Syllabus for 4 Year B. Tech Course in Electronics and Communication Engineering

SEVENTH SEMESTER

Sl. No.	Code	Subject	Contacts			Credits
			L	T	P	
A. Theory						
1	TIU-UEC-T40#	Career Advancement & Skill Development-VII-Managerial Commerce	2	0	0	2
2	TIU-UEC-E40#	Elective - II	3	0	0	3
3	TIU-UEC-E40#	Elective - III	3	0	0	3
4	TIU-UEC-E40#	Elective - IV	3	0	0	3
B. Practicals						
1	TIU-UEC-L40#	Elective - II Lab	0	0	3	1.5
C. Sessionals						
1	TIU-UEC-P40#	Project - I	0	2	4	4
2	TIU-UES-S499	Entrepreneurship Skill Development	0	0	2	2
Total						18.5

Elective - II

TIU-UEC-E40#: RF and Microwave Engineering

TIU-UEC-E40#: Digital Image and Video Processing

TIU-UEC-E40#: Electronic Measurement and Instrumentation

Elective - III

TIU-UEC-E40#: Power Electronics

TIU-UEC-E40#: Adaptive Signal Processing

TIU-UEC-E40#: Embedded Systems

Elective - IV (Open Elective)

TIU-UES-E40#: Object Oriented Programming

TIU-UES-E40#: Database Management System

TIU-UES-E40#: Artificial Intelligence and Soft Computing

TIU-UES-E40#: Internet of Things

TIU-UES-E40#: Operations Research

TIU-UEN-T40#: Career Advancement & Skill Development-VII-Managerial Commerce
L-T-P: 2-0-0
Credits: 2
Detailed Syllabus:
Embedded systems & IOT
Module – I
Introduction to RISC microcontrollers: Von- Neumann and Harvard architectures, Introduction to 8051 family microcontrollers, 8051 architecture, Register banks and Special Function Registers, Block Diagram, Addressing Modes, Instruction Set, Timers, Counters, Stack Operation, Programming using PIC microcontroller.

Module – II
Introduction to Embedded Systems: Overview of Embedded Systems, Features, Requirements and Applications of Embedded Systems, Recent Trends in the Embedded System Design, Common architectures for the ES design, Embedded Software design issues, Communication Software, Introduction to Development and Testing Tools.

Module – III

8051 Interfacing: 8051 interfacing with Keyboard, display Units (LED, 7-segment display, LCD), ADC, DAC, Stepper motor, Introduction to AVR family and its architecture. Interfacing and Communication Links Serial Interfacing: SPI / Micro wire Bus, I2C Bus, CAN Bus.

Module – IV

Robotics: Overview of Robotics, Pattern recognition and robots, Use of Embedded Systems in Robotics, Robots and Computer Vision.

Elective - II

TIU-UEC-40#: RF and Microwave Engineering

L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various microwave system components their properties.
2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.
3. Design microwave systems for different practical application.

Detailed Syllabus:

Module 1:

Microwave & its property, Rectangular and Circular Waveguide: modes, cutoff frequency; Transmission Line: Current and Voltage Distribution, Input impedance, Short Circuit and Open Circuit, Quarter Wave Transformer. (L-8)

Module 2:

Smith chart and impedance matching techniques, S-matrix: representation, properties, shift in reference planes, generalized S-matrix. (L-8)

Module 3:

Wave propagation in planar lines: design, effective dielectric constant, attenuation, dispersion, power- handling capability; lumped elements and their design. (L-8)

Module 4:

Passive components: (i) Reciprocal Type: Resonators/cavities, Attenuators, Junction Tees, Magic Tee, Directional couplers, power splitters/combiners, filters; (ii) Non- reciprocal components: isolators, circulators and Gyrators. (L-8)

Module 5:

Microwave sources: Klystron, Magnetron, TWTs, transistor amplifier and oscillator design, Gunn oscillator; Tunnel diode oscillator, microwave systems. (L-8)

Recommended Textbooks:

1. R.E. Collin, “Microwave Circuits”, McGraw Hill
2. K. C. Gupta and I. J. Bahl, “Microwave Circuits”, Artech house
3. D. M. Pozar, “Microwave Engineering”, Wiley
4. R. E. Collin, “Foundations for Microwave Engineering”, Wiley
5. S. Y. Liao, “Microwave Devices & Circuits”, Prentice Hall
6. P. A. Rizzi, “Microwave Engineering: Passive Circuits”, Prentice Hall
7. R. Ludwig & P. Bretchko, “RF Circuit Design”, Pearson
8. K. C. Gupta, “Microwaves”, New Age
9. M. Mitra, “Microwave Engineering”, Dhanpat Rai
10. G. S. N. Raju, “Microwave Engineering”, I. K. International
11. J. P. Agarwal, M. L. Sisodia & V. L. Gupta, “Microwave and Radar Engineering”, New Age
12. E. C. Jordan & K. G. Balmain, “Electromagnetic Fields and Radiating Systems”, McGraw Hill

TIU-UEC-L40#: Digital Image and Video Processing
L-T-P: 3-0-0
Credits: 3
Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding.

Detailed Syllabus:
Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures. (4)
Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass. (6)

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. (6)
Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation. (4)
Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets. (6)

Image Compression-Redundancy–inter-pixel and psychovisual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000. (4)
Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full- search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X. (4)
Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking. (2)

Recommended Textbooks:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

TIU-UEC-L40# : Electronic Measurements
L-T-P: 3-0-0
Credits: 3
Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of different measuring instruments.
2. Understand different measurement techniques.
3. Design different instrumentation circuits.

Detailed Syllabus:
Module-1
Electrical Measurements
Standards of Measurement & Errors, Review of indicating and integrating instruments: Voltmeter, Ammeter, Ohmmeter – series & shunt type, Wattmeter, Analog & Digital Multimeter, Megger and Energy meter, Q-meter. (6)

Module-2

Measurement of Resistance, Inductance and Capacitance
Measurement of low, medium and high resistances, insulation resistance measurement, AC bridges for inductance and capacitance measurement. (4)

Module-3

Instrument Transformers

Current and Potential transformers, ratio and phase angle errors, design considerations and testing. (4)

Module-4

Electronic Measurements

Electronic voltmeter, multimeter, wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Spectrum & Wave analyzer. Digital counter, frequency meter, voltmeter, multimeter and storage oscilloscope. (8)

Module-5 Instrumentation

Transducers, classification & selection of transducers, strain gauges, LVDT, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermisters, thermocouples, Resistance thermometers, photo-diodes & photo-transistors, encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application. Data Acquisition Systems. (8)

Module-6

Systems applications:

Biometrics, Digital scent technology, Three-dimensional integrated circuit, Molecular electronics, Nano electromechanical systems, Electronic nose, Flexible electronics, E-textiles, Memristor, Thermal copper pillar bump, Spintronics. (6)

Recommended Textbooks:

1. A. K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai
2. A. D. Helfrick and W. D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall
3. B. E. Jones, "Instrumentation Measurement and Feedback", McGraw Hill
4. E. W. Golding, "Electronic Measurement and Measuring Instruments", Sir Isaac Pitman & Sons.
5. H. Buckingham and E. N. Price, "Principles of Electronic Measurements"
6. H. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill.
7. D. Bell, "Electronic Instrumentation and Measurements", Oxford University Press

Elective - III

TIU-UEC-E40#: Power Electronics

L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Build and test circuits using power devices such as SCR.
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters.

3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

Detailed Syllabus:

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode. (8)

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor. (6)

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper. (6)

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter. (6)

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.
Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive. (10)

Recommended Textbooks:

1. Muhammad H. Rashid, " Power electronics" Prentice Hall of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P. C. Sen., " Modern Power Electronics", edition II, Chand & Co.
4. V. R.Moorthi, "Power Electronics", Oxford University Press.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla, "Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

Elective - III
TIU-UEC-E40#: Adaptive Signal Processing
L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.
2. Mathematically represent the 'adaptability requirement'.
3. Understand the mathematical treatment for the modeling and design of the signal processing systems.

Detailed Syllabus:

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices. (6)

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean square error and mis-adjustment. (6)

Variants of the LMS algorithm: the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram-Schmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces. (8)

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice. (6)

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array. (10)

Recommended Textbooks:

1. S. Haykin, "Adaptive Filter Theory", Prentice Hall, 1986.
2. C. Widrow and S. D. Stearns, "Adaptive Signal Processing", Prentice Hall, 1984.

Elective - III

TIU-UEC-E40#: Embedded Systems

L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.

Detailed Syllabus:

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems, Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. subsystem interfacing, interfacing with external systems, user interfacing. Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems. (360

Recommended Textbooks:

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K. J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Elective - IV (Open Elective)

TIU-UEC-E40#: Object Oriented Programming

L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.
4. Design applications with an event-driven graphical user interface.

Detailed Syllabus:

Abstract data types and their specification.

How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.

Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance.

Inheritance in OO design.

Design patterns. Introduction and classification. The iterator pattern.
Model-view-controller pattern.
Commands as methods and as objects.
Implementing OO language features.
Memory management.
Generic types and collections
GUIs. Graphical programming with Scala and Swing
The software development process. (36)

Recommended Textbook:

1. Barbara Liskov, "Program Development in Java", Addison-Wesley, 2001.
2. E. Balaguruswamy, "Object Oriented Programming with C++", McGraw Hill
3. R. Lafore, "Object Oriented Programming in C++", Sams

Elective - IV (Open Elective)
TIU-UEC-E40#: Database Management System
L-T-P: 3-0-0
Credits: 3
Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. For a given query write relational algebra expressions for that query and optimize the developed expressions.
2. For a given specification of the requirement design the databases using E R method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms.
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Detailed Syllabus:
Module 1
Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL),
Data Manipulation Language (DML).
Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations. (8)

Module 2:

Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server.
Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.
Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. (10)

Module 3:
Storage strategies: Indices, B-trees, hashing. (4)

Module 4:
Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery. (6)

Module 5:
Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection. (6)

Module 6:
Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining. (2)

Recommended Textbooks:

1. A. Silberschatz, H. F. Korth and S. Sudarshan, “Database System Concepts”, McGraw Hill
2. J. D. Ulman, “Principles of Database and Knowledge – Base Systems - Vol - 1”, Computer Science Press
3. R. Elmasri and S. Navathe, “Fundamentals of Database Systems”, Pearson
4. Serge Abiteboul, Richard Hull and Victor Vianu, “Foundations of Databases”, Addison-Wesley

Elective - IV (Open Elective)
TIU-UEC-E40#: Artificial Intelligence and Soft Computing
L-T-P: 3-0-0
Credits: 3
Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand the various searching techniques, constraint satisfaction problem and example problems - game playing techniques.
2. Apply these techniques in applications which involve perception, reasoning and learning.

3. Understand Fuzzy sets and applications.
4. Understand different neural network algorithms.

Detailed Syllabus:

Artificial Intelligence

Introduction – Agents – Problem formulation – uninformed search strategies – heuristics - informed search strategies – constraint satisfaction Logical agents – propositional logic – inferences – first-order logic – inferences in first order logic – forward chaining – backward chaining - unification - resolution planning with state-space search – partial-order planning – planning graphs – planning and acting in the real world. (12)

Soft Computing

Fuzzy Sets and Applications:

Crisp sets, definition, operations, and properties.

Fuzzy sets, introduction, types of fuzzy sets, membership functions, some definitions, operations, examples, measures of fuzziness.

Fuzzy logic controller, Mamdani approach, Takagi-Sugeno approach, examples, advantages and disadvantages of FLC.

Fuzzy clustering, methods, Fuzzy C-Means Clustering and Entropy based clustering, examples.

Neural networks and Applications: Neurons, transfer functions, layers of neurons, static & dynamic neural networks, types of training of neural networks.

Multi-Layer Feed Forward Neural Network, forward computation and training using Back-propagation algorithm, example, steps to be followed for designing a suitable neural network, advantages and disadvantages of NN.

Radial Basis Function Network, forward computation and training using Back-propagation algorithm.Introduction to Self-organizing Map, Recurrent Neural Network.

Evolutionary Computation techniques and Applications:

Deficiencies of Classical traditional techniques, Algorithmic descriptions of a few evolutionary algorithms like Genetic Algorithm, Particle Swarm Optimization. (24)

Recommended Textbooks:

1. A. Konar, “Artificial Intelligence and Soft Computing”, CRC Press
2. S. Haykin, “Neural Networks”, Pearson
3. Ritch & Knight, “Artificial Intelligence”, Tata McGraw Hill
4. D. K. Pratihar, “Soft Computing, Fundamentals and Applications”, Narosa

Elective - IV (Open Elective)

TIU-UEC-E40#: Internet of Things

L-T-P: 3-0-0

Credits: 3

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand what IoT technologies are used for today, and what is required in certain scenarios.
2. Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
3. Apply these technologies to tackle scenarios in teams of using an experimental platform.
4. for implementing prototypes and testing them as running applications.

Detailed Syllabus:

Unit 1:Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6. (6)

Unit 2:Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog. (6)

Unit 3:Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration. (6)

Unit 4:Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts. (6)

Unit 5:Operating systems requirement of IoT environment, study of mbed, RIoT, and Contiki operating systems, Introductory concepts of big data for IoT applications. (8)

Unit 6:Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation. (8)

References:

1. A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, VPT publisher, 2014.
2. A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.
3. CunoPfister, “Getting started with Internet of Things”, Maker Media, 1 st edition, 2011.
4. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web resources :

1. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2. https://developer.mbed.org/handbook/AnalogIn
3. http://www.libelium.com/50_sensor_applications/M2MLabs Mainspring
4. http://www.m2mlabs.com/frameworkNode-RED http://nodered.org/

Elective - IV (Open Elective)
TIU-UEC-E40#: Operations Research
L-T-P: 3-0-0
Credits: 3
Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand basics of linear programming.
2. Find solutions of optimization problems.
3. Understand game theory and queuing models.

Detailed Syllabus:
Linear Programming: OR Models, Convex Sets, Graphical Method, Simplex Method, Big M Method. (6)

Transportation and Assignment Formulation of Transportation Problem, Initial Feasible Solution Methods, Optimality Test, Degeneracy in TP; Assignment Problem, Hungarian Method, Travelling Salesman Problem. (10)

Game Theory: Two Person Zero Sum Game, Pure and Mixed Strategies, Algebraic Solution Procedure, Graphical Solution, Solving by Linear Programming. (10)

Inventory and Queuing Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model; Elements of Queuing Model, Pure Birth Death Model. (10)

Recommended Textbooks:

1. H. A. Taha, “Operations Research”, Prentice Hall of India.
2. Ravindran, Phillips and Solberg, “Operations Research”, Wiley.

Elective - II Lab
TIU-UEC-E40#: RF & Microwave Lab
L-T-P: 0-0-3
Credits: 1.5
List of Experiments:

1. Study of Reflex Klystron characteristics.
2. Study of Gunn diode characteristics.
3. Radiation pattern of horn antenna.
4. Measurement of VSWR and reflection coefficient of a standing wave pattern in a waveguide.
5. Measurement of frequency and wavelength of a microwave signal.
6. Measurement of dielectric constant of solid and liquid.

Elective - II Lab

TIU-UEC-E40#: Digital Image and Video Processing Lab
L-T-P: 0-0-3
Credits: 1.5
List of Experiments:
Matlab programs to demonstrate basic image processing algorithms.

Elective - II Lab
TIU-UEC-E40# :Measurement Lab
L-T-P: 0-0-3
Credits: 1.5
List of Experiments:

1. Measurement of strain using strain gauge.
2. Measurement of medium resistance using voltmeter- ammeter method.
3. Study of temperature sensors.
4. Study of Linear Variable Differential Transformer (LVDT).
5. Measurement of self-inductance using Maxwell's bridge.
6. Measurement of three phase power using two-wattmeter method.
7. Measurement of low resistance using Kelvin-double bridge.
8. Measurement of hysteresis and eddy current losses.
9. Study on different sub-system of CRO.