

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH. (MECHATRONICS)**

EFFECTIVE FROM ACADEMIC YEAR 2019- 20 ADMITTED BATCH

R19 COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Applied Industrial Pneumatics	3	0	0	3
Professional Core - II	Applied Industrial Hydraulics	3	0	0	3
Professional Elective - I	1. Industrial Electrical & Electronics 2. Programmable Logic Controller & Applications 3. Artificial Intelligence	3	0	0	3
Professional Elective - II	1. Instrumentation & Sensor Technology 2. Control Systems 3. Micro-controller & Applications	3	0	0	3
	Research Methodology & IPR	2	0	0	2
Lab - I	Pneumatics Lab	0	0	4	2
Lab - II	Hydraulics Lab	0	0	4	2
Audit - I	Audit Course - I	2	0	0	0
	Total	16	0	8	18

I Year II Semester

Course Code	Course Title	L	T	P	Credits
Professional Core - III	Advanced CNC Technologies	3	0	0	3
Professional Core - IV	Industrial Robotics	3	0	0	3
Professional Elective - III	1. Fuzzy Logic & Neural Networks 2. Manufacturing Systems: Simulation Modelling & Analysis 3. Additive Manufacturing Technologies	3	0	0	3
Professional Elective - IV	1. Automation in Manufacturing 2. MEMS 3. Design for Manufacturing & Assembly	3	0	0	3
	Mini Project with Seminar	0	0	4	2
Lab - III	CNC Lab	0	0	4	2
Lab - IV	Robotics Lab	0	0	4	2
Audit - II	Audit Course - II	2	0	0	0
	Total	14	0	12	18

II Year I Semester

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. Nano Technology 2. Intelligent Manufacturing Systems 3. Autotronics & Vehicle Intelligence	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review - II	0	0	12	6
	Total	6	0	12	12

II YEAR II SEMESTER

Course Code	Course Title	L	T	P	Credits
Dissertation	Dissertation Work Review - III	0	0	12	6
Dissertation	Dissertation Viva-Voce	0	0	28	14
	Total	0	0	40	20

***For Dissertation Work Review - I, Please refer 7.8 in R19 Academic Regulations.**

Audit Course I & II:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

APPLIED INDUSTRIAL PNEUMATICS (Professional Core- I)

UNIT-I:

Merits of Fluid power & its utility for increasing productivity through Low Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, signaling & control system.

UNIT-II:

Pneumatic control elements (control valves & remote control system), Basic pneumatic circuits for controlling single & double acting cylinder, Basic pneumatic circuits, Advanced pneumatic circuits for controlling multi-cylinders (operable).

UNIT-III:

Advanced pneumatic circuits for controlling multi-cylinders (inoperable circuits), Electro pneumatics with relay logic, Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

UNIT-IV:

Programmable sequential control using pneumatic modular elements, Stepper controls.

UNIT-V:

Programmable logic controllers-introduction, architecture hardware. Components-basics of PLC programming – Programming timers counters-master and jump controls- data manipulations and instructions.

REFERENCES:

1. Pneumatic Hand Book by Trade and technical press Ltd.
2. Pneumatics Circuits and Low Cost Automation by Fawcett, Trade and technical press.
3. Pneumatic Systems by Majumdar. S.R, Tata McGraw-Hill
4. Hydraulics & Pneumatics Power for Production by Stewart, Industrial press.
5. Fluid Power Logic Circuit Design by Peter Rohner, The Macmillan press 1979.
6. Pneumatics- Jagadeesha T, Universities press

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

APPLIED INDUSTRIAL HYDRAULICS (Professional Core-II)

Prerequisites: Fluid Mechanics, fluid power Engineering, Mathematics,

Course Objectives:

- To provide fundamentals of Hydraulic System
- To design simple Hydraulic circuits
- To propose and design special circuits for low cost automation.

Course Outcome: Upon completion of this course the student shall be able to

- Have fundamental of fluid power control
- Design special circuits for low cost automation

UNIT-I:

Introduction to Industrial Hydraulics Power System elements and standard symbolic representation (CETOP symbols)

UNIT-II:

Various control valves used in Hydraulics System, Hydraulics accessories, advantages of Hydro-Pneumatics and its applications, different types of Hydraulics pumps and their applications, Hydraulics system and their classification.

UNIT-III:

Hydraulics circuits Hydraulic motors, Hydraulic fluids and effective contamination control.

UNIT-IV:

Electro hydraulics system, Servo valves and proportional valves, Design of Cartridge Valves,

UNIT-V:

Hydraulics systems with PID controls Trouble shooting and remedial measures in Hydraulic system

REFERENCES:

1. Hydraulic Hand Book by Trade and technical press ltd.
2. Hydraulic Circuits by Fawcett, Trade and technical press.
3. Oil Hydraulic Systems BY Majumdar. S.R. Tata MC Graw-Hill
4. Fluid Mechanics and Hydraulics by Jagdish Lal, Metropolitan Book company
5. Hydraulic Systems Hand Book, Utility publications limited.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

INDUSTRIAL ELECTRICAL & ELECTRONICS (Professional Elective - I)

UNIT-I:

Basic Electrical Engineering, AC & DC Motor characteristics, Speed controls, Starting principles, Selection of proper motors for various applications.

Special Purpose Electrical Machines: - Induction generators self-excitation requirements, steady state analysis, voltage regulation, different methods of voltage control, application to mini and micro hydel systems.

UNIT-II:

Doubly fed induction machines: control via static converter, power flow, voltage/frequency control (generation mode), application to grid connected wind and mini/micro hydel systems.

Switched Reluctance Motor: Construction, operating performance, control and applications.

Brushless DC Machines: construction operation, performance, control and applications.

UNIT-III:

Linear Machines: Linear Induction Machines and Linear Synchronous Machines. Construction, operation, performance, control and applications. Application of permanent magnets in electrical machine:- structure, magnetic materials used, types of motors e.g. PMDC and PM Synchronous Machine, control and applications. Recent developments in electrical machines.

UNIT-IV:

Basic Electronics, Diodes, Transistor configurations, SCR Controls, FET, UJT, A/D Conversion, D/A Conversion, Optoelectronic devices: photo diode/transistor, LDR, LED and LCD and PLASMA displays, opto-coupler, opto-interrupter, high speed detectors – PIN and avalanche photo diodes, DC Power Supplies, AC Power Supplies, Special operational amplifiers, Timing and counting circuits

UNIT-V:

Digital Control Theory: Basic Digital concepts, Structure of a computer-controlled system. Review of Z-transform. Computation of time response of Discrete Data system. Bilinear Transformation. W-plane, prewar ping, inverse transformation. Design of discrete controllers. Z-domain compensation, w-plane compensation, state variable feedback, deadbeat controller sampled data version of PID controllers. Effect of Data. Digitization. Effect of finite word size, limit cycle determination. Programmable logic devices: PLA, PLD, CPLD, FPGA and its application.

REFERENCE BOOKS:

1. Electrical Machines by P. S. Bimbra
2. Power Plant Management by Z. Aghoni
3. Power Electronics by P. S. Bimbra
4. Low Power Electronics by Allen Helberg
5. Micro Electronics by Sedra Smith

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

PROGRAMMABLE LOGIC CONTROLLER & APPLICATIONS (Professional Elective - I)

UNIT-I:

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT-II:

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation.

Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT-III:

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT-IV:

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT-V:

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

REFERENCE BOOKS:

1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition, PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworth and F.D Hackworth – Jr- Pearson, 2004.
3. Tilak Thakur “Mechatronics” Oxford University Press 2016.
4. Fundamentals of programmable logic controllers a practical approach by Vijay Singh, new age publication.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

ARTIFICIAL INTELLIGENCE (Professional Elective - I)

Course Objectives:

- To learn the difference between optimal reasoning Vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities.
- To learn different knowledge representation techniques
- To understand the applications of AI: namely game playing, theorem proving, expert systems, machine learning and natural language processing.

Course Outcomes:

- Possess the ability to formulate an efficient problem space for a problem expressed in English
- Possess the ability to select a search algorithm for a problem and characterize its time and space complexities.
- Possess the skill for representing knowledge using the appropriate technique.
- Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems, Machine Learning and Natural Language Processing.

UNIT-I:

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Searching: Searching for solutions, uniformed search strategies-breadth first search, depth first search, depth limited search, iterative deepening depth first search bi-direction search comparison. Search with partial information greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions.

UNIT-II:

Local search Algorithms, Hill climbing, simulated, annealing search, local beam search, genetical algorithms. Constrain satisfaction problems: Backtracking search for CSPs local search for constraint satisfaction problems.

Game Playing: Adversial search, games, minimax, algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions and cutting of search.

UNIT-III:

Knowledge Representation & reasons logical agents, knowledge- Based agents, the wumpus world, logic, propositional logic, resolution patterns in propositional logic, resolution, forward & backward, chaining. First order logic. Inference in first order logic, propositional Vs first order inference, unification & lifts forward chaining, backward chaining, resolution.

UNIT-IV:

Planing- Classical planning problem, Language of planning problems, expressiveness and extension, planning with state-space search, forward states spare search, backward states space search, Heuristics for stats space search, planning search, planning with state space search, partial order planning graphs.

UNIT-V:

Learning-Forms of learning, induction learning, learning decision tree, statistical learning methods, learning with complex data, learning with hidden variables- the EM algorithm. Instance based learning, neural networks.

TEXT BOOKS:

1. Artificial Intelligence- A Modern approach, second edition, Stuart Russell, Peter Norvig, PHI/Pearson Education.
2. Artificial Intelligence, 3rd Edition, Patrick Henry Winston., Pearson Edition.

REFERENCE BOOKS:

1. Artificial Intelligence, 2nd Edition, E. Rich and K. Knight (TMH).
2. Artificial Intelligence and Expert Systems-Patterson PHI
3. Expert Systems: Principles and Programming-Fourth Edition, Giarrantana /Riley, Thomson
4. PROLOG Programming for Artificial Intelligence. Ivan Bratka-Third Edition-Pearson Education.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

INSTRUMENTATION & SENSOR TECHNOLOGY (Professional Elective - II)

UNIT-I:

Measurement and Characteristics: Elements of a Measurement System; Classification of Instruments; Static Performance Parameters; Loading and Impedance Matching; Errors and Uncertainties in Measurement; Process and Standards of Calibration; Dynamic Characteristics- Transfer Function Representation of a Measurement System, Impulse and Step Responses of First and Second Order Systems, Frequency Response of First and Second Order Systems.

UNIT-II:

Mechanical Transducers: Temperature- Bimetallic Element and Fluid Expansion type Thermometers; Pressure- Manometers and Bourdon Gauges; Force- Balances, Helical Spiral Springs, Load Cells and Elastic Force Devices; Torque- Torsion Bars and Flat Spiral Springs; Liquid Level- Float Systems and Level to Pressure Converters; Flow- Pitot Static Tubes and Turbine type Flow Meters. Hot Wire Anemometer

Proximity Sensors- Reed Sensors, Inductive proximity sensor, capacitive proximity sensor, Optical sensor with through beam, Ultrasonic sensors.

UNIT-III:

Electrical Transducers: Resistance Thermometers; Interfacing Resistive Transducers to Electronic Circuits; Thermistors- Measurement of Temperature and Thermal Conductivity, Temperature Control; Resistance Strain Gauges- Gauge Factor, Bonded and Un-bonded Strain Gauges; Self Generating and Non Self Generating Inductive Transducers; Linear Variable Differential Transformers; Capacitive Transducers - Potentiometric Transducers; Thermoelectric Transducers and Sources of Errors in Thermocouples; Piezoelectric Transducers;

UNIT-IV:

Basic Signal Conditioning Elements: Amplifiers- Non-Electrical and Electrical types; Op Amps- Inverting, Non-Inverting, Summing, Differential, and Charge Amplifiers; Differentiating and Integrating Elements; Filters; Data Transmission Elements- Electrical, Pneumatic, Position and Radio Frequency Transmission types; Compensation Elements for First and Second Order Systems - Basic Indicating, Recording, and Display Elements.

UNIT-V:

Feedback in Instruments- Principles of Feedback and Advantages & Disadvantages of Feedback; Digital Voltmeters-Ramp and Dual Slope types; Servo type Potentiometric and Magnetic Tape Recorders; Digital Recorders of Memory type; Data Displays-Analog and Digital types.

REFERENCE BOOKS:

1. Electronic Measurements and Instrumentation, K. Lal Kishore, Pearson Education Publications
2. Electronic Instrumentation, H. S. Kalsi-TMH Publications
3. Albert D Helfrick and William D Cooper; Modern Electronic Instrumentation and Measurement Techniques; 2004, PHI
4. BC Nakra, and Chaudhry; Instrumentation, Measurement and Analysis; 2004, Tata McGraw-Hill.
5. DVS Murthy; Transducers and Instrumentation; 2003, PHI.

6. CS Rangan, GR Sarma, and VSV Mani; Instrumentation Devices and Systems; Tata McGraw-Hill
7. Doebelin and Ernest; Measurement Systems Application and Design; 2004, Tata McGraw-Hill.
8. Tilak Thakur "Mechatronics" Oxford University Press 2016.

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CONTROL SYSTEMS (Professional Elective - II)

UNIT-I:

Mathematical Model for Physical Systems - Open loop – closed loop control – Differential equations of physical systems – Transfer functions – Block diagram algebra – Signal flow graphs - Reduction using Mason's gain formula.

Industrial Automatic Controls - Classification – Proportional derivative and integral control actions – Liquid level control systems with proportional and integral control – Pneumatic, hydraulic and electronic controllers

UNIT-II:

Transient Response Analysis - Standard signals – transient response of first and second order systems – Steady state errors and error constants.

UNIT-III:

Transfer Function Representation: Transfer function of DC servomotor – AC servomotor – Synchronous transmitter and receiver. Block diagram representation of systems – Representation by signal flow graph.

UNIT-IV:

Stability Analysis: Concepts of Stability - Necessary conditions for stability – Hurwitz stability criterion – Routh's stability criterion – Relative stability. Frequency Response Analysis - The root locus concept – Frequency response, polar plot, Bode plot – Nyquist stability criterion.

UNIT-V:

State Variable Model and Analysis - Concepts of state & state variables – Derivation of state models from Block diagrams - State space representation of systems – Transfer matrix - Solution of state equation – State transition matrix – Concepts of controllability and observability.

TEXT BOOKS:

1. Control systems, Principles and Design / M Gopal / TMH
2. Modern Control Engineering/ K.Ogata / Prentice Hall
3. Control Systems /Anand Kumar / Prentice Hall

REFERENCE BOOKS:

1. Control Systems Engineering /Nagrath & M. Gopal/ Wiley Eastern
2. Automatic control systems/ B.C.Kuo/John Wiley & Sons\ Modern Control Systems/ Richard C.Dorf and Robert H. Bishop

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
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MICRO-CONTROLLER & APPLICATIONS (Professional Elective - II)

UNIT – I:

Overview of 8-bit Microcontrollers- Intel, Motorola, and overview of the 8051 family- 8051 Architecture.

UNIT – II:

8051 Assembly languages programming – addressing modes Instruction set- Jump, Loop+ CALL instructions & programs- Arithmetic instructions, Logic Instructions & Programs – Single bit instructions & Programming- I/o- Port programming.

UNIT – III:

Timer/ Counter, programming of 8051 serial communication, interrupts.

UNIT – IV:

Interfacing 8051 to external memory- semiconductor memory-Memory address decoding- Interfacing with external ROM-data memory space- Interfacing to 8255 Architecture of PIC microcontrollers features, interfacing of I/O devices with PIC Controllers. PIC16c6x, 16c7x. 18x, 24x PIC memory organization.

UNIT – V:

Applications – Interfacing of LCD to 8051- Interfacing ADC, Sensors- Interfacing stepper motor- Interfacing keyboard- Interfacing DAC to 8051. ARM Controllers Introduction to ARM controllers. Comparison between RISC & CISC processor. Versions & variants of ARM processor. Register model of ARM processor. Modes of Operation. Applications of ARM processor.

REFERENCE BOOKS:

1. Muhammad Ali Mazzid, Jancie Gillispe Mazid “The Microcontroller & Embedded Systems”, Pearson Education, 2000.
2. Julio Sanchez and Maria P. Canton, Microcontroller Programming-The Microchip PIC, CRC Press
3. Myke Predko “ Programming & Customizing the 8051”, Tata McGraw Hill, 1999
4. Raj Kamal “Embedded systems, Architecture, Programming and Design, “Tata McGraw Hill, 2003.
5. Kenneth J. Ayala, The 8051 Microcontroller, CENGAGE Publisher
6. Fernando E. Valdes-Perez and Ramon Pallas-Areny, Microcontrollers-Fundamentals and Applications with PIC, CRC Press
7. KVK Prasad, Embedded Real Time Systems, Dearm Tech Publishers.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

RESEARCH METHODOLOGY AND IPR

Prerequisite: None

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis, Plagiarism, Research ethics

UNIT-III:

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-IV:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-V:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year I Sem. (MECHATRONICS)**

PNEUMATICS LAB (Lab – I)

LIST OF EXPERIMENTS

Do any TEN of the following Experiments

1. Study of pneumatic components:
 - i. Air compressor along with air receiver tank
 - ii. FRL unit
 - iii. Control valves
2. Draw the Circuit diagram to operate a Single Acting Pneumatic Cylinder using 3/2 Push Button Direction Control Valve (Manual).
3. Draw the Circuit diagram to operate a Double Acting Pneumatic Cylinder using two 3/2 Push Button Direction Control Valves (Manual).
4. Draw the circuit diagram to operate Double Acting Pneumatic Cylinder using 5/2 Direction Control Valve (solenoid) and Push button momentary switch.
5. Draw the circuit diagram to operate Double Acting Pneumatic Cylinder using 5/2 Direction Control Valve (solenoid) and Push button Latch Switch.
6. Draw the circuit diagram for sequential operation of Single acting Pneumatic cylinder & Double acting pneumatic cylinder using sequence valve.
7. Draw the Circuit diagram to operate a Single Acting Pneumatic Cylinder using 5/2 single solenoid control valve and PLC.
8. Draw the Circuit diagram to operate a Double Acting Pneumatic Cylinder using 5/2 DCV (Double Solenoid) and PLC.
9. Draw the circuit diagram for sequential operation of Single acting Pneumatic cylinder & Double acting Pneumatic cylinder using PLC.
10. Draw the circuit diagram for speed control of single & Double Acting Pneumatic Cylinder.
11. Simulation of Single Acting Pneumatic Cylinder using 3/2 Push Button Direction Control Valve using Simulation software.
12. Simulation of Double Acting Pneumatic Cylinder using 5/2 Push Button Direction Control Valve using Simulation software.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
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HYDRAULICS LAB (Lab - II)

LIST OF EXPERIMENTS

Do Any TEN of the Following Experiments

1. Study of Pressure relief valve and Directional Control valves in Hydraulic System.
2. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (Manual type).
3. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/3 Direction Control Valve (Manual type).
4. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (Single Solenoid) using Push button momentary switch.
5. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (Single Solenoid) using Latch Switch.
6. Circuit for measurement of oil pressure in a hydraulic system.
7. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (Solenoid Control) using Push button switch for varying flow rate using flow control valve.
8. Draw the Circuit diagram to operate Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (Solenoid Control) using Latch for varying flow rate using flow control valve.
9. Simulation of Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve (manual control) using simulation software.
10. Simulation of Double Acting Hydraulic Cylinder using 4/3 Direction Control Valve (manual control) using simulation software.
11. Simulation of Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve using Push button with spring return valve.
12. Simulation of Double Acting Hydraulic Cylinder using 4/2 Direction Control Valve Using Electrical control with spring return valve.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

ADVANCED CNC TECHNOLOGIES (Professional Core - III)

Course Objectives: The course is intend to

- To make the students familiar with computer aided programming, different tooling for CNC.
- To use computers in the area of manufacturing to reduce manual processing and linking computers to all manufacturing machines and increase the productivity, reduce the unnecessary costs.

Course Outcomes:

- After completing this course, the students should be able to
- To familiarize the components of computer aided manufacturing and to introduce CNC machines and computer aided process planning.
- CNC machines and its constructional features and part programming

UNIT-I:

Features of NC machines fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, features on N/C machine tools, design consideration of NC machine tool, methods of improving machine accuracy.

UNIT-II:

NC part programming manual programming basic concepts, point to point contour programming, canned cycles, parametric programming. Tooling for CNC machines. Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

UNIT-III:

DNC systems and adaptive control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constraints, adaptive control of machining processes like turning, grinding.

UNIT-IV:

Rapid Prototyping: Introduction, Stereo lithography, Selective laser sintering, fusion deposition modeling (FDM), LOM, rapid tooling.

UNIT-V:

Post Processors for CNC: Introduction to post processors: The necessity of a processor, the general structure of a post processor, the functions of a post processor, DAPP based post processor, communication channels and major variables in the DAPP based post processor, the creative of a DAPP processor.

TEXT BOOKS:

1. Computer control of manufacturing systems/Yoram Korem/Mc Graw Hill Int. 1983.
2. Machine tools hand book Volume 3, (Automation & Control)/Manfred weck/John Wiley and sons, 1984.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
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INDUSTRIAL ROBOTICS (Professional Core - IV)

Prerequisites: Kinematics of machinery

Course Objectives:

- To demonstrate knowledge of different types of actuators used in robotic systems.
- To analyze the position and velocity kinematics of a robot arm, implement in 2D.
- To analyze the dynamics of a robot arm, implement in 2D.
- To analyze sensor signals to implement real-time control algorithms.
- To demonstrate knowledge of error propagation in electrical, mechanical and computational systems.
- To construct, program, and test the operation of a robotic system to perform a specified task.

Course Outcomes: After doing this course, the student should be able to,

- Understand the evolution, classification, structures and drives for robots.
- Teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.
- Expose the students to build a robot for any type of application.

UNIT-I:

Introduction: Automation and Robotics, Robot anatomy configuration, motions joint motion and notation, work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Power Transmission Systems.

UNIT-II:

Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT-III:

Robot Dynamics: Lagrange – Euler & Newton - Euler formulations, problems on two link planar manipulators, configuration of robot controller.

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV:

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT-V:

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.

Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

TEXT BOOKS:

1. Introduction to Robotics Mechanics & Control by John J. Craig, Pearson
2. Industrial robotics by Mikell P. Groover, McGraw Hill.

REFERENCE BOOKS:

1. Industrial robotics by Mikell P. Groover, McGraw Hill
2. Robotics by K.S. Fu, McGraw Hill.
3. Introduction to Robotics Mechanics & Control by John J. Craig, Pearson
4. Robot Analysis by Lung Wen Tsai, John Wiley & Sons
5. Robot Analysis and Control by Asada H. and J. E. Slotin, Wiley, New York

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

FUZZY LOGIC & NEURAL NETWORKS (Professional Elective - III)

UNIT- I

Fuzzy Set Theory and Fuzzy Logic Control: Basic concepts of fuzzy sets- Operations on fuzzy sets- Fuzzy relation equations- Fuzzy logic control- Fuzzification –Defuzzification- Knowledge base- Decision making logic- Membership functions – Rule base.

UNIT- II

Adaptive Fuzzy Systems: Performance index- Modification of rule base- Modification of membership functions- Simultaneous modification of rule base and membership functions- Genetic Algorithms-Adaptive fuzzy system- Neuro fuzzy systems.

UNIT- III

Artificial Neural Networks: Introduction- History of neural networks- multilayer perceptions- Back propagation algorithm and its Variants- Different types of learning, examples.

UNIT- IV

Mapping and Recurrent Networks: Counter propagation –Self organization Map- Cognitron and Neocognitron- Hopfield Net- Kohonen Nets- Grossberg Nets- Art-I, Art-II reinforcement learning

UNIT- V

Case Studies: Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing

TEXT BOOK:

1. Vallum B. R And Hayagriva V.R C++, Neural networks and Fuzzy logic, BPB Publications, New Delhi, 1996

REFERENCE BOOKS:

1. Fuzzy logic & Neural Networks/ Chennakesava R. Alavala/ New Age International, 2008
2. Neural Networks for control, Millon W. T, Sutton R.S and Werbos P.J, MIT Press 1992
3. Fuzzy sets Fuzzy logic, Klir, G.J and Yuan B.B Prentice Hall of India Pvt. Ltd., New Delhi
4. Neural Networks and Fuzzy systems, Kosko.. Prentice hall of India Pvt. Ltd., New Delhi 1994
5. Introduction to Fuzzy control, Dirankov D. Hellendoorn H, Reinfrank M., Narosa Publications House, New Delhi 1996.
6. Introduction to Artificial Neural systems, Zurada J. M Jaico Publishing House, New Delhi 1994

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

**MANUFACTURING SYSTEMS: SIMULATION MODELLING & ANALYSIS
(Professional Elective - III)**

Prerequisites: Operations Research, Optimization Techniques and Applications and Probability Statistics

Course Objectives:

- Learn way of analyzing the systems.
- Classification of systems based nature of dynamics and knowledge of elements.
- To develop simulation model for dynamic discrete – event stochastic system.
- To run the model and collect the data.
- To analyze the output data of simulation for specified for performance measures bases on type of simulation and method of output data analysis.

Course Outcomes:

At the end of course, student should able to

- Define the state of system W.R.T specified performance measures.
- Identify Dynamic Discrete- event stochastic system.
- Develop simulation model for the said system
- Analyze the model and present the results to specified confidence level.

UNIT - I:

System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1& 2 errors – Framing – strong law of large numbers.

UNIT - II:

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT - III:

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poison. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

UNIT - IV:

Output data analysis – Types of Simulation with respect to output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT –V:

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – New boy paper problem.

TEXT BOOKS:

1. Simulation Modelling and Analysis by Law, A.M. & Kelton, McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation by Banks J. & Carson J.S., PH, Englewood Cliffs, NJ, 1984.

REFERENCE BOOKS:

1. Simulation of Manufacturing Systems by Carrie A., Wiley, NY, 1990.
2. A Course in Simulation by Ross, S.M., McMillan, NY, 1990.
3. Simulation Modelling and SIMNET by Taha H.A., PH, Englewood Cliffs, NJ, 1987.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

ADDITIVE MANUFACTURING TECHNOLOGIES (Professional Elective - III)

Prerequisites: Basics of Manufacturing, Basic knowledge in Calculus, Physics, Thermodynamics, and Chemistry

Course Objectives: The objective of the Course is to study methods used in additive manufacturing, theories governing the additive manufacturing, give information on materials, explain relations between materials to be processed and methods of additive manufacturing with introduction to common machines used for the technology and show applications and business opportunities with future directions.

Course outcomes:

- Understand the fundamentals for additive manufacturing and how it is different and discuss about various types of liquid based, solid based and powder-based AM technologies.
- Understand the various types of Pre-processing, processing, post-processing errors in AM. Also to know the various types of data formats and software's used in AM.
- Know the various applications of AM in design analysis, aerospace, automotive, biomedical and other fields.

UNIT-I:

Introduction: Prototyping fundamentals: Need for time compression in product development, Need for Additive Manufacturing, Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, Commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

UNIT-II:

Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Poly jet: Process, Principle, working principle, Applications, Advantages and Disadvantages, Case studies. Micro fabrication.

Solid-based AM Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III:

Powder Based AM Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Arc Spray Metal Deposition, Investment Casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT-IV:

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.

AM Software's: Need for AM software, Features of various AM software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, Surgi Guide, 3-matic, Simplant, Mesh Lab.

UNIT-V:

AM Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Web Based Rapid Prototyping Systems

TEXT BOOK:

1. Rapid prototyping: Principles and Applications by Chua C.K., Leong K.F. and LIM C.S, World Scientific publications, Third Edition, 2010.

REFERENCE BOOKS:

1. Rapid Manufacturing by D.T. Pham and S.S. Dimov, Springer, 2001.
2. Wholers Report 2000 by Terry Wohlers, Wohlers Associates, 2000.
3. Rapid Prototyping & Engineering Applications by Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

AUTOMATION IN MANUFACTURING (Professional Elective - IV)

Prerequisites: Production Technology, Machine Tools, Operations Research

Course Objectives:

- Lower Cost and Improve Time-to-Market
- Automation investment life-cycle analysis
- Empowered teams of talented employees
- Partnering with automation suppliers
- On-line process analysis
- Procedural process control
- Information integration and data warehousing

Course Outcomes: Upon completion of this course the student will be able to:

- Illustrate the basic concepts of automation in machine tools.
- Analyze various automated flow lines, Explain assembly systems and line balancing methods.
- Describe the importance of automated material handling and storage systems.
- Interpret the importance of adaptive control systems, automated inspection systems.

UNIT-I:

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT-II:

Introduction to Material Handling: Overview of Material Handling Equipment, Considerations in Material Handling System Design, the 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT -III:

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

UNIT-IV:

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT-V:

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at

Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.

TEXT BOOK:

1. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.

REFERENCE BOOKS:

1. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
2. Automation by Buckingham W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

MEMS (Professional Elective - IV)

Prerequisites: Electronic Circuits, Basic knowledge in material science

Course Objectives:

- To make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- To design, analysis, fabrication and testing the MEMS based components.
- To introduce the students various opportunities in the emerging field of MEMS.
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Course Outcomes: At the end of the course, the student will be able to

- Synthesize and characterize nanomaterials for engineering applications
- Design and analyze methods and tools for micro and nano manufacturing.
- Improve the quality of MEMS by analyzing the variables of the underlying micro and nano manufacturing method
- Select appropriate industrially-viable process, equipment and tools for a specific product.

UNIT-I:

Overview and working principles of MEMS and Microsystems: MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics

UNIT-II:

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT-III:

Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis

UNIT-IV:

Thermo Fluid Engineering & Microsystems Design: Overview of Basics of Fluid Mechanics in Macro and Micro scales, Basic equations in Continuum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT-V:

Materials for MEMS & Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

TEXT BOOKS:

1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002
2. Foundation of MEMS/ Chang Liu/Pearson, 2012

REFERENCE BOOKS:

1. An Introduction to Microelectromechanical Systems Engineering by Maluf M., Artech House, Boston 2000
2. Micro robots and Micromechanical Systems by Trimmer, W.S.N., Sensors & Actuators, Vol 19, 1989.
3. Applied Partial Differential Equations by Trim, D.W., PWS-Kent Publishing, Boston, 1990.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

DESIGN FOR MANUFACTURING & ASSEMBLY (Professional Elective - III)

Prerequisites: Manufacturing Processes, Engineering Materials

Course Objectives: The objective of course is identify the manufacturing constraints that influence the design of parts and part systems. Students will be introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.

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

- Understand the quality aspects of design for manufacture and assembly
- Apply Boothroyd method of DFM for product design and assembly
- Apply the concept of DFM for casting, welding, forming and assembly
- Identify the design factors and processes as per customer specifications
- Apply the DFM method for a given product

UNIT - I:

Introduction: Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of design Ling for economical production - creativity in design. Materials: Selection of Materials for design Developments in Material technology - criteria for material selection - Material selection interrelationship with process selection process selection charts.

UNIT - II:

Machining Process: Overview of various machining processes - general design rules for machining - Dimensional tolerance and surface roughness - Design for machining - Ease - Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts. **Metal Casting:** Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting.

UNIT - III:

Metal Joining: Appraisal of various welding processes, Factors in design of weldments - general design guidelines - pre and post treatment of welds - effects of thermal stresses in weld joints - design of brazed joints. Forging - Design factors for Forging - Closed dies forging design - parting lines of dies drop forging die design - general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking. **PLASTICS:** Viscoelastic and Creep behavior in plastics – Design guidelines for Plastic components – Design considerations for Injection Moulding.

UNIT-IV

Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-V:

Design of Manual Assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and

fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

TEXT BOOKS:

1. Assembly Automation and Product Design/ Geoffrey Boothroyd/ Marcel Dekker Inc., NY, 1992.
2. Engineering Design - Material & Processing Approach/ George E. Deiter/McGraw Hill Intl. 2nd Ed. 2000.
3. Hand Book of Product Design/ Geoffrey Boothroyd/ Marcel and Dekken, N.Y. 1990.

REFERENCES:

1. Computer Aided Assembly London/ A Delbainbre/
1. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst & Winston Anstony Knight/CRC Press/2010

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

CNC Lab (Lab-III)

LIST OF EXPERIMENTS

Do Any TEN of the following Experiments

1. Study and operation of CNC lathe machine.
2. Study and operation of CNC milling machine.
3. Preparation of testing of typical part programs on CNC Lathe machine.
4. Preparation of testing of typical part programs on CNC milling machine.
5. Exercises using CAM software.
6. Training on Desktop Tutors.
7. Part program generation through G and M codes for Turning, Boring, Drilling, Reaming and Milling.
8. Development of tool path simulation by setting tool offsets for multi-operations.
9. Study of various cutting tools used in CNC Machines such as twist drill, End Mill Cutter, Ball nose cutter and other Standard tooling.
10. Machining of various Components by generation of CNC code by using CAM Software.
11. Interfacing the CNC Codes to the CNC Lathe and CNC Mill.
12. Study and Operation of NC simulator for CNC Machining Operations.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. I Year II Sem. (MECHATRONICS)**

ROBOTICS LAB (Lab – IV)

LIST OF EXPERIMENTS

Do Any TEN of the following Experiments

1. Study of Robot and its components
2. Robot Programming using teach pendent.
3. Determination of Robot specifications.
4. Study of Programmable Logic Controller setup with software.
5. PLC Programming for operation of motor with fan using different logic condition switch relay timers.
6. PLC Programming for operation of buzzer using different logic conditions using latch and unlatch.
7. PLC Programming for operation of indicator lamp and LED lights using different logic conditions with ON Delay Timer and OFF Delay Timer.
8. PLC Programming using AND gate using different input and output devices.
9. PLC Programming using OR gate using different input and output devices.
10. PLC Programming using NAND gate using different input and output devices.
11. PLC Programming using NOR gate using different input and output devices.
12. PLC Programming using EXOR gate using different input and output devices

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (MECHATRONICS)**

NANO TECHNOLOGY (Professional Elective - V)

Course Outcomes: At the end of the course, the student is able to

- To understand the evolution of Nano systems, and various fabrication techniques.
- Learn about nano materials and various nano measurements techniques.

UNIT - I:

Over View of Nanotechnology: Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

UNIT - II:

Nanodefects, Nano Partiles and Nanolayers: Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide-chemical composition – doping properties – optical properties

UNIT - III:

Nanostructuring: Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

UNIT - IV:

Science and Synthesis of Nano Materials: Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes

UNIT - V:

Characterization of Nano Materials: Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TEXT BOOKS:

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. FahrnerW.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou, Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003.

REFERENCES:

1. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN: 8493-9138-5.

2. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc., 2013, ISBN: 978-93-82291-39-8 29.
3. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN: 470-85106-6.
4. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003.
5. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (MECHATRONICS)**

INTELLIGENT MANUFACTURING SYSTEMS (Professional Elective - V)

UNIT - I:

Computer Integrated Manufacturing Systems – Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM.
Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top-down and Bottom-up Approach, Volume of Information. Intelligent Manufacturing – System Components, System Architecture and Data Flow, System Operation.

UNIT - II:

Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Inference Engine, Knowledge Acquisition.

UNIT - III:

Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing

UNIT - IV:

Automated Process Planning – Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning
Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

UNIT - V:

Group Technology: Models and Algorithms – Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System, Structure of Knowledge based system for group technology (KBSGT) – Data Base, Knowledge Base, Clustering Algorithm.

REFERENCES:

1. Intelligent Manufacturing Systems/ Andrew Kusiak/Prentice Hall.
2. Artificial Neural Networks/ Yagna Narayana/PHI/2006
3. Automation, Production Systems and CIM / Groover M.P./PHI/2007
4. Neural networks: A comprehensive foundation/ Simon Haykin/ PHI.
5. Artificial neural networks/ B. Vegnanarayana/PHI
6. Neural networks in Computer intelligence/ Li Min Fu/ TMH/2003
7. Neural networks/ James A Freeman David M S kapura/ Pearson education/2004
8. Introduction to Artificial Neural Systems/Jacek M. Zurada/JAICO Publishing House Ed. 2006.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. II Year I Sem. (MECHATRONICS)**

AUTOTRONICS & VEHICLE INTELLIGENCE (Professional Elective - V)

Prerequisites: Basic knowledge in sensor technology, IC engines and image processing.

Course Objectives:

- To understand the automotive electronics
- To introduce the different vehicle systems
- To broaden the importance of vehicle intelligence system

Course Outcomes:

- Analyse various electronics systems like sensors, fuel injection system, ECU
- Design of intelligence vehicle systems

UNIT-I:

Automotive fundamentals: The engine components drive train starting & charging systems operation ignition system, suspension systems, brakes, ABS steering systems.

UNIT-II:

Automotive Sensors: Temperature sensor, gas sensor, knock sensor, pressure sensor, flow sensor, torque sensor, crash sensor, speed sensor and acceleration sensor, micro sensor, smart sensor, operation, types, characteristics, advantage and their applications.

UNIT-III:

Fuel injection and Ignition system: Introduction, fuel system components, electronic fuel system, fuel injection, types, throttle body versus port injection, electronic control fuel injection, operation, different types, fuel injectors, idle speed control, continuous injection system, high pressure diesel fuel injection, MPFI system, electronic ignition system, operation, types, electronic spark timing control.

UNIT-IV:

Electrical Vehicles and Hybrid Vehicles: Introduction, electric vehicle development, system layout, basic system components, electric battery solar cells, rapid charging system, motor drive system, fuel cell electric vehicle, hybrid vehicle, series hybrid vehicle, parallel hybrid vehicle, CNG electric hybrid vehicle.

UNIT-V:

Vehicle Intelligence: Introduction, based structure, vision based autonomous road vehicles, architecture for dynamics vision system, features, applications, a visual control system using image processing and fuzzy theory, an application of mobile robot vision to a vehicle information system, objective detection, collision warning and avoidance system, low type pressure warning systems.

TEXT BOOK:

1. Understanding automotive electronics, William B Ribben, 6th Edition Elsevier science, 2003.

REFERENCE BOOKS:

1. Sensor and Transducers, Ronald k jurgen, SAE-2003.
2. Automotive technology by jack Erjavec, Robert Scharff Delmar Publications, Inc 1992.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (MECHATRONICS)**

ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)

Prerequisite: None

Course objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

UNIT-I:

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II:

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-III:

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT-IV:

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

UNIT-V:

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT-VI:

useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT BOOKS/ REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (MECHATRONICS)**

DISASTER MANAGEMENT (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- critically understand the strengths and weaknesses of disaster management approaches,
- planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I:

Introduction:

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT-II:

Repercussions Of Disasters And Hazards:

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT-III:

Disaster Prone Areas In India:

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT-IV:

Disaster Preparedness And Management:

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT-V:

Risk Assessment Disaster Risk:

Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

UNIT-VI:

Disaster Mitigation:

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

TEXT BOOKS/ REFERENCES:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. TECH. (MECHATRONICS)**

SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Course Outcomes: Students will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT-I:

Alphabets in Sanskrit,

UNIT-II:

Past/Present/Future Tense, Simple Sentences

UNIT-III:

Order, Introduction of roots,

UNIT-IV:

Technical information about Sanskrit Literature

UNIT-V:

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TEXT BOOKS/ REFERENCES:

1. "Abhyastupustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
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VALUE EDUCATION (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course outcomes: Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

UNIT-I:

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

UNIT-II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT-III:

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

UNIT-IV:

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT-V:

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

TEXT BOOKS/ REFERENCES:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

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CONSTITUTION OF INDIA (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

UNIT-I:

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working)

UNIT-II:

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT-III:

Contours of Constitutional Rights & Duties: Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT-IV:

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions

UNIT-V:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-VI:

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

TEXT BOOKS/ REFERENCES:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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PEDAGOGY STUDIES (Audit Course - I & II)

Prerequisite: None

Course Objectives: Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes: Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT-I:

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

UNIT-II:

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT-III:

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-IV:

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT-V:

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

TEXT BOOKS/ REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeamong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M. TECH. (MECHATRONICS)**

STRESS MANAGEMENT BY YOGA (Audit Course - I & II)

Prerequisite: None

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes: Students will be able to:

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT-I:

Definitions of Eight parts of yog. (Ashtanga)

UNIT-II:

Yam and Niyam.

UNIT-III:

Do`s and Don`t`s in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT-IV:

Asan and Pranayam

UNIT-V:

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

TEXT BOOKS/ REFERENCES:

1. 'Yogic Asanas for Group Training-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS
(Audit Course - I & II)**

Prerequisite: None

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes: Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I:

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II:

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III:

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV:

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCES:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.