B.E. (Mechatronics Engineering) 2016 – Revised Course Scheme and Syllabus (1st - 4th Year) after modifications of 109th SUGC on October 18, 2016

SEMESTER – I (GROUP-A)

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA003	MATHEMATICS-I	3	1	0	3.5
2	UTA007	COMPUTER PROGRAMMING - I	3	0	2	4.0
3	UPH004	APPLIED PHYSICS	3	1	2	4.5
4	UEE001	ELECTRICAL ENGINEERING	3	1	2	4.5
5	UHU003	PROFESSIONAL COMMUNICATION	2	0	2	3.0
6	UTA008	ENGINEERING DESIGN-I	2	4	0	4.0
TOTAL			**16**	**7**	**8**	**23.5**

SEMESTER – II (GROUP-A)

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA004	MATHEMATICS-II	3	1	0	3.5
2	UTA009	COMPUTER PROGRAMMING-II	3	0	2	4.0
3	UES009	MECHANICS	2	1	2*	2.5
4	UEC001	ELECTRONIC ENGINEERING	3	1	2	4.5
5	UCB008	APPLIED CHEMISTRY	3	1	2	4.5
6	UTA010	ENGINEERING DESIGN-II (CATAPULT AND MORE SUCH PROJECTS) (6 SELF EFFORT HOURS)	1	0	2	5.0
TOTAL			**15**	**4**	**8**	**24.0**

* EACH STUDENT WILL ATTEND ONE LAB SESSION OF 2 HRS IN A SEMESTER FOR A BRIDGE PROJECT IN THIS COURSE (MECHANICS).

SEMESTER – III

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA031	OPTIMIZATION TECHNIQUES	3	1	0	3.5
2	UTA002	MANUFACTURING PROCESSES	2	0	3	3.5
3	UES010	SOLIDS AND STRUCTURES	3	1	2	4.5
4	UES011	THERMO-FLUIDS	3	1	2	4.5
5	UTA011	ENGINEERING DESIGN-III (BUGGY AND MORE SUCH PROJECTS) (6 SELF EFFORT HOURS)	1	0	4	6.0
6	UME306	MECHANICS OF MACHINES	3	1	2	4.5
TOTAL			**15**	**4**	**13**	**26.5**

SEMESTER – IV

SR. NO.	COURSE NO.	TITLE	L	T	P	CR
1	UMA007	NUMERICAL ANALYSIS	3	1	2	4.5
2	UES012	ENGINEERING MATERIALS	3	1	2	4.5
3	UMT802	INDUSTRIAL AUTOMATION	3	0	2	4.0
4	UEN004	ENERGY AND ENVIRONMENT	3	0	0	3.0
5	UME409	COMPUTER AIDED DESIGN & ANALYSIS (WITH PROJECT)(INCL. 7 SELF EFFORT HOURS)– II	3	0	3	8.0
6	UEC404	SIGNALS AND SYSTEMS (UEC-PREREQUISITE FOR DSP)	3	1	2	4.5
TOTAL			**18**	**4**	**11**	**28.5**

SEMESTER – V

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UME513	DYNAMICS AND VIBRATION	3	1	2	4.5
2.	UEC502	DIGITAL SIGNAL PROCESSING	3	1	2	4.5
3.	UME408	MACHINE DESIGN	3	2	0	4.0
4.	UEI501	CONTROL SYSTEMS	3	1	2	4.5
5.	UEC507	MICROPROCESSORS AND MICROCONTROLLERS	3	1	2	4.5
6.	UTA012	INNOVATION AND ENTREPRENEURSHIP(5 Self effort Hours)	1	0	2	4.5
TOTAL			**16**	**6**	**10**	**26.5**

SEMESTER – VI

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UMT695	PROJECT SEMESTER*				20
TOTAL						**20.0**

OR (ALTERNATE SCHEME) **

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UMT696	GROUP PROJECT				13
2.	UME847	RAPID PROTOTYPING	2	1	2	3.5
3.	UME836	OPERATIONS MANAGEMENT	3	1	0	3.5
TOTAL			**5**	**2**	**2**	**20.0**

* To be carried out in Industry/Research Institution. Credit of project semester shall to be finalized centrally at Thapar University.
** Additional subject to be introduced. Effort should be made to send all students to internship in industry.

OR

Start-up Semester
This module shall be offered as an alternative to internship for interested students. This semester will comprise of hands-on workshops on innovation & entrepreneurship and a project course. Students will be encouraged to extensively use design lab and venture lab.

SEMESTER – VII

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UEE401	ALTERNATING CURRENT MACHINES	3	1	2	4.5
2.		ELECTIVE I	3	1	-	3.5
3	UME501	APPLIED THERMODYNAMICS	3	1	2	4.5
4.	UME502	AUTOMOBILE ENGINEERING	3	0	2	4.0
5.	UEE504	POWER ELECTRONICS	3	1	2	4.5
6.	UMT893	CAPSTONE PROJECT (Starts) 4 self-effort hours	0	0	2	--
TOTAL			**15**	**4**	**10**	**21**

SEMESTER – VIII

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UME805	ROBOTICS ENGINEERING	3	1	0	3.5
2.	UHU005	HUMANITIES FOR ENGINEERS	2	0	2	3.0
3.	UEC608	EMBEDDED SYSTEMS	2	0	2	3.0
4.	UEI701	DATA ACQUISITION AND SYSTEM DESIGN	3	0	2	4.0
5.	UMT893	CAPSTONE PROJECT (Completion) 8 self-effort hours	0	0	2	8.0
6.		ELECTIVE II	3	1	0	3.5
TOTAL			**13**	**2**	**8**	**25.0**

ELECTIVE-I

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UME832	FINITE ELEMENT METHODS	3	1	0	3.5
2.	UEI841	ADVANCED CONTROL SYSTEMS	3	1	0	3.5
3.	UPE501	WORK STUDY AND ERGONOMICS ENGINEERING	3	1	0	3.5
4.	UME722	SYSTEM MODELLING AND SIMULATION	3	1	0	3.5
5.	UME844	MACHINE TOOL DESIGN	3	1	0	3.5
6.	UEC705	IMAGE PROCESSING AND COMPUTER VISION	3	1	0	3.5
7.	UCS521	ARTIFICIAL INTELLIGENCE	3	1	0	3.5

ELECTIVE-II

SR. NO.	COURSE NO.	COURSE NAME	L	T	P	CR
1.	UEC742	MEMS	3	1	0	3.5
2.	UEI846	BIO–MEDICAL DSP	3	1	0	3.5
3.	UEI831	BIO–SENSOR AND MEMS	3	1	0	3.5
4.	UEI702	VIRTUAL INSTRUMENTATION	2	0	3	3.5
5.	UEC816	BASICS OF COMMUNICATION ENGINEERING (Specialized course)	2	1	2	3.5

Semester wise Credits for BE (Mechatronics)	
Semester	**Credits**
First	23.5
Second	24.0
Third	26.5
Fourth	28.5
Fifth	26.5
Sixth	20.0
Seventh	21.0
Eighth	25.0
	Total Credits: 195.0

UMT802 - INDUSTRIAL AUTOMATION

L	T	P	Cr
3	0	2	4.0

Course objectives: This course imparts adequate background on state of art automation technologies as well as to provide hands-on knowledge to truly appreciate the contemporary automation technologies, the integration and application in modern manufacturing industries. Demonstrates problem-solving skills in automation with circuits design and ability to do the interfaces of different sensors, controllers and actuators as per application criteria. Also, introduces the practical methods of automatic control of advance machines, critical processes, systems and also new enabling technologies for reshaping the manufacturing practices.

Prerequisite(s): None

Factory Automation and Integration: Basic concepts, types of automation, automation strategies, automation technologies, applications around us and in manufacturing industries.

Design and Operation of Logic Control Circuits for Hydraulics and Pneumatics: Basic elements of hydraulics/pneumatics, fluid power control elements and standard graphical symbols for them, hydraulic & pneumatic cylinders, hydraulic & pneumatic valves for pressure, flow & direction control, Circuit design approach and real time examples; sequence operation of two/more than two cylinders as per the design requirement to automate the systems. Hydraulics/pneumatic safety and their applications to clamping, traversing and releasing operations

Design and Operation of Logic Control Circuits for Electro-Pneumatic Logic Control Circuits: Electro-pneumatic systems, solenoid valves, different sensors, factory automation sensors, electrical sensors, process automation sensors and their interfaces as per application criteria. Circuit design approach using relay logic circuits and real time examples; sequence operation of two/more than two cylinders as per the design requirement to automate the systems. Electro pneumatic & electro hydraulic systems using relay logic circuits.

Industrial Control Systems: Programmable Logic Controllers (PLC) based control system, programming languages & instruction set, ladder logic, functional blocks, structured text, and applications. Human Machine Interface (HMI) & Supervisory Control and Data Acquisition System (SCADA); motion controller, applications of RFID technology and machine vision.

Research Micro Projects: Students in a group will carry out micro project on design and implementation of an automatic modular system which can be useful in contemporary automation industries. The methodologies will be followed as first design and simulation of automated systems using Festo Fluid SIM, SIROS, PLC software and then implementation by using pneumatic controls, electro-pneumatic controls, PLC and motion controls.

Course learning outcomes (CLOs): The students will be able to

1. analyze and comprehend the benefits and applications of automation technologies in various contemporary manufacturing systems
2. design and simulate a system or process to meet desired requirements of automation within realistic constraints of various logic circuits on software and the same can be applied to automate the different processes in contemporary industry systems
3. develop automation technologies by using the different automation approaches and skills to solve the complex industrial problems necessary for contemporary engineering practice

Text Books:

1. *Groover, M. P., Automation, Production System & Computer Integrated Manufacturing, Pearson Education Asia (2009).*
2. *Esposito, A., Fluid Power with Applications, Sixth Edition, Pearson Education (2009).*
3. *Majumdar, S. R., Pneumatic Systems, McGraw Hill (2005).*

Reference Books:

1. *Nakra, B. C., Theory and Applications of Automatic Controls, Revised 2nd Edition, New Age International Publishers (2014).*
2. *Morriss, S. B., Automated Manufacturing Systems, McGraw Hill (2006).*
3. *Auslander, D. M. and Kempf, C. J., Mechatronics: Mechanical System Interfacing, Prentice Hall Inc., New Jersey (1996).*
4. *John W. Webb & Ronald A. Reis, Programmable Logic Controllers – Principles and Applications, Fifth Edition, Pearson Education (2008).*
5. *John R. Hackworth & Frederick D. Hackworth Jr, Programmable Logic Controllers – Programming Methods and Applications, Pearson (2011).*
6. *Workbook of Pneumatic and Electropneumatics by FESTO*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	40
3	Sessionals (Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	30

UEC507: MICROPROCESSOR AND MICROCONTROLLER

L	T	P	Cr.
3	1	2	4.5

Course objectives: To Introduce the basics of microprocessors and microcontrollers technology and related applications. Study of the architectural details and programming of 16 bit 8085 microprocessor and its interfacing with various peripheral ICs; Study of architecture and programming of 8051 processor.

Introduction to Microprocessor: General definitions of microprocessors and micro controllers, Similarities and Dissimilarities sors and microcontrollers. Basic Architecture and characteristics of microprocessors, Interfacing of microprocessors with RAMs, ROMs. Introduction to peripheral-interfacing, INTEL 8085 Microprocessor: Pin Functions, Architecture, Addressing Modes, Instruction Set, Timing Diagrams, Interrupts, Programming Examples.

INTEL 8086 Microprocessor: Pin Functions, Architecture, Characteristics and Basic Features of Family, Segmented Memory, CLOsck Generator (8284), Bus Controller (8288), MIN/MAX Modes of 8086, Addressing Modes, Instruction Set, Data Transfer Instructions, Arithmetic, Logical, Shift & Rotate Instructions, String Instructions, Flag Control Instructions, Transfer of Control Instructions, Processor Control Instructions, Interrupt Structures, Multitasking and Multiprogramming, Programming Examples.

Microcontroller: Introduction to Microcontrollers, Evolution, MCS-51 Family Overview, Important Features, Architecture. 8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types. Assembly Programming. Timer Registers, Timer Modes, Serial Communication using 8051, Serial Port Baud Rate. Interrupt Organization, Processing Interrupts.

Memory and Peripheral Interfacing: Memory types, Memory address decoding, MCS-51 interfacing with external program and data memory, interfacing with peripheral ICs 8255, key boards, LEDs, LCDs, PWM, ADCs, and DACs etc.

Laboratory Work: Programming of 8085 and 8086 microprocessors in Assembly, Programming of 8051 microcontroller in Assembly and C language, Interfacing of 8051 with LEDs, LCDs, PWM, ADCs, and DACs.

Course learning outcomes (CLOs): The student will be able to

1. acquire knowledge about microprocessors and its need
2. write the programs using 8085 and 8086 microprocessor
3. know the internal architecture and interfacing of different peripheral devices with 8085 and 8086 microprocessor
4. design the system using 8051 processors.

Text Books:

1. *Gaonkar, Ramesh, Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing India Pvt, Ltd., 2005.*

2. *Hall, D.V, Microprocessor and Interfacing, Tata McGraw Hill Publishing Company, 2006*
3. *Ayala, Kenneth J, The 8051 Microcontroller: Architecture, Programming, and Application, 2008.*
4. *Mckenzie, Scott, The 8051 Microcontroller, PHIs, 1995.*

Reference Books:

1. *Rafiquzzaman, M., Microprocessors and Microcomputer-Based System Design, CRC Press, 1995.*
2. *Gibson, Glenn A, Liu, Yu-Cheng, Microcomputer Systems: The 8086/8088 Family Architecture Programming And Design, Pearson, 2001.*
3. *Simon, David E, An Embedded System Primer, Pearson Education, 2005.*

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessional (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations)	40

UMT696: GROUP PROJECT

L	T	P	Cr
-	-	-	13.0

Course Objectives: To develop design skills according to a Conceive-Design-Implement-Operate (CDIO) compliant methodology. To implement engineering skill and knowledge to complete the identified project work while encouraging creativity and innovation. To develop spirit of team work, communication skills through group-based activity and foster self-directing learning and critical evaluation.

Scope of work:

For this course groups of the students shall be formulated with one student acting as group leader and students shall be encouraged for self-learning. During this project work students are expected to identify the problem of their choice through interactions with industry, R&D labs and other reputed institutions. Subsequently, each group shall make presentation of their effort of problem formulation in fourth-fifth week of the semester followed by completion of project work. Apart from this each group shall be making periodic presentation during semester for continuous evaluation and monitoring.

At the end of this project each group shall be required to submit a detailed technical report, daily diary and presentations related to the project undertaken.

Course Learning Outcomes (CLOs):

The students will be able to

1. identify a problem based on the need analysis of community /industry/ research.
2. create a flowchart of methodology for solving the identified problem
3. demonstrate team work with work division, team meetings and communications among team members.
4. write technical report for the project work and present the same through power point presentations or posters.

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1.	Regular Evaluations	30
2.	Final Evaluation- Presentation and Report, Daily diary	70

UMT893: CAPSTONE PROJECT

	L	T	P	Cr.
UMT893: Semester VII Part-I (Starts)	**0**	**0**	**2**	**--**
UMT893: Semester VIII Part-II Completion)	**0**	**0**	**2**	**8.0**

Course Objectives: Implement the project in a group for designing and fabrication of a mechatronic system. Do a detailed design of the system considering various criterion and decision making for optimization. Use various resources like books, research literature, internet, CAD CAE software tools, for refining the system design to make it practical. Detailed design record in the form of document, spread sheets, graphs, tables, images, videos and presentations for review and evaluation.

A project based course to teach integrated approach to the design of mechatronic systems using concepts of mechanical, electrical, electronics and computer engineering courses studied in the previous semesters. The mechatronic systems are to be introduced / reviewed the concepts of Morphology of design. Detailed flow chart of stages of design. Design of integrated mechatronic systems. Top down – bottom up design. Designing for satisfying requirements of reliability, robustness, integration of multidisciplinary sub-systems, stability and control. Optimized design, manufacturing, assembly, installation, maintenance, cost, transportation-to-site aspects and the use of a system design approach using various courses already studied by the students and guide in the use of software tools specific to the selected project. Use of Excel spreadsheet for design calculations and iterations. CAD design: mechanism design and analysis, kinematic and dynamic using ProEngineer/Creo. Electronic control system design using Lab View. Sensitivity studies for feasibility and optimization of mass properties. Finite Element Analysis: FEA fundamentals. Types of analysis. Types of simplifications used in FEA to reduce time and model complexity. Use of Pro/Mechanic for analysis. Sensitivity, Feasibility, and Optimization studies in FEA. Animated assembly sequence. Production drawings using CAD s/w: views, dimensioning, x-sections, BOM, Ballooning, Assembly-exploded & simplified views, tolerance, machining symbol.

Practice: Each student either individually or in a group, will be assigned a mechatronic system design project involving problem definition, selection, analysis, synthesis, optimization and detailing for production. Assembly and detailed production drawings will be prepared for the presentation of the design along with a printed report, PPT presentation and soft copy submission of work using software tools for final evaluation by a committee. Specialized software may be used for the design modeling, synthesis, optimization, analysis and for production drawings.

Part-I shall be evaluated for 30% of the marks in the VII semester and marks shall be carried forward to the next semester.

Design details evolved in Capstone Project Part-I will be used for the manufacture of prototype in Part-II of Capstone project work. Use of conventional / unconventional manufacturing processes for the fabrication of the physical prototype. The final manufacturing and working of the system will be required to be analyzed.

Part-II shall be evaluated for 70% of the marks which shall essentially consist of power

point / poster presentation and submission of a group project report.The course concludes with a final showcase using poster/ presentation along with comprehensive viva.

Course Outcomes:

1. Ability to work in a group for a mechatronic system design / design and fabrication project conceptualization, planning and execution.
2. Ability to do a detailed and optimized mechatronic system design with various criterion of design like manufacturability, assembly, reliability, integration of mechanical and electronic systems, maintenance, cost, packaging etc.
3. Ability to record the steps of design and prepare a design report in different forms like document, spreadsheet, presentations, production drawings, simulation images/videos etc.

Reference materials:

1. Books of courses of mechanical, electrical, electronics and computer engg. courses studied in the previous semesters.
2. Design manuals of electro-mechanical systems specific to every project.
3. Online literature of subject area on research, NPTEL lectures and relevant web pages.

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1.	Semester VII Problem definition, Regular evaluation.	15
2.	Semester VII Final Design Detailing.	15
3.	Semester VIII Regular evaluation	10
4.	Semester VIII Final Evaluation showcase, project website and Report	60

UEC742: MEMS

L	T	P	Cr
3	1	0	3.5

Course objectives: To educate the student to understand the fundamentals of Micro Electro Mechanical Systems (MEMS), different materials used for MEMS, semiconductors and solid mechanics to fabricate MEMS devices, various sensors and actuators, applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Introduction: History of Micro-Electro-Mechanical Systems (MEMS), Market for MEMS, MEMS materials: Silicon, Silicon Dioxide, Silicon Nitride, Polysilicon, Silicon Carbide, Polymers, Thin metal films, Clean rooms.

Process Technologies: Wafer cleaning and surface preparation, Oxidation, Deposition Techniques: Sputter deposition, Evaporation, Spin-on methods and CVD, Lithography: Optical, X-ray and E-Beam, Etching techniques, Epitaxy, Principles of bulk and surfacemicromachining, Lift-off process, Doping: Diffusion and Ion Plantation, Wafer Bonding: Anodic bonding and Silicon fusion bonding, Multi User MEMS Process (MUMPs), Introduction to MEMS simulation and design tools, Lumped element modeling and design, Electrostatic Actuators, Electromagnetic Actuators, Linear and nonlinear system dynamics.

Sensing and Actuation Principles: Mechanical sensor and actuation: Principle, Beam and Cantilever, Microplates, Capacitive effects, Piezoelectric Materials as sensing and actuating elements, Strain Measurement, Pressure measurement, Thermal sensor and actuation, Micro-Opto-Electro mechanical systems (MOEMS), Radio Frequency (RF) MEMS, Bio-MEMS.

Application case studies: Pressure Sensor, Accelerometer, Gyroscope, Digital Micromirror Devices (DMD), Optical switching, Capacitive Micromachined Ultrasonic Transducers (CMUT)

Course Learning Outcomes (CLOs): The student will be able to

1. integrate the knowledge of semiconductors and solid mechanics to fabricate MEMS devices
2. analyze operation of micro devices, micro systems and their applications
3. design the micro devices using the MEMS fabrication process
4. apply different materials used for MEMS

Text Books:

1. *Franssila Sami, Introduction to Micro Fabrication, WILEY, 2nd Edition, 2010*
2. *NadimMaluf, An Introduction to Microelectromechanical Systems Engineering, Artech House, 3rd edition, 2000.*
3. *Mahalik Nitaigour Premchand,MEMS, McGraw-Hill, 2007.*

Reference Books:

1. *Senturia Stephen D., Microsystem Design, Springer US, (2013).*
2. *Madou Marc J., Fundamentals of Microfabrication, CRC Press, (2002).*
3. *StephrnBeeby, Graham Ensell, Michael Kraft, Neil White, MEMS Mechanical Sensors, artech House (2004).*

4. *Chang Liu, Foundations of MEMS, Pearson Education Inc., (2012)*
5. *Tai Ran Hsu,MEMS& Micro systems Design and Manufacture Tata McGraw Hill, NewDelhi, 2002.*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST	30
2.	EST	45
3.	Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations)	25

UEC705: IMAGE PROCESSING AND COMPUTER VISION

L	T	P	Cr
3	1	0	3.5

Course objective: To make students understand image fundamentals and how digital images can be processed, Image enhancement techniques and its application, Image compression and its applicability, fundamentals of computer vision, geometrical features of images, object recognition and application of real time image processing.

Introduction: Digital image representation, fundamental steps in image processing, elements of digital image processing systems digitization.

Digital Image fundamentals: A Simple Image Model, Sampling and Quantization, Relationship between Pixel, Image Formats, Image Transforms.

Image Enhancement: Histogram processing, image subtraction, image averaging, smoothing filters, sharpening filters, enhancement in frequency and spatial domain, low pass filtering, high pass filtering.

Image Compression: Fundamentals, Image Compression Models, Elements of Information Theory, Error-Free Compression, Lossy Compression, Recent Image Compression Standards.

Computer Vision: Imaging Geometry; Coordinate transformation and geometric warping for image registration, Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component Analysis, Shape priors for recognition.

Laboratory Work:

1. Introduction to image processing on MATLAB.
2. Image effects based on image quantization.
3. Image enhancement algorithms for histogram processing, filtering.
4. Fourier transform of images and filtering in frequency domain.
5. Realization of any one image compression algorithm.
6. Introduction to computer vision tools.

Minor Project: *Image Compression and Facial Feature Detection with FPGA/ASIC/ARM/ DSP Processors.*

Course learning outcome (CLO):

Upon completion of the course, the student will be able to:

1. Fundamentals of image processing.
2. Basic skills to enhancing images.
3. Fundamental and state of the art image compression standards.
4. Real time image processing with computer vision.

Text Books:

1. Gonzalez, R.C., and Woods, R.E., Digital Image Processing, Dorling Kingsley (2009) 3rd ed.
2. Jain A.K., Fundamentals of Digital Image Processing, Prentice Hall (2007).
3. Sonka M., Image Processing and Machine Vision, Prentice Hall (2007) 3rd ed.
4. D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall.
5. B. K. P. Horn, Robot Vision, McGraw-Hill.
6. E. Trucco and A. Verri, Introductory Techniques for 3D Computer Vision, Prentice Hall.
7. Richard Szeliski, Computer Vision: Algos and Applications, Springer.

Reference Books:

1. Tekalp A.M., Digital Video Processing, Prentice Hall (1995).
2. Ghanbari M., Standard Codecs: Image Compression to Advanced Video Coding, IET Press (2003).

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	20
2	EST	40
3	Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations)	40

UCS521: ARTIFICIAL INTELLIGENCE

L	T	P	Cr
3	1	0	3.5

Course objective: To be familiar with the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, machine learning, knowledge acquisition and learning methods in solving particular engineering problems.

Overview: foundations, scope, problems, and approaches of AI.

Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents

Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Knowledge Representation and Reasoning: ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge, sample applications.

Planning: planning as search, partial order planning, construction and use of planning graphs

Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. Learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Languages for AI problem solving: Introduction to PROLOG syntax and data structures, representing objects and relationships, built-in predicates. Introduction to LISP- Basic and intermediate LISP programming

Expert Systems: Architecture of an expert system, existing expert systems like MYCIN, RI, Expert system shells.

Course learning outcomes (CLOs):

On completion of this course, the students will be able to

1. Learn the basics and applications of artificial intelligence and categorize various problem domains, basic knowledge representation and reasoning methods.
2. Analyze basic and advanced search techniques including game playing, evolutionary search algorithms, constraint satisfaction.
3. Learn and design intelligent agents for concrete computational problems.
4. Design of programs in AI language(s).
5. Acquire knowledge about the architecture of an expert system and design new expert systems for real life applications.

Text Books:

1. *Rich E., Artificial Intelligence, Tata McGraw Hills (2009).*
2. *George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education Asia (2009).*

Reference Books:

1. *Patterson D.W, Introduction to AI and Expert Systems, Mc GrawHill (1998).*
2. *Shivani Goel, Express Learning- Artificial Intelligence, Pearson Education India (2013).*

UEI702: VIRTUAL INSTRUMENTATION

L	T	P	Cr.
2	0	3	3.5

Course Objective: The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

Review of Virtual Instrumentation: Historical perspective, Block diagram and Architecture of Virtual Instruments

Data-flow Techniques: Graphical programming in data flow, Comparison with conventional programming.

VI Programming Techniques: VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

Data Acquisition Basics: ADC, DAC, DIO, Counters and timers.

Common Instrumentation Interfaces: RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

Use of Analysis Tools: Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

Additional Topics: System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

Laboratory Work : Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multiplot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ

Course Learning Outcomes (CLO): After the completion of the course student will be able to :

1. demonstrate the working of LabVIEW.
2. explain the various types of structures used in LabVIEW.
3. analyze and design different type of programs based on data acquisition.
4. demonstrate the use of LabVIEW for signal processing, image processing etc.
5. use different analysis tools

Text Books:

1. Johnson, G., LabVIEW Graphical Programming, McGraw–Hill (2006).
2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).

Reference Book:

1. *Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessional (May include Assignments//Quizes/Lab Evaluations)	40

UEC816: BASICS OF COMMUNICATION ENGINEERING

L	T	P	Cr
2	1	2	3.5

Prerequisites: A course on signal and system.

Course Objectives: The aim of this course is to introduce students to the theory and application of communication systems. To provide students the knowledge of analog and digital communication system this includes AM, FM, PM, PCM and digital modulation technique.

Introduction to Communication system: Definition and Evolution of communication systems, Elements of Communication systems, Types of communication system and different application.

Amplitude Modulation: Introduction, Equation of AM signal, Modulation index and efficiency of AM system, Generation and demodulation of AM signals.Introduction of SSB-SC, DSB-SC and VSB AM systems, Types of AM receivers.

Frequency Modulation: Generalized concept of angle modulation, Frequency and Phase modulation theory, Mathematical representation of frequency and phase modulated wave, Bandwidth of FM, Narrow and wide band FM, FM generation and demodulation, Comparison between AM and FM.

Pulse modulation: Sampling theorem, pulse amplitude modulation (PAM), pulse position modulation (PPM), pulse width modulation (PWM), Quantization, Pulse code modulation (PCM), time division multiplexing (TDM), Delta modulation.

Digital modulation: Line coding, different line coding techniques, Amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), quadrature amplitude modulation (QAM), constellation diagram, generation and reception of BPSK, introduction of MPSK, MFSK and MQAM.

Telephony: Principles of telephony, Telephone transmitter and receiver, Side tone, Necessity for telephone exchange, Tones in telephony, Pulsed and DTMF dialing.

Laboratory Work:

1. Experiment based on analog communication system like generation of AM, FM and PM signals.
2. Experiments based on reception of AM and FM signal.
3. Experiments of sampling theorem
4. Experiments of PCM system.
5. Experiments based digital communication system like PSK, ASK and FSK.

Micro Project:

1. Fabrication of FM transmitter and receiver.

Course Learning Outcomes (CLOs): The student will be able to

1. explain the principles of modulation.

2. describe and explain a number of analog modulation schemes and calculate bandwidth and power consumption of the different schemes.
3. describe and explain a number of digital modulation techniques.
4. apply the concepts of sampling and TDM to determine the data rate and bandwidth of digital signal.
5. explain the principle of telephony.

Text Books:

1. *S. Haykin, Communication Systems, Wiley, 2001.*
2. *Lathi, B.P., Modern Analog and Digital Communication, Oxford University Press, 2007.*

Reference Books:

1. *Kennedy, G., Electronic Communication Systems, McGraw-Hill, 2002.*
2. *Schweber, W., Electronic Communication Systems, Prentice-Hall of India Private Limited, 2002.*
3. *B. Sklar, Digital Communications, Fundamentals and Applications, Prentice Hall 2001*
4. *T. Cover, Elements of Information Theory, Wiley, 2006.*
5. *S. Haykin, Communication Systems, Wiley 2001.*

Evaluation Scheme:

S.No.	Evaluation Elements	Weightage (%)
1.	MST	25
2.	EST	35
3.	Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations)	40