Course code | Course name | L-T-P-Credits | Year Of Introduction
--- | --- | --- | ---
AE482 | INDUSTRIAL INSTRUMENTATION | 3-0-0-3 | 2016

**Prerequisite:** Nil

**Course Objectives**
- To equip the students with the basic knowledge of pressure, temperature, flow, level, density and viscosity measurements.
- To understand the construction and working of measuring instruments

**Syllabus**
- Temperature measurement- Pressure measurement- Measurement of viscosity- Flow measurement- Anemometers- Target flow meters- Level measurement

**Expected outcome**
- The student will be able to understand the various instruments used for industrial measurement.

**Text Books**

**Reference Books**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Temperature measurement: Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. Thermistors, principle and sensor types, manufacturing techniques, measuring circuits, linearization methods and applications. Pneumatic and suction pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Pressure measurement basics, mechanical type instruments, electromechanical type, low pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Description</td>
<td>Marks</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>III</td>
<td>Measurement of viscosity: definitions, units, Newtonian and Newtonian behaviour, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application. Measurement of density, definitions, units, liquid density measurement, gas densitometers, its application and selection.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Flow measurement: Introduction, definitions and units, classification of flow meters, pitot tubes, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Anemometers: Hot wire/hot film anemometer, laser Doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine Coriolis, gyroscopic and heat transfer type mass flow meters. Target flow meters: V-cone flow meters purge flow regulators, flow switches, flow meter calibration concepts, flow meter selection and application.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Level measurement: introduction, float level devices, displacer level devices, rotating paddle switches, diaphragm and deferential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave level switches, radar and vibrating type level sensors. Level sensor selection and application.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100          Exam Duration: 3 Hours

**Part A**
Answer any two out of three questions from Module 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.  \( (15 \times 2 = 30 \text{ marks}) \)

**Part B**
Answer any two out of three questions from Module 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.  \( (15 \times 2 = 30 \text{ marks}) \)

**Part C**
Answer any two out of three questions from Module 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.  \( (20 \times 2 = 40 \text{ marks}) \)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE484</td>
<td>INSTRUMENTATION SYSTEM DESIGN</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objective**  
- To equip the students with the basic Concept of Instrumentation system design  
- To understand the construction and working of different instrumentation system

**Prerequisite : NIL**

**Syllabus**  
Temperature measurement- Pressure measurement- Measurement of viscosity- Flow measurement- Anemometers- Target flow meters- Level measurement

**Expected outcome**  
The students will be able to understand the concepts behind instrumentation system design and its working

**Text Books**  

**Reference Books**  

## Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction: Concept of generalized measurement system, functional elements, generalized input-output configuration, static sensitivity, drifts, linearity, hysteresis, threshold, resolution, static stiffness and input-output impedance</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Transducers: Operating principle, construction and design of variable resistive transducers, variable inductive transducers, variable capacitive transducers, piezoelectric transducers, magnetostrictive transducers</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Hall effect, eddy current, ionization, optical transducers, digital transducers, single shaft encoders, photo voltaic cell, photo conductive, photo emissive, fiber optic sensors, concept of smart and intelligent sensor, bio-sensors | 7     | 15%                 |
| IV     | Construction and performance of industrially important transducer for measuring displacement, speed, vibrations, temperature, electrical power, strain, torque Force, Design of intelligent instrumentation system. | 6     | 15%                 |

**SECOND INTERNAL EXAMINATION**

| V      | Signal Conditioning & Recording (Part1): Quarter, half and full bridge circuit, active filters, differential instrumentation amplifiers, carrier amplifiers | 8     | 20%                 |
| VI     | Signal Conditioning & Recording (Part2): design of display elements, LED, bar graph displays, LCDs, nixie tube and their interfacing | 7     | 20%                 |
QUESTION PAPER PATTERN:

Maximum Marks: 100

Exam Duration: 3 Hours

Part A
Answer any two out of three questions from 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 from 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 from Module 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions. (20 x 2 = 40 marks)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AO482</td>
<td>FLIGHT AGAINST GRAVITY</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce the basic concepts of aerospace engineering and the current developments in the field.

**Syllabus:**

**Text Book:**

**Reference:**

### Syllabus & Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Historical Developments in Aeronautical Activities: Early air vehicles: Balloons, Biplanes and Monoplanes</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Helicopters; Developments in aerodynamics, aircraft materials, aircraft structures &amp; aircraft propulsion.</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Aircraft Configurations: Different types of flight vehicles and their classifications; Components of fixed wing airplane and their functions; Airfoils, wings and other shapes.</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>FIRST INTERNAL EXAMINATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Principles of Atmospheric Flight: Physical properties and structure of the atmosphere: The Standard Atmosphere, Temperature, Pressure and Altitude relationships, Mach number Evolution of theory of lift and drag, Maneuvers, Concepts of stability and control.</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Introduction to Space Flight: Introduction to basic concepts, the upper atmosphere Space vehicle trajectories-some basic concepts, Kepler’s Laws of planetary motion.</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Introduction to airplane structures and materials : General types of construction, Monocoque, semi-monocoque. Typical wing and fuselage structure. Metallic and non-metallic materials Use of aluminium alloy, titanium, stainless steel and composite materials.</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Power plants used in airplanes : Basic ideas about piston, turboprop and jet engines.</td>
<td>3</td>
<td>20%</td>
</tr>
</tbody>
</table>
Comparative merits, Principles of operation of rocket, types of rockets and typical applications. | 3
---|---
Exploration into space. | 2

**END SEMESTER EXAM**

**Question Paper Pattern**

Maximum marks: 100 Exam duration: 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: AU484  
Course Name: MICROPROCESSOR AND EMBEDDED SYSTEMS  
L-T-P -C: 3-0-0-3  
Year of Introduction: 2016

Prerequisite: NIL

Course Objectives
• To impart the basic concepts of microprocessors
• To impart the basic concepts of embedded systems

Syllabus
Introduction to microprocessors, Intel 8085 microprocessor, Instruction Set of 8085, Assembly language programming, Interfacing I/O devices, Overview of embedded system, Intel 8051 microcontroller, 8051 interfacing, Other microcontroller architectures: PIC-Atmel AVR-ARM

Expected outcome.
The students will
i. Get idea about Intel 8085 Microprocessor
ii. Be able to do assembly language programming
iii. Gain an overview of embedded systems
iv. Know about Intel 8051 microcontroller and its interfacing

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to microprocessors: Microcomputers and microprocessors, 8/16/32/ 64-bit microprocessor families. Internal architecture of Intel 8085 microprocessor: Block diagrams, Registers, Functional details of pins, Control signals.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Instruction Set of 8085: Instruction set, Instruction format, Addressing modes. Machine cycle and instruction cycles, Timing diagrams, Fetch and execute operations. Assembly Language Programming: Data copy operations, Arithmetic operations, Branching operations, Logic and bit manipulation instructions</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Interfacing I/O devices: Interrupts, Programmable interface</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
IV  
7  15%

SECOND INTERNAL EXAMINATION

V  
**Intel 8051 microcontroller:** Architecture, Memory organization, Registers and I/O ports, Addressing modes, Instruction sets, Assembly language programming.  
7  20%

VI  
**8051 interfacing:** Keyboard, Stepper motor, ADC, DAC, and LCD module interface. Frequency counter and temperature measurement.  
Other microcontroller architectures: Microchip technology PIC, Atmel AVR, ARM core processors.  
7  20%

END SEMESTER EXAM

**Question Paper Pattern**

Maximum marks: 100  
Duration: 3 hrs

The question paper should 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.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU486</td>
<td>Noise, Vibration and Harshness</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : NIL

**Course Objectives**
- To impart the basics of noise, vibration, sources of vibration and noise in automobiles
- To study the effect of noise and vibration on human beings and nature.
- To introduce the methods of measurement of noise and vibration.
- To provide knowhow on various methods to reduce the vibration and noise

**Syllabus**

**Expected outcome.**
The students will
i. understand the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertain to an automobile
ii. know about reduction of noise and vibration from an automobile.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>Course</td>
<td>Description</td>
<td>Weight</td>
<td></td>
</tr>
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<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>FIRST INTERNAL EXAMINATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Introduction to Transportation Noise and Vibration Sources, Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise, aerodynamic noise, tyre noise, brake noise</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Reduction of noise and vibrations I: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>SECOND INTERNAL EXAMINATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Reduction of noise and vibrations; noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis. Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
Question Paper Pattern

Maximum marks: 100
Duration: 3 hrs

The question paper should 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.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM482</td>
<td>BIOMEDICAL INSTRUMENTATION</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To impart knowledge about the principle and working of different types of biomedical electronic equipment/devices.

**Syllabus**

**Expected Outcome**
At the end of the course the students will be
- Familiar with the principle and applications various analytical, diagnostic and therapeutic instruments
- Knowing the different methods and modalities used for medical imaging.

**Text Books:**

**Reference Books:**
3. John G Webster (Ed), Encyclopedia of Medical Devices and Instrumentation ,Wiley
5. Webster J,’ Medical Instrumentation-Application and Design’, John Wiley

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Origin of bioelectric potentials – resting and action potentials - propagation of action potentials – Examples of bioelectric potentials - ECG, EEG, EMG, ERG, EOG, EGG – Electrodes for measurement of biopotentials. Transducers for measurement of temperature, pressure &amp; displacement - Basic principles only</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Electrical activity of heart, electrocardiogram - lead systems - ECG machine – block diagram Cardiac pacemakers – internal and external pacemakers, defibrillators – basic principles. Measurement of heart sounds – phonocardiography</td>
<td>2</td>
<td>15%</td>
</tr>
</tbody>
</table>
**Measurement of blood pressure** – sphygmomanometer & oscillometric methods. Photo plethysmography - for pulse rate measurement - Pulse oximeters

Holter recorders. Cardiac stress testing – methods & protocols

**Patient monitoring systems** - Bed side & central station

**FIRST INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Questions</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Electrical activity of brain - Electro encephalogram – EEG measurement &amp; waveforms - block diagram. Evoked potential - types &amp; applications</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Electrical activity of Muscle – Electromyogram (EMG) – Types of electrodes.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spiro meter - measurement of respiratory parameters.</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Heart lung machine, Infant incubators, Infusion pumps, Artificial heart valves - Basic principles &amp; block diagram only.</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Lithotripsy – principles, types &amp; applications. Surgical diathermy - Basic principles &amp; block diagram only.</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Questions</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>X-ray radiography - Principles of x-ray generation – Block diagram of x-ray machine - Description. Angiography - Basic principles</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>X-ray computed tomography - Principle of operation, sectional imaging, scanner configurations. Reconstruction of images - Iterative &amp; Fourier methods</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>VI</td>
<td>Ultrasonic imaging – Basic principles - Ultrasonic transducers &amp; Types - modes of image display-Principles &amp; applications. Doppler &amp; colour flow imaging</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>MRI – Basic Principles - FID signal-excitation &amp; emission – Basic pulse sequences - Block diagram</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours

There shall be three parts for the question paper.

**Part A** includes Modules 1 & 2 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part B** includes Modules 3 & 4 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part C** includes Modules 5 & 6 and shall have three questions of twenty marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Note:** Each part shall have questions uniformly covering both the modules in it.
Course code    | Course Name                        | L-T-P-Credits | Year of Introduction |
--------------|------------------------------------|---------------|----------------------|
BM484         | MEDICAL IMAGING & IMAGE PROCESSING TECHNIQUES | 3-0-0-3       | 2016                 |

Course Objectives
- To introduce the underlying principles of biomedical imaging modalities such as US, X-ray, CT, SPECT, PET and MRI
- To provide an overview of the image processing techniques used in these images

Syllabus
Imaging Techniques – X-ray - CT, Nuclear medicine imaging modalities - SPECT and PET, Ultrasound Imaging - Doppler ultrasound, Magnetic resonance imaging –T1, T2 and Proton density weighted, Thermography and Microwave imaging, Image sampling and quantization, Image enhancement-spatial and frequency domain methods, Image segmentation-edge based and region based.

Expected Outcome
The students will be able to
i. Identify major processes involved in formation of medical images
ii. Recognize the imaging modality from their visualizations
iii. Classify the various medical image processing algorithms
iv. Describe fundamental methods for image enhancement and segmentation

Reference Books:
2. Atam P Dhawan, Medical Imaging Analysis, Wiley Interscience publication, 2003

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>X-ray imaging – basic principles of image formation – block diagram of an x-ray machine. Digital radiography - basic principles.</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>X-ray Computed Tomography - basic principles, contrast scale, different generations of CT scanners, basic principles of image reconstruction.</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Ultrasonic imaging – Physical principles, Transducer parameters, Different modes - A-mode, M-mode (echocardiograph), B-mode. Principles of Doppler ultrasonic imaging.</td>
<td>4</td>
<td>15%</td>
</tr>
</tbody>
</table>
Magnetic Resonance Imaging – Principles of MRI, T1 weighted, T2 weighted and proton density weighted images, applications of MRI

<table>
<thead>
<tr>
<th>FIRST INTERNAL EXAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
</tr>
<tr>
<td>Nuclear medicine imaging modalities - Emission Computed Tomography – SPECT &amp; PET</td>
</tr>
<tr>
<td>Thermography - Physics of thermography, applications of thermography</td>
</tr>
<tr>
<td>IV</td>
</tr>
<tr>
<td>Image sampling and quantization, Image enhancement in spatial domain-gray level transformations, histogram processing</td>
</tr>
<tr>
<td>Smoothing and sharpening, spatial filters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECOND INTERNAL EXAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
</tr>
<tr>
<td>Image enhancement in frequency domain- filtering- low pass high pass , band pass and band stop filters</td>
</tr>
<tr>
<td>Homomorphic filter, Zooming operation</td>
</tr>
<tr>
<td>VI</td>
</tr>
<tr>
<td>Image segmentation - detection of discontinuities- point, line, edge, edge-based image segmentation- edge linking and boundary detection</td>
</tr>
<tr>
<td>Region based segmentation- region growing, region splitting and merging</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>END SEMESTER EXAM</th>
</tr>
</thead>
</table>

QUESTION PAPER PATTERN:

Maximum Marks: 100  
Exam Duration: 3 Hours

There shall be three parts for the question paper.

**Part A** includes Modules 1 & 2 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part B** includes Modules 3 & 4 and shall have three questions of fifteen marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Part C** includes Modules 5 & 6 and shall have three questions of twenty marks out of which two are to be answered. There can be subdivisions, limited to a maximum of 4, in each question.

**Note:** Each part shall have questions uniformly covering both the modules in it.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT362</td>
<td>Sustainable Energy Processes</td>
<td>3-0-0</td>
<td>3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce the current and potential future energy systems, covering resources, extraction, conversion, and applications, with emphasis on meeting regional and global energy needs in a sustainable manner.

**Syllabus**
Classification of energy, extraction, conversion, and applications of solar energy, wind energy, ocean energy, biomass energy, fuel cells and hydrodynamic systems, merits and demerits of various energy systems, energy storage.

**Expected outcome**
Students who successfully complete this course should be able to
  i. Identify global and Indian energy sources.
  ii. Explain capture, conversion and application of solar and wind energy.
  iii. Explain conversion of biomass to energy.
  iv. Explain the capture of energy from oceans.
  v. Explain fuel cells and energy storage routes.

**Reference Books**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>General classification of energy</strong></td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Solar energy</strong></td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAM
### III Wind energy
- Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy.

### IV Biomass energy

### V Energy from the oceans

### VI Fuel cells

---

### QUESTION PAPER PATTERN:

Maximum Marks: 100  
Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.
Course Code  | Course Name                                | L-T-P | Credits | Year of Introduction
---           | ------------------------------------------|------|--------|---------------------
BT461        | Design of Biological Wastewater Treatment Systems | 3-0-0 | 3      | 2016

Prerequisite: Nil

Course Objectives
- To provide the necessary theoretical background for the design of most common biological waste treatment systems.

Syllabus
Characteristics and *impacts of wastewater on* the environment, basic design considerations, types of biological treatment processes and reactors, aerobic suspended growth systems, anaerobic digesters, design consideration for upflow anaerobic sludge blanket reactors, biogas production.

Expected outcome
A student who successfully completes this course will be able to
i. Explain the characteristics of wastewater.
ii. Identify different types of reactors for wastewater treatment.
iii. Design a completely mixed activated sludge system.
iv. Explain the design features of an upflow anaerobic sludge blanket reactor.
v. Explain the factors affecting biogas production.

Reference Books

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Wastewater-origin, characteristics, <em>impacts of wastewater on</em> the environment, basic design considerations-estimation of wastewater quantities, variation in wastewater flow rates-average daily flow, maximum daily flow, peak hourly flow, minimum daily flow, minimum hourly flow, process flow sheet, reactor considerations.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Objectives and fundamentals of biological treatment, types of biological treatment processes, types of reactors used for wastewater treatment process, kinetics of biological treatment systems-batch and continuous systems, biological nitrogen removal, biological phosphorous removal.</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAM
### Question Paper Pattern:

**Maximum Marks:** 100  
**Exam Duration:** 3 hours

The question paper consists of Part A, Part B and Part C.

**Part A** consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

**Part B** consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

**Part C** consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Aerobic suspended growth systems- Conventional activated sludge processes and its modifications-theoretical principles, design of completely mixed activated sludge system, F/M ratio, hydraulic loading, MLSS, MLVSS, sludge age, sludge return, calculation of the reactor volume, production and removal of excess sludge, sludge volume index, Solids Retention Time (SRT) or Mean Cell Residence Time, oxygen requirements.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Aerobic attached growth system-Trickling filters-theoretical principles, classification, design principles, process design considerations, Oxidation ponds-construction and design considerations, aerobic sludge digestion, waste stabilization ponds, oxidation ditches-theory and design, factors affecting the design, theory and design of rotating biological contactors</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Fundamentals of anaerobic treatment, types of anaerobic digesters-conventional systems, high-rate systems and combined treatment systems, design of upflow anaerobic sludge blanket reactors, anaerobic sequencing batch reactor, anaerobic filters-upflow and downflow anaerobic filters, sludge treatment and disposal, sludge digestion, sludge drying, sludge conditioning, sludge drying characteristics.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Biogas technology-microbiology of biogas production, process parameters for a biogas plant, biogas yield from different substrates, methods to enhance biogas production-effect of heating, insulation and stirring on gas production, basic components of a biogas plant, biogas plant designs-continuous type plants, semi-continuous plants, fixed dome type, floating gasholder digester (KVIC),kinetic models for predicting biogas production, design equations of biogas plants.</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

**VI**

**Biogas Technology - Microbiology of Biogas Production**

Process parameters for a biogas plant, biogas yield from different substrates, methods to enhance biogas production: effect of heating, insulation and stirring on gas production, basic components of a biogas plant, biogas plant designs: continuous type plants, semi-continuous plants, fixed dome type, floating gasholder digester (KVIC), kinetic models for predicting biogas production, design equations of biogas plants.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE482</td>
<td>ENVIRONMENTAL IMPACT ASSESSMENT</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisites: Nil

Course Objectives:
- To study the various types of environmental pollution
- To study the impact of various types of pollutants and their assessment techniques

Syllabus:
Pollution, Types. Air pollution-sources, effects, types of pollutants. Water pollution, characteristics of water pollutants, Solid wastes, sources, types, soil pollution, pesticide pollution. Noise pollution, Impacts, positive and negative Environmental impact assessment, steps of doing EIA, methodology adopted, EIA procedure in India, Case studies.

Course Outcomes:
- The students will have a basic knowledge of various pollution sources and their impacts

Text Books / References:
3. John Glasson, Riki Therivel & S Andrew Chadwick “Introduction to EIA” University College London Press Limited
5. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)

COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>INTRODUCTION: Classification of Pollution and Pollutants, AIR POLLUTION: Primary and Secondary Pollutants, air pollutants-sulfur dioxide- nitrogen dioxide, carbon monoxide, Impact of air pollutants on human, vegetation and environment, , Ambient Air Quality Standards</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>WATER POLLUTION: Point and Non-point Source of Pollution, Major Pollutants of Water, Physical, chemical and biological characteristics of water , Water borne diseases, Water Quality standards</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAMINATION

| IV | NOISE POLLUTION: Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures | 6 | 15 |

### SECOND INTERNAL EXAMINATION

| V | Impacts of pollutants, types, scale of impact-Global, local pollutants. Climate change, Ozone layer depletion, Deforestation, land degradation Environmental impact assessment, Need for EIA | 8 | 20 |
| VI | EIA Procedure-Screening, Scoping, EIA procedure in India, Impact analysis- checklists, matrix methods, overlay analysis, Case studies of EIA | 8 | 20 |

### END SEMESTER EXAMINATION

**QUESTION PAPER PATTERN (External Evaluation):**

Maximum Marks :100  
Exam Duration: 3 Hrs

- **Part A -Module I & II**: 2 questions out of 3 questions carrying 15 marks each
- **Part B - Module III & IV**: 2 questions out of 3 questions carrying 15 marks each
- **Part C - Module V &VI**: 2 questions out of 3 questions carrying 20 marks each

**Note:**

1. Each part should have at least one question from each module
2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE484</td>
<td>APPLIED EARTH SYSTEMS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisites:** Nil

**Course objectives:**
- Appreciation of earth as a system of interrelated components
- Understanding mechanisms that give rise to oceanographic and atmospheric phenomena
- Comprehension of processes that result in characteristic land features in different climatic regimes

**Syllabus:**

**Expected Outcomes:**
- The students would understand the roles of surface and sub surface phenomena in shaping surface features of earth
- The course would appreciate the ramifications of any atmospheric, oceanographic or land process on other component subsystems including biosphere.

**Text Books / References:**
QUESTION PAPER PATTERN (End Semester Exam)

Maximum Marks: 100
Exam Duration: 3 Hrs

Part A - Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

Note: 1. Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
**Course Code:** CE486  
**Course Name:** GEOINFORMATICS FOR INFRASTRUCTURE MANAGEMENT  
**L-T-P-C:** 3-0-0-3  
**Year of Introduction:** 2016

**Prerequisites:** Nil

**Course Objectives:**
- To expose the concept of GIS and Remote sensing
- To introduce the applications of GIS and Remote sensing for infrastructure management

**Syllabus:**

**Course Outcomes:**
The students will
- Understand various satellite data products and their uses.
- Know about the Geospatial data and its importance in Spatial analysis.
- Apply Geoinformatics techniques in various engineering applications and for infrastructure development.

**Text Books / References:**

**COURSE PLAN**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Remote Sensing: Energy sources and radiation principles- Interaction of EM energy with atmosphere and surface features,</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Part</td>
<td>Module</td>
<td>Question Paper Pattern</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A</td>
<td>I &amp; II</td>
<td>Spectral reflectance patterns, Data acquisition - Multistage and multispectral remote sensing concept</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>V &amp; VI</td>
<td>Coordinate Systems: Geographic coordinate systems-approximations of earth, ellipsoid and geoid models, geodetic datum and vertical datum, coordinate transformation, Map projections-concepts, properties, and types. GIS: Geographical concepts and terminology, Components of GIS, Spatial and non-spatial data, Vector and raster data; Methods of data input, Spatial data editing; Vector data analysis-buffering, overlay, slivers; Raster data analysis- categories; GIS output: cartographic and non-cartographic output</td>
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<tr>
<td></td>
<td></td>
<td>Digital Elevation Models and Digital Terrain Models; Land use/ Land cover mapping, Ground Water Potential Zonation Mapping, Hazard Zonation Mapping. Site suitability analysis for Residential area, Industrial area, Recreational Area, Solid Waste Disposal, Water treatment plant Network Analysis- Water supply line, Sewer line, Power line, Telecommunication, Road network</td>
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<td>END SEMESTER EXAMINATION</td>
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</tr>
</tbody>
</table>

**QUESTION PAPER PATTERN (End semester examination)**

- **Maximum Marks : 100**
- **Duration : 3 hours**

**Part A** - Module I & II : 2 questions out of 3 questions carrying 15 marks each

**Part B** - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

**Part C** - Module V &VI : 2 questions out of 3 questions carrying 20 marks each

**Note** : 1. Each part should have at least one question from each module

2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
### Course Code
CE488

### Course Name
DISASTER MANAGEMENT

### L-T-P-Credits
3-0-0-3

### Year of Introduction
2016

---

#### Course Objectives
- To provide an overview of the common hazards and their dynamics
- To inculcate the basic concepts of disaster management

#### Syllabus

#### Expected Outcome
The students will:
- i. get general ideas about the processes involved in natural and anthropogenic disasters
- ii. understand the concepts of disaster management and measures to mitigate and contain common episodes of disasters

#### References:

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#### COURSE PLAN

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Fundamental concepts of hazards and disasters: Introduction to key concepts and terminology of hazard, vulnerability, exposure, risk, crisis, emergencies, Disasters, Resilience. Basic concept of Earth as a system and its component sub systems. Climate Change vis-a-vis the interrelationships of the subsystems- Green House Effect and Global warming. basic</td>
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</tbody>
</table>
**QUESTION PAPER PATTERN (End Semester Examination)**

Maximum Marks :100  
Exam Duration: 3 Hrs

<table>
<thead>
<tr>
<th>Part A -Module I &amp; II</th>
<th>2 questions out of 3 questions carrying 15 marks each</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part B - Module III &amp; IV</td>
<td>2 questions out of 3 questions carrying 15 marks each</td>
</tr>
<tr>
<td>Part C - Module V &amp; VI</td>
<td>2 questions out of 3 questions carrying 20 marks each</td>
</tr>
</tbody>
</table>

**Note:**  
1. Each part should have at least one question from each module  
2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE494</td>
<td>ENVIRONMENTAL HEALTH AND SAFETY</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Pre-requisites: Nil

Course Objectives:
- To introduce the different types of hazards in industries and the management of hazards.
- To learn the various types of pollution.

Syllabus:
Occupational health and toxicology- Lead-nickel, chromium and manganese toxicity-gas poisoning-Industrial hygiene, Physical, chemical and biological hazards, Safety and Health Management, noise-effects, source, Electrical Hazards and Hazards in Construction Industry, Air pollution, Water pollution, Hazardous Waste Management, pollution control in different industries

Expected Outcomes:
The students will
i. Be able to understand the various occupational hazards and the techniques that can be adopted for managing hazards and related problems
ii. Become aware regarding air pollution and water pollution problems and pollution control in industries

Text Books / References:
1. Gerard Kiely, Environmental Engineering, McGraw hill Education
2. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)

COURSE PLAN

<table>
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<tr>
<th>Module</th>
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<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Occupational Health And Toxicology : occupational related diseases, silicosis, asbestosis, pneumoconiosis, etc. lead, nickel, chromium and manganese toxicity, effects and prevention –Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects. Industrial Hygiene.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Noise, noise exposure regulation. Ionizing radiation, types, effects. Chemical hazards - dust, fumes, mist, vapour, fog, gases, Methods of Control. Biological hazards - Classification of Biohazardous agents – bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III | Radiation and Industrial Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effect on human health, animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone | 6 | 15% |

| IV | Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Introduction of Construction industry, Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting and Cementing work, Transportation of men and material, | 6 | 15% |

**SECOND INTERNAL EXAMINATION**

| V | Water Pollution - water pollutants - health hazards - effluent quality standards, tannery, textile effluents Hazardous Waste Management - waste identification, characterization and classification, health hazards - toxic and radioactive wastes - recycling and reuse. | 8 | 20% |

| VI | Pollution Control In Process Industries - Pollution control in process industries like cement, paper, petroleum products-textile, tanneries-thermal power plants – dyeing and pigment industries - eco-friendly energy. | 8 | 20% |

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN (External Evaluation):**

Maximum Marks : 100  
Exam Duration: 3 Hrs

Part A - Module I & II : 2 questions out of 3 questions carrying 15 marks each  
Part B - Module III & IV : 2 questions out of 3 questions carrying 15 marks each  
Part C - Module V &VI : 2 questions out of 3 questions carrying 20 marks each  

**Note:** 1. Each part should have at least one question from each module  
2. Each question can have a maximum of 4 subdivisions (a,b,c,d)
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH482</td>
<td>PROCESS UTILITIES AND PIPE LINE DESIGN</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite**: Nil

**Course Objectives**

1. To impart the basic concepts of project engineering
2. To develop understanding about process auxiliaries and utilities in process industries

**Syllabus**

Process Auxiliaries: Piping design, Piping insulation, Piping fittings, Valves, Pumps, Process control and instrumentation diagram.

Process Utilities: Process Water, Steam, Compressors and Vacuum Pumps, Methods of vacuum development and their limitations, materials handling under vacuum. Refrigeration and Chilling systems, Oil heating systems, Nitrogen systems

**Expected Outcome**

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

i. Acquire the overall knowledge about the process plant.
ii. Understand the importance of process auxiliaries and utilities in process industries.
iii. Learn the conceptual design of chemical process plant.
iv. Build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry.

**References:**


**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Process Auxiliaries: Basic considerations and flow diagrams in chemical engineering plant design. Piping design: Selection of material, pipe sizes, working pressure, Basic principles of piping design, piping drawings, pipe installations, overhead installations, Process steam piping, selection and determination of steam – pipe size, Piping insulation, application of piping insulation, weather proof and fire resisting pipe insulation jackets, piping fittings, pipe joints</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Valves: Types of valves, selection criteria of valves for various systems. Pumps: Types of pumps, NPSH requirement, pump location, pump piping, pump piping support. Process control and instrumentation diagram, control system design for process auxiliaries.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>FIRST INTERNAL EXAMINATION</td>
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</tr>
<tr>
<td>III Process Utilities: Process Water: Sources of water, hard and soft water, Requisites of industrial water and its uses, Methods of water treatment, Chemical softening, Demineralization, Resins used for water softening, Water for boiler use, cooling purposes, cooling towers, drinking and process water treatment, reuse and conservation of water, 27 50% water resources management, waste water treatment and disposal</td>
<td>7</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>IV Steam: Steam generation and its application in chemical process plants, distribution and utilization, boilers, design of efficient steam heating systems, steam economy, condensate utilization, steam traps, their characteristics, selection and application, waste heat utilization</td>
<td>7</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>SECOND INTERNAL EXAMINATION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V Compressors and Vacuum Pumps: Types of compressors and vacuum pumps and their performance characteristics, Methods of vacuum development and their limitations, materials handling under vacuum, lubrication and oil removal in compressors and pumps, instrument air.</td>
<td>7</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>VI Refrigeration and Chilling systems. Oil heating systems, Nitrogen systems.</td>
<td>7</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

END SEMESTER EXAMINATION

**Question Paper Pattern:**

Maximum Marks: 100  
Exam Duration: 3 Hours

**Part A:** There shall be Three questions uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.  
(2 x15= 30 Marks)

**Part B:** There shall be Three questions uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.  
(2 x15= 30 Marks)

**Part C:** There shall be Three questions uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any Two questions. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.  
(2 x20= 40 Marks)
Course code       Course Name          L-T-P-Credits  Year of Introduction
CH484            FUEL CELL TECHNOLOGY  3-0-0-3         2016

Prerequisite : Nil

Course Objectives
- To expose the students to the fundamental knowledge required in the development of fuel cell technology.

Syllabus

Expected Outcome
At the end of the course the students will be able to:
1. Know the fundamentals of electrochemistry, thermodynamics, fluid mechanics, and heat and mass transfer, appropriate for the design or review of components of fuel cells and fuel cell systems.
2. Analyze the fuel cell technology and compare different types of fuel cell systems.
3. Calculate the various losses in fuel cells and analyze the fuel cell power plant subsystems.
4. Defend the significance of fuel cell technology in the new global energy scenario.
5. Distinguish the expectancies of hydrogen as a fuel and energy vector in the context of renewable energy.

References Books:
2. Costamagna, P.; Srinivasan, S, J Power Sources 2001, 102, 242-269..

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. exam marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction:</strong> Fuel Cell, Brief History of fuel cells, Types of Fuel Cells, Working of a PEM fuel Cell, Fuel Cell and conventional processes – comparison, Energy &amp; power relations, units, Application scenarios, Advantages and disadvantages.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Section</td>
<td>Topics</td>
<td>7</td>
<td>15%</td>
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</tr>
<tr>
<td><strong>Reaction Kinetics</strong></td>
<td>Electrochemical reaction fundamentals, electrode kinetics, Charge transfer and activations energy, Exchange current density - slow and fast reactions. Potential and equilibrium - galvanic potential, Reaction rate and potential - Butler Volmer equation &amp; Tafel equation, Electrocatalysts and reaction kinetics – typical exchange current densities, Electrode design basics</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Charge and Mass Transport</strong></td>
<td>Charge transport resistances, voltage losses, Ionic and electronic conductivites, Ionic conduction in different FC electrolytes: Aquesous, polymeric and ceramic, Diffusive transport &amp; voltage loss: Limiting current density, Nerstian and kinetic effect, Convective transport: flow channels, gas diffusion / porous layer, gas velocity, pressure, Flow channel configurations</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Overview of Fuel Cell Types</strong></td>
<td>Overview of Fuel Cell Types: PAFC, PEMFC, AFC, MCFC, SOFC. Major Cell Components, Material Properties, Processes and Operating Conditions of PEMFC.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stack Design</strong></td>
<td>Sizing of a Fuel Cell Stack, Stack Configuration, Uniform distribution of Reactants, Heat removal, Stack Clamping Fuel Cell Diagnostics: Polarization Curve, Current Interrupt, AC Impedance Spectroscopy, Pressure drop as a diagnostic tool.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td><strong>END SEMESTER EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Question Paper Pattern**

Maximum Marks: 100  
Exam Duration: 3 Hours

**Part A:** There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.  
(2 x15= 30 Marks)

**Part B:** There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.  
(2 x20= 40 Marks)

**Part C:** There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.  
(2 x15= 30 Marks)
<table>
<thead>
<tr>
<th>COURSE CODE</th>
<th>COURSE NAME</th>
<th>L-T-P-C</th>
<th>YEAR OF INTRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC482</td>
<td>Biomedical Engineering</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course objectives:**
- To introduce basics of biomedical engineering technology
- To understand the anatomy & physiology of major systems of the body in designing equipment for medical treatments.
- To impart knowledge about the principle and working of different types of bio-medical electronic equipment/devices.

**Syllabus:**
Human body-overview, Physiological systems of body, Measurement of physiological parameters, Assisting and therapeutic devices, Medical laboratory equipments, Telemetry in patient care, Patient safety, Medical imaging system

**Expected outcome:**
The students will be able:
- i. To understand diagnosis and therapy related equipments.
- ii. To understand the problem and identify the necessity of equipment for diagnosis and therapy.
- iii. To understand the importance of electronics engineering in medical field.
- iv. To understand the importance of telemetry in patient care

**Text Books:**

**References:**
3. John G Webster, “Medical Instrumentation application and design”, 3ed,John Wiley

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Course content</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.)</td>
<td>2</td>
<td>15%</td>
</tr>
</tbody>
</table>
| II | Electrode theory: Nernst relation  
Bio potential electrodes: Microelectrodes, skin surface electrodes, needle electrodes. | 1 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Instrumentation for clinical laboratory: Bio potential amplifiers-instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Heart and cardiovascular system (brief discussion), electro conduction system of the heart. Electrocardiography, ECG machine block diagram, ECG lead configurations, ECG recording system, Einthoven triangle, analysis of ECG signals.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters.</td>
<td>2</td>
</tr>
<tr>
<td><strong>FIRST INTERNAL EXAM</strong></td>
<td></td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording, analysis of EEG.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Electromyography: Nerve conduction velocity, instrumentation system for EMG.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Instruments for clinical laboratory: Oxymeters, pH meter, blood cell counter, flame photometer, spectrophotometer</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Therapeutic Equipments: Principle, block schematic diagram, working and applications of: pacemakers, cardiac defibrillators, heart–lung machine, dialyzers, surgical diathermy equipment, ventilators</td>
<td>6</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL EXAM</strong></td>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>V</td>
<td>Medical Imaging systems (Basic Principle only): X-ray imaging - Properties and production of X-rays, X-ray machine, applications of X-rays in medicine.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Computed Tomography: Principle, image reconstruction, scanning system and applications.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Ultrasonic imaging systems: Basic pulse echo system, propagation of ultrasonic through tissues and reflections, display types, A-Scan, B-Scan, M-Scan, applications, real-time ultrasonic imaging systems and probes.</td>
<td>3</td>
</tr>
<tr>
<td>VI</td>
<td>Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging</td>
<td>3</td>
</tr>
<tr>
<td>Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Patient Safety: Electric shock hazards, leakage current, safety codes for electro medical equipments</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**Question Paper Pattern (End semester exam)**

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, and Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part, any two questions are to be answered. Mark patterns are as per the syllabus with 100% for theory.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE482</td>
<td>ENERGY MANAGEMENT AND AUDITING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: NIL

Course Objectives
- To enable the students to understand the concept of energy management
- To understand the different methods used to control peak demand
- To understand the energy management opportunities in different systems
- To understand how the use of energy audit.
- To understand the different methods used for the economic analysis of energy projects

Syllabus

Expected outcome.
The students will be able to:
  i. Understand the different methods used to reduce energy consumption
  ii. Know energy audit
  iii. Do economic analysis of energy projects

Text Book/References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>General principles of Energy management and Energy management planning.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Load scheduling-Case studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Energy management opportunities in Lighting and Motors. Electrolytic</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Process and Electric heating, Case studies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
| III | Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler. Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. | 8 | 15% |
| **SECOND INTERNAL EXAMINATION** | | | |
| V | Energy audit -Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management. | 7 | 20% |
| VI | Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies. | 6 | 20% |

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hrs.

**Part A:** 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x5)=40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part C:** 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part D:** 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10) =20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P-C</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE484</td>
<td>Control Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : NIL

**Course Objectives**
- To give the knowledge of Mathematical model of physical systems.
- To impart knowledge of different control equipment.
- To provide knowhow of analysing systems with mathematical model.

**Syllabus**
Linear Time Invariant systems: Open loop-and closed loop control systems, Transfer function: Mechanical, Electromechanical systems, block diagram representation, signal flow graph. Control system components. Time domain analysis of control systems. PID controllers, Concept of stability, Frequency domain analysis, Introduction to Statespace.

**Expected outcome.**
The students will have the
i. Concept of modelling in transfer function and state space domain
ii. Ability to analyse stability of linear time invariant systems.

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Open loop-and closed loop control systems: Transfer function -T.F of simple linear time invariant systems - Mechanical andElectromechanical systems – Force voltage and force current analogy - block diagram representation - blockdiagram reduction - signal flow graph - Mason's gain formula - characteristics equation.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Control system components: DC and AC servo motor – synchro - magnetic amplifier - gyroscope - stepper motor - Tacho meter.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Time domain analysis of control systems: Transient and steady state responses - test signals - time domain specifications - first and second order systems - impulse and step responses - steady state error analysis - static error coefficient of type 0,1,2 systems - Dynamic error coefficients</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>PID controllers, Concept of stability: stability of feedback system - Routh's stability criterion - Root locus -General rules for constructing Root loci - effect of addition of poles and zeros.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Frequency domain analysis: Introduction - Bode plot-Polar plot-</td>
<td>6</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
gain margin - phase margin.

| VI | Introduction to state space: State concept, state equation of simple systems, physical and phase variables, Eigen value and eigenvectors, conversion of state space model to transfer function. | 8 | 20% |

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hrs.

Part A: 8 compulsory questions.
One question from each module of Module I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x5)=40

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part C: 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

Part D: 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10)=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
Course code | Course Name | L-T-P-C | Year of Introduction
--- | --- | --- | ---
EE486 | SOFT COMPUTING | 3-0-0-3 | 2016

Prerequisite: NIL

Course Objectives
- To provide the concepts of soft computing techniques such as neural networks, fuzzy systems, genetic algorithms

Syllabus
Introduction To Soft Computing And Neural Networks, Fuzzy Sets And Fuzzy Logic: Fuzzy Sets, Neuro-Fuzzy Modelling, Machine Learning, Machine Learning Approach to Knowledge Acquisition

Expected outcome.
The students will be able to get ideas on:
- i. Artificial Intelligence, Various types of production systems, characteristics of production systems.
- ii. Neural Networks, architecture, functions and various algorithms involved.
- iii. Fuzzy Logic, Various fuzzy systems and their functions.
- iv. Genetic algorithms, its applications and advances

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem .Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction To Soft Computing And Neural Networks : Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Adaptive Networks – Feed forward Networks – Supervised Learning</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
<table>
<thead>
<tr>
<th>Section</th>
<th>Topics</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
</table>
Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees | 7 | 15% |
| IV      | Data Clustering Algorithms – Rulebase Structure Identification Neuro-Fuzzy Control. | 7 | 15% |

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Section</th>
<th>Topics</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Applications of GA in Machine Learning - Machine Learning Approach to Knowledge Acquisition. Support Vector Machines for Learning – Linear Learning Machines – Support Vector Classification – Support Vector Regression - Applications.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hrs.

**Part A:** 8 compulsory questions.

One question from each module of Module I - IV; and two each from Module V & VI.  
Student has to answer all questions. (8 x5)=40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: (2 x 10 )=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part C:** 3 questions uniformly covering Modules III & IV. Student has to answer any 2 from the 3 questions: (2 x 10 )=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.

**Part D:** 3 questions uniformly covering Modules V & VI. Student has to answer any 2 from the 3 questions: (2 x 10 )=20. Each question can have maximum of 4 sub questions (a,b,c,d), if needed.