| ت | اسم المادة | تفاصيل المفردات |
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| 1 | Advanced Control Theory<br>المرحلة الرابعة | **1. System Modes and Modes Decomposition**<br>   Eigen-values and Eigen-vectors, Diagonalization of (n×n) Matrix,<br>   Diagonal Jordan, Controllable Canonical Form, Observable Canonical Form, Decomposition of Transfer Function.<br>**2. Solution of Homogeneous and Non-Homogeneous System**<br>   State transition matrix, Solution of time-invariant state-space equation, Cayley-Hamilton theorem, Sylvester Expansion   theorem, Solution of time-varying state equation.<br>**3. Controllability and Observability of Continuous System**<br>**4. Stability in Sense of Liapynov.**<br>**5. Pole-Placement Using State Feedback Design** |
| 2 | Computer Control<br>المرحلة الرابعة | **1.  Sampled Data Control Systems**<br>  Sampling and reconstruction, properties of sampled signal, ideal Sampler, Z.O.H.<br>**2.  Analysis of  Discrete Control System**<br>   Open-loop system, closed-loop system, system time-response, steady state error analysis, mapping S-   plane /Z-plane.<br>**3.  Stability Analysis**<br>   Bilinear transformation, Z into W, the Routh-Hurwitz criterion,  and Jury's stability test.<br>**4.   Design of Digital Controllers**<br>   Direct design controller, dead-beat controller, PID controller,   Design and realization, response between sampling instants,   discrete Time equivalent controller, Root locus, Modified Z- transform.<br>**5.  Time -Domain Analysis.**<br>Impulse Response and step response for LTI processors (systems).<br>Digital convolution.<br>Difference equations.<br>**6.  Frequency-Domain Analysis (I).**<br>Discrete Fourier Transform (DFT), DFT for periodic sequences, DFT for aperiodic digital sequence, DFT properties. |

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| Fast Fourier Transform (FFT).<br>Frequency Response of LTI processor.<br>**7. Frequency –Domain Analysis the Z-transform.**<br>Definition and properties of the Z-transform.<br>Z-plane poles and Zeros.<br>**8. Design of Recursive digital filter (IIR)**<br>Simple design based on Z-plane poles and zeros.<br>Filters derived from analog designs.<br>Frequency sampling filters. | | |
| **1. Model Reference Adaptive Control.**<br>**2. Self-Tuning Regulator.**<br>**3. Gain Scheduling.** | Adaptive Control<br>المرحلة الرابعة | 3 |
| **1. Neural networks (NNs):**<br> -Artificial Neuron Types of Activation functions types of NNs (Feed-forward, Feedback, Supervised and Unsupervised), and types of recall.<br> -Learning Algorithms: Hebbian, perceptron and delta learning rules.<br> -Generalized delta learning rule (Error back propagation algorithm for single and multiple layers.<br>**2. Fuzzy Logic (FL):**<br> - Fuzzy concepts, Fuzzy sets, and Fuzzy operations.<br> -Fuzzification, Inference Engine, Rule-Base, and defuzzification<br> -Fuzzy Logic Control (FCL).<br>**3. Binary Genetic Algorithm (GA).**<br> -Elements of GA, Genetic Operators, Initialization, Coding, Fitness Function, Selection, Crossover (Mating), and Mutation | Intelligent Control Systems<br>المرحلة الرابعة | 4 |
| **1. Introduction to Industrial Robot Manipulator**<br> Robotics, Classification of robots, advantages and disadvantages of robots, robot components, anatomy of a robot, robot degrees of freedom, robot Coordinates, robot Reference Frames, robot languages, world Reference Frame, Joint Reference Frame, Tool Reference Frame.<br>**2. Robot Kinematics**<br> a) Matrix representation of a Point in space, Representation a Vector in space, Representation of the reference frame at the origin, Representation of a Frame in space relative to the reference frame, | Robotics<br>المرحلة الرابعة | 5 |

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| Representation of a Rigid Body, Homogeneous Transformation matrices, Representation of Transformations: pure translation, pure rotation combined transformations, <br> b) Robot Arm Kinematics, Manipulator parameters, The Denavit-Hartenberg (D-H) Representation, Arm Matrix. <br> **3. Robot Inverse Kinematics** <br> Inverse Kinematics (Geometric Approach), Two-Link Planar Robot, Articulated Configuration <br> **4. Robot Trajectory planning** <br> Path Vs Trajectory planning, Joint-Space Vs. Cartesian-space Descriptions, Basics of Trajectory planning, Joint–space Trajectory planning methods, third-order polynomial Trajectory planning. | | |
| **1. Linear algebra and Matrices** <br> Vector, Solution of linear equations, Matrices <br> **2. Ordinary differential equations** <br> Series solution to ODE (power series solution, Legendre polynomial, Frobenius solution and Bessel's function) and Partial differential Equations. <br> **3. Complex Analysis** <br> **4. Numerical Analysis** | Mathematics (II) <br> المرحلة الثالثة | 6 |
| **1. Signal flow graph and Mason's formula.** <br> **2. Transient Response Analysis.** <br> **3. Routh – stability criterion.** <br> **4. Root locus design of lead, lag, and lag-lead compensator.** <br> **5. PID controller design.** <br> **6. Bode plot.** <br> **7. Nyquist stability.** <br> **8. Describing function techniques.** <br> **9. Phase plane method.** | Control <br> المرحلة الثالثة | 7 |
| **1. Introduction to OP–Amp** <br> Analysis of Typical 741 OP–Amp with Negative Feedback, Partial OP–Amp, Circuit, Offset Voltages, Compensation, Drift, I/P Bias Current, CMRR, Data Sheets and Characteristics, Frequency Response, Slew Rate. <br> **2. Linear Application** <br> DC and AC Amplifiers, Inverting & Non-inverting | Electronics (II) and Microprocessors <br> المرحلة الثالثة | 8 |

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| Amplifiers, Summer, Integrator, Differentiator, Instrumentation Amplifier Voltage to Current & Current to Voltage Converters, Dual Phase Amplifiers, Electronic Analog Computation.<br><br>**3. Microprocessors**<br>  a) Internal Architecture of the 8086 Mp.<br>  b) External Architecture of the 8086 Mp.<br>  c) Addressing Modes.<br>  d) Instruction Set.<br>  e) Stack.<br>  f)Interfacing with 8255 | | |
| **1. Calculus**<br>limit and continuity, Differentiation, Integration, Series and sequence<br>**2. Partial derivative.**<br>**3. Vector valued function.**<br>**4. Double integral.**<br>**5. Fourier series and Laplace transform.**<br>**6. Ordinary differential equations**<br>  first order, linear set of equations | Mathematics (I)<br>المرحلة الأولى<br>المرحلة الثانية | 9 |
| **1. Bipolar Junction Transistor (BJT)**<br>  Construction, Operation, Characteristics, Configuration (C.E, C.B, C.C), Ratings.<br>**2. D.C. Biasing and Thermal Stability**<br>  Biasing Techniques, Stability Factors, Effect of Temperature.<br>**3. Small Signal Analysis of BJT and FET Amplifiers**<br>  H-parameters Mode, re-model, Equivalent Circuit, Voltage Gain, Current Gain, Input Impedance, Output Impedance.<br>**4. Field Effect Transistor (FET)**<br>  Construction, Types, Characteristics, Biasing and D.C. Analysis.<br>**5. FET Amplifiers**<br>  A.C. Analysis of Common Source, Common Drain, Common Gate Amplifiers. | Electronics (I)<br>المرحلة الثانية | 10 |