Course code	Course Name	L-T-P - Credits	Year of Introduction
MR401	Advanced Automation Systems	4-0-0--4	2016

Prerequisite : NIL

Course Objectives

- To make students familiar with the automation and control technologies in modern manufacturing
- To provide knowledge on the elements of modern manufacturing systems

Syllabus

Automated production systems- Manufacturing operations- Industrial control systems-Automated Manufacturing Systems-Cellular manufacturing-Group Technology-Automated flexible manufacturing Systems- Advanced inspection systems-Lean Production systems and agile manufacturing systems.

Expected outcome .

After completing the course the students will have

i. know the functions of the elements of modern manufacturing systems
ii. know the modern philosophies of automated manufacturing and the advanced automation systems.

Text Book:

1. Mikell P Groover, Automation, Production Systems and Computer –Integrated Manufacturing, Pearson Education

References:

1. Groover , Automation , Production systems and CIM , Prentice Hall of India
2. Radhakrishnan, P Subramanian S,CAD/CAM and CIM ,Wiley Eastern
3. HMT Mechatronics, TATA Mc Graw Hill

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Production system facilities-low medium and high quantity production-Manufacturing support systems-Automation in production systems-manual labor in production systems-automaton principles and strategies-USA principle-ten strategies of Automation and Production Systems-Automation Migration strategy-manufacturing industries and products-manufacturing operations-processing and assembly operations-product /production relationships-production quantity and product variety-product and part complexity-limitations and capabilities of a manufacturing plant	10	15%
II	Elements of an automated system- power to accomplish the Automated process-program of Instructions-control systems-advanced automation functions-safety monitoring-maintenance and repair diagnostics-Error detection and Recovery-levels of automation, variables and parameters in process industries and discrete manufacturing industries-continuous and discrete control systems-computer process control-control requirements-capabilities of computer control and levels of industrial process control-computer process monitoring-direct digital control-numerical control and robotics-PLC-supervisory control-distributed control systems	10	15%

FIRST INTERNAL EXAMINATION			
III	Components of a manufacturing system-production machines-material handling system-computer control system-human resources-classification of manufacturing systems-types of operations performed-number of work stations-automation levels-part or product variety-Type I type II and type III manufacturing systems-manufacturing progress functions-learning curves	9	15%
IV	Part families-parts classification and coding-features and examples of part classification and coding systems-production flow analysis-cellular manufacturing-composite part concept-machine cell design-application of group technology-survey of industry practice-quantitative analysis in cellular manufacturing-grouping parts and machinery by rank order clustering-arranging machines in GT Cells.	9	15%
SECOND INTERNAL EXAMINATION			
V	Inspection metrology-contact and non contact inspection techniques-conventional measuring and gauging techniques-coordinate measuring machines-CMM construction-CMM operation and planning-CMM softwares-CMM applications and benefits-flexible inspection systems-inspection probes on machine tools-surface measurements-stylus instruments-machine vision-image acquisition and digitizing-image processing, digitizing analysis and interpretation- machine vision applications –non contact non optical inspection techniques.	9	20%
VI	Flexible manufacturing systems-types of FMS-FMS components-workstations-material handling and storage systems-computer control systems-human resources-FMS applications and benefits-FMS planning and implementation issues-FMS planning and design issues-FMS operational issues-lean production-agile manufacturing-market forces and agility-reorganizing the production for agility-manning relationships for agility-agility versus mass production-comparison of lean and agile manufacturing.	9	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions (3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR403	Nanotechnology	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To provide basic knowledge of Nanotechnology and its applications
- To give an exposure on Nanomaterial and fabrication of Nanostructures

Syllabus

Introduction to nanotechnology- Nanomaterial- Quantum dots- Nanostructure fabrication methods- Preparation of nanomaterial - Characterization methods- Carbon nanotube preparation, properties and applications - Self assembly of materials- smart materials- Nano fluids- Nano composites- Nano fillers- Nano clays- Nano cluster- Nano wires-applications- Safety issues with Nano scale powders- micro and nanofabrication techniques- photo resist materials- Nano lithography- soft lithography- Introduction to MEMS- NEMS and Nano electronics- -bio-nanotechnology and Nano medicines- Nano bots- targeted drug delivery- dendrimers- Nano sensors- applications of nanotechnology

Expected outcome.

On completion of the course students will

i. be familiar with various nano fabrication methods.
ii. acquire knowledge on MEMS, NEMS,CNT, AFM, SEM,TEM etc

Text Book:

1. A.K. Bandyopdhyay, *Nanomaterials*,New age international publishers
2. Nanocomposite science and technology, Pulikel M. Ajayan, Wiley – VCH 2005
3. Nanolithography and patterning techniques in microelectronics, Davis G. Bucknall, Wood head publishing 2005.

References:

1. V.S.Muralidharan, A Subramnya, Nano science and Technology Ane books Pvt Ltd
2. Lynn E. Foster, Nanotechnology - Science, Innovations & Opportunity, Pearson, 2012
3. John Mongillo, Nano Technology Greenwood Press

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to nanotechnology-top down and bottom up Approach-Nanomaterial-effects of surface to volume ratio-Quantum dots	7	15%
II	Nano structure fabrication methods-Ball milling-CVD- solgel methods-Preparation of Nanomaterial like gold, silver, and different type of Nano oxides	7	15%
	FIRST INTERNAL EXAMINATION		
III	Characterisation methods-Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy-Carbon nanotube preparation- properties and applications of CNT	7	15%

IV	Self assembly of materials- self assembled Nano layers- smart materials- Nano fluids- Nano composites- Nano fillers- Nano clays- Nano cluster- Nano wires-applications	7	15%
SECOND INTERNAL EXAMINATION			
V	Safety issues with Nano scale powders- micro and nanofabrication techniques- photo lithography- photo resist materials- Nano lithography- soft lithography	7	20%
VI	Introduction to MEMS, NEMS and Nano electronics, bio-nanotechnology and Nano medicines, Nano bots, targeted drug delivery, dendrimers- Nano sensors- applications of nanotechnology	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS

8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS

5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions

(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS

4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions

(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR405	Embedded Systems	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To make students familiar with the architecture, hardware and software elements, programming models, tools for embedded system design and implementation of embedded system.
- To give students knowledge on the hardware and real time operating systems used for the embedded systems design.
- To expose students to the concepts of embedded system principles, software development tools and RTOS

Syllabus

Embedded system, Functional building block of embedded system- Characteristics- Challenges in embedded system design- Classification-SOC- Custom Single-purpose processors- Application specific instruction set processors- General-purpose processors- Standard single-purpose processors-Common memory device- Types of I/O devices - Serial devices - Parallel port devices - Sophisticated features- Development tools-S/W Architectures.

Expected outcome.

The student will be familiar with

- the concepts of embedded systems
- the basic concepts of real time Operating system design.
- the design techniques to develop software for embedded systems
- the general purpose operating systems and the real time operating systems

Text Book:

1 Rajkamal, "*Embedded Systems – Architecture, Programming and Design*", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

2. Frank Vahid and Tony Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, Wiley, 2002.

3. David E.Simon, "A*n embedded software primer"*, Pearson Education Asia 2001.

References:

1. Wayne Wolf, "*Computers as Components: Principles of Embedded Computer Systems Design*", The Morgan Kaufmann Series in Computer Architecture and Design, Elsevier Publications, 2008.

2. Dainel W. Lewis, *Fundamentals of embedded software where C and assembly meet,* PHI 2002.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Embedded system- Functional building block of embedded system- Characteristics of embedded system applications- Challenges in embedded system design- Embedded system design processes	7	15%
II	Classification - Processors in the system - Other h/w units. Software components - Typical applications - Embedded systems on a chip (SoC) and use of VLSI circuits.	7	15%
FIRST INTERNAL EXAMINATION			

III	Custom Single-purpose processors : Hardware-Combinational Logic- Transistors and logic gates- Basic combinational and Sequential logic design- Custom single purpose processor design and optimization. Application specific instruction set processors- Microcontrollers- Digital signal processors	7	15%
IV	General-purpose processors: Software: Basic architecture- Datapath- Control unit- Memory- Instruction execution- Pipelining- Superscalar and VLIW architectures- Instruction set- Program and data memory space- Registers- I/O- Interrupts- Operating Systems- Standard single-purpose processors: Peripherals-some examples such as Timers-counters- Analog-digital converters.	7	15%
SECOND INTERNAL EXAMINATION			
V	Common memory devices - Memory selection - Memory map - Internal devices & I/O devices map - Direct memory access -. Types of I/O devices - Serial devices - Parallel port devices - Sophisticated features - Timer and Counting devices - Advanced serial bus & I/O - High speed Buses - Common types - Advanced Buses.	7	20%
VI	**Development tools**: Host and Target machines – linker / locators – debugging techniques. **S/W Architectures:** Round robin-round robin with interrupt – function queue scheduling- RTOS.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR407	Autotronics	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- This course provides basic knowledge on the working of automobiles and the electrical and electronic systems in automobiles.

Syllabus

Automotive fundamentals: The engine-components-systems -Automotive sensors -Fuel injection and Ignition system –Electronic ignition system- Safety and comfort - Electric vehicles and hybrid vehicles - Vehicle Intelligence - mobile robot vision -object detection- collision warning and Avoidance system-low tire pressure warning system.

Expected outcome .

Students will

- acquire knowledge on the sensors used in vehicles
- be familiar with the various electronic controls used in automobiles
- become familiar with advanced comfort and safety systems used in automobiles

Text Book:

1. Tom Denton, Automobile electrical and electronic systems, BH Publication, Third edition. 2004

References:

1. Willium B. Ribbens, Understanding Automotive Electronics - Sixth edition Elsevier Science 2003
2. Ronald K.Jurgen, Sensors and Transducers - SAE 2003
3. Jack Erjavec, Robert Scharff, Automotive Technology - Delmar publications Inc 1992
4. Ronald K.Jurgen, Electric and Hybrid-electric vehicles - SAE 2002
5. Ichiro Masaki, Vision-based Vehicle Guidance - Springer Verlag, Newyork 1992
6. Jay Webster, Class Room Manual For Automotive Service And System - Delmer Publications Inc 1995
7. Ron Hodkinson, John Fenton, Light Weight Electric/Hybrid Vehicle Design - Read Educational and Professional Publications Ltd. 2001.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Automotive fundamentals: The engine-components-Drive train -Starting & charging systems operation- Ignition system- Suspension systems-brakes -ABS - Steering system –Adaptive Cruise Control	7	15%
II	Automotive sensors: introduction- working principle of sensors- throttle position sensors-manifold pressure sensor-mass air flow sensor-engine coolant temperature sensors-vehicle speed sensors- crankshaft position sensors-exhaust gas oxygen sensors	7	15%
FIRST INTERNAL EXAMINATION			

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 – multi point fuel injection system –Electronic ignition system-operation-types-Electronic spark timing control.	7	15%
IV	Safety and comfort : antilock braking system-traction control system-electric seats- mirrors and sun roofs- central locking and electric windows-cruise control-electric power steering-electronic clutch-electronic suspension system-airbags	7	15%
SECOND INTERNAL EXAMINATION			
V	Electric vehicles and hybrid vehicles: Introduction-Electric Vehicle development- system layout- basic system components-fuel cell Electric vehicle. Hybrid vehicle: series Hybrid Vehicle - parallel Hybrid Vehicle-CNG Electric hybrid vehicle.	7	20%
VI	Vehicle Intelligence: Introduction -basic structure-vision based autonomous road vehicles-architecture for dynamic vision system -features-applications. An application of mobile robot vision to a vehicle information system-object detection-collision warning and Avoidance system-low tire pressure warning system.	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR409	Micro Electro Mechanical Systems	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To impart knowledge in micro machining techniques and Micro Electro Mechanical systems

Syllabus

Micro electro mechanical system – micro fabrication – microsystems and miniaturization- Materials for MEMS - Microsystems packaging- Micro Manufacturing Techniques - Micro-fabrication special machining - Theory of micromachining- Binder less wheel-Free form optics – Micro sensors: acoustic – Micro actuation - MEMS with micro actuators - Laws of scaling- Applications of MEMS - Future of MEMS

Expected outcome.

On completion of the course the student will be able to understand

i. the technology for fabrication of MEMS
ii. the behavior of materials used in MEMS
iii. the applications of MEMS

Text Books:

1. Tai-Ran Hsu MEMS & Microsytems Design and Manufacture, Tata McGraw-Hill publishing company Ltd.
2. N. Maluf, *an Introduction to Microelectro Mechanical Systems Engineering*, Artech House, 2000.

References:

1. V.C.Venaktesh , Precision Engineering, Tata McGraw-Hill Publishing Company Limited
2. Madou M.J., *Fundamentals of micro fabrication*, CRC Press, 1997.
3. Chang Liu, *Foundation of MEMS*, Illinois ECE Series, Pearson Prentice Hall 2006.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Micro electro mechanical system: MEMS and microsystems – evolution of microfabrication – microsystems and miniaturization- Materials for MEMS - Microsystems packaging.	7	15%
II	Micro Manufacturing Techniques: Photolithography- chemical Vapour Deposition – Physical Vapour Deposition- Etching Processes-Bulk micro manufacturing- surface micro manufacturing- LIGA process.	7	15%
FIRST INTERNAL EXAMINATION			

III	Micro-fabrication special machining: Laser beam micro machining- Electrical Discharge Machining- Ultrasonic Machining- Electro chemical Machining- Electron beam machining. Clean room-New Materials	7	15%
IV	Mechanical micromachining: Theory of micromachining-Chip formation-size effect in micromachining-microturning-micromilling- microdrilling- Precision Grinding : Partial ductile mode grinding- Binderless wheel-Free form optics.	7	15%
SECOND INTERNAL EXAMINATION			
V	Microsensors:acoustic- biomedical- chemical- optical- pressure-thermal- Microactuation : actuation using thermal forces- shape memory alloys- piezo electric crystals-electrostatic forces. MEMS with micro actuators: microgrippers - micromotors-microvalves-micropumps.	7	20%
VI	Laws of scaling- Applications of MEMS in various industries : Automobile- defence- healthcare- Aerospace- industry- Future of MEMS	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME469	FINITE ELEMENT ANALYSIS	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

1. To learn the mathematical background of finite element methods.
2. To understand the basics of finite element formulation.
3. To practice finite element methodologies through structural and heat transfer problems.

Syllabus

Introduction; Brief history; Review of elasticity; Direct approach;1D bar element; Analogous problems; Beam elements; Plane truss; Coordinate transformations; Interpolation functions; Shape functions; Variational methods; Strong and weak form; Rayleigh Ritz method; FE formulation using minimization of potential; Consistent nodal loads; Higher order elements; Iso parametric elements; Weighted residual methods; FEA software packages.

Expected outcome

The students will be able to

i. understand the mathematical background of FEM .
ii. solve real life problems using finite element analysis

Text Books:

1. Chandrupatla T R., Finite Element Analysis for Engineering and Technology, University Press, 2004
2. Hutton D V., Fundamentals of Finite Element Analysis, Tata McGraw-Hill, 2005
3. Logan D L., A first course in the Finite Element Method, Thomson-Engineering, 2012
4. Seshu P., Text Book of Finite Element Analysis, PHI Learning Pvt. Ltd., 2003

References Books:

1. Cook R D., Malkus D S., Plesha M E.,Witt R J., Concepts and Analysis of Finite Element Applications, John Wiley & Sons,1981
2. Reddy J N., An introduction to the Finite Element Method, McGraw- Hill, 2006

Course

Module	Contents	Hours	End Sem. Exam Marks
I	Introduction to Finite Element Method (FEM)- Brief history- Application of FEA- Advantages and disadvantages. Review of elasticity- Strain displacement relations- Compatibility-Stress strain relations- Boundary conditions- Plane stress, plane strain and axisymmetry.	2	15%

	Direct approach-1D bar element- element stiffness- Assembly of elements- properties of [K] matrix- Treatment of boundary conditions- Stress computation.	4	
II	Analogous problems of torsion, heat conduction and laminar pipe flow. Beam elements- FE formulation-element stiffness matrix- boundary conditions.	4	20%
	Plane truss- Element formulation-Co ordinate transformation- Local and global co ordinates- Stress calculations.	4	
FIRST INTERNAL EXAMINATION			
III	Interpolation functions-Shape functions- Lagrange interpolation- 1D linear and quadratic element	3	15%
	Variational methods: Functionals- Strong and weak form- Essential and natural boundary conditions.	3	
IV	Principle of stationary potential energy- Rayleigh Ritz method.	3	20%
	FE formulation using minimization of potential- B matrix- Element matrices for bar element- Consistent nodal loads.	4	
SECOND INTERNAL EXAMINATION			
V	Higher order elements- Quadratic and cubic elements-Pascal's triangle-Serendipity elements.	3	15%
	Iso parametric elements, Natural coordinates, Area co ordinates-Quadrilateral elements-Jacobian matrix-Gauss quadrature.	5	
VI	Weighted residual method: Galerkin FE formulation. Axially loaded bar-Heat flow in a bar	5	15%
	Structure of FEA software package. Introduction to Modal analysis, non linear analysis and coupled analysis.	2	
END SEMESTER EXAMINATION			

Question Paper Pattern

Maximum marks: 100, **Time: 3 hrs**

The question paper should consist of three parts

Part A
There should be 2 questions each from module I and II
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part B
There should be 2 questions each from module III and IV
Each question carries 10 marks
Students will have to answer any three questions out of 4 (3X10 marks =30 marks)

Part C
There should be 3 questions each from module V and VI
Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: Each question can have a maximum of four sub questions, if needed.

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Course code	Course Name	L-T-P - Credits	Year of Introduction
MR461	Fuzzy Logic Controllers	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To provide students an exposure to the basics of fuzzy logic, neural networks and the applications of these concepts .

Syllabus

Fuzzy Logic – fuzzy sets and membership – Classical Relations and Fuzzy Relations - fuzzy Cartesian product and composition- Membership functions - Fuzzy to Crisp Conversions – defuzzification methods- Fuzzy Rule Based Systems – graphical techniques of inference- Fuzzy Decision Making - Fuzzy Control Systems - Artificial Neural Networks –Back propagation algorithm and its variants – Different types of learning- examples

Expected outcome

Upon completion of this course the student will

i. be familiar with fundamental of fuzzy approaches
ii. acquire knowledge on fuzzy linguistic descriptions and their analytical forms
iii. be familiar with the feature of Neural Networks, types of activation functions and their classifications

Text Books:

1. Vallum B.R and Hayagriva V.R C++, Neural networks and Fuzzy logic , BPB Publications, New Delhi , 1996
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill International Editions

References:

1. Millon W.T , Sutton R.S and Werbos P.J, Neural Networks for control MIT Press 1992
2. Klir ,G.J and Yuan B.B Fuzzy sets and Fuzzy logic , Prentice Hall of India Pvt. Ltd. New Delhi 1997
3. Kosko. Neural Networks and Fuzzy systems,. Prentice hall of India Pvt. Ltd. New Delhi 1994
4. Dirankov D. Hellendoorn H, Reinfrank M ,.Introduction to Fuzzy control , Narosa Publishing House .. New Delhi 1996
5. Zurada J.M Introduction to Artificial Neural Systems Jaico Publishing House , New Delhi 1994

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Fuzzy Logic: introduction – uncertainty and imprecision – uncertainty in information – fuzzy sets and membership – chance versus ambiguity. Classical Sets and Fuzzy Sets: classical sets: operations on classical sets- properties of classical sets- mapping of classical sets to functions – fuzzy sets: fuzzy set operations- properties of fuzzy sets	7	15%
II	Classical Relations and Fuzzy Relations: Cartesian product – crisp relations: cardinality of crisp relations- properties of crisp relations – fuzzy relations: cardinality of fuzzy relations-	7	15%

	operations on fuzzy relations- properties of fuzzy relations- fuzzy Cartesian product and composition.		
FIRST INTERNAL EXAMINATION			
III	Membership Functions: features of membership functions – standard forms and boundaries – fuzzification – membership value assignments – membership function generation- Fuzzy to Crisp Conversions: lambda-cuts for fuzzy sets – lambda cuts for fuzzy relations – defuzzification methods.	7	15%
IV	Fuzzy Rule-Based Systems– graphical techniques of inference- Fuzzy Decision Making: fuzzy synthetic evaluation – fuzzy ordering – preference and consensus – multi objective decision making – fuzzy Bayesian decision method – decision making under fuzzy states and fuzzy actions.	7	15%
SECOND INTERNAL EXAMINATION			
V	Fuzzy Control Systems: review of control system theory – simple fuzzy logic controllers –general fuzzy logic controllers – special forms of fuzzy logic control system models – examples of fuzzy control system design.	7	20%
VI	Artificial Neural Networks: Introduction – history of neural networks – multilayer perceptron –Back propagation algorithm and its variants – Different types of learning- examples	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

PART B: 10 MARK QUESTIONS
2 optional questions from each of first four modules. (4 x10 = 40 marks)

PART C: 15 MARK QUESTIONS
2 optional questions from each of last two modules. (2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR463	Bio Mechatronics	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

The course enables the students to:

- understand types of sensors used in biomedical applications.
- be familiar with various equipment in bio-medical applications and the techniques of diagnosis

Syllabus

Cell structure – electrode – electrolyte interface- electrode potential- electrodes for their measurement- ECG- EEG- EMG -Basic transducer principles – Bio & Nano sensors - Input isolation- – instrument power supply- Telemetry principles – Bio telemetry-Electrocardiograph measurements – blood pressure measurement – blood flow measurement – phonocardiography – vector cardiography - Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards- Centralized patient monitoring system- computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis

Expected outcome

The students will

i. gain knowledge in medical measurements.
ii. be able to select appropriate equipments for medical applications.
iii. have knowledge on diagnosis and analysis capabilities of biomedical equipments.

Text Books:

Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2002.

References:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 1989.
2. Geddes L.A., and Baker, L.E., Principles of Applied Bio-medical Instrumentation, 3rd Edition, John Wiley and Sons, 1995.
3. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Edition, Prentice Hall of India, 1999.
4. Tompkins W.J., Biomedical Digital Signal Processing, Prentice Hall of India, 1998.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Cell structure – electrode – electrolyte interface- electrode potential- resting and action potential – electrodes for their measurement- ECG- EEG- EMG – machine description – methods of measurement – three equipment failures and trouble shooting	7	15%
II	Basic transducer principles Types – source of bioelectric potentials – resistive- inductive- capacitive- fiber-optic- photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application	7	15%

FIRST INTERNAL EXAMINATION			
III	Input isolation- DC amplifier- power amplifier- and differential amplifier – feedback- op-Amp-electrometer amplifier- carrier Amplifier – instrument power supply- Oscillagraphic – galvanometric - X-Y- magnetic recorder- storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry	7	15%
IV	Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography	7	15%
SECOND INTERNAL EXAMINATION			
V	Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards- Centralized patient monitoring system	7	20%
VI	Introduction – computers in medicine – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR465	Entrepreneurship	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To impart knowledge on enterprises and entrepreneurship
- To impart knowledge on the various elements in a business systems

Syllabus

Entrepreneurial perspectives- entrepreneurship and economic development- Characteristics of entrepreneur- Process of business opportunity identification and evaluation- industrial policy- Business- Environment market survey - project report preparation- Process and strategies for starting venture- entrepreneurship in international environment- achievement motivation- Time management creativity and innovation structure of the enterprise- Technology acquisition for small units- financing of project and working capital- break even analysis and economic ratios technology transfer and business

Expected outcome

On completion of this subject students will

i. acquire knowledge on the techno economic feasibility assessment procedure .
ii. be able to prepare project proposals
iii. Know the various forms of finance and support available for entrepreneurs.

Text Books:

1. Pandey G.W., A complete Guide to successful Entrepreneurship, Vikas Publishing
2. Harold Koontz & Heinz Weihrich, Essentials of Management, McGraw hill International

References:

1. Hirich R.D. &Peters Irwin M.P., Entrepreneurship, McGraw Hill
2. Rao T V, Deshpande M V, Prayag Mehta & Manohar S Nadakarni, Developing Entrepreneurship a Hand Book, Learning systems

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Entrepreneurial perspectives- understanding of entrepreneurship process- entrepreneurial decision process- entrepreneurship and economic development	7	15%
II	Characteristics of entrepreneur- entrepreneurial competencies- managerial functions for enterprise- Process of business opportunity identification and evaluation- industrial policy	7	15%
FIRST INTERNAL EXAMINATION			

III	Business- Environment market survey - project report preparation-study of feasibility and viability of a project assessment of risk in the industry	7	15%
IV	Process and strategies for starting venture- stages of small business growth- entrepreneurship in international environment- entrepreneurship- achievement motivation	7	15%
SECOND INTERNAL EXAMINATION			
V	Time management creativity and innovation structure of the enterprise- planning, implementation and growth- Technology acquisition for small units	7	20%
VI	Formalities to be completed for setting up a small scale uniforms of organizations for small scale units-financing of project and working capital-venture capital and other equity assistance available- break even analysis and economic ratios technology transfer and business	7	20%
END SEMESTER EXAM			

QUESTION PAPER PATTERN

Maximum Marks : 100 Exam Duration:3 hours

PART A: FIVE MARK QUESTIONS
8 compulsory questions –1 question each from first four modules and 2 questions each from last two modules (8 x 5= 40 marks)

PART B: 10 MARK QUESTIONS
5 questions uniformly covering the first four modules. Each question can have maximum of three sub questions, if needed. Student has to answer any 3 questions
(3 x10 = 30 marks)

PART C: 15 MARK QUESTIONS
4 questions uniformly covering the last two modules. Each question can have maximum of four sub questions, if needed. Student has to answer any two questions
(2 x15 = 30 marks)

Course code	Course Name	L-T-P - Credits	Year of Introduction
**451	Seminar and Project Preliminary	0-1-4-2	2016
Prerequisite : Nil			

Course Objectives

- To develop skills in doing literature survey, technical presentation and report preparation.
- To enable project identification and execution of preliminary works on final semester project

Course Plan

Seminar: Each student shall identify a topic of current relevance in his/her branch of engineering, get approval of faculty concerned, collect sufficient literature on the topic, study it thoroughly, prepare own report and present in the class.

Project preliminary:

Identify suitable project relevant to the branch of study. Form project team (not exceeding four students). The students can do the project individually also. Identify a project supervisor. Present the project proposal before the assessment board (excluding the external expert) and get it approved by the board.

The preliminary work to be completed: (1) Literature survey (2) Formulation of objectives (3) Formulation of hypothesis/design/methodology (4) Formulation of work plan (5) Seeking funds (6) Preparation of preliminary report

Note: The same project should be continued in the eighth semester by the same project team.

Expected outcome.

The students will be able to

i. Analyse a current topic of professional interest and present it before an audience
ii. Identify an engineering problem, analyse it and propose a work plan to solve it.

Evaluation

Seminar : **50 marks**

(Distribution of marks for the seminar is as follows: i. Presentation : 40% ii. Ability to answer questions : 30% & iii. Report : 30%)

Project preliminary : **50 marks**(Progress evaluation by the supervisor : 40% and progress evaluation by the assessment board excluding external expert : 60%. Two progress evaluations, mid semester and end semester, are mandatory.)

Note: All evaluations are mandatory for course completion and for awarding the final grade.

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR431	Mechatronics Lab	0-0-3-1	2016

Prerequisite : Nil

Course Objectives

- To provide hands on experience on the working of hydraulic and pneumatic controls, speed control, and PID controllers
- To impart proficiency in programming of robots
- To impart knowledge on virtual instrumentation and vision systems

List of Exercises/Experiments :

1. Design and assembly of pneumatic/hydraulic kit
2. Study of different type of pneumatic and hydraulic valve.
3. Study of reciprocating movement of double acting cylinder using pneumatic direction control valve.
4. Speed control stepper and servo motor using micro processor kit.
5. Programming Robot (Pick and place robot)
6. Sensors for automotives
7. Tool condition monitoring using sensors.
8. PID Controller
9. Automatic door opening and closing
10. Virtual Instrumentation
    a. Data acquisition
    b. Image acquisition
    c. Stepper and servo control device
    d. Signal conditioning of strain gauge. LVDT, Thermocouple, pressure transducer, etc.,
11. A/D and D/A conversion
12. Machine Vision system
13. Study of robot end effectors

Expected outcome.

The students will be able to

- Develop pneumatic circuits for automating various operations
- Program a robot for a pick and place operation
- Prescribe sensors for monitoring and control operations
- Acquire knowledge on analog and digital data convertors