## THE UNIVERSITY OF TECHNOLOGY

Department of Electrical & Electronic Engineering

### FOURTH YEAR

(Communication Engineering Section)

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Units</th>
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<td>First Term</td>
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<tr>
<td>C 401</td>
<td>Final Year Project</td>
<td>1</td>
<td>3</td>
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<tr>
<td>EG 402</td>
<td>Industrial Management</td>
<td>2</td>
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<td>C 403</td>
<td>Communication Systems II</td>
<td>3</td>
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<td>C 404</td>
<td>Satellite &amp; Mobile Communication</td>
<td>3</td>
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<td>C 405</td>
<td>Information Theory</td>
<td>2</td>
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<td>C 406</td>
<td>Microwave Engineering</td>
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<td>C 407</td>
<td>Signal Processing</td>
<td>2</td>
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<td>C 408</td>
<td>Elective Subjects</td>
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<td>C 409</td>
<td>Microwave &amp; Communication Labs.</td>
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<td>6</td>
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<td>Total</td>
<td>17</td>
<td>9</td>
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### Total Hours per Week

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<th>First Term</th>
<th>Second Term</th>
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<td>28</td>
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**Elective Subjects**

1. Fiber optics.
2. Optical communication System.
4. Image Processing.

**Note**: Two subjects shall be selected from the above list (one subject per each term) For the course C 408.
Independent work is carried out by the students under staff supervision. The work may be experimental or both experimental and theoretical. A project report is presented at the end of the year.
1) **Productivity:**
Production and productivity, productivity measurements, factors influencing productivity, value added.

2) **Forecasting Analysis:**
Forecasting by least square, regression method, moving average method.

3) **Linear Programming:**
Linear programming conditions, mathematical formulation for linear programming, graphical method, algebraic method, simplex method, assignment method.

4) **Replacement Theory:**
Replacement of times that deteriorate with time, replacement of items that fall completely and suddenly, replacement and maintenance.

5) **Decisions:**
Decisions under certainty, decisions under risk, decisions under uncertainty, decisions under conflict.

6) **Application of Networks in Industrial Projects:**
The principles of the network, critical path method (CPM), program evaluation and review technique.

7) **Project Evaluation:**
Stages of evaluation, evaluation under commercial profit, evaluation under social profit, technical evaluation.

8) **Quality Control:**
Quality control and international standards organization (ISO).

9) **Inventory Control.**

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**INDUSTRIAL MANAGEMENT**

EG 402

Year: Fourth

Theory : 2hr/Week
Practical: -hr/Week

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1) **Productivity:**
4hrs.
Production and productivity, productivity measurements, factors influencing productivity, value added.

2) **Forecasting Analysis:**
4hrs.
Forecasting by least square, regression method, moving average method.

3) **Linear Programming:**
12hrs.
Linear programming conditions, mathematical formulation for linear programming, graphical method, algebraic method, simplex method, assignment method.

4) **Replacement Theory:**
6hrs.
Replacement of times that deteriorate with time, replacement of items that fall completely and suddenly, replacement and maintenance.

5) **Decisions:**
4hrs.
Decisions under certainty, decisions under risk, decisions under uncertainty, decisions under conflict.

6) **Application of Networks in Industrial Projects:**
12hrs.
The principles of the network, critical path method (CPM), program evaluation and review technique.

7) **Project Evaluation:**
6hrs.
Stages of evaluation, evaluation under commercial profit, evaluation under social profit, technical evaluation.

8) **Quality Control:**
8hrs.
Quality control and international standards organization (ISO).

9) **Inventory Control.**
4hrs.
1) **Pulse Code Modulation:**
   Pulse Code Modulation (PCM); Quantization process; Representation of binary data; Noise consideration in PCM system; S/N performance of PCM; Limitations and modifications of PCM; Delta modulation; Delta-Sigma modulation; Adaptive delta modulation; Differential PCM (DPCM); Inter-Symbol Interference (ISI); Pulse shaping to reduce ISI; Equalization; Equalizer types; Matching filter.

2) **Digital Modulation:**
   Amplitude Shift Keying (ASK); Frequency Shift Keying (FSK); Phase Shift Keying (PSK); Coherent and non-coherent detection; Differential PSK (DPSK); Error performance of binary systems; Quadrature Amplitude Modulation (QAM); Quadrature Phase Shift Keying (QPSK); Offset-QPSK (OQPSK); Minimum Shift Keying (MSK); Multilevel modulation techniques (MFSK, M-ray PSK & M-ray QAM); Error performance of M-ray systems; Comparison between performance of digital modulation types; Bandwidth efficiency; Power spectra of modulated signals; Carrier recovery & clock recovery.

3) **Spread Spectrum System (SSS):**
   Types of spread spectrum systems; frequency hopping, time hopping, chirp, & hybrid; Linear code generation; Synchronization of spread spectrum systems; acquisition SSS & tracking SSS; Application of SSS.

4) **Ciphering & Deciphering Devices:**
   Introduction to communication security; cipher systems; Crypt analysis; Security & data encryption standard; Public – key cryptography- RAS – key crypto systems; The knapsack problem; Cryptographic security systems.

**Recommended textbook: "**
1) Introduction: 6hrs.
History of Satellite; Characteristics of satellite communication systems; Orbital satellites; Geostationary satellite; Orbital patterns; Orbital classifications; Spacing and frequency allocations look-angle.

2) Satellite System Modeling: 4hrs.
Up-link models; Down-link models; Transponder models; Comparison between transponder types; Frequency bands; characteristics of satellite channel.

3) Satellite System Link Equation (Power Link Budget): 8hrs.
Antennas; Receiving & transmitting equipment parameter; Link losses Up-link & Down-link equations; Influence of propagation medium; Atmospheric effect; Ionosphere effect.

4) Satellite Networks: 18hr.
One-way link; Broadcast network; Two-way link between two earth stations; Multiple Access Techniques; Frequency Division Multiple Access (FDMA); Time Division Multiple Access (TDMA); Multiplexing & Modulation with FDMA & TDMA; Inter-modulation product; Time Random Multiple Access (TRMA); Code Division Multiple Access (CDMA); Hybrid Multiple Access Techniques; Fixed & demand assignment; Multi-beam satellite network; FDMA with multi-beam satellite network; TDMA with multi-beam satellite network (SS/TDM).

5) Earth Station Technologies: 9hrs.
Organization of an earth station; Earth station design objective; Earth station equipment; Antenna pointing and tracking; Mobile & transponder earth station.

6) Introduction of Mobile Communication: 3hrs.
Frequencies used for radio communication; Classification of radio frequencies; Atmosphere; Skip distance & Maximum Usable Frequency.

Fundamentals elements; Frequency reuse; Channel assignment strategies; Handoff; Interference; Capacity; Planning Cellular system; Improve capacity; Tracking grade of service.

8) Propagation & Path Loss: 14hr.
Large-scale path loss; free-space propagation model; reflection; Diffraction; Scattering; Line budget design; Long-distance path loss model; Long-normal shadowing; Small scale multi-path propagation; Types of fading; Impulse responses model of multi-path; Mobile multipath channel.
9) **Mobile Networks**: 10hrs.
   Introduction; Cellular networks (BT, BTC, MTSO, Registers, ……); Difference between mobile & fixed telephone networks; first gen., second gen., third gen.,

10) **Mobile Standard**: 4hrs.
   Digital cellular; AMPS; GSM; IS-95; Mobile to satellite.

**Recommended textbook**: " 
# INFORMATION THEORY

**Year:** Fourth  
**Theory:** 2 hr/Week  
**Tutorial:** 1 hr/Week

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<thead>
<tr>
<th>1) <strong>Introduction:</strong></th>
<th>16 hr.</th>
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<tr>
<td>Source of information; Uncertainly; Information &amp; entropy; Discrete memory-less channels; Memory channel; Channel model BSC and TSC; Joint and conditional entropies; Capacity and efficiency of symmetric and non-symmetric discrete channels; Optimum threshold mutual information; Channel capacity; Entropy; Channel capacity of a continuous.</td>
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<tr>
<th>2) <strong>Source Coding Theorem:</strong></th>
<th>12 hr.</th>
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<tr>
<td>Mathematical model of information source; Huffman coding; Shannon-Fano codes; Types of errors.</td>
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<tr>
<th>3) <strong>Channel Coding:</strong></th>
<th>32 hr.</th>
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<tr>
<td>Source of errors; Parity; BRC; Information rate; Galois field modern algebra; Taxonomy of codes; linear block codes; vector spaces syndrome; Minimum distance &amp; correction; Hamming code BCH codes; cyclic code; Reed-Solomon codes; Convolution encoder; (connection of convolution, representation, code tree, trellis diagram, state diagram); Maximum likelihood decoding; Viterbi algorithm; Trellis-code modulation; Turbo code.</td>
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**Recommended textbook:**
1) **Electromagnetic Waves:**
Wave equation for time varying fields and boundary conditions; Plane waves in dielectric and conducting media; Surface impedance.

2) **Transmission Lines (TL):**
Derivation and solution of TL equations; Parameters and characteristics of TL; High frequency effects; Transients on TL; Coaxial TL; Strip-lines.

3) **Waveguides:**
Waves between parallel planes; Rectangular waveguide; Circular waveguide; Waveguide for long distance communication

4) **Impedance Matching:**
Theory and applications of Smith chart; Impedance matching; Impedance transformers.

5) **Electromagnetic Resonators:**
Distributed parameter resonant circuit; Cavity resonators; Excitation of resonators.

6) **Microwave Passive Devices:**
Terminations; Attenuators & phase shifters; Waveguide bends twists; Scattering matrix; T. and hybrid junctions; Directional couplers; Microwave filters; Ferrite devices such as isolators, circulators, phase shifters, etc.

7) **Microwave Active Devices:**
Klystron and reflex Klystron tubes; Magnetron and traveling wave tubes; Point contact and schottkey barrier detectors; Avalanche and transfer electron devices; PIN diodes; GUNN diodes; Microwave amplifier and oscillators used in communication and satellite systems.

**Recommended textbook: "**
1) **Introduction:**
Classification of signals; Systems; Types of response.

2) **Analog Signal Processing:**
Correlation; Auto- & Cross-correlation; Power spectral density; Parsevals theorem; Wiener-Khintchine theorem; White noise; Band limited white noise; Detection by auto- & cross-correlation.

3) **Analog Filter Design:**
Types of filter responses; Butterworth & chebyshev filters; Filter order; Design procedures.

4) **Digital Signal Processing (DSP):**
The scope of DSP; Sampling and A/D conversion; Basic types of digital signals; Digital processors and Linear Time Invariant (LTI) systems; TMS family.

5) **Time Domain Analysis:**
Impulse response of the system; Step response of the system; Digital convolution; Difference equations.

6) **Frequency Domain Analysis:**
The Discrete Fourier Transform (DFT) of aperiodic signals; Properties of DFT; Frequency response of LTI processors; Inverse Discrete Fourier Transform (IDFT); Basis of Fast Fourier Transform (FFT); FFT algorithms.

7) **Design of Finite Impulse Response (FIR) Digital Filter:**
Simple moving average filter; The Fourier Transform method; Truncation and windowing; Filter realization.

8) **Design of Infinite Impulse Response (IIR) Digital Filter:**
Pole-Zero placement method; Filter derived from analog design; the bilinear transformation and impulse invariant filters; IIR filter realization.

**Recommended textbook:** "
1) **Introduction:**
Historical development; The general system; Advantages of optical fiber communication.

2) **Optical Fiber Waveguides:**
Fiber types; Ray theory transmission; Total internal reflection; Acceptance angle; Numerical aperture; Electromagnetic mode theory for optical propagation; Electromagnetic waves; Modes in a planer guide.

3) **Transmission Characteristics of Optical Fibers:**
Attenuation; Material absorption losses; Intrinsic and extrinsic absorption; Linear scattering; Rayleigh and mie scattering; Nonlinear scattering losses; Stimulated Brillouin and Raman scattering; Fiber bend losses; Dispersion; Intra-modal dispersion; Inter-modal dispersion; modal noise.

**Recommended textbook:**
John M. Senior
Optical Fiber Communications Principle and Practice
1) **Optical Sources and Detectors:** 10hrs.
LED characteristics; The semiconductor injection laser; Multimode injection laser; Single mode laser; Longer wavelength lasers; Injection laser characteristics; Optical detection principles; p-n photodiode; p-i-n photodiode; Avalanche photodiodes.

2) **Optical Amplifiers:** 4hrs.
Semiconductor optical amplifiers; Erbium-Doped fiber amplifiers; Amplifier noise; System application.

3) **Optical Fiber Systems:** 10hrs.
System design considerations; Component choice; Multiplexing; Digital systems; The optical transmitter and receiver; Channel losses; Optical power budget; Line coding; Analog systems; Direct intensity modulation; Sub-carrier intensity modulation; Wavelength Division Multiplexing (WDM).

4) **Optical Networks:** 6hrs.
Basic network topologies; Performance of linear Buses and star architectures; SONET/SDH.

**Recommended textbook:**
John M. Senior
Optical Fiber Communications Principle and Practice
1) Computer network philosophy, computer network architecture, hardware and software standard protocols. 8hrs.

2) Data transmission types, transmission technology, data traffic routing, error detection & correction, addressing, economic trade offs, international standards. 12hrs.

3) Design examples; interfacing two different computers. 10hrs.
1) **Introduction:**
Image processing concept, digital image processing system, digitization transformer, image representation and image types (binary, cray-scale, color and multispectral).

2) **Image analysis:**
   a-**Preprocessing**
   Region of interest (crop, zoom, shrink, translate and rotate), image algebra, spatial filters, image quantization and gradient function.
   b-**Edge/Line detection**
   Reports operator, Sobel operator, Prewitt operator, Kirsch compass mask, Robinson mask, Frei-chen mask and Hough transform.
   c-**Discrete transforms**
   Fourier transform, cosine transform, walsh transform, filtering transform and wavelet transform.

3) **Image enhancement:**
Gray-scale modification, image sharpening and image smoothing.
RADAR SYSTEM

Year: Fourth

Theory: 2 hr/week

1) An introduction to radar. 2hrs.
2) Radar equation. 4hrs.
3) Radar theory. 6hrs.
4) CW and FM-CW radars. 4hrs.
5) MTI and pulse Doppler radars. 6hrs.
6) Radar clutter. 4hrs.
7) ECM and ECCM. 2hrs.

Recommended textbook: Skolnic M I.
Introduction to Radar System.