FFT, implementation. Other Separable Image Transforms: Walsh Transforms, Discrete Cosine Transform, Hadamard Transform, the Haar & Slant transform.

Study of basic functions of image processing toolbox of Matlab software

Reference Books –

1. Research in education, By J W Best and J V Kann. Pearson/ Allyn and Bacon.
2. Research Methodology - Methods and Techniques, C K Kothari, New Age International.
3. Solar Photovoltaic's: Fundamentals, Technologies and Applications, C. S. Solanki, 2nd Edition, Prentice Hall of India, 2011.
4. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice-Hall Inc, Englewood Cliffs, NJ, USA,
5. Physics of Solar Cells: From Basic Principles to Advanced Concepts Peter Würfe Wiley-VCH; 1 edition
6. Organic Electronics: Materials, Manufacturing, and Applications Hagen Klauk Wiley-VCH; 1 edition
7. Organic Molecular Solids Markus Schwoerer (Author), Hans Christoph Wolf, Wiley-VCH; 1 edition (March 27, 2007)
8. Semiconductor Devices Modeling and Technology" by Nandita Das Gupta and Amitava Das Gupta, Prentice Hall of India Pvt.Ltd.
9. Digital Image Processing : Gonzalez and Woods, 2nd Edition, Pearson Education Publication
10. Fundamental of Digital Image Processing - A.K.Jain, PHI.

Paper II

Photonics, Advanced Concepts in Solar Cell Technologies and Nano Science &Technology

Unit I - Photonics

Classification of Optical processes, Optical coefficients, Optical materials, Concept of Excitons, Free and Frenkel excitons,

Light emission in solids, Interband luminescence, direct gap materials, indirect gap materials, Photoluminescence.
General principle of electroluminescence devices, Light emitting diodes, Material selection for light emitting diodes, Diode lasers, Inorganic electroluminescence, ACTFEL device, EL characteristics, EL excitation mechanism.

Unit II - Advanced Concepts in Solar Cell Technologies
Need of sustainable energy sources, Sustainable Sun's energy, Concepts Fundamental limits on conversion efficiency Shockley-Queisser theory, Multiple Junction solar cells, Quantum dot solar cells, Intermediate band solar cells, Photon splitting and multi-application High efficiency c-Si solar cells, Staebler-Wronski effect
Fabrication of crystalline Si solar cells, Thin film crystalline Silicon solar cell technologies, Thin Cadmium Telluride and Copper Indium Gallium Selenide Cell Technologies.

Unit III -
Solar PV modules, Series and parallel connection of cells, Mismatch in series and parallel connection, PV module power output as function of temperature and solar radiation
Concentrators Photovoltaic (CPV) Cells- Light concentration, concentration ratio, Optics for CPV paraboloid reflector Compound parabolic concentrator Fresnel's Lens concentrator
Tracking requirement of CPV

Unit IV -
Introduction to thin films Two dimensional material, various methods of thin films growth, Molecular Beam Epitaxy (MBE), Controlled deposition of single Atomic Layer, Liquid Phase Epitaxy (LPE) ,and Vapour Phase Epitaxy (VPE), Characterization of thin Film. Application of thin film, Metal nanoclusters, semi conducting nanoparticles, rare gas and molecular clusters, methods of synthesis, carbon nanostructures, applications of carbon nanotubes, bulk nanostructured materials, solid disordered nanostructures, nanostructured crystals, photonic crystals.

Unit V -
Introduction to Nano science, Classification of Nano materials, Size dependence of properties, Energy Bands, Chemical Mechanical, Magnetic, Structural, Optical (linear & non-linear) properties of nanoparticles. Emergence of nanotechnology: Bottom-up & Top-down approach.

Reference Books -

1. Optical Properties of Solids Mark Fox Oxford University Press
2. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, Prentice Hall of India, 2011.
3. Solar cells: Operating principles, technology and system applications, by Martin A. Green, Prentice-Hall Inc, Englewood Cliffs, NJ, USA,

4. Fiber Optic Communication - Govind P. Agrawal, 3rd Edition, Wiley Series in Systems
5. Introduction to Nanotechnology- Charles P.Poole and Frank J.Ovens, Wiley and Sons
6. Nanostructures: Theory & Modelling : C. Delerue & M. Lannoo (Springer)
7. Nanotechnology-Basic Science and Emerging Technologies by M. Wilson, Kamali Kannangara Geoff Smith, Michelle Simmons, B, Raguse
8. Nanotechnology- An Introduction to Nanostructuring Techniques-Wolfgang Fritzsche
9. Nanomaterials- synthesis, Properties & application A.S.Edelstein & R C Cammarata Introduction to Nanotechnology-Charles P. Pool;e. Jr. & Frank J. Qwens)"

Paper III - Digital Image Signal Processing

Unit I - Image Enhancement

Spatial domain methods and frequency domain methods, Enhancement by point processing: histogram processing, Image subtraction, image averaging. Spatial Filtering: smoothing and sharpening filters. Enhancement in the frequency Domain: low pass, high pass and homomorphic filtering. Generation of spatial masks from frequency domain specifications, Color image processing: color fundamentals, color models, pseudo color image processing, full color image processing.

Unit II - Image Restoration

Degradation Model for continuous functions, discrete formulation, Diagonalization of circulant and Block Circulant matrices: curculant matrices block circulant matrices, effect of diagonalization on the degradation model. Algebraic approach to restoration: unconstrained and constrained restoration. Inverse filtering , least mean square (Wiener) filter , Constrained least squares Restoration, Interactive Restoration , restoration in the spatial domain , geometric transformations : spatial transformations ,gray level interpolation

Unit III- Image Compression

Fundamentals: coding redundancy, inter pixel redundancy, psycho visual redundancy, fidelity criteria. Image compression models: the source encoder and decoder, the channel encoder and decoder. Elements of information theory: measuring information, the information channel, fundamental coding theorems. Error free compression: variable length coding, bit plane coding, lossless predictive coding. Lossy Compression: Lossy predictive coding, transform coding.
Image Compression standards: binary image compression standards, continuous tone image compression standards.

Unit IV - Image Segmentation

Detection of discontinuities: point, line, edge and combined detection. Edge linking and boundary detection: local processing, global processing via the Hough Transform, global processing via graph theoretic techniques. Thresholding: foundation, the role of illumination, simple global thresholding, optimal thresholding, thresholding selection based on boundary characteristics, thresholds based on several variables. Region oriented segmentation, use of motion in segmentation.

Unit V - Image Representation, description and recognition

Representation schemes: chain codes, signature, boundary segments. Boundary descriptors: some simple descriptors, Fourier descriptors, Regional descriptors: topological descriptors, moments, Relational descriptors. Recognition: Elements of image analysis, patterns and patterns classes, Decision theoretic methods: matching, optimum statistical classifiers, structural methods. Interpretation: logical systems (predictive calculus), semantic networks, production systems.

Reference Books –

1. Digital Image Processing – Gonzalez and Woods, 2nd Edition, Pearson Education Publication
2. Digital Image Processing – Gonzalez and Woods, Pearson Education using Matlab Publication
3. Digital Image Processing – B.Chanda, D.Dutta and Majumdar Analysis, PHI Publication
4. Fundamentals of Digital Image Processing – S. Annadurai ,R.Shanmugalakshmi, Pearson education
5. Digital Image Processing - Rafael C Conzalez & Richard E. Woods, AWL.
6. Fundamental of Digital Image Processing - A.K. Jain, PHI.
7. Digital Picture Processing - Rose field Kak.
8. Digital Image Processing - W.K.Pratt.

Dissertation- Marks: 150

Students individually will carry out a detail study on a topic and implement a related system. The study must include literature survey, methodology and proposed work, experimental details and results, modifications to be included and future directions, applications etc. A report is to be prepared and submitted under the guidance of a supervisor. The report should contain design, implementation and experimental details. The topics involved in the work should be related to the courses undertaken by the student till this portion of progression under the programme and have contemporary relevance. It can involve research and development oriented works and be carried out with an eye on the needs of the industry. The work must be defended through a presentation in front of a panel constituted by selected experts. The quality of the work should be reflected by at least one publication in conference proceedings/ journals etc.