Course code	Course Name	L-T-P - Credits	Year of Introduction
MR302	**Robotics Engineering**	**4-0-0 -4**	**2016**

Prerequisite : NIL

Course Objectives

- To provide basic knowledge on the concepts of robotics in the context of manufacturing industry
- To impart knowledge on robotic kinematics, machine vision, sensor system and their application in real time industry.
- To learn the principles of robot drives and controls.

Syllabus

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space- precision of movement-Drives and control systems and its operation-Mechanical Components of Robots-Robot End Effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms — Robot end effector interface-Sensors in Robotics- Descriptions - Positions - Orientations, frames, Mappings - Changing descriptions from frame to frame. Transformation arithmetic - translations - rotations - transformations - transform equations - Introduction to manipulations – Forward Kinematics and inverse Kinematics. - Methods of Robot Programming (Quantitative treatment only) - on-line/off-line - Show and Teach - Teach Pendant - Lead and Teach- Lead Teach method – robot program as a path in space - motion interpolation - WAIT - SIGNAL - DELAY Command- Application - Machining – Welding - Assembly - Material Handling

Expected outcome

The students will

- Understand the kinematics of robots and adaptive control.
- Understand the robot actuators and controls.
- Get knowledge on sensors and selection of sensors for robotic applications.
- Get knowledge in robot cell layouts and their applications.
- Get knowledge in robot programming , artificial intelligence and machine vision.

Text Books:

1. M.P. Groover, Industrial Robotics – Technology, Programming and Applications, McGraw- Hill, USA, 1986.
2. John J.Craig , “Introduction to Robotics”, Pearson, 2009.

References:

i. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.
ii. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991.
iii. Arthor Critchlow, Introduction to Robotics, Macmillan, 1985.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work Volume- Spatial resolution – Accuracy and Repeatability of Robots- wrist configurations- motion - roll - Pitch - Yaw	10	15%
II	Drives - Hydraulic motor – DC servo motors – stepper motors – operation. Mechanical Components of Robots- Power	9	15%

	transmission systems- Gear transmission. Belt drives- cables- Roller Chains- Link – Road Systems- Rotary to linear motion conversion- Rack and pinion drives- ball bearing screws- speed reducers- Harmonic drives.		
FIRST INTERNAL EXAMINATION			
III	Robot End Effectors: Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers – Robot end effector interface.	9	15%
IV	Sensors in Robotics: Position sensors – Potentiometers- encoders – LVDT- Velocity sensors- Acceleration Sensors- Force- Pressure and Torque sensors- Touch and Tactile sensors- Proximity- Range and sniff sensors- RCC- VOICE recognition and synthesizers- contact and non contact sensors.	9	15%
SECOND INTERNAL EXAMINATION			
V	Descriptions - Positions - Orientations- frames- Mappings - Changing descriptions from frame to frame. Transformation arithmetic - translations - rotations - transformations - transform equations - transformation of free vectors. Introduction to manipulations – Forward Kinematics and inverse Kinematics.	10	20%
VI	Methods of Robot Programming (Quantitative treatment only) - on-line/off-line - Show and Teach - Teach Pendant - Lead and Teach.. Lead Teach method – robot program as a path in space - motion interpolation - WAIT - SIGNAL - DELAY Commands Application - Machining – Welding - Assembly - Material Handling - Loading and Unloading in hostile and remote environment.	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
MR304	Digital Image Processing and Machine Vision	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To give the fundamentals of image processing and mathematical transforms necessary for image processing.
- To familiarise the image enhancement techniques.
- To know image restoration and image compression procedures.
- To provide the concept of image segmentation and image representation techniques.

Syllabus

Elements of visual perception – Image sampling and quantization- Basic relationship between pixels – Basic geometric transformations- FFT – Separable Image Transforms -Walsh – Hadamard – DCT- Haar-Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing- sharpening filters –Frequency domain filters- Homomorphic filtering- Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse-Lossless compression: Variable length coding - predictive coding-DPCM. Lossy Compression: Transform coding – Wavelet coding – Basics of Image compression standards: JPEG- MPEG- Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes– Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.- Machine Vision- sensing- low and higher level vision- image acquisition and digitization- cameras- CCD- CID- CPD- illumination and types- image processing and analysis- feature extraction- applications.

Expected outcome

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

- Basic concepts of digital image processing
- Various steps involved in digital image processing
- Techniques involved in machine vision

Text Books:

1.. Rafel C.Gonzalez and Richard E.Woods. Digital Image Processing, Addison Wesley, 1993.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997
3. Vernon D, Machine Vision – Automated Visual Inspection and Robot Vision, Prentice Hall, International Ltd., 1991
4. Ramesh Jain, Rangachar Kasturi, Brain G. Schunk, Machine Vision, McGraw Hill International Editions, Computer Science Series.

References:

1. William K. Pratt, Digital Image Processing, John Wiley, NY, 1987.
2. Sid Ahmed M.A., Image Processing Theory, Algorithms and Architectures, McGraw Hill, 1995.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Elements of visual perception – Image sampling and quantization- Basic relationship between pixels – Basic	7	15%

	geometric transformations-Introduction to Fourier Transform Properties of 2D Fourier Transform – Separable Image Transforms –Walsh – Discrete Cosine Transform- Haar		
II	Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging –Spatial filtering: Smoothing- sharpening filters –Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering.	7	15%
FIRST INTERNAL EXAMINATION			
III	Model of Image Degradation/restoration process – Noise models – Inverse filtering –Least mean square filtering – Constrained least mean square filtering – Blind image restoration – Pseudo inverse	7	15%
IV	Lossless compression: Variable length coding – LZW coding – Bit plane coding- predictive coding-DPCM. Lossy Compression: Wavelet coding-Digital Image Watermarking. – Basics of Image compression standards: JPEG- MPEG	7	15%
SECOND INTERNAL EXAMINATION			
V	Edge detection – Thresholding - Region Based segmentation – Boundary representation: chain codes– Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors - Regional descriptors –Simple descriptors- Texture.	7	20%
VI	Machine Vision- sensing- low and higher level vision- image acquisition and digitization- cameras- CCD- CID- CPD- illumination and types- image processing and analysis- feature extraction- applications.	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
MR306	Mechanics of Solids	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To acquaint with the basic concepts of stress and deformation in solids.
- To impart knowledge on the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

Syllabus

Simple Stress and Strain- analysis of deformable bodies – Material behavior – stress-strain diagrams.- deformation in axially loaded bars– statically indeterminate problems – principle of superposition. Elastic strain energy for uniaxial stress – Poisson's ratio – biaxial deformations – Bulk modulus - Relations between elastic constants - Torsion theory of elastic circular bars – economic cross-sections – statically indeterminate problems – shaft design for torsional load. - Axial force- shear force and bending moment - elastic curve – point of inflection -Stresses in beams- Pure bending – flexure formula for beams – section modulus - flexural rigidity - economic sections – beam of uniform strength - Shearing stress formula for beams – springs- Columns.

Expected outcome

The students will be

i. familiar with the basic concepts of stress and deformations.
ii. familiar with the methods to measure stress and deformation in engineering materials.

Text Books:

1. E. P. Popov, T. A. Balan, Engineering Mechanics of Solids, Pearson Education, New Delhi.
2. R K Bansal, Mechanics of solids, Laxmi Publications
3. P. N. Singh, P. K. Jha, Elementary Mechanics of Solids, Wiley Eastern Limited, New Delhi.

References:

1. Gere, Timoshenko, Mechanics of Materials, CBS Publishers & Distributors, New Delhi.
2. I.H. Shames, J. H. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, New Delhi.
3. F. Beer, E. R. Johnston, J. T. DeWolf, Mechanics of Materials, Tata McGraw Hill, New Delhi
4. S. H. Crandal, N. C. Dhal, T. J. Lardner, An Introduction to the Mechanics of Solids, McGraw Hill
5. A. Pytel, F. L. Singer, Strength of Materials, Harper & Row Publishers, New York.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Simple Stress and Strain: Introduction to analysis of deformable bodies – internal forces – method of sections – assumptions and limitations. Simple stresses – stresses due to normal- shear and bearing loads – strength design of simple members. Definition of linear and shear strains- Material behavior-stress-strain diagrams.	7	15%

II	Hooke's law for linearly elastic isotropic material under axial and shear deformation – deformation in axially loaded bars– statically indeterminate problems – principle of superposition. Elastic strain energy for uniaxial stress. Definition of stress and strain at a point (introduction to stress and strain tensors and its components only) – Poisson's ratio – biaxial deformations – Bulk modulus - Relations between elastic constants.	7	15%
FIRST INTERNAL EXAMINATION			
III	Torsion: Torsion theory of elastic circular bars – assumptions and limitations – torsional rigidity – economic cross-sections – statically indeterminate problems – shaft design for torsional load.	7	15%
IV	Stresses in beams: Pure bending – flexure formula for beams – assumptions and limitations – section modulus - flexural rigidity - economic sections – beam of uniform strength. Shearing stress formula for beams – assumptions and limitations.	7	15%
SECOND INTERNAL EXAMINATION			
V	Axial force- shear force and bending moment: Diagrammatic conventions for supports and loading - axial force- shear force and bending moment in a beam – differential relations between load- shear force and bending moment - shear force and bending moment diagrams by direct and summation approach – elastic curve – point of inflection.	7	20%
VI	Types of springs- stiffness stresses and deflection in helical spring and leaf spring. Columns – Buckling and stiffness due to axial loads – Euler- Rankin and Empirical formulae for columns with different conditions.	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
MR308	Digital Manufacturing	3-0-0 -3	2016

Prerequisite : NIL

Course Objectives

- To impart knowledge in FMS and shop floor control.
- To give knowledge in CNC machines and their programming.
- To enlighten on the working principles of various sensors in digital manufacturing.

Syllabus

Introduction to Computer Integrated Manufacturing- - classification - open loop and closed loop systems - special tool holders- Automatic tool changers. NC part programming - part programming examples. Controls in CIM- material handling in CIM- AGV- Vehicle guidance- vehicle management and safety automated storage systems- ASRS components and operations- features of ASRS- Quality control Condition monitoring of manufacturing systems – Role of sensors in manufacturing automation-operation principles of different sensors in Robotics and manufacturing – pneumatic- Light sensors– encoder- resolver- potentiometers- range- proximity – Temperature sensors -Pressure sensors –position sensors- displacement and velocity sensors. – sensors for monitoring force- vibration and noise. Acoustics emission sensors-principles and applications-concept of tool wear and its monitoring-MRP-MRPII-Shop floor control –Factory data collection systems – Automatic identification methods – Bar code technology- magnetic strips- automated data collection system – Agile manufacturing-flexible manufacturing.

Expected outcome

The students will

i. Understand the concept of FMS and shop floor control.
ii. Get knowledge on the construction and working of sensors used in robotics and digital manufacturing.
iii. Get knowledge in automatic identification methods.

Text Books:

1. Sabrie Salomon, Sensors and Control Systems in Manufacturing, McGraw Hill Int. Ed., 1994.
2. Mikell P. Groover, Automation Production System and Computer Integrated Manufacturing, Prentice Hall of India Ltd., 2001
3. Patranabis .D, Sensors and Transducers, Wheeler publishers, 1994.
4. S.R.Deb, Robotics technology and flexible automation, Tata McGraw Hill publishing Co. Ltd., 1994.

References:

1. Richard D. Klafter, Robotic Engineering, Prentice Hall of India Pvt., Ltd., 2001.
2. Julian W. Gardner, Micro Sensor MEMS and Smart Devices, John Wiley & Sons, 2001
3. Randy Frank, Understanding Smart Sensors, Artech house, USA, 1996

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Computer Integrated Manufacturing- fundamentals of numerical control and Computer Numerical Control- advantages of NC system - classification of NC system - open loop and closed loop systems - special tool	7	15%

	holders- Automatic tool changers – Digital inspection		
II	NC part programming - manual programming - part programming examples- point to point programming and contour programming- computer aided programming concepts- post processor- program languages- APT- programming - part programming examples.	7	15%
FIRST INTERNAL EXAMINATION			
III	Controls in CIM- material handling in CIM- AGV- Vehicle guidance- vehicle management and safety automated storage systems- ASRS components and operations- features of ASRS-	7	15%
IV	Introduction – Role of sensors in manufacturing automation- operation principles of different sensors in Robotics and manufacturing – pneumatic- Light sensors– encoder- resolver- potentiometers- range- proximity- – Temperature sensors - Pressure sensors –position sensors- displacement and velocity sensors.	7	15%
SECOND INTERNAL EXAMINATION			
V	Quality control Condition monitoring of manufacturing systems-principles –sensors for monitoring force- vibration and noise. Acoustics emission sensors-principles and applications- concept of tool wear and its monitoring	7	20%
VI	MRP-MRPII-Shop floor control –Factory data collection systems – Automatic identification methods – Bar code technology- magnetic strips- automated data collection system – Agile manufacturing-flexible manufacturing	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
HS300	Principles of Management	3-0-0-3	2016

Prerequisite : Nil

Course Objectives

- To develop ability to critically analyse and evaluate a variety of management practices in the contemporary context;
- To understand and apply a variety of management and organisational theories in practice;
- To be able to mirror existing practices or to generate their own innovative management competencies, required for today's complex and global workplace;
- To be able to critically reflect on ethical theories and social responsibility ideologies to create sustainable organisations.

Syllabus

Definition, roles and functions of a manager, management and its science and art perspectives, management challenges and the concepts like, competitive advantage, entrepreneurship and innovation. Early contributors and their contributions to the field of management. Corporate Social Responsibility. Planning, Organizing, Staffing and HRD functions, Leading and Controlling. Decision making under certainty, uncertainty and risk, creative process and innovation involved in decision making.

Expected outcome.

A student who has undergone this course would be able to

i. manage people and organisations
ii. critically analyse and evaluate management theories and practices
iii. plan and make decisions for organisations
iv. do staffing and related HRD functions

Text Book:

Harold Koontz and Heinz Weihrich, *Essentials of Management*, McGraw Hill Companies, 10th Edition.

References:

1. Daft, *New era Management*, 11th Edition, Cengage Learning
2. Griffin, *Management Principles and Applications*, 10th Edition, Cengage Learning
3. Heinz Weirich, Mark V Cannice and Harold Koontz, *Management: a Global, Innovative and Entrepreneurial Perspective*, McGraw Hill Education, 14th Edition
4. Peter F Drucker, *The Practice of Management*, McGraw Hill, New York
5. Robbins and Coulter, *Management*, 13th Edition, 2016, Pearson Education

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Introduction to Management: definitions, managerial roles and functions; Science or Art perspectives- External environment-global, innovative and entrepreneurial perspectives of Management (3 Hrs.)– Managing people and organizations in the context of New Era- Managing for competitive advantage - the Challenges of Management (3 Hrs.)	6	15%

II	**Early Contributions and Ethics in Management**: Scientific Management- contributions of Taylor, Gilbreths, Human Relations approach-contributions of Mayo, McGregor's Theory, Ouchi's Theory Z (3 Hrs.) Systems Approach, the Contingency Approach, the Mckinsey 7-S Framework Corporate Social responsibility- Managerial Ethics. (3 Hrs)	6	15%
FIRST INTERNAL EXAMINATION			
III	**Planning:** Nature and importance of planning, -types of plans (3 Hrs.)- Steps in planning, Levels of planning - The Planning Process. – MBO (3 Hrs.).	6	15%
IV	**Organising for decision making:** Nature of organizing, organization levels and span of control in management Organisational design and structure –departmentation, line and staff concepts (3 Hrs.) Limitations of decision making- Evaluation and selecting from alternatives- programmed and non programmed decisions - decision under certainty, uncertainty and risk-creative process and innovation (3 Hrs.)	6	15%
SECOND INTERNAL EXAMINATION			
V	**Staffing and related HRD Functions:** definition, Empowerment, staff – delegation, decentralization and recentralisation of authority – Effective Organizing and culture-responsive organizations –Global and entrepreneurial organizing (3 Hrs.) Manager inventory chart-matching person with the job-system approach to selection (3 Hrs.) Job design-skills and personal characteristics needed in managers-selection process, techniques and instruments (3 Hrs.)	9	20%
VI	**Leading and Controlling:** Leading Vs Managing – Trait approach and Contingency approaches to leadership - Dimensions of Leadership (3 Hrs.) - Leadership Behavior and styles – Transactional and Transformational Leadership (3 Hrs.) Basic control process- control as a feedback system – Feed Forward Control – Requirements for effective control – control techniques – Overall controls and preventive controls – Global controlling (3 Hrs.)	9	20%
END SEMESTER EXAM			

Question Paper Pattern

Max. marks: 100, Time: 3 hours .
The question paper shall consist of three parts

Part A: 4 questions uniformly covering modules 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 : 4 questions uniformly covering modules 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: 6 questions uniformly covering modules V and VI. Each question carries 10 marks
Students will have to answer any four questions out of 6 (4X10 marks =40 marks)

Note: In all parts, each question can have a maximum of four sub questions, if needed.

Course code	Course name	L-T-P-Credits	Year of Introduction
AE403	BIOMEDICAL INSTRUMENTATION	3-0-0-3	2016

Prerequisite : Nil

Course objectives

- To impart knowledge of the principle of operation and design of biomedical instruments.
- To render a broad and modern account of biomedical instruments.
- To introduce idea about human physiology system

Syllabus

Electro physiology- Bioelectric potential and cardiovascular measurements- Respirator and pulmonary measurements and rehabilitation- Patient monitoring systems- Clinical Laboratory Instruments- Imaging technique & Telemetry.

Expected outcome

At the end of the semester students will

i. be able to understand about human physiology
ii. have knowledge of the principle operation and design and the background knowledge of biomedical instruments and specific applications of biomedical engineering

Text Books

1. Arumugam.M. "*Biomedical Instrumentation*", Anuradha Agencies Publishers, Kumbakonam, 2006.
2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, Prentice Hall, New Delhi, 1998.

Reference Books:

1. Geddes L. A. and Baker L. E., *"Principles of Applied Biomedical Instrumentation",* 3rd Edition, John Wiley, New York, 1989.
2. John. G. Webster, *"Medical Instrumentation, Application and Design"* John Wiley, New York, 1998
3. R.S.Khandpur, *"Handbook of Biomedical Instrumentation",* Prentice Hall of India, New Delhi, 2003
4. Richard Aston, *"Principles of Bio-medical Instrumentation and Measurement*", Merril Publishing Company, New York, 1990.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Electro physiology: Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and uni-polar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems.	7	15%
II	Bioelectric potential and cardiovascular measurements: EMG - Evoked potential response, EEG, foetal monitor. ECG phonocardiography, vector cardiograph, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.	6	15%
FIRST INTERNAL EXAMINATION			
III	Respirator and pulmonary measurements and rehabilitation:	7	15%

	Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine.		
IV	Patient monitoring systems: Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.	7	15%
SECOND INTERNAL EXAMINATION			
V	Clinical Flame photometer - spectrophotometer – Colorimeter- chromatography- Automated Biochemical analysis system - Blood Gas Analyzer: Blood pH Measurement- Measurement of Blood pCO2- Blood pO2 Measurement- Blood Cell Counters: Types and Methods of cell Counting.	7	20%
VI	Recent trends: Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Module 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Module 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Module 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)

Course code	Course Name	L-T-P-Credits	Year of Introduction
ME368	Marketing Management	3-0-0-3	2016

Prerequisite : Nil

Course Objectives: :

- To introduce the concept of market and marketing
- To give idea about launching a new product
- To introduce the various marketing strategies

Syllabus:

Introduction to marketing, Social and Marketing planning, Consumer behavior, Marketing communication, Designing the message, New trends in marketing

Expected Outcomes:

The students will be able to

i. state the role and functions of marketing within a range of organizations.
ii. describe key marketing concepts, theories and techniques for analyzing a variety of marketing situations.
iii. identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken
iv. synthesize ideas into a marketing plan

Text books:

1. Majumdar R., Marketing Research, Text, Applications and Case Studies, New Age International (P), 1991
2. Ramaswamy V.S. & Namkumari S, Marketing Management: Planning, Implementation and Control, Macmillan India Limited, 2002
3. Robert, Marketing Research, Prentice Hall of India,1999
4. T N Chabra and S K Grover : Marketing management, Dhanpat Rai, 2007

Reference books:

1. Kotler P, Marketing Management: Analysis, Planning, Implementation and Control, Prentice Hall of India,1993
2. Stanton W.J., Etzel M.J. & Walker B.J, Fundamentals of Marketing, McGraw Hill International Edition, 1994

COURSE PLAN

Module	Contents	Hours	End Sem. Exam. Marks
I	Introduction to marketing - concept of market and marketing – marketing environment - controllable factors - factors directed by top management - factors directed by marketing - uncontrollable factors - demography, economic conditions, competition.	7	15%
II	Social and Marketing planning - marketing planning process - Boston consultancy group model - marketing mix - marketing mix variables. Developing, testing and launching of new products .	7	15%

	FIRST INTERNAL EXAMINATION		
III	Market segmentation and market targeting - introduction to segmentation - targeting and product positioning. Marketing research - need and scope - marketing research process – research objectives, developing research plan, collecting information, analysis, and findings.	**7**	**15%**
IV	Consumer behaviour - factors influencing consumer behaviour - perceived risks Product life cycle - marketing strategies for different stages of product life cycle	**6**	**15%**
SECOND INTERNAL EXAMINATION			
V	Marketing communication - marketing mix variables - steps in developing effective communication - identification of target audience - determination of communication objectives	**7**	**20%**
V1	Designing the message - selecting the communication channels - promotion mix evaluation - advertising and sales promotion - factors in advertising - sales promotion tools. New trends in marketing- Brand management - significance of branding to consumers and firms	**8**	**20%**
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.

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR362	Digital Signal Processing	3-0-0:3	2016

Prerequisite : NIL

Course Objectives

- To introduce students the basics of Signals and Systems, Digital Signal Processing and DSP processors.
- To teach students on the design of digital filters and implementation of digital filters using various structures.

Syllabus

Signals and systems- Basic element of digital signal processing-Concept of continuous time and discrete time signals- Discrete time system- Anlaysis of Linear time invariant systems- Direct and inverse Z transform- Convolution and correlation. Classification of continuous and Discrete Time signal –- Classification of systems : Linear- Time invariant- Causal -Stable- Invertible systems- BIBO Stability criterion. Spectrum of discrete time signal- Discrete Time Fourier transform and its properties- Discrete Fourier Transform and its properties- Linear convolution using DFT- Fast Fourier Transform- Z-transform and its properties- Inverse Z-transform using partial fraction and residue methods. Design of analog filters using Butterworth and Chebyshev approximation- Frequency transformation- Design of digital IIR filters-Impulse Invariant and Bilinear transformation methods- Structures for IIR digital filters. Design of digital FIR filters – Fourier series- Frequency sampling and windowing methods- Structure for FIR filters- Comparison of IIR and FIR filters. Representation of Numbers in Digital System – Fixed and Floating point Numbers- Finite word length effects- Introduction to TMS320C5X

Expected outcome

After the completion of this course the students will be able to

i. understand the basic concepts of signals and systems.
ii. design and implement digital IIR and FIR filters.
iii. learn the architecture of the DSP processor.

Text Books:

1. Alan V. Oppenheim, Ronald W. Schaffer, *Discrete Time Signal Processing*, PHI, 1999.
2. John G. Proakis and Dimitris C. Manolakis, *Digital Signal Processing Principles, Algorithms and Applications*, Prentice Hall of India, 3rd edition, 1996.
3. Ramesh Babu C, *Digital Signal Processing,* Durai, Laxmi Publications, 2005

References:

1. Rabiner L. R. and C. B. Gold, *Theory and Applications of Digital Signal Processing*, Prentice Hall India, 1987.
2. Sanjit Mitra, *Digital Signal Processing – A Computer Based Approach*, Tata Mc Graw Hill, 2001.
3. 3. Ashok Ambardar, *Digital Signal processing – A modern Introduction*, Thomson Publishers 2007.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**Signals and systems**: Basic element of digital signal processing- Concept of continuous time and discrete time signals- Discrete time system- Anlaysis of Linear time invariant systems- Direct and inverse Z transform- Convolution and correlation	7	15%

II	Classification of continuous and Discrete Time signal – Periodic- Even and Odd- Energy and Power- Deterministic and Random- Complex exponential signals- Elementary signals – UNIT step- Ramp- Impulse- Classification of systems : Linear- Time invariant- Causal -Stable- Invertible systems- BIBO Stability criterion.	7	15%
FIRST INTERNAL EXAMINATION			
III	**TRANSFORMATION OF DISCRETE TIME SIGNALS** Spectrum of discrete time signal- Discrete Time Fourier transform and its properties- Discrete Fourier Transform and its properties- Linear convolution using DFT- Fast Fourier Transform- Z-transform and its properties- Inverse Z-transform using partial fraction and residue methods.	7	15%
IV	**IIR FILTERS** Design of analog filters using Butterworth and Chebyshev approximation- Frequency transformation- Design of digital IIR filters- Bilinear transformation methods.	7	15%
SECOND INTERNAL EXAMINATION			
V	**FIR FILTERS** Design of digital FIR filters – Fourier series- Frequency sampling and windowing methods- Structure for FIR filters- Comparison of IIR and FIR filters.	7	20%
VI	**FINITE WORD LENGTH EFFECTS AND DSP PROCESSOR** Representation of Numbers in Digital System – Fixed and Floating point Numbers- Finite word length effects- Introduction to TMS320C5X Processor architecture- Central processing unit- Memory- Addressing modes- Pipelining.	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
MR364	Energy Engineering and Management	3-0-0-3	2016

Prerequisite : NIL

Course Objectives

- To study the engineering aspects of solar, wind and bio energy sources.
- To create awareness about the auditing and management techniques related to energy and technology

Syllabus

Solar energy engineering- Bio energy engineering- Wind energy engineering- Energy audit and management- Waste management- Technology management

Expected outcome.

The students will

i. be familiar with the concepts of solar energy engineering, wind energy engineering and bio energy engineering.

ii. grasp the basics of energy auditing techniques, waste management and technology management.

Text Books

1. W R Murphy, G A McKay, Energy Management , Butterworth-Heinemann Ltd
2. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005.
3. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Printice Hall, 2000
4. Chakraverthy A, "Biotechnology and Alternative Technologies for Utilization of Biomass or Agricultural Wastes", Oxford & IBH publishing Co, 1989.

References:

1. D. Yogi Goswami, Frank Kreith, Jan. F. Kreider, "Principles of Solar Engineering", 2nd Edition, Taylor & Francis, 2000, Indian reprint, 2003 2. Edward E. Anderson, "Fundamentals for solar energy conversion", Addison Wesley Publ. Co., 1983
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.
3. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
4. Wind energy Handbook, Edited by T. Burton, D. Sharpe, N. Jenkins and E. Bossanyi, John Wiley & Sons, 2001.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	**SOLAR ENERGY ENGINEERING** Source of radiation – solar constant– solar charts – Measurement of diffuse- global and direct solar radiation: pyrheliometer- pyranometer- pyregeometer- net pyradiometer- sunshine recorder. **Photo-voltaic cell** – characteristics-cell arrays-power electric circuits for output of solar panels- choppers-inverters-batteries-charge regulators- Construction concepts.	7	15%
II	**BIO ENERGY ENGINEERING** Sources and Classification. Chemical composition- properties of biomass. Energy plantations .Size reduction- Briquetting- Drying- Storage and handling of biomas-Thermo chemical conversion of lignocelluloses biomass. Incineration- Processing for liquid fuel production.	7	15%

FIRST INTERNAL EXAMINATION			
III	**WIND ENERGY ENGINEERING** Measurement and instrumentation – Beau fort number -Gust parameters – wind type – power law index -Betz constant - Terrain value. Energy in wind– study of wind applicable Indian standards – Steel Tables- Structural Engineering- Grid-combination of diesel generator- Battery storage – wind turbine circuits- Wind farms— fatigue stress	7	15%
IV	**ENERGY AUDIT AND MANAGEMENT** Energy Audit -various Energy Conservation Measures in Steam -Losses in Boiler. Energy Conservation in Steam Systems - Case studies.-Organizational background desired for energy management motivation- detailed process of M&T- Thermostats- Boiler controls- proportional- differential and integral control- optimizers; compensators.	7	15%
SECOND INTERNAL EXAMINATION			
V	**WASTE MANAGEMENT** Sources- Types- Compositions- Properties Physical- Chemical and Biological - Collection - Transfer Stations – Waste minimization and recycling of Municipal Waste. -Size Reduction - Aerobic Composting - Incineration for Medical /Pharmaceutical Waste -Environmental Impacts - Environmental Effects due to Incineration.	7	20%
VI	**TECHNOLOGY MANAGEMENT** Invention- Innovation- Industrial & IPR- Patents- Copyrights- Trademarks- Design Registration- Trade Secrets- WTO- Trade-Patent Specifications- Patent Search Websites. -Technology Transfer Model- Technology Search Strategy- Dimensions of Technology Transfer- Features of Technology Package- Routes of Technology Transfer	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
MR332	**Manufacturing Engineering Lab**	**0-0-3-1**	**2016**

Prerequisite : ME220 Manufacturing technology

Course Objectives

- To demonstrate specific machine tools
- To familiarise with the different manufacturing operations

LIST OF EXPERIMENTS (Any 6 Exercises)

1.Centre Lathe- 2 Exercises (4 sections)

2. Drilling Machine-1 Exercises (2 sections)

3. Milling Machine-2 Exercises (4 sections)

4. Shaping Machine-1 Exercises (2 sections)

5.Slotting Machine-1 Exercises (2 sections)

6 Grinding Machine-1 Exercises (2 sections)

7. CNC Processes Machine-1 Exercises (2 sections)

Expected outcome.

On completion of the course the student will be able to

i. Operate specific machine tools and perform simple machining operations.

ii. Develop simple CNC part programs

Text Book:

1. Sharma, P.C., *A textbook of Production Technology – Vol I and II,* S. Chand & Company Ltd., NewDelhi, 1996.
2. Rao, P.N., *Manufacturing Technology, Vol I & II,* Tata McGraw Hill Publishing Co., New Delhi, 1998.

Course code	Course Name	L-T-P - Credits	Year of Introduction
MR334	Advanced Instrumentation Lab	0-0-3-1	2016

Prerequisite: MR205 Science of measurements

Course Objectives

- To make students familiar with the techniques for measuring process parameters and techniques in metrology.

List of Experiments

1) Measurement of pressure

   a. Calibration of Bourdon tube pressure gauge using dead weight pressure gauge tester.
   b. Calibration of strain gauge pressure cell

2) Measurement of temperature

   Non contact temperature measurement- Radiation pyrometer and infrared pyrometer- Time constant of temperature measuring device

3) Measurement of vibration

   Piezo electric Accelerometers and vibrometers

4) Measurement of torque and force

   Measurement of cutting force during turning, drilling and milling using tool force dynamometer

5) Acoustic measurement-

   Sound level meter-octave band filter- preparation of noise Contours

6) Measurement of rotation speed

   Measurement of rotation speed using tachometer , tacho generator and stroboscopic tachometer – Calibration of tachometers

7) Metrology

   a. Measurement of surface finish using stylus type surface roughness measuring device
   b. Tool makers microscope- Measurement of tool wear using tool makers microscope
   c. Study and use of linear and angular measuring devices- vernier caliper, outside and inside micrometer, vernier depth gauge, vernier height gauge, feeler gauge, screw pitch gauge, sine bar, slip gauge- bevel protractor- profile projector
   d. Measurements of gears and screw threads

8) Analysis of exhaust gases and flue gases

   Analysis of exhaust gases and flue gases with the help of orsats apparatus, Gas chromatograph, paramagnetic oxygen analyser, smokemeter etc.

Expected outcome .

After completing the lab, the students will be able to

i. understand and use advanced techniques for measuring parameter like pressure, force, torque, rotation speed, temperature, vibration, noise level and emission
ii. familiarize themselves with basic measuring devices and procedures for calibration.

Course code	Course Name	L-T-P - Credits	Year of Introduction
**352	Comprehensive Examination	0-1-1-2	2016
Prerequisite : Nil			

Course Objectives

- To assess the comprehensive knowledge gained in basic courses relevant to the branch of study
- To comprehend the questions asked and answer them with confidence.

Assessment

Oral examination – To be conducted by the college (@ three students/hour) covering all the courses up to and including V semester– 50 marks

Written examination - To be conducted by the Dept. on the date announced by the University– common to all students of the same branch – objective type (1 hour duration)– 50 multiple choice questions (4 choices) of 1 mark each covering the six common courses of S1&S2 and six branch specific courses listed – questions are set by the University - no negative marks – 50 marks.

Note: Both oral and written examinations are mandatory. But separate minimum marks is not insisted for pass. If a students does not complete any of the two assessments, grade I shall be awarded and the final grade shall be given only after the completion of both the assessments.

The two hours allotted for the course may be used by the students for discussion, practice and for oral assessment.

Expected outcome.

- The students will be confident in discussing the fundamental aspects of any engineering problem/situation and give answers in dealing with them