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<td>Civil Engineering Workshops</td>
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Total Credits: 24/23  
Hours: 30  
Cumulative Credits: 24/23  

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<td>Analog Electronic Circuits</td>
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<td>DC Machines and Transformers</td>
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<td>EE204</td>
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<td>EE206</td>
<td>Material Science</td>
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<td>Measurements and Instrumentation</td>
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<td>HS200</td>
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## SEMESTER – V

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<td>EE307</td>
<td>Signals and Systems</td>
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<td>EE309</td>
<td>Microprocessor and Embedded Systems</td>
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**Total Credits: 23  
Hours: 28  
Cumulative Credits: 117**

### Elective – I

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<tr>
<td>EE363</td>
<td>Computer Organization and Architecture</td>
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<td>EE365</td>
<td>Digital System Design</td>
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<tr>
<td>EE367</td>
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<td>EE369</td>
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### SEMESTER – VI

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<td>Advanced Control Theory</td>
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<td>EE306</td>
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**Total Credits:** 23  **Hours:** 27  **Cumulative Credits:** 140

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<td>EE366</td>
<td>Illumination Technology</td>
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<td>Soft Computing</td>
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# SEMESTER – VII

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<td>Distributed generation and smart grids</td>
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Total Credits: 22  
Hours: 27  
Cumulative Credits: 162

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<td>EE463</td>
<td>Computer Aided Power Systems Analysis</td>
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<td>EE465</td>
<td>Power Quality</td>
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<td>EE467</td>
<td>Nonlinear Control Systems</td>
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<td>Industrial Instrumentation &amp; Automation</td>
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Total Credits: 18  Hours: 29  Cumulative Credits: 180

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<td>EE466</td>
<td>Digital Image Processing</td>
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<td>EE472</td>
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**Elective – V (Non-departmental)**

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<td>Noise Vibration and Harshness</td>
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**Course Objectives**

In this course the students are introduced to some basic tools in Mathematics which are useful in modelling and analysing physical phenomena involving continuous changes of variables or parameters. The differential and integral calculus of functions of one or more variables and of vector functions taught in this course have applications across all branches of engineering. This course will also provide basic training in plotting and visualising graphs of functions and intuitively understanding their properties using appropriate software packages.

**Syllabus**

Single Variable Calculus and Infinite series, Functions of more than one variable, Partial derivatives and its applications, Calculus of vector valued functions, Multiple Integrals.

**Expected outcome**

At the end of the course the student will be able to (i) check convergence of infinite series (ii) find maxima and minima of functions two variables (iii) find area and volume using multiple integrals (iv) apply calculus of vector valued functions in physical applications and (v) visualize graphs and surfaces using software or otherwise.

**Text Books**

1. Anton, Bivens, Davis: Calculus, John Wiley and Sons, 10th ed

**References:**


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<td>Basic ideas of infinite series and convergence - .Geometric series- Harmonic series- Convergence tests-comparison, ratio, root tests (without proof). Alternating series- Leibnitz Test- Absolute convergence, Maclaurins series-Taylor series - radius of convergence. (For practice and submission as assignment only: Sketching, plotting and interpretation of hyperbolic functions using suitable software. Demonstration of convergence of series by software packages)</td>
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<td>II</td>
<td>Partial derivatives and its applications(Book I –sec. 13.3 to 13.5 and 13.8)</td>
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<tr>
<td></td>
<td>Partial derivatives–Partial derivatives of functions of more than two variables - higher order partial derivatives - differentiability, differentials and local linearity - The chain rule – Maxima and Minima of functions of two variables - extreme value theorem (without proof)-relative extrema</td>
<td></td>
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<tr>
<td>FIRST INTERNAL EXAM</td>
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<tr>
<td><strong>III</strong> Calculus of vector valued functions <em>(Book I-12.1, 12.2, 12.4 &amp; 12.6, 13.6 &amp; 13.7)</em></td>
<td></td>
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<tr>
<td>Introduction to vector valued functions-parametric curves in 3-space</td>
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<tr>
<td>Directional derivatives and gradients-tangent planes and normal vectors</td>
<td></td>
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<tr>
<td>(For practice and submission as assignment only: Graphing parametric curves and surfaces using software packages )</td>
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</tr>
<tr>
<td><strong>IV</strong> Multiple integrals <em>(Book I - sec. 14.1, 14.2, 14.3, 14.5)</em></td>
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<tr>
<td>Double integrals- Evaluation of double integrals</td>
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<tr>
<td>Double integrals in non-rectangular coordinates- reversing the order of integration-</td>
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<tr>
<td>Area calculated as a double integral-</td>
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<tr>
<td>Triple integrals(Cartesian co ordinates only)-</td>
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<tr>
<td>volume calculated as a triple integral-</td>
<td></td>
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<tr>
<td>(applications of results only)</td>
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<tr>
<th>SECOND INTERNAL EXAM</th>
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</thead>
<tbody>
<tr>
<td><strong>Topics in vector calculus</strong> <em>(Book I-15.1, 15.2, 15.3)</em></td>
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<tr>
<td>Vector and scalar fields- Gradient fields –</td>
</tr>
<tr>
<td>V</td>
</tr>
</tbody>
</table>

| VI | Topics in vector calculus (continued) (Book I sec., 15.4, 15.5, 15.7, 15.8) Green’s Theorem (without proof- only for simply connected region in plane), surface integrals – Divergence Theorem (without proof for evaluating surface integrals), Stokes’ Theorem (without proof for evaluating line integrals) (All the above theorems are to be taught in regions in the rectangular co ordinate system only) | 2 | 20% |

END SEMESTER EXAM

Open source software packages such as gnuplot, maxima, scilab, geogebra or R may be used as appropriate for practice and assignment problems.

TUTORIALS: Tutorials can be ideally conducted by dividing each class in to three groups. Prepare necessary materials from each module that are to be taught using computer. Use it uniformly to every class.
**Course No.** | **Course Name** | **L-T-P-Credits** | **Year of Introduction**
---|---|---|---
PH100 | ENGINEERING PHYSICS | 3-1-0-4 | 2016

**Course Objectives**
Most of the engineering disciplines are rooted in Physics. In fact a good engineer is more or less an applied physicist. This course is designed to provide a bridge to the world of technology from the basics of science and to equip the students with skills in scientific inquiry, problem solving, and laboratory techniques.

**Syllabus**

**Expected outcome**
Familiarity with the principles of Physics and its significance in engineering systems and technological advances.

**References:**
- Aruldhas, G., Engineering Physics, PHI Ltd.
- Beiser, A., Concepts of Modern Physics, McGraw Hill India Ltd.
- Bhattacharya and Tandon, Engineering Physics, Oxford India
- Bijlal and Subramanyam, A Text Book of Optics, S. Chand & Co.
- Dominic and Nahari, A Text Book of Engineering Physics, Owl Books Publishers
- Hecht, E., Optics, Pearson Education
- Mehta, N., Applied Physics for Engineers, PHI Ltd
- Palais, J. C., Fiber Optic Communications, Pearson Education
- Pandey, B. K. and Chathurvedi, S., Engineering Physics, Cengage Learning
- Philip, J., A Text Book of Engineering Physics, Educational Publishers
- Premlet, B., Engineering Physics, Mc GrawHill India Ltd
- Sarin, A. and Rewal, A., Engineering Physics, Wiley India Pvt Ltd
- Seears and Zemansky, University Physics, Pearson
- Vasudeva, A. S., A Text Book of Engineering Physics, S. Chand & Co
## 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>Harmonic Oscillations: Differential equation of damped harmonic oscillation, forced harmonic oscillation and their solutions- Resonance, Q factor, Sharpness of resonance- LCR circuit as an electrical analogue of Mechanical Oscillator (Qualitative) Waves: One dimensional wave - differential equation and solution. Three dimensional waves - Differential equation &amp; its solution. (No derivation) Transverse vibrations of a stretched string.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Quantum Mechanics: Uncertainty principle and its applications-formulation of Time dependent and Time independent Schrödinger equations- physical meaning of wave function- Energy and momentum Operators-Eigen values and functions One dimensional infinite square well potential. Quantum mechanical Tunnelling (Qualitative) Statistical Mechanics: Macrostates and Microstates. Phase space. Basic postulates of Maxwell- Boltzmann, Bose-Einstein and Fermi Dirac</td>
<td>6</td>
<td>15%</td>
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**FIRST INTERNAL EXAM**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>V</td>
<td>Acoustics: Intensity of sound- Loudness-Absorption coefficient - [ \text{Reverberation and reverberation time- Significance of reverberation time- Sabine’s formula (No derivation)} ] -Factors affecting acoustics of a building.</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>V</td>
<td>Ultrasonics: Production of ultrasonic waves - Magnetostriction effect and Piezoelectric effect - Magnetostriction oscillator and Piezoelectric oscillator - Detection of ultrasonics - Thermal and piezoelectric methods - Applications of ultrasonics - NDT and medical.</td>
<td>4</td>
<td></td>
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<tr>
<td>VI</td>
<td>Photonics: Basics of solid state lighting - LED – Photodetectors - photo voltaic cell, junction &amp; avalanche photo diodes, photo transistors, thermal detectors, Solar cells- I-V characteristics - Optic fibre-Principle of propagation-numerical aperture-optic communication system (block diagram) - Industrial, medical and technological applications of optical fibre. Fibre optic sensors - Basics of Intensity modulated and phase modulated sensors.</td>
<td>5</td>
<td>20%</td>
</tr>
<tr>
<td>Course No.</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
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</tr>
<tr>
<td>CY100</td>
<td>ENGINEERING CHEMISTRY</td>
<td>3-1-0-4</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**

To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like new generation engineering materials, storage devices, different instrumental methods etc. And to develop abilities and skills that are relevant to the study and practice of chemistry.

**Syllabus**


**Expected outcome**

The student will be able to apply the knowledge of chemistry and will be equipped to take up chemistry related topics as part of their project works during higher semester of the course.

**References Books:**

- Ahad, J., Engineering Chemistry, Jai Publications
- Dara, S. S., Engineering Chemistry, S Chand Publishers
- Jain and Jain, Engineering Chemistry, Dhanpat Rai Publishers
- Kaurav, Engineering Chemistry with Laboratory Experiments. PHI, ISBN 9788120341746
- Manjooran K. S., Modern Engineering Chemistry, Kannatheri Publication
- Seymour, R. B., Introduction to Polymer Chemistry, McGraw Hill
- Wiley India, Engineering Chemistry, ISBN 9788126543205

**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>Spectroscopy: Introduction, Beer Lamberts Law (no derivations)(Numericals)</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>UV-visible spectroscopy - Principle, Instrumentation and applications</td>
<td>2</td>
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<td></td>
<td>IR spectroscopy - Principle and applications (Numaerials)</td>
<td>2</td>
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<tr>
<td></td>
<td>$^1$H NMR spectroscopy - Principle, chemical shift - spin - spin splitting and applications including MRI(brief), Spectral Problems</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Electrochemistry: Different types of electrodes (general) – SHE, Calomel electrode, Glass electrode and determination of $E^\circ$ using SHE &amp; Calomel</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>Electrode</td>
<td>Electrochemical series and its applications (Numericals)</td>
<td>1</td>
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<tr>
<td>Nernst equation - Derivation, application &amp; numericals</td>
<td>2</td>
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<tr>
<td>Potentiometric titration - Acid-base and redox titration</td>
<td>2</td>
<td></td>
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<tr>
<td>Lithium ion cell and Fuel cell.</td>
<td>1</td>
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</tbody>
</table>

**FIRST INTERNAL EXAM**

| III Instrumental Methods: Thermal analysis - Principle, instrumentation and applications of TGA and DTA. | 3 |
| Chromatographic methods - Basic principles, column, TLC. Instrumentation and principles of GC and HPLC. | 4 |
| Conductivity - Measurement of conductivity | 1 |

| IV Chemistry of Engineering Materials: Copolymers - BS, ABS - Structure and Properties. | 1 |
| Conducting Polymers - Polyaniline, Polypyrrole - Preparation, Structure and Properties. | 2 |
| OLED – An introduction | 1 |
| Advanced Polymers – Kevlar, Polybutadiene rubber and silicone rubber: Preparation, Structure and Properties. | 2 |
| Nanomaterials – Definition, Classification, chemical methods of preparation - hydrolysis and reduction | 2 |
| Properties and Applications – Carbon Nano Tubes and fullerenes. | 1 |

**SECOND INTERNAL EXAM**

| V Fuels and Lubricants: Fuels - Calorific Value, HCV and LCV - Determination of calorific value of a solid and liquid fuel by Bomb calorimeter - Dulong's formula and Numericals. | 3 |
| Liquid fuel - Petrol and Diesel - Octane number & Cetane number | 1 |
| Biodiesel - Natural gas. | 2 |
| Lubricant - Introduction, solid, semisolid and liquid lubricants. | 1 |
| Properties of lubricants - Viscosity Index, Flash point, Fire point, Cloud point, Pour point and Aniline point. | 2 |

| VI Water Technology: Types of hardness, Units of hardness, Estimation of Hardness – EDTA method. Numericals based on the above | 3 |
| Water softening methods - Ion exchange process - Principle. Polymer ion exchange. | 2 |
| Reverse Osmosis - Disinfection method by chlorination and UV | 1 |
| Dissolved oxygen, BOD and COD. | 2 |
| Sewage water Treatment - Trickling Filter and UASB process. | 1 |

**END SEMESTER EXAM**

12
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE100</td>
<td>ENGINEERING MECHANICS</td>
<td>3-1-0-4</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**
1. To apply the principles of mechanics to practical engineering problems.
2. To identify appropriate structural system for studying a given problem and isolate it from its environment.
3. To develop simple mathematical model for engineering problems and carry out static analysis.
4. To carry out kinematic and kinetic analyses for particles and systems of particles.

**Syllabus**
- Statics: Fundamental concepts and laws of mechanics; Force systems; Principle of moments; Resultant of force and couple systems; Equilibrium of rigid body; Free body diagram; Equilibrium of a rigid body in three dimension; Support reactions; Properties of surfaces and solids - Centroid, Moment of inertia, Polar moment of inertia, Mass moment of inertia, Product of inertia and Principal moment of inertia; Theorems of Pappus – Guldinus; Friction; Principle of virtual work.
- Dynamics: Rectangular and cylindrical coordinate system; Combined motion of rotation and translation; Newton’s second law in rectilinear translation; D’Alembert’s principle; Mechanical vibration; Simple harmonic motion; Spring-mass model.

**Expected outcome**
1. Students will be able to apply and demonstrate the concepts of mechanics to practical engineering problems.
2. Students will be able to determine the properties of planes and solids.
3. Students will be able to apply fundamental concepts of dynamics to practical problems.

**Text Books:**
- Shames, I. H., Engineering Mechanics - Statics and Dynamics, Pearson Prentice

**References Books:**
- Benjamin J., Engineering Mechanics, Pentex Book Publishers and Distributors
- Bhavikkatti, S. S., Engineering Mechanics, New Age International Publishers
<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>Statics: Fundamental concepts and laws of mechanics – Rigid body – Principle of transmissibility of forces</td>
<td>2</td>
<td>15%</td>
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<tr>
<td></td>
<td>Coplanar force systems - Moment of a force – Principle of moments</td>
<td>2</td>
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<td></td>
<td>Resultant of force and couple system</td>
<td>4</td>
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<tr>
<td></td>
<td>Equilibrium of rigid body – Free body diagram – Conditions of equilibrium in two dimensions – Two force and three force members.</td>
<td>3</td>
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<tr>
<td>II</td>
<td>Types of supports – Problems involving point loads and uniformly distributed loads only.</td>
<td>5</td>
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<tr>
<td></td>
<td>Force systems in space – Degrees of freedom – Free body diagram – Equations of equilibrium – Simple resultant and Equilibrium problems.</td>
<td>4</td>
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<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td>III</td>
<td>Properties of planar surfaces – Centroid and second moment of area (Derivations not required) - Parallel and perpendicular axis theorem – Centroid and Moment of Inertia of composite area.</td>
<td>3</td>
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<tr>
<td></td>
<td>Polar Moment of Inertia – Radius of gyration – Mass moment of inertia of cylinder and thin disc (No derivations required).</td>
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<tr>
<td></td>
<td>Product of inertia – Principal Moment of Inertia (conceptual level).</td>
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<td></td>
<td>Theorems of Pappus and Guldinus.</td>
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<tr>
<td>IV</td>
<td>Friction – Characteristics of dry friction – Problems involving friction of ladder, wedges and connected bodies.</td>
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<td></td>
<td>Definition of work and virtual work – Principle of virtual work for a system of connection bodies – Problems on determinate beams only.</td>
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<td></td>
<td><strong>SECOND INTERNAL EXAM</strong></td>
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<tr>
<td>V</td>
<td>Dynamics: Rectangular and Cylindrical co-ordinate system</td>
<td>1</td>
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<tr>
<td></td>
<td>Combined motion of rotation and translation – Concept of instantaneous centre – Motion of connecting rod of piston and crank of a reciprocating pump.</td>
<td>4</td>
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<tr>
<td></td>
<td>Rectilinear translation – Newton’s second law – D’Alembert’s Principle – Application to connected bodies (Problems on motion of lift only).</td>
<td>4</td>
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<tr>
<td>VI</td>
<td>Mechanical vibrations – Free and forced vibration - Degree of freedom.</td>
<td>1</td>
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<td></td>
<td>Simple harmonic motion – Spring-mass model – Period – Stiffness – Frequency – Simple numerical problems of single degree of freedom.</td>
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**END SEMESTER EXAM**
**Course No:** BE110  
**Course Name:** ENGINEERING GRAPHICS  
**L-T-P Credits:** 1-1-3-3  
**Year of Introduction:** 2016

* As this course is practical oriented, the evaluation is different from other lecture based courses.

**Points to note:**

1. End semester examination will be for 50 marks and of **3 hour** duration.
2. End semester exam will include all modules except Module IV.
3. 100 marks are allotted for internal evaluation: first internal exam 40 marks, second internal exam 40 marks (CAD Lab Practice) and class exercises 20 marks.
   
   4. The first internal exam will be based on modules I and II and the second internal exam will be a practical exam in CAD based on Module IV alone. Second internal exam may be conducted at the end of the semester.

**Course Objectives**

To enable the student to effectively communicate basic designs through graphical representations as per standards.

**Syllabus**

Introduction to Engineering Graphics; Orthographic projections of lines and solids, Isometric projection, Freehand sketching, Introduction to CAD, Sections of solids, Development of surfaces, Perspective projection.

**Expected outcome**

Upon successful completion of this course, the student would have accomplished the following abilities and skills:

1. Fundamental Engineering Drawing Standards
2. Dimensioning and preparation of neat drawings and drawing sheets.
3. Interpretation of engineering drawings
4. The features of CAD software
### References Books:
- Benjamin, J., Engineering Graphics, Pentex Publishers
- Bhatt, N., D., Engineering Drawing, Charotar Publishing House Pvt Ltd.
- Parthasarathy, N. S., and Murali, V., Engineering Drawing, Oxford University Press
- Varghese, P. I., Engineering Graphics, V I P Publishers
- Venugopal, K., Engineering Drawing & Graphics, New Age International Publishers

### Course Plan

<table>
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<tr>
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<th>Hours</th>
<th>Sem. Exam Marks</th>
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<tbody>
<tr>
<td>1</td>
<td>6 exercises</td>
<td>14</td>
<td>20%</td>
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<tr>
<td></td>
<td>Introduction to Engineering Graphics: Need for engineering drawing.</td>
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<td></td>
<td>Drawing instruments; BIS code of practice for general engineering drawing.</td>
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<td></td>
<td>Orthographic projections of points and lines:-Projections of points in different quadrants; Projections of straight lines inclined to one of the reference planes, straight lines inclined to both the planes; True length and inclination of lines with reference planes; Traces of lines.</td>
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<tr>
<td></td>
<td>12 exercises</td>
<td>Orthographic projections of solids: Projections of simple solids* in simple positions, projections of solids with axis inclined to one of the reference planes and axis inclined to both the reference planes.</td>
<td>11</td>
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<tr>
<td>II</td>
<td>12 exercises</td>
<td>Isometric Projections: Isometric projections and views of plane figures simple* and truncated simple* solids in simple position including sphere and hemisphere and their combinations. Freehand sketching: Freehand sketching of real objects, conversion of pictorial views into orthographic views and vice versa.</td>
<td>09</td>
</tr>
<tr>
<td>III</td>
<td>6 exercises</td>
<td>Introduction to Computer Aided Drafting - familiarizing various coordinate systems and commands used in any standard drafting software - drawing of lines, circle, polygon, arc, ellipse, etc. Creating 2D drawings. Transformations: move, copy, rotate, scale, mirror, offset and array, trim, extend, fillet, chamfer. Dimensioning and text editing. Exercises on basic drafting principles, to create technical drawings. Creation of orthographic views of simple solids from pictorial views. Creation of isometric views of simple solids from orthographic views. Solid modelling and sectioning of solids, extraction of 2D drawings from solid models. (For internal examination only, not for University Examination).</td>
<td>15</td>
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<td>(Additional hours are allotted in U slot for CAD practice)</td>
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<tr>
<td>IV</td>
<td>9 exercises</td>
<td>Sections and developments of solids: Sections of simple* solids in simple vertical positions with section plane inclined to one of the reference planes - True shapes of sections. Developments of surfaces of these solids.</td>
<td>12</td>
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<tr>
<td>V</td>
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<tr>
<td>VI</td>
<td>6 exercises</td>
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<td></td>
<td>Intersection of surfaces: - Intersection of prism in prism and cylinder in cylinder - axis bisecting at right angles only.</td>
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<td></td>
<td>Perspective projections: - perspective projections of simple* solids.</td>
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<td>09</td>
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</table>

*Triangular, square, pentagonal and hexagonal prisms, pyramids, cones and cylinders.

END SEMESTER EXAM

Note:

1. First angle projection is to be followed.

2. CAD Practice is mandatory and shall be conducted in the time slot allotted for U slot in addition to 15 hours allotted for Module IV

**Question Paper Pattern:** Question Paper shall contain eight questions of 10 marks each out of which five questions are to be answered as explained below. **The duration of examination is 3 hours.**

Part A: **Three** questions from Modules I & II out of which **two** are to be answered.

Part B: **Five** questions from Modules III, V & VI out of which **three** are to be answered.

The questions are to be answered in A4 size booklet containing grid/plain sheets supplied by the university. Drawing sheets are not needed.

The evaluation of answers shall be based on the correctness of solution, judging the knowledge of student in concepts and principles of Engineering Graphics. Accuracy and neatness shall not be criteria for evaluation.
**Course Objective**

The objective of this course is to set a firm and solid foundation in Electrical Engineering with strong analytical skills and conceptual understanding of basic laws and analysis methods in electrical and magnetic circuits.

**Syllabus**

Fundamental Concepts of Circuit Elements and Circuit variables, Real and Ideal independent voltage and current sources, V-I relations; Basic Circuit Laws, Analysis of resistive circuits, Magnetic Circuits, Electromagnetic Induction; Alternating current fundamentals, Phasor Concepts, Complex representation, Phasor analysis of RL, RC, RLC circuit, admittances; Complex Power, Resonance in series and parallel circuits; Three-phase systems, analysis of balanced and unbalanced star and delta connected loads.

**Expected outcome**

The course will enable students to learn advanced topics in Electrical Engineering

**References Books:**

- Bhattacharya, S. K., Basic Electrical & Electronics Engineering, Pearson
- Bird, J., Electrical Circuit Theory and Technology, Routledge, Taylor & Francis Group
- Hughes, Electrical and Electronic Technology, Pearson Education
- Parker and Smith, Problems in Electrical Engineering, CBS Publishers and Distributors
- Sudhakar and Syam Mohan, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill
- Suresh Kumar, K. S, Electric Circuits and Networks, Pearson Education
<table>
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<tr>
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<th>Hours</th>
<th>Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Basic Circuit Laws: Kirchhoff’s current and voltage laws, analysis of resistive circuits-mesh analysis–super mesh analysis Node analysis-super node analysis, star delta transformation Numerical problems (Module II)</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Magnetic Circuits: Magneto motive force, flux, reluctance, permeability-comparison of electric and magnetic circuits, analysis of series magnetic circuits Parallel magnetic circuits, magnetic circuits with air-gaps. Numerical problems (Module III)</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Alternating current fundamentals:-Generation of Alternating voltages-waveforms, Frequency, Period, RMS and average values, peak factor and form factor of periodic waveforms (pure sinusoidal) and composite waveforms</td>
<td>3</td>
<td>15%</td>
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<tr>
<td></td>
<td>Phasor Concepts, Complex representation (exponential, polar and rectangular forms) of sinusoidal voltages and currents phasor diagrams</td>
<td>2</td>
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<tr>
<td></td>
<td>Complex impedance - series and parallel impedances and admittances, Phasor analysis of RL, RC, RLC circuits</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Numerical problems. (Module IV)</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Complex Power : Concept of Power factor: active, reactive and apparent power</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resonance in series and parallel circuits</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Energy, bandwidth and quality factor, variation of impedance and admittance in series and parallel resonant circuits</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Numerical problems (Module V)</td>
<td>2</td>
</tr>
<tr>
<td>VI</td>
<td>Three phase systems: Star and delta connections, three-phase three wire and three-phase four-wire systems</td>
<td>2</td>
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<tr>
<td></td>
<td>Analysis of balanced and unbalanced star and delta connected loads</td>
<td>2</td>
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<tr>
<td></td>
<td>Power in three-phase circuits. Active and Reactive power measurement by one, two, and three wattmeter methods</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Numerical problems (Module VI)</td>
<td>2</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAMINATION**
Course No. | Course Name | L-T-P-Credits | Year of Introduction
--- | --- | --- | ---
BE103 | INTRODUCTION TO SUSTAINABLE ENGINEERING | 2-0-1-3 | 2016

Course Objectives
- To have an increased awareness among students on issues in areas of sustainability.
- To understand the role of engineering and technology within sustainable development.
- To know the methods, tools, and incentives for sustainable product-service system development.
- To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

Syllabus

Expected outcome
The student will be
- Able to understand the different types of environmental pollution problems and their sustainable solutions.
- Able to work in the area of sustainability for research and education.
- Having a broader perspective in thinking for sustainable practices by utilizing the engineering knowledge and principles gained from this course.

Reference Books:
- Bradley, A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
### 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>Sustainability - Introduction, Need and concept of sustainability, Social - environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.</td>
<td>L4</td>
<td>15%</td>
</tr>
</tbody>
</table>
|        | Students may be assigned to do at least one project eg:  
|        | a) Identifying/assessment of sustainability in your neighbourhood in education, housing, water resources, energy resources, food supplies, land use, environmental protection etc.  
|        | b) Identify the threats for sustainability in any selected area and explore solutions for the same                                                                                                      | P1    |                 |
| II     | Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon footprint. | L6    | 15%             |
|        | Students may be assigned to do at least one project for eg:  
|        | a) Assessing the pollution status of a small area  
|        | b) Programmes for enhancing public environmental awareness  
|        | c) Observe a pond nearby and think about the different measures that can be adopted for its conservation                                                                                               | P3    |                 |
| III    | Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India.                                                                                       | L4    | 15%             |
|        | Students may be assigned to do at least one project eg:  
|        | a) Conducting LCA of products (eg. Aluminium cans, PVC bottles, cars etc. or activities (Comparison of land filling and open burning)  
|        | b) Conducting an EIA study of a small project (eg. Construction of a building)                                                                                                                          | P2    |                 |
| IV | Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings, Sustainable cities, Sustainable transport. | L5 | 15% |
| V | Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. | L5 | 20% |
| VI | Green Engineering, Sustainable Urbanisation, industrialisation and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis. | L5 | 20% |

**SECOND INTERNAL EXAM**

Students may be assigned to do at least one project eg:

a) Consider the design aspects of a sustainable building for your campus

b) Explore the different methods that can be adopted for maintaining a sustainable transport system in your city.

Students may be assigned to do at least one project eg:

a) Find out the energy savings that can be achieved by the installation of a solar water heater

b) Conduct a feasibility study for the installation of wind farms in Kerala

Students may be assigned to do a group project eg:

a) Collect details for instances of climate change in your locality

b) Find out the carbon credits you can gain by using a sustainable transport system (travelling in a cycle or car pooling from college to home)

c) Have a debate on the topics like: Industrial Ecology is a Boon or Bane for Industries? Are we scaring the people on Climate Change unnecessarily? Technology enables Development sustainable or the root cause of unsustainability?

**END SEMESTER EXAM**
Course Objectives

1. To inculcate the essentials of Civil Engineering field to the students of all branches of Engineering.
2. To provide the students an illustration of the significance of the Civil Engineering Profession in satisfying societal needs.

Syllabus

General introduction to Civil Engineering - Introduction to types of buildings, Components of a residential building, Introduction to industrial buildings; Introduction to planning of residential buildings - Simple building plans; Introduction to the various building area terms; Setting out of a building; Surveying – Principles, Objectives, Horizontal measurements with tapes, Ranging; Levelling – Instruments, Reduction of levels; Modern surveying instruments; Building materials – Bricks, cement blocks, Cement, Cement mortar, Steel; Building construction – Foundations, Brick masonry, Roofs, Floors, Decorative finishes, Plastering, Paints and Painting; Basic infrastructure and services – Elevators, Escalators, Ramps, Air conditioning, Sound proofing, Towers, Chimneys, Water Tanks; Intelligent buildings.

Expected outcome

1. The students will be able to illustrate the fundamental aspects of Civil Engineering.
2. The students will be able to plan and set out a building.
3. Students will be able to explain the concepts of surveying for making horizontal and vertical measurements.
4. They will able to illustrate the uses of various building materials and explain the method of construction of different components of a building.
5. Students will be able to discuss about various services in a building.

References Books:

- Gopi, S., Basic Civil Engineering, Pearson Publishers
- Kandy, A. A., Elements of Civil Engineering, Charotar Publishing house
- McKay, W. B. and McKay, J. K., Building Construction Volumes 1 to 4, Pearson India Education Services
- Minu, S., Basic Civil Engineering, Karunya Publications
- Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
- Rangwala, S. C. and Dalal, K. B., Building Construction, Charotar Publishing house

### 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>General Introduction to Civil Engineering - Various disciplines of Civil engineering, Relevance of Civil engineering in the overall infrastructural development of the country. Introduction to types of buildings as per NBC; Selection of site for buildings. Components of a residential building and their functions. Introduction to industrial buildings – office / factory / software development office / power house / electronic equipment service centre (any one related to the branch of study) Students have to visit one such building and submit an assignment about the features of any one of the listed building related to their branch (Not included for exam).</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Building planning - Introduction to planning of residential buildings- Site plan, Orientation of a building, Open space requirements, Position of doors and windows, Size of rooms; Preparation of a scaled sketch of the plan of a single storeyed residential building in a given site plan. Introduction to the various building area terms - Computation of plinth area / built up area, Floor area / carpet area - for a simple single storeyed building; Setting out of a building.</td>
<td>4</td>
<td>15%</td>
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</table>

### FIRST INTERNAL EXAM

<table>
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<tr>
<th>Level</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Surveying - Principles and objectives of surveying;</td>
<td>1</td>
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<td></td>
<td>Horizontal measurements – instruments used – tape, types of tapes;</td>
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<td></td>
<td>Ranging (direct ranging only) – instruments used for ranging.</td>
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<td></td>
<td>Levelling - Definitions, principles, Instruments (brief discussion only) -</td>
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<td></td>
<td>Level field book - Reduction of levels - problems on levelling (height of collimation only).</td>
<td>3</td>
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<tr>
<td></td>
<td>Modern surveying instruments – Electronic distance meter, digital level, total station, GPS (Brief discussion only).</td>
<td>1</td>
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<tr>
<td>IV</td>
<td>Building materials - Bricks, cement blocks - Properties and specifications.</td>
<td>2</td>
<td>15%</td>
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</tbody>
</table>
### Cement
- OPC, properties, grades; other types of cement and its uses (in brief).
- Cement mortar – constituents, preparation.
- Concrete – PCC and RCC – grades.
- Steel - Use of steel in building construction, types and market forms.

### SECOND INTERNAL EXAM

| V | Building construction – Foundations; Bearing capacity of soil (definition only); Functions of foundations, Types - shallow and deep (sketches only). | 2 |
|   | Brick masonry – header and stretcher bond, English bonds – Elevation and plan (one brick thick walls only). | 2 |
|   | Roofs – functions, types, roofing materials (brief discussion only). | 1 |
|   | Floors – functions, types; flooring materials (brief discussion only). | 1 |
|   | Decorative finishes – Plastering – Purpose, procedure. | 1 |
|   | Paints and Painting – Purpose, types, preparation of surfaces for painting (brief discussion only). | 2 |

| VI | Basic infrastructure and services - Elevators, escalators, ramps, air conditioning, sound proofing (Civil engineering aspects only) | 2 |
|    | Towers, Chimneys, Water tanks (brief discussion only). | 1 |
|    | Concept of intelligent buildings. | 2 |

### END SEMESTER EXAM
Course Objectives
To expose the students to the thrust areas in Mechanical Engineering and their relevance by covering the fundamental concepts.

Syllabus
Thermodynamics, laws of thermodynamics, implications, cycles, energy conversion devices, steam and water machines, engines, turbo machines, refrigeration and air conditioning, power transmission devices in automobiles, latest trends, engineering materials and manufacturing processes, types of materials, alloys, shape forming methods, machine tools.

Expected outcome
The student will be able to understand the interdependence of the thrust areas in Mechanical Engineering and their significance leading to the development of products, processes and systems.

References Books:
- Balachandran, Basic Mechanical Engineering, Owl Books
- Benjamin, J., Basic Mechanical Engineering, Pentex Books
- Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
- Crouse, Automobile Engineering, Tata Mc-Graw-Hill, New Delhi
- Nag, P. K., Basic and Applied Thermodynamics, Tata McGraw-Hill
- Pravin Kumar, Basic Mechanical Engineering
- Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI

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>Thermodynamics: Laws of Thermodynamics, significance and Applications of thermodynamics, entropy, Ideal and real gas equations; Analysis of Carnot cycle, Otto cycle, Diesel cycle; Efficiency of these cycles.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Energy conversion devices: Boilers, Steam turbines, Gas turbines; Working principle of two stroke and four stroke I.C.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
**Engines (SI and CI), Fuels, CRDI, MPFI, Hybrid Engines, Reciprocating pumps, centrifugal pumps and hydraulic turbines. (Elementary ideas only)**

**FIRST INTERNAL EXAM**

| III | Refrigeration and Air Conditioning: Vapour compression refrigeration systems, Heat Pump, COP, Study of household refrigerator, Energy Efficiency Rating, Psychrometry, Psychrometric processes, window air conditioner, split air conditioner. Refrigerants and their impact on environment. | 7 | 15% |

| IV | Automobiles and Power Transmission Devices, Different types of automobiles, types of power units in automobiles; major components and their functions (brief description only); Belts and belt drives; Chain drive; Rope drive; Gears and gear trains; friction clutch (cone and single plate), brakes (types and applications only). | 7 | 15% |

**SECOND INTERNAL EXAM**

| V | Materials and manufacturing processes: Engineering materials, Classification, properties, Alloys and their Applications; Casting, Sheet metal forming, Sheet metal cutting, Forging, Rolling, Extrusion; Metal joining processes - soldering, brazing and welding; Powder metallurgy. (Elementary ideas only). | 7 | 20% |

| VI | Machine Tools (Basic elements, Working principle and types of operations), Lathe, Drilling Machine, Shaper, planer, slotter, Milling Machine, Grinding machine; Introduction to CNC machines. | 7 | 20% |

**END SEMESTER EXAM**

**Question Paper Pattern:**

**Part A:** Modules I and II – three questions of 15 marks each – out of which two questions are to be answered.

**Part B:** Modules III and IV – three questions of 15 marks each – out of which two questions are to be answered.

**Part C:** Modules V and VI – three questions of 20 marks each – out of which two questions are to be answered.

Each question can have maximum of four subdivisions (a,b,c,d).

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<table>
<thead>
<tr>
<th>Course No:</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC100</td>
<td>BASICS OF ELECTRONICS ENGINEERING</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

1) To get basic idea about types, specification and common values of passive and active components.

2) To familiarize the working of diodes, transistors, MOSFETS and integrated circuits.

3) To understand the working of rectifiers, amplifiers and oscillators.

4) To get a basic idea about measuring instruments

5) To get a fundamental idea of basic communication systems and entertainment electronics

**Syllabus**


**Expected Outcome**

Student can identify the active and passive electronic components. Student can setup simple circuits using diodes and transistors. Student will get fundamental idea about basic communication systems and entertainment electronics.

**Text Books:**

- Bell, D. A., Electronic Devices and Circuits, Oxford University Press
- Tomasy, W., Advanced Electronic Communication system, PHI Publishers

**References Books:**

- Boylested, R. L. and Nashelsky, L., Electronic Devices and Circuit Theory, Pearson Education
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Evolution of Electronics, Impact of Electronics in industry and in society.</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Resistors, Capacitors: types, specifications. Standard values, marking, colour coding.</td>
<td>3</td>
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<td></td>
<td>Inductors and Transformers: types, specifications, Principle of working.</td>
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<td></td>
<td>Electro mechanical components: relays and contactors.</td>
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<tr>
<td></td>
<td>PN Junction diode: Intrinsic and extrinsic semiconductors, Principle of operation, V-I characteristics, principle of working of Zener diode, Photo diode, LED and Solar cell.</td>
<td>4</td>
<td>20%</td>
</tr>
<tr>
<td>II</td>
<td>Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, input and output characteristics of common emitter configuration (npn only).</td>
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<td></td>
<td><strong>FIRST INTERNAL EXAM</strong></td>
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<tr>
<td>III</td>
<td>Rectifiers and power supplies: Block diagram description of a dc power supply. Half wave and full wave (including bridge) rectifier, capacitor filter, working of simple zener voltage regulator.</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Amplifiers and Oscillators: Circuit diagram and working of common emitter amplifier, Block diagram of Public Address system, concepts of feedback, working principles of oscillators, circuit diagram &amp; working of RC phase shift oscillator.</td>
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<tr>
<td></td>
<td>Analogue Integrated circuits: Functional block diagram of operational amplifier, ideal operational amplifier, inverting and non-inverting Amplifier.</td>
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<td>15%</td>
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<tr>
<td>IV</td>
<td>Digital ICs: Logic Gates.</td>
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<tr>
<td></td>
<td>Electronic Instrumentation: Principle and block diagram of digital multimeter, digital storage</td>
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oscilloscope, and function generator.

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<tr>
<th>SECOND INTERNAL EXAM</th>
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<tbody>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td>Radio communication: principle of AM &amp; FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver.</td>
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<tr>
<td>Satellite communication: concept of geostationary Satellite system.</td>
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<tr>
<td><strong>VI</strong></td>
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<tr>
<td>Mobile communication: basic principles of cellular communications, concepts of cells, frequency reuse.</td>
</tr>
<tr>
<td>Optical communication: block diagram of the optical communication system, principle of light transmission through fiber, advantages of optical communication systems.</td>
</tr>
<tr>
<td>Entertainment Electronics Technology: Basic principles and block diagram of cable TV, CCTV, DTH system.</td>
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</tbody>
</table>

END SEMESTER EXAM

Note: Analysis is not required in this course.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
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<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH110</td>
<td>ENGINEERING PHYSICS LAB</td>
<td>0-0-2-1</td>
<td>2016</td>
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</tbody>
</table>

**Course Objectives**

This course is designed (i) to impart practical knowledge about some of the phenomena they have studied in the Engineering Physics course and (ii) to develop the experimental skills of the students.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

**Basics**

1. Study of application of Cathode Ray Oscilloscope (CRO) for Frequency and Amplitude measurements. Lissajous figures (useful for different types of polarized light.)
2. Temperature measurement – Thermocouple

**Waves, Oscillations and Ultrasonics**

4. Wave length and velocity measurement of ultrasonic waves in a liquid using ultrasonic diffraactometer.
5. The LCR Circuit – Forced and damped harmonic oscillations.

**Interference**

7. Wave length measurement of a monochromatic source of light using Newton’s Rings method.
9. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.

**Diffraction**

10. To determine the slit or pinhole width.
11. To measure wavelength using a millimeter scale as a grating.
12. Determination the wavelength of He-Ne laser or any standard laser using diffraction grating.
13. To determine the wavelength of monochromatic light using grating.
14. Determination of dispersive power and resolving power of a plane transmission grating.
Polarisation

15. Kerr Effect - To demonstrate the Kerr effect in nitrobenzene solution and to measure the light intensity as a function of voltage across the Kerr cell using photo detector.
16. To measure the light intensity of plane polarised light as a function of the analyzer position.
17. Laurent’s Half Shade Polarimeter - To observe the rotation of the plane of polarization of monochromatic light by sugar solution and hence to determine the concentration of solution of optically active substance.

Laser & Photonics

18. To determine the speed of light in air using laser.
19. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
20. Determination of the particle size of lycopodium powder.
21. I-V characteristics of solar cell
22. To measure Planck’s constant using photo electric cell.

Reference Books:

- Gupta, S. K., Engineering Physics Practical, Krishna Prakashan Pvt. Ltd.
- Koser, A. A., Practical Engineering Physics, Nakoda Publishers and Printers India Ltd
- Sasikumar, P. R. Practical Physics, PHI.

Website:

- http://www.indosawedu.com
<table>
<thead>
<tr>
<th>Course No.</th>
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<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>CY 110</td>
<td>ENGINEERING CHEMISTRY LAB</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Estimation of Total Hardness – EDTA method.
3. Estimation of Copper in Brass.
4. Estimation of dissolved oxygen by Winklers method.
5. Estimation of chloride in water.
6. Preparation of Urea formaldehyde and Phenol-formaldehyde resin.
7. Determination of Flash point and Fire point of oil by Pensky Martin Apparatus.
8. Determination of wavelength of absorption maximum and colorimetric estimation of $\text{Fe}^{3+}$ in solution.
9. Determination of molar absorptivity of a compound other than $\text{Fe}^{3+}$.
10. Analysis of IR spectra of any three organic compounds.
11. Analysis of $^1\text{H}$ NMR spectra of any three organic compounds.
13. Verification of Nernst equation for electrochemical cell.
15. Conductivity measurements of salt solutions.
16. Flame photometric estimation of Na+ to find out the salinity in sand.

**Expected outcome**

The student will be able to apply and demonstrate the theoretical concepts of Engineering Chemistry.

**References:**
- Practical Engineering Chemistry Lab Manual, Owl book publishers
List of Exercises / Experiments (Minimum of 8 mandatory)
(For Civil Engineering Branch)

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape and cross staff.

Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (No mortar required) - corner portion – length of side walls 60 cm.

Construct a wall of height 50 cm and wall thickness 2 bricks using English bond (No mortar required) - corner portion – length of side walls 60 cm.

Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier caliper, screw gauge etc.).

Testing of building materials: The student should do the compression testing of any three construction materials and compare the strength (bricks, hollow block, laterite block, cement concrete cube, stone block, and so on).

Computation of Centre of gravity and Moment of inertia of a given rolled steel section by actual measurements.

Introduction to simple plumbing and sanitary fittings.

Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

Home assignment 2: Report preparation - The student should collect the construction details of any one unique Civil Engineering structure, prepare and submit a detailed report with neat illustrations.

Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report including their market rates.

(For branches other than Civil Engineering)

Setting out of a building: The student should set out a building (single room only) as per the given building plan using tape only.

Setting out of a building: The student should set out a building (single room only) as per the
given building plan using tape and cross staff.

Building area computation: The student should prepare a rough sketch of a given single storeyed building and by taking linear measurements compute plinth area and carpet area of the given building.

Construct a wall of at least a height of 500mm and wall thickness 1 brick using English bond (No mortar required) - corner portion – length of side walls at least 600mm.

Compute the area and/or volume of various features of a building/structure such as door and window size, number of bricks required to construct a wall of a building, diameter of bars used in windows etc. – To create an awareness of measurements and units (use tape or other simple measuring instruments like vernier calipers, screw gauge etc.).

Horizontal measurements: Find the area of an irregular polygon set out on the field.
Vertical measurements: Find the level difference between any two points.

Computation of Centre of gravity and Moment of inertia of a given rolled steel section by sketching and measurements.

Home assignment 1: Preparation of a building model - The students in batches should prepare and submit a building model for a given plinth area in a given site plan constrained by a boundary wall. The minimum requirements of a residential building viz., drawing cum dining room, one bed room and a kitchen should be included. The concept of an energy efficient building should also be included in the model.

Home assignment 2: Report preparation - The student should collect the construction details of an industrial building related to their branch of study, prepare and submit a detailed report with neat illustrations.

Home assignment 3: Report preparation - The students should collect samples of building materials, prepare and submit a detailed report about their market rates.
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<tr>
<th>Sl. No</th>
<th>Name of No. Shop floor</th>
<th>Exercises</th>
<th>No of sessions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td>Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc. And accessories (b) Components: Bearings, seals, O-rings, circlips, keys etc.</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Carpentry</td>
<td>Any one model from the following: 1. T-Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joint (a) Demonstrating the forgability of different materials (MS, Al, Alloy steel and Cast steel) in cold and hot states (b) Observing the qualitative differences in the hardness of these materials (c) Determining the shape and dimensional variations of Al test specimen due to forging under different states by visual inspection and measurements</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Smithy</td>
<td>Any one exercise from the following 1. Bench moulding 2. Floor moulding 3. Core making</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Foundry</td>
<td>Any one exercise from the following</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Welding</td>
<td>Making joints using Electric arc welding. Bead formation in horizontal, vertical and overhead positions</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Fitting and Assembly</td>
<td>Filing exercise and any one of the following exercises Disassembling and reassembling of 1. Cylinder piston assembly 2. Tail stock assembly 3. Time piece/clock 4. Bicycle or any machine</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Machines</td>
<td>Demonstration and applications of Drilling machine, Grinding machine, Shaping machine, Milling machine and lathe</td>
<td>2</td>
</tr>
</tbody>
</table>
Course Objectives
The objective of this course is to familiarize the students with commonly used components, accessories and measuring equipment in Electrical installations. The course also provides hands on experience in setting up of simple wiring circuits.

List of Exercises / Experiments (Minimum of 8 mandatory)
1. Identify different types of cables/wires and switches and their uses.
2. Identify different types of fuses & fuse carriers, MCB and ELCB, MCCB with ratings and usage.
3. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring).
4. Wiring of light/fan circuit using Two way switches (Staircase wiring)
5. Wiring of fluorescent lamps and light sockets (6 A)
6. Wiring of Power circuit for controlling power device (16A socket)
7. Godown wiring / Tunnel wiring
8. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, Main switch and Energy meter.
10. Wiring of backup power supply including inverter, battery and load for domestic installations.
11. Demonstration and measurement of power consumption of electric iron, mixer grinder, single phase pump, exhaust fan, etc.

Expected outcome
1. Familiarity with supply arrangements and their limitations, knowledge of standard voltages and their tolerances, safety aspects of electrical systems and importance of protective measures in wiring systems.
2. Knowledge about the types of wires, cables and other accessories used in wiring. Creating awareness of energy conservation in electrical systems.
3. Students should be able to wire simple lighting circuits for domestic buildings, distinguish between light and power circuits.
4. To measure electrical circuit parameters and current, voltage and power in a circuit.
5. Familiarity with backup power supply in domestic installation.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC110</td>
<td>ELECTRONICS ENGINEERING WORKSHOP</td>
<td>0-0-2-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

This course gives the basic introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

**List of Exercises / Experiments (Minimum of 8 mandatory)**

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)]

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools, Interpret data sheets of discrete components and IC’s, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, CRO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de-soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor, UJT and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]

7. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (Any Four circuits)
   1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
   2. LED blinking circuit using a stable multi-vibrator with transistor BC 107.
   3. Square wave generation using IC 555 timer in IC base.
   5. RC coupled amplifier with transistor BC 107.
   6. AND and NAND gates in diode transistor logic.

8. Familiarization of electronic systems (Any three systems)
1. Setting up of a PA system with different microphones, loud speakers, mixer etc.
2. Assembling and dismantling of desktop computer/laptop/mobile phones.
3. Coil/Transformer winding.
4. Identify the subsystems of TV, DTH, CCTV, Cable TV, CRO, Function generator etc.
5. Screen printing and PCB pattern transfer
6. Soldering & de-soldering of SMD using hot air soldering station.
7. Introduction to robotics- Familiarization of components (motor, sensors, battery etc.) used in robotics and assembling of simple robotic configurations.

**Expected outcome**

Student can identify the active and passive electronic components. Student gets hands-on assembling, testing, assembling, dismantling, fabrication and repairing systems by making use of the various tools and instruments available in the Electronics Workshop.
Course No. | Course Name | L-T-P-Credits | Year of Introduction |
--- | --- | --- | --- |
MA102 | DIFFERENTIAL EQUATIONS | 3-1-0-4 | 2016 |

**Course Objectives**

This course introduces basic ideas of differential equations, both ordinary and partial, which are widely used in the modelling and analysis of a wide range of physical phenomena and has got applications across all branches of engineering. The course also introduces Fourier series which is used by engineers to represent and analyse periodic functions in terms of their frequency components.

**Syllabus**

Homogeneous linear ordinary differential equation, non-homogeneous linear ordinary differential equations, Fourier series, partial differential equation, one dimensional wave equation, one dimensional heat equation.

**Expected Outcome**

At the end of the course students will have acquired basic knowledge of differential equations and methods of solving them and their use in analysing typical mechanical or electrical systems. The included set of assignments will familiarise the students with the use of software packages for analysing systems modelled by differential equations.

**TEXT BOOKS**


**REFERENCES:**

- Simmons: Differential Equation with Applications and its historical Notes, 2e McGrawHill Education India 2002
## COURSE PLAN

<table>
<thead>
<tr>
<th>MODULE</th>
<th>CONTENT</th>
<th>HRS</th>
<th>END SEM. EXAM MARKS (OUT OF 100)</th>
</tr>
</thead>
</table>
| I      | HOMOGENEOUS DIFFERENTIAL EQUATIONS  
(Text Book 1 : Sections 1.7, 2.1, 2.2, 2.6, 3.2)  
Existence and uniqueness of solutions for initial value problems, Homogenous linear ODEs of second order. Homogenous linear ODEs with constant coefficients, Existence and Uniqueness of solutions Wronskian,  
Homogenous linear ODEs with constant Coefficients (Higher Order)  
(For practice and submission as assignment only: Modelling of free oscillations of a mass–spring system) | 3 | 17 |
| II     | NON-HOMOGENEOUS LINEAR ORDINARY DIFFERENTIAL EQUATIONS  
(Text Book 2: Sections 1.2.7 to 1.2.14)  
The particular Integral (P.I.), Working rule for P.I. when \(g(x) = x^m\), To find P.I. when \(g(x) = e^{ax}\cdot V_1(x)\),  
Working rule for P.I. when \(g(x) = x\cdot V(x)\), Homogeneous Linear Equations, PI of Homogenous equations  
Legendêre’s Linear Differential Equations  
Method of variation of parameters for finding PIs (For practice and submission as assignments only: Modelling forced oscillations, resonance, electric circuits) | 7 | 17 |
| III    | FOURIER SERIES  
(Text Book 2 - Sections 4.1,4.2,4.3,4.4)  
Periodic functions, Orthogonality of Sine and Cosine functions (Statement only), Fourier series and Euler’s formulas  
Fourier cosine series and Fourier sine series (Fourier series of even and Odd functions)  
Half range expansions (All results without proof) | 3 | 17 |
| IV | PARTIAL DIFFERENTIAL EQUATIONS  
( Text Book 2 : Sections : 5.1, 5.1.1, 5.1.2, 5.1.5, 5.2.6- 5.2.10)  
Introduction to partial differential equations, formation of PDE, Solutions of first order PDE (Linear only)  
Lagrange’s Method  
Linear PDE with constant coefficients, Solutions of Linear Homogenous PDE with constant coefficients, Shorter method for finding PI when \( g(x,y)=f(ax+by) \), Method of finding PI when \( g(x,y) = x^m y^n \), method of find PI when \( g(x,y)= e^{ax+by} V(x,y) \) | 3 | 17 |
| --- | --- | --- |
| V | ONE DIMENSIONAL WAVE EQUATION  
( Text Book 2: Sections :6.1-- 6.4)  
Method of separation of variables  
The wave Equation  
Vibrations of a stretched string  
Solutions of one dimensional wave equation using method of separation of variables and problems | 2 | 16 |
| VI | ONE DIMENSIONAL HEAT EQUATION  
( Text Book 2: sections 6.7, 6.8 ,6.9, 6.9.1 ,6.9.2)  
The equation of Heat conduction  
One dimensional Heat transfer equation.  
Solutions of One Dimensional Heat transfer equation, A long insulated rod with ends at zero temperatures, A long insulated rod with ends at non zero temperatures | 1 | 16 |

**END SEMESTER EXAM**

*TUTORIALS:* Tutorials can be ideally conducted by dividing each class into three groups. Prepare necessary materials from each module that can be practiced using computer software. Use them uniformly in every class.
<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE102</td>
<td>DESIGN AND ENGINEERING</td>
<td>2-0-2-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

The purpose of this course is:-
1. To excite the student on creative design and its significance;
2. To make the student aware of the processes involved in design;
3. To make the student understand the interesting interaction of various segments of humanities, sciences and engineering in the evolution of a design;
4. To get an exposure as to how to engineer a design.

**Syllabus**

Design and its objectives; Role of science, engineering and technology in design; Engineering as a business proposition; Creative design and the Design Process; Design evaluation and communication of designs; Design for function and strength; Material selection and design detailing; Role of standards in design Engineering the design; Design for “X”; Product centered and user centered design; Aesthetics and ergonomics; Concepts of value engineering, concurrent engineering and reverse engineering in design; Culture based design; Modular design; Design optimization needs; User interface; Intelligent and autonomous products; Internet of things; Advanced products and human psychology; Life cycle design; Product and its environment; Design as a marketing tool; Products and IPR; Product liability.

**Expected outcome**

The student will be:-
- Able to appreciate the different elements involved in good designs and to apply them in practice when called for.
- Aware of the product oriented and user oriented aspects that make the design a success.
- Will be capable to think of innovative designs incorporating different segments of knowledge gained in the course;
- Students will have a broader perspective of design covering function, cost, environmental sensitivity, safety and other factors other than engineering analysis.

**References 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>Design and its objectives; Design constraints; Design functions; Design means and Design from; Role of Science, Engineering and Technology in design; Engineering as a business proposition; Functional and Strength Designs. Design form, function and strength; How to initiate creative designs? Initiating the thinking process for designing a product of daily use. Need identification; Problem Statement; Market survey-customer requirements; Design attributes and objectives; Ideation; Brain storming approaches; arriving at solutions; Closing on to the Design needs. An Exercise in the process of design initiation. A simple problem is to be taken up to examine different solutions- Ceiling fan? Group Presentation and discussion.</td>
<td>L2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Design process- Different stages in design and their significance; Defining the design space; Analogies and “thinking outside of the box”; Quality function deployment-meeting what the customer wants; Evaluation and choosing of a design. Design Communication; Realization of the concept into a configuration, drawing and model. Concept of “Complex is Simple”. Design for function and strength. Design detailing- Material selection, Design visualisation- Solid modelling; Detailed 2D drawings; Tolerancing; Use of standard items in design; Research needs in design; Energy needs of the design, both in its realization and in the applications. An exercise in the detailed design of two products (Stapler/ door/clock)</td>
<td>L2</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Prototyping- rapid prototyping; testing and evaluation of design; Design modifications; Freezing the design; Cost analysis. Engineering the design – From prototype to product. Planning; Scheduling; Supply chains; inventory; handling.</td>
<td>L2</td>
<td>15%</td>
</tr>
</tbody>
</table>
| IV | Design for “X”; covering quality, reliability, safety, manufacturing/construction, assembly, maintenance, logistics, handling, disassembly, recycling, re-engineering etc.  
List out the design requirements(x) for designing a rocket shell of 3 meter diameter and 8 meter length.  
Design mineral water bottles that could be packed compactly for transportation. | P4 | L4 | 15% |

**SECOND INTERNAL EXAM**

Value engineering, Concurrent engineering, Reverse engineering in design; Culture based design; Architectural designs; Motifs and cultural background; Tradition and design;  
Study the evolution of Wet grinders; Printed motifs; Role of colours in design.  
Make sharp corners and change them to smooth curves-check the acceptance. Examine the possibility of value addition for an existing product. | L2 | L4 | 20% |

| VI | Modular design; Design optimization; Intelligent and autonomous products; User interfaces; communication between products; autonomous products; internet of things; human psychology and the advanced products.  
Design as a marketing tool; Intellectual Property rights – Trade secret; patent; copy-right; trademarks; product liability.  
Group presentation of any such products covering all aspects that could make or mar it. | L3 | P6 | 20% |

**END SEMESTER EXAM**

**Evaluation Scheme:**

First internal exam – closed book exam – 25 marks  
Second internal exam – open book exam – 25 marks
Assignment/projects – 50 marks (iv) End semester exam – open book exam – 50 marks (2 hours duration – conducted by the University)

First Test: Marks: 25 Closed Book:

Questions may cover:-

Topics covered in the lectures.

How to arrive at the design details for a specific need gap given.

Sketching the design of a product that is to meet the given user requirements.

Second Test: Marks: 25 Open Book:

Students are permitted to bring in class notes, own notes, text books and other books (Maximum 3/4 books) for the test. Access to internet and mobile phones is NOT permitted.

Assignments: Marks: 20 Two assignments are to be given (10 marks each). These assignments are to cover specific design/s, sketching of the design, and a short but well written write-up on the design.

Projects: Marks: 30 Two mini projects are to be assigned. One is to be a group project and the other an individual one. A group of 3 or 4 students can take up the group project. Each project is to be evaluated for 15 marks.

The Group Project is to be done in the practical hours given for the course. Projects including the group projects are to be evaluated based on individual presentations and answers to the questions raised. These presentations could be done during the practical hours.

Question Paper Pattern for End Semester Examination (Open Book)

Part A – Eight questions of each 5 marks, out of which six questions are to be answered.

Part B – Three questions of each 10 marks, out of which two questions are to be answered.
Course No. | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
MA201 | LINEAR ALGEBRA AND COMPLEX ANALYSIS | 3-1-0-4 | 2016

**Prerequisite:** Nil

**Course Objectives**

**COURSE OBJECTIVES**

- To equip the students with methods of solving a general system of linear equations.
- To familiarize them with the concept of Eigen values and diagonalization of a matrix which have many applications in Engineering.
- To understand the basic theory of functions of a complex variable and conformal Transformations.

**Syllabus**

Analyticity of complex functions-Complex differentiation-Conformal mappings-Complex integration-System of linear equations-Eigen value problem

**Expected outcome**

At the end of the course students will be able to

(i) solve any given system of linear equations
(ii) find the Eigen values of a matrix and how to diagonalize a matrix
(iii) identify analytic functions and Harmonic functions.
(iv) evaluate real definite Integrals as application of Residue Theorem
(v) identify conformal mappings(vi) find regions that are mapped under certain Transformations

**Text Book:**

**References:**
1. Dennis g Zill & Patric D Shanahan - A first Course in Complex Analysis with Applications-Jones & Bartlet Publishers
3. Lipschutz, Linear Algebra, 3e (Schaums Series) McGraw Hill Education India 2005

**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>Complex differentiation Text 1[13.3,13.4] Limit, continuity and derivative of complex functions</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analytic Functions</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cauchy–Riemann Equation(Proof of sufficient condition of analyticity &amp; C R Equations in polar form not required)-Laplace’s Equation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Harmonic functions, Harmonic Conjugate</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Conformal mapping: Text 1[17.1-17.4] Geometry of Analytic functions Conformal Mapping,</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mapping $w = z^2$ conformity of $w = e^z$.</td>
<td>2</td>
<td>15%</td>
</tr>
</tbody>
</table>
The mapping \( w = z + \frac{1}{z} \)

Properties of \( w = \frac{1}{z} \)

Circles and straight lines, extended complex plane, fixed points

Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes

Conformal mapping by \( w = \sin z \) & \( w = \cos z \)

(Assignment: Application of analytic functions in Engineering)

<table>
<thead>
<tr>
<th>FIRST INTERNAL EXAMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method</td>
</tr>
<tr>
<td>Cauchy’s Integral Theorem(without proof), Independence of path(without proof), Cauchy’s Integral Theorem for Multiply Connected Domains (without proof)</td>
</tr>
<tr>
<td>Cauchy’s Integral Formula- Derivatives of Analytic Functions(without proof)Application of derivative of Analytical Functions</td>
</tr>
<tr>
<td>Taylor and Maclaurin series(without proof), Power series as Taylor series, Practical methods(without proof)</td>
</tr>
<tr>
<td>Laurent’s series (without proof)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECOND INTERNAL EXAMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear system of Equations Text 1(7.3-7.5)</td>
</tr>
<tr>
<td>Linear systems of Equations, Coefficient Matrix, Augmented Matrix</td>
</tr>
<tr>
<td>Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it.</td>
</tr>
</tbody>
</table>
| VI | Linear independence-rank of a matrix
|    | Vector Space-Dimension-basis-vector space $\mathbb{R}^3$
|    | Solution of linear systems, Fundamental theorem of non-homogeneous linear systems (Without proof)-Homogeneous linear systems (Theory only) |
|    | 2 |
|    | 1 |
|    | Matrix Eigen value Problem Text 1.(8.1,8.3 &8.4) |
|    | Determination of Eigen values and Eigen vectors-Eigen space |
|    | Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof) |
|    | Basis of Eigen vectors- Similar matrices Diagonalization of a matrix-Quadratic forms- Principal axis theorem(without proof) |
|    | (Assignment-Some applications of Eigen values(8.2)) |
|    | 3 |
|    | 2 |
|    | 4 |

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks : 100
Exam Duration: 3 hours

The question paper will consist of 3 parts.
Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.
**Course No.** EE201  
**Course Name** CIRCUITS AND NETWORKS  
**L-T-P-Credits** 3-1-0-4  
**Year of Introduction** 2016

**Prerequisite:** Nil

**Course Objectives:**
To learn about various techniques available to solve various types of circuits and networks  
To gain the capability to synthesize a circuit for a particular purpose.

**Syllabus**
AC Circuit Analysis (Steady State AC Analysis), Network topology, Transient analysis,  
Laplace transform – properties, Transformed circuits, Two port networks, Symmetrical two port reactive networks as filters, Network functions, Network Synthesis

**Expected outcome.**
Ability to solve any DC and AC circuits  
Ability to apply graph theory in solving networks  
Ability to apply Laplace Transform to find transient response  
Ability to synthesize networks

**Text Book:**
2. Sudhakar and Shyam Mohan: Circuits and Networks: Analysis and Synthesis, 5e, McGraw Hill Education,

**Data Book (Approved for use in the examination):** Nil

**References:**
3. D Roy Chaudhuri: Networks and Systems, New Age Publishers  
5. Valkenberg: Network Analysis, Prentice Hall of India  
6. B.R. Gupta: Network Systems and Analysis, S.Chand & Company Ltd

**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>Network theorems – Superposition theorem – Thevenin’s theorem – Norton’s theorem – Reciprocity Theorem – Maximum power transfer theorem – dc and ac steady state analysis – dependent and independent sources</td>
<td>9 hours</td>
<td>15%</td>
</tr>
</tbody>
</table>
FIRST INTERNAL EXAMINATION

| III | Steady state and transient response – DC response & sinusoidal response of RL, RC and RLC series circuits | 9 hours | 15% |
| IV | Application of Laplace transform in transient analysis – RL, RC and RLC circuits (Series and Parallel circuits) – step and sinusoidal response |
| | Transformed circuits – coupled circuits - dot convention - transform impedance/admittance of RLC circuits with mutual coupling – mesh analysis and node analysis of transformed circuits – solution of transformed circuits including mutually coupled circuits in s-domain | 10 hours | 15% |

SECOND INTERNAL EXAMINATION

| V | Two port networks – Z, Y , h, T parameters – relationship between parameter sets – condition for symmetry & reciprocity – interconnections of two port networks – driving point and transfer immittance – T-π transformation. | 9 hours | 20% |
| VI | Network functions–Network synthesis-positive real functions and Hurwitz polynomial-synthesis of one port network with two kinds of elements-Foster form I&II-Cauer form I&II. | 8 hours | 20% |

END SEMESTER EXAM

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 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 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.
Course No. | Course Name | L-T-P -Credits | Year of Introduction  
--- | --- | --- | ---  
EE203 | ANALOG ELECTRONICS CIRCUITS | 3-1-0-4 | 2016  

**Prerequisite :** Nil  

**Course Objectives**  
- To impart an in depth knowledge in electronic semiconductor devices & circuits giving importance to the various aspects of design & analysis.  
- To provide knowledge about different types amplifier & oscillator circuits and their design.  
- To provide a thorough understanding of the operational amplifier circuits and their functions.  

**Prerequisites:** Nil  

**Syllabus**  
Diode clipping and clamping circuits and Zener voltage regulators, BJT biasing, AC Equivalent Circuit of BJT and CE amplifier analysis, Biasing of JFET and MOSFET, Frequency response of BJT and FET amplifiers, Power amplifiers using BJT, Feedback amplifiers & Oscillator Circuits  

**Expected outcome:** Upon successful completion of the course the students will be able to  
1. Design biasing scheme for transistor circuits  
2. Model BJT and FET amplifier circuits  
3. Choose a power amplifier with appropriate specifications for electronic circuit applications  
4. Design & analyse oscillator circuits using BJT  
5. Choose Operational amplifier(OPAMP) for specific applications including waveform generation.  
6. Design & implement analog circuits using OPAMPs  

**Text Book:**  

**Data Book ( Approved for use in the examination):** Nil  

**References:**  
<table>
<thead>
<tr>
<th>Module</th>
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<th>Sem.ExamMarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Diode Circuits:</strong> Diode clipping circuits - Single level and two level clippers - Clamping circuits – Design of Zener Voltage Regulators. <strong>Bipolar Junction Transistors:</strong> Review of BJT characteristics- Operating point of a BJT – Factors affecting stability of Q point and DC Biasing – Biasing circuits: fixed bias, collector to base bias, voltage division bias and self bias. (Derivation of stability factors for Voltage Divider Biasing only) –Bias compensation using diode and thermistor. Low frequency equivalent circuit of BJT. Common Emitter amplifier - AC Equivalent Circuit – Role of coupling and emitter bypass capacitors – h parameter model of BJT -Amplifier gains and impedances calculations using h equivalent circuit.</td>
<td>9 hours</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Field Effect Transistors:</strong> Review of JFET and MOSFET construction, working and characteristics- Biasing a JFET and MOSFET using voltage divider bias— CS and CD amplifiers – small signal models-FET as switch and voltage controlled resistance. <strong>Frequency response of Amplifiers</strong> : Miller’s Theorem- BJT Internal Capacitances at high frequency operations- High frequency analysis of CE Amplifier using hybrid Pi Model -Low Frequency Response of Common Emitter amplifier — CE High frequency response-Gain bandwidth product- —Low and High Frequency response of FET amplifiers</td>
<td>9 hours</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Multistage amplifiers:</strong> Direct, RC, transformer coupled amplifiers – <strong>Power amplifiers using BJT:</strong> Class A, Class B and Class AB and class C- Conversion efficiency and distortion in power amplifiers. <strong>Feedback Amplifiers</strong>- Effect of positive and negative feedbacks- Basic feedback topologies and their properties</td>
<td>8 hours</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Oscillators:</strong> Bark Hausen’s criterion – RC oscillators (RC Phase shift oscillator and Wein Bridge oscillator) –LC oscillators (Hartley and Colpitt’s)- Derivation of frequency of oscillation for the above mentioned oscillators- Crystal oscillator.</td>
<td>8 hours</td>
<td>15%</td>
</tr>
</tbody>
</table>
Operational Amplifiers: Review of Operational Amplifier basics - Analysis of fundamental differential amplifier - Properties of ideal and practical Op-Amp - Gain, CMRR and Slew rate of IC 741 and LM 301 - Drift and frequency compensation in OP Amps - Open loop and Closed loop Configurations - Concept of virtual short and its relation to negative feedback

SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Description</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>OP-AMP Circuits</td>
<td>Review of inverting and non-inverting amplifier circuits - Summing and difference amplifiers, Differentiator and Integrator circuits - Logarithmic amplifier - Half Wave Precision rectifier - Instrumentation amplifier. Comparators: Zero crossing and voltage level detectors, Schmitt trigger.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Wave form generation using Op-Amps</td>
<td>Square, triangular and ramp generator circuits using Op-Amp - Effect of slew rate on waveform generation. Timer 555 IC: Internal diagram of 555 IC - Astable and Monostable multivibrators using 555 IC. Oscillator circuits using Op-amps: RC Phase shift oscillator, Wein Bridge oscillator, LC Oscillators (Derivation not required) - Crystal oscillator.</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

END SEMESTER EXAM

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 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 questions: (2 x 10) =20

Part C: 3 questions uniformly covering modules III&IV
Student has to answer any 2 questions: (2 x 10) =20

Part D: 3 questions uniformly covering modules V&VI
Student has to answer any 2 questions: (2 x 10) =20

Note: Each question can have maximum of 4 sub questions, if needed.
Course No. | Course Name | L-T-P -Credits | Year of Introduction
--- | --- | --- | ---
EE205 | DC MACHINES AND TRANSFORMERS | 3-1-0-4 | 2016

**Prerequisite : Nil**

**Course Objectives**
To give exposure to the students about the concepts of direct current machines and transformers, including their constructional details, principle of operation and performance analysis.

**Syllabus:**
Electromagnetic principles for Machines, electrodynamic equations and their solution, Magnetic Circuits for Machines, construction of DC machines, DC generators, DC motor, Transformers - single phase and three phase, Construction of single phase and three phase transformers, losses and efficiency, equivalent circuit, testing. Transformer connections.

**Expected outcome.**
After the successful completion of this course, the students will be able to
1. identify dc generator types, and appreciate their performance
2. describe the principle of operation of dc motor and select appropriate motor types for different applications.
3. analyse the performance of different types of dc motors
4. describe the principle of operation of single phase transformers
5. analyse the performance of single phase transformers
6. familiarize with the principle of operation and performance of three phase transformers.

**Text Book**

**Reference Books**

**Data Book (Approved for use in the examination): Nil**

<p>| Course Plan |</p>
<table>
<thead>
<tr>
<th>Contents</th>
<th>Hours</th>
<th>Semester Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
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</table>

**FIRST INTERNAL EXAMINATION**

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<tr>
<td>9 hours</td>
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<tbody>
<tr>
<td>9 hours</td>
<td>15%</td>
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</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>V</th>
<th>Transformer losses and efficiency – voltage regulation – OC &amp; SC test – Sumpner’s test – all day efficiency Autotransformer – saving of copper – current rating and kVA rating of autotransformers, parallel operation of single phase transformers, necessary and desirable conditions of parallel operation, on load and off load tap changers.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 hours</td>
<td>20%</td>
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<tr>
<td>9 hours</td>
<td>20%</td>
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</table>

**END SEMESTER EXAM**

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

**Part A:** 8 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 questions: (2 x 10) =20

**Part C:** 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) =20

**Part D:** 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

**Note:** Each question can have maximum of 4 sub questions, if needed.
### Course Objectives
- To impart knowledge about programming in C
- To learn basics of PYTHON.

### Syllabus
Introduction to Programming, Basic elements of C, Control statements in C, Arrays and Strings, Functions, Storage classes, Structures and Pointers, File Management in C, Introduction to Python

### Expected outcome
1. Ability to design programs using C language
2. Ability to develop simple programs using Python

### Text Book:

### Data Book (Approved for use in the examination): Nil

### References:
3. Ashok Kamthane, Programming with ANSI & Turbo C - Pearson education

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem.ExamMarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><strong>Introduction to Programming</strong>: Machine language, assembly language, and high level language. Compilers and assemblers. Flow chart and algorithm – Development of algorithms for simple problems. <strong>Basic elements of C</strong>: Structure of C program – Keywords, Identifiers, data types, Operators and expressions – Input and Output functions</td>
<td>5 hours</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Control statements in C</strong>: if, if-else, while, do-while and for statements, switch, break, continue, go to, and labels. Programming examples.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td><strong>Arrays and Strings</strong>: Declaration, initialisation, processing arrays and strings – two dimensional and multidimensional arrays – application of arrays. Example programs.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>Functions</strong>: Functions – declaring, defining, and accessing functions – parameter passing methods – passing arrays to functions, Recursion. <strong>Storage classes</strong> – extern, auto, register and static. Example programs.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**
| V | **Structures** – declaration, definition and initialization of structures, unions  
**Pointers**: Concepts, declaration, initialization of pointer variables, Accessing a Variable through its Pointer Chain of Pointers, Pointer Expressions, Pointer Increments and Scale Factor, Pointers and Arrays, examples | **8 hours** | **20%** |
|---|---|---|---|
| VI | **File Management** – File operations, Input/Output Operations on Files, Random Access to Files, File pointer.  
**Introduction to Python**: Basic Syntax, Operators, control statements, functions, examples | **8 hours** | **20%** |

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

**Part A**: 8 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 questions: (2 x 10) =20

**Part C**: 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) =20

**Part D**: 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) =20

**Note**: Each question can have maximum of 4 sub questions, if needed.
Course code | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
HS200 | Business Economics | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives
- To familiarize the prospective engineers with elementary Principles of Economics and Business Economics.
- To acquaint the students with tools and techniques that are useful in their profession in Business Decision Making which will enhance their employability;
- To apply business analysis to the “firm” under different market conditions;
- To apply economic models to examine current economic scenario and evaluate policy options for addressing economic issues;
- To gain understanding of some Macroeconomic concepts to improve their ability to understand the business climate;
- To prepare and analyse various business tools like balance sheet, cost benefit analysis and rate of returns at an elementary level.

Syllabus
Business Economics - basic concepts, tools and analysis, scarcity and choices, resource allocation, marginal analysis, opportunity costs and production possibility curve, Fundamentals of microeconomics - Demand and Supply Analysis, equilibrium, elasticity, production and production function, cost analysis, break-even analysis and markets. Basics of macroeconomics - the circular flow models, national income analysis, inflation, trade cycles, money and credit, and monetary policy. Business decisions - investment analysis, Capital Budgeting decisions, forecasting techniques and elementary Balance Sheet and taxation, business financing, international investments.

Expected outcome
A student who has undergone this course would be able to
i. make investment decisions based on capital budgeting methods in alignment with microeconomic and macroeconomic theories.
ii. able to analyse the profitability of the firm, economy of operation, determination of price under various market situations with good grasp on the effect of trade cycles in business.
iii. gain knowledge on Monetary theory, measures by RBI in controlling interest rate and emerging concepts like Bit Coin.
iv. gain knowledge of elementary accounting concepts used for preparing balance sheet and interpretation of balance sheet.

Text Books
References:
15. Yogesh, Maheswari, Management Economics, PHI learning, New Delhi, 2012
17. Varshney and Maheshwari, Managerial Economics. Sultan Chand. New Delhi

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>Business Economics and its role in managerial decision making-meaning-scope-relevance-economic problems-scarcity Vs choice (2 Hrs)-Basic concepts in economics-scarcity, choice, resource allocation- Trade-off-opportunity cost-marginal analysis- marginal utility theory, Law of diminishing marginal utility -production possibility curve (2 Hrs)</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Basics of Micro Economics I-Demand and Supply analysis-equilibrium-elasticity (demand and supply) (3 Hrs.) -Production concepts-average product-marginal product-law of variable proportions- Production function-Cobb Douglas function-problems (3 Hrs.)</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Basics of Micro Economics II-Concept of costs-marginal, average, fixed, variable costs-cost curves-shut down point-long run and short run (3 Hrs.)- Break Even Analysis-Problem-Markets-Perfect Competition, Monopoly and Monopolistic Competition, Oligopoly-Cartel and collusion (3 Hrs.)</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>
SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>V</th>
<th>Business Decisions I - Investment analysis - Capital Budgeting - NPV, IRR, Profitability Index, ARR, Payback Period (5 Hrs.) - Business decisions under certainty - uncertainty - selection of alternatives - risk and sensitivity - cost benefit analysis - resource management (4 Hrs.)</th>
<th>9</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Business Decisions II - Balance sheet preparation - principles and interpretation - forecasting techniques (7 Hrs.) - business financing - sources of capital - Capital and money markets - international financing - FDI, FPI, FII - Basic Principles of taxation - direct tax, indirect tax - GST (2 hrs.)</td>
<td>9</td>
<td>20%</td>
</tr>
</tbody>
</table>

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.
<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>HS210</td>
<td>LIFE SKILLS</td>
<td>2-0-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives**

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

**Syllabus**


**Critical Thinking & Problem Solving:** Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

**Teamwork:** Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

**Ethics, Moral & Professional Values:** Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

**Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

**Expected outcome**

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams
- Handle Engineering Ethics and Human Values.
- Become an effective leader.
**Resource Book:**


**References:**

- Shalini Verma (2014); “*Development of Life Skills and Professional Practice*”; First Edition; Sultan Chand (G/L) & Company
- John C. Maxwell (2014); “The 5 Levels of Leadership”, Centre Street, A division of Hachette Book Group Inc.

## Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours L-T-P</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Need for Effective Communication. Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication, Types of barriers; Miscommunication; Noise; Overcoming measures, Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills. <strong>Technical Writing:</strong> Differences between technical and literary style, Elements of style; Common Errors, <strong>Letter Writing:</strong> Formal, informal and demi-official letters; business letters, <strong>Job Application:</strong> Cover letter, Differences between bio-data, CV and Resume, <strong>Report Writing:</strong> Basics of Report Writing; Structure of a report; Types of reports. <strong>Non-verbal Communication and Body Language:</strong> Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language <strong>Interview Skills:</strong> Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication, <strong>Group Discussion:</strong> Differences between group discussion and debate; Ensuring success in group discussions, <strong>Presentation Skills:</strong> Oral presentation and public speaking skills; business presentations, <strong>Technology-based Communication:</strong> Netiquettes; effective e-mail messages; power-point presentation; enhancing editing skills using computer software.</td>
<td>2</td>
<td>See evaluation scheme</td>
</tr>
<tr>
<td>II</td>
<td>Need for Creativity in the 21\textsuperscript{st} century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Critical thinking Vs Creative thinking, Functions of Left Brain &amp; Right brain, Convergent &amp; Divergent Thinking, Critical reading &amp; Multiple Intelligence.</td>
<td>2</td>
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</tr>
<tr>
<td></td>
<td>Steps in problem solving, Problem Solving Techniques, Problem Solving through Six Thinking Hats, Mind Mapping, Forced Connections.</td>
<td>2</td>
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</tr>
<tr>
<td></td>
<td>Problem Solving strategies, Analytical Thinking and quantitative reasoning expressed in written form, Numeric, symbolic, and graphic reasoning, Solving application problems.</td>
<td>2</td>
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</table>

| III | Introduction to Groups and Teams, Team Composition, Managing Team Performance, Importance of Group, Stages of Group, Group Cycle, Group thinking, getting acquainted, Clarifying expectations. | 3 |
|     | Group Problem Solving, Achieving Group Consensus. | 2 |
|     | Group Dynamics techniques, Group vs Team, Team Dynamics, Teams for enhancing productivity, Building & Managing Successful Virtual Teams. Managing Team Performance & Managing Conflict in Teams. | 3 |
|     | Working Together in Teams, Team Decision-Making, Team Culture & Power, Team Leader Development. | 2 |

| IV | Morals, Values and Ethics, Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully. | 3 |
|    | Caring, Sharing, Honesty, Courage, Valuing Time, Cooperation, Commitment, Empathy, Self-Confidence, Character | 2 |
|    | Spirituality, Senses of 'Engineering Ethics', variety of moral issued, Types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, Consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest, customs and religion, application of ethical theories. | 3 |
|    | Engineering as experimentation, engineers as responsible experimenters, Codes of ethics, Balanced outlook on. | 3 |
|    | The challenger case study, Multinational corporations, Environmental ethics, computer ethics, | 2 |
| V | Weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE), India, etc. | 3 |
| Introduction, a framework for considering leadership, entrepreneurial and moral leadership, vision, people selection and development, cultural dimensions of leadership, style, followers, crises. | 4 |
Growing as a leader, turnaround leadership, gaining control, trust, managing diverse stakeholders, crisis management | 2 |
Implications of national culture and multicultural leadership Types of Leadership, Leadership Traits. | 2 |
Leadership Styles, VUCA Leadership, DART Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders, making of a Leader, Formulate Leadership | 2 |

**END SEMESTER EXAM**

**EVALUATION SCHEME**

**Internal Evaluation**

*(Conducted by the College)*

**Total Marks: 100**

**Part – A**

*(To be started after completion of Module 1 and to be completed by 30th working day of the semester)*

1. **Group Discussion** – Create groups of about 10 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation is as follows;

   (i) Communication Skills – 10 marks
   (ii) Subject Clarity – 10 marks
   (iii) Group Dynamics - 10 marks
   (iv) Behaviors & Mannerisms - 10 marks

   *(Marks: 40)*
Part – B

(To be started from 31st working day and to be completed before 60th working day of the semester)

2. Presentation Skills – Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation is as follows;

(i) Communication Skills* - 10 marks
(ii) Platform Skills** - 10 marks
(iii) Subject Clarity/Knowledge - 10 marks

(Marks: 30)

* Language fluency, auditability, voice modulation, rate of speech, listening, summarizes key learnings etc.

** Postures/Gestures, Smiles/Expressions, Movements, usage of floor area etc.

Part – C

(To be conducted before the termination of semester)

3. Sample Letter writing or report writing following the guidelines and procedures. Parameters to be used for evaluation is as follows;

(i) Usage of English & Grammar - 10 marks
(ii) Following the format - 10 marks
(iii) Content clarity - 10 marks

(Marks: 30)

External Evaluation
(Conducted by the University)

Total Marks: 50

Time: 2 hrs.

Part – A

Short Answer questions

There will be one question from each area (five questions in total). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows;

(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content
Part – B

Case Study

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion
(ix) Answer the question at the end of the case
<table>
<thead>
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<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE234</td>
<td>ELECTRONIC CIRCUITS LAB</td>
<td>0-0-3-4</td>
<td>2046</td>
</tr>
</tbody>
</table>

**Course Objectives**
To design and develop various electronic circuits using discrete components and OPAMPS.

**List of Exercises/Experiments**:
2. Half wave and Full wave (Centre-tapped and bridge) Rectifiers with and without filters.
   Calculation of Ripple factor, Rectification efficiency, and % regulation.
3. Clipping circuits using diodes
4. Clamping circuits using diodes
5. RC coupled amplifier using BJT in CE configuration.
   Measurement of gain, input and output impedance and frequency response.
6. JFET amplifier.
   Measurement of voltage gain, current gain, input and output impedance.
7. Design and testing of simple zener voltage regulators
8. OPAMP circuits — Design and set up of inverting and non-inverting amplifier, scale changer, adder, integrator, differentiator.
9. Precision rectifier using Op-amps
10. Phase shift oscillator using OPAMPs.
11. Wein’s Bridge oscillator using OPAMPs.
12. Waveform generation — Square, triangular and sawtooth wave form generation using OPAMPs.
15. Astable and monostable circuit using 555 IC.
16. RC phase shift oscillator using BJT.
17. Introduction to circuit simulation using any circuit simulation software.
18. Introduction to PCB layout software.

**Expected outcome.**
The student should be able to design and implement various electronic circuits using BJTs and OPAMPS.

**Text Book/References:**
<table>
<thead>
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<tbody>
<tr>
<td>EE233</td>
<td>PROGRAMMING LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**
To impart knowledge and develop skills in programming

**List of Exercises/Experiments : (Minimum 12 exercises/experiments are mandatory)**

1. At least four simple programs using input output statements (example: area of rectangle, circle, etc)
2. At least four Simple programs using decision statements (Example: Even or odd, pass or fail)
3. At least four Programs using Control statements and decision statements (Example maximum, minimum of a given set of numbers, hcf, lcm)
4. Program to add n numbers
5. Programs to print patterns
6. Program to check whether a number is prime
7. Program to generate Fibonaacii series
8. Array manipulation (searching, insertion and sorting)
9. Few programs using pointers
10. Functions Pass by value Pass by reference
11. Recursive functions (example: Fibonaacii series and factorial)
12. String manipulation — compare, copy, reverse operations
13. Matrix operations: addition multiplication, determinant and inverse
14. Reading from a file and writing to a file Merging and appending of files.
15. Solution of algebraic and transcendental equations: Bisection, Newton- Raphson method- comparison
16. Introductory programs using Python
17. Function calls in Python

**Expected outcome.** 1. Ability to design programs using C language  
2. Ability to develop simple programs using Python

**References:**
3. Introduction to computation and programming using Python, John V. Guttag, PHI Learning, New Delhi
Course No. | Course Name | L-T-P - Credits | Year of Introduction
--- | --- | --- | ---
MA202 | Probability distributions, Transforms and Numerical Methods | 3-1-0-4 | 2016

Prerequisite: Nil

Course Objectives
- To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in various Engineering and social life situations.
- To know Laplace and Fourier transforms which has wide application in all Engineering courses.
- To enable the students to solve various engineering problems using numerical methods.

Syllabus
Discrete random variables and Discrete Probability Distribution.
Continuous Random variables and Continuous Probability Distribution.
Fourier transforms.
Laplace Transforms.
Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.

Expected outcome
After the completion of the course student is expected to have concept of
(i) Discrete and continuous probability density functions and special probability distributions.
(ii) Laplace and Fourier transforms and apply them in their Engineering branch
(iii) numerical methods and their applications in solving Engineering problems.

Text Books:

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>II</td>
<td><strong>Continuous Probability Distributions.</strong> (Relevant topics in section 5.1, 5.2, 5.5, 5.7 Text1)</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Continuous Random Variable, Probability density function,</td>
<td></td>
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<tr>
<td></td>
<td>Cumulative density function, Mean and variance.</td>
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<tr>
<td></td>
<td>Normal Distribution, Mean and variance (without proof).</td>
<td>4</td>
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<tr>
<td></td>
<td>Uniform Distribution. Mean and variance.</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Exponential Distribution, Mean and variance.</td>
<td>2</td>
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</tbody>
</table>

| 15% |

**FIRST INTERNAL EXAMINATION**

| III | **Fourier Integrals and transforms.** (Relevant topics in section 11.7, 11.8, 11.9 Text2) | 3 |
|     | Fourier Integrals. Fourier integral theorem (without proof). |  |
|     | Fourier Transform and inverse transform. | 3 |
|     | Fourier Sine & Cosine Transform, inverse transform. | 3 |

| 15% |

| IV | **Laplace transforms.** (Relevant topics in section 6.1, 6.2, 6.3, 6.5, 6.6 Text2) | 3 |
|    | Laplace Transforms, linearity, first shifting Theorem. |  |
|    | Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. | 4 |
|    | Unit step function, second shifting theorem. | 2 |
|    | Convolution Theorem (without proof). | 2 |
|    | Differentiation and Integration of transforms. | 2 |

| 15% |

**SECOND INTERNAL EXAMINATION**

| V | **Numerical Techniques.** (Relevant topics in section 19.1, 19.2, 19.3 Text2) | 2 |
|   | Solution Of equations by Iteration, Newton- Raphson Method. |  |
|   | Interpolation of Unequal intervals-Lagrange’s Interpolation formula. | 2 |
|   | Interpolation of Equal intervals-Newton’s forward difference formula, Newton’s Backward difference formula. | 3 |

| 20% |

| VI | **Numerical Techniques.** (Relevant topics in section 19.5, 20.1, 20.3, 21.1 Text2) | 3 |
|    | Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method. |  |
|    | Numeric Integration-Trapezoidal Rule, Simpson’s 1/3 Rule. | 3 |
|    | Numerical solution of firstorder ODE-Euler method, Runge-Kutta Method (fourth order). | 3 |

| 20% |

**END SEMESTER EXAM**
QUESTION PAPER PATTERN:

Maximum Marks : 100  
Exam Duration: 3 hours

The question paper will consist of 3 parts.
Part A will have 3 questions of 15 marks each uniformly covering modules I and II. Each question may have two sub questions.

Part B will have 3 questions of 15 marks each uniformly covering modules III and IV. Each question may have two sub questions.

Part C will have 3 questions of 20 marks each uniformly covering modules V and VI. Each question may have three sub questions.

Any two questions from each part have to be answered.
Course Number: EE202
Course Name: Synchronous and Induction Machines
L-T-P-Credits: 3-1-0-4
Year of Introduction: 2016

Prerequisite: NIL

Course Objectives
To give exposure to the students about the concepts of alternating current machines including the constructional details, principle of operation and performance analysis.

To learn the characteristics of induction machines and to learn how it can be employed for various applications.

Syllabus
Alternators – basic principle, constructional details, armature windings, armature reaction, voltage regulation and determination of regulation by different methods; parallel operation of alternators and synchronization; Synchronous motors – principle, performance and power relations; synchronous induction motors.

Induction motors – basic principle, rotating magnetic field, constructional details, mechanical power and torque, performance analysis, starting methods, braking, testing, equivalent circuit and circle diagrams; single phase induction motors.

Induction generator – principle of operation.

Expected Outcome
After the successful completion of this course, the students will be able to
1. identify alternator types, and appreciate their performance
2. determine the voltage regulation and analyse the performance of alternators
3. describe the principle of operation of synchronous motor and different applications.
4. describe the principle of operation of 3-phase induction motors and select appropriate motor types for different applications.
5. analyse the performance of 3-phase induction motors
6. familiarize with principle of operation and application of 1-phase induction motors.

Text Book

Reference Books

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Semester Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Alternators - basic principle, constructional features of salient pole type and cylindrical type alternators, advantages of stationary armature, turbo-alternator. Armature winding – types of armature winding—single layer, double layer, full pitched and short pitched winding,</td>
<td>8 hours</td>
<td>15%</td>
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<tr>
<td>II</td>
<td>9 hours</td>
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**FIRST INTERNAL EXAMINATION**

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<td>III</td>
<td>9 hours</td>
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**SECOND INTERNAL EXAMINATION**

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<tbody>
<tr>
<td>IV</td>
<td>9 hours</td>
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</table>

| Circle Diagrams – Tests on Induction Motors for Determination of Equivalent Circuit and Circle Diagram. |
|---|---|
| V | 10 hours | 20% |
Cogging, crawling and noise production in cage motors – remedial measures.
Double cage induction motor – principle, torque-slip curves.
Starting of induction motors – types of starters – DOL starter, autotransformer starter, star-delta starter, rotor resistance starter – starting torque and starting current-numerical problems.
Braking of induction motors – plugging, dynamic braking and regenerative braking (no numerical problems).
Speed control – stator voltage control, V/f control, rotor resistance control.

| VI | Induction generator – principle of operation, grid connected and self excited operation, comparison of induction generator with synchronous generators. |
|    | Synchronous induction motor – principle of operation. |
|    | Single-phase induction motor – double field revolving theory, equivalent circuit, torque slip curve. |
|    | Types of single phase induction motor – split phase, capacitor start, capacitor start and run types. |
|    | Principle of shaded pole motor – applications. |

END SEMESTER EXAM

EXAMINATION PAPER PATTERN (End semester exam)

**Part A**: 8 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 questions; (2 x 10) =20

**Part C**: 3 questions uniformly covering modules III&IV
Student has to answer any 2 questions; (2 x 10) =20

**Part D**: 3 questions uniformly covering modules V&VI
Student has to answer any 2 questions; (2 x 10) =20

**Note**: Each question can have maximum of 4 sub questions, if needed.
<table>
<thead>
<tr>
<th>Course No.</th>
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<tbody>
<tr>
<td>EE20</td>
<td>Digital Electronics and Logic Design</td>
<td>2-1-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**

To impart knowledge about digital logic and to gain the ability to design various digital circuits

**Syllabus**

Review of Number Systems and Codes, Digital Logic, Combinational Logic Circuits, Data Processing Circuits, Arithmetic Circuits, Flip-Flops, Registers, Counters, DACs and ADCs, Design of synchronous Sequential Circuits, Introduction to HDL.

**Expected outcome.**

After the successful completion of the course, the student will be able to:

1. Familiar with various number systems and Boolean algebra
2. design and analyse any digital logic gate circuits and Flip flop based systems.
3. Familiar with combinational circuits
4. gain the capability of implementing various counters,
5. describe the operation of ADC and DAC circuits
6. acquire basic knowledge on VHDL

**Text Book:**

1. Floyd T.L, Digital Fundamentals , 10/e, Pearson Education, 2011

**References:**


**Data Book (Approved for use in the examination):** Nil
<table>
<thead>
<tr>
<th>Module</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Number Systems and Codes : Binary, Octal and hexadecimal conversions- ASCII code, Excess -3 code, Gray code, Error detection and correction - Parity generators and checkers – Fixed point and floating point arithmetic. Binary addition and subtraction, unsigned and signed numbers, 1’s complement and 2’s complement arithmetic.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>TTL logic and CMOS logic - Logic gates, Universal gates - Boolean Laws and theorems, Sum of Products method, Product of Sum method – K map representation and simplification(upto four variables) - Pairs, Quads, Octets, Dont care conditions.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Combinational circuits: Adders _ Full adder and half adder – Subtractors, halfsubtractor and fullsubtractor – Carry Look ahead adders – ALU(block diagram only). Multiplexers, Demultiplexers, Encoders, BCD to decimel decoders.</td>
<td>7 hours</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Sequential circuits: Flip-Flops, SR, JK, D and T flip-flops, JK Master Slave Flip-flop, Conversion of flip-flops, Registers -SISO,SIPO, PISO, PIPO. Counters : Asynchronous Counters – Modulus of a counter – Mod N counters.</td>
<td>8 hours</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Synchronous counters: Preset and clear modes, Counter Synthesis: Ring counter, Johnson Counter, Mod N counter, Decade counter. State Machines: State transition diagram, Moore and Mealy Machines – Design equation and circuit diagram.</td>
<td>7 hours</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Digital to Analog conversion – R-2R ladder, weighted resistors. Analog to Digital Conversion - Flash ADC, Successive approximation, Integrating ADC.</td>
<td>8 hours</td>
<td>20%</td>
</tr>
</tbody>
</table>
Memory Basics, Read and Write, Addressing, ROMs, PROMs and EPROMs, RAMs, Sequential Programmable Logic Devices - PAL, PLA, FPGA (Introduction and basic concepts only)

Introduction to VHDL, Implementation of AND, OR, half adder and full adder.

END SEMESTER EXAM

QUESTION PAPER PATTERN (End semester exam)

Part A: 8 questions.

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

Student has to answer all questions. (8 x 5) = 40

Part B: 3 questions uniformly covering modules I & II

Student has to answer any 2 questions: (2 x 10) = 20

Part C: 3 questions uniformly covering modules III & IV

Student has to answer any 2 questions: (2 x 10) = 20

Part D: 3 questions uniformly covering modules V & VI

Student has to answer any 2 questions: (2 x 10) = 20

Note: Each question can have maximum of 4 sub questions, if needed.
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<tr>
<th>Course No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EE206</td>
<td>MATERIAL SCIENCE</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite : Nil**

**Course Objectives**
To impart knowledge in the field of material science and their applications in electrical engineering

**Syllabus:**

**Expected Outcome:**
After the completion of the course student will be able to:
1. Describe the characteristics of conducting and semiconducting materials
2. Classify magnetic materials and describe different laws related to them
3. Classify and describe different insulators and to explain the behaviour of dielectrics in static and alternating fields
4. Describe the mechanisms of breakdown in solids, liquids and gases
5. Classify and describe Solar energy materials and superconducting materials
6. Gain knowledge in the modern techniques for material studies

**Text Book:**

**References:**
1. Tareev, Electrical Engineerin Materials, Mir Publications
5. Indulkar O.S &Thiruvegadam S., An Introduction to electrical Engineering Materials, S. Chand
7. Seth. S.P and Gupta P. V, A Course in Electrical Engineering Materials, Dhanpathrai

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
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<tbody>
<tr>
<td>I</td>
<td>Conducting Materials: Conductivity- dependence on temperature and composition – Materials for electrical applications such as resistance, machines, solders etc.</td>
<td>8</td>
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<tr>
<td></td>
<td>Semiconductor Materials: Concept, materials and properties- – Basic ideas of Compound semiconductors, amorphous and organic semiconductors- applications.</td>
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<tr>
<td></td>
<td>Dielectrics: Introduction to Dielectric polarization and classification –Clausius Mosotti relation- Behavior of dielectric in static and alternating fields</td>
<td></td>
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<tr>
<td>II</td>
<td>Insulating materials and classification- properties- Common insulating materials used in electrical apparatus-Inorganic,</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Dielectric Breakdown: Mechanism of breakdown in gases, liquids and solids—basic theories including Townsend’s criterion, Streamer mechanism, suspended particle theory, intrinsic breakdown, electro-mechanical breakdown- Factors influencing Ageing of insulators- Application of vacuum insulation- Breakdown in high vacuum-Basics of treatment and testing of transformer oil.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Magnetic Materials: Origin of permanent magnetic dipoles- Classification of magnetic materials -Curie-Weiss law- Properties and application of iron, alloys of iron- Hard and soft magnetic materials– Ferrites- Magnetic materials used in electrical machines, instruments and relays-</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Superconductor Materials:-Basic Concept- types-characteristics-applications Solar Energy Materials: Photo thermal conversion- Solar selective coatings for enhanced solar thermal energy collection –Photovoltaic conversion – Solar cells -Silicon, Cadmium sulphide and Gallium arsenic – Organic solar cells.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Modern Techniques for materials studies: Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials</td>
<td>7</td>
<td>20%</td>
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</tbody>
</table>

**END SEMESTER EXAM**

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

**Part A:** 8 questions.
One question from each module of Module I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x 5) = 40

**Part B:** 3 questions uniformly covering modules I&II.
Student has to answer any 2 questions: (2 x 10) = 20

**Part C:** 3 questions uniformly covering modules III&IV.
Student has to answer any 2 questions: (2 x 10) = 20

**Part D:** 3 questions uniformly covering modules V&VI.
Student has to answer any 2 questions: (2 x 10) = 20

**Note:** Each question can have maximum of 4 sub questions, if needed.
Prerequisite: Nil

Course Objectives
To develop understanding of various electrical measuring instruments and instrumentation devices

Syllabus
Measurements standards, errors in measurements, operating torques, classification of electrical meters, Measurement of voltage, current, resistance, power, energy, high voltage and high currents. Magnetic measurements, ac potentiometers, ac bridges, CRO, Transducers

Expected Outcomes:
After the completion of the course student will be able to:
1. Compare different types of instruments-their working principles, advantages and disadvantages.
2. Explain the operating principles of various ammeters, voltmeters and ohm meters
3. Describe wattmeters and energy meters
4. Describe different flux and permeability measurements methods
5. Identify different AC potentiometers and bridges,
6. Understand the working and applications of cathode ray oscilloscope
7. Identify the transducers for physical variables and to describe operating principle

Text Book:
2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria & Sons

References:
2. Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India
4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<tbody>
<tr>
<td>I</td>
<td>General principles of measurements – measurement system - measurement standards – characteristics - errors in measurement - calibration of meters - significance of IS standards of Instruments. Classification of meters - operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operating, principles shunts and multipliers – extension of range.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Measurement of resistance: measurement of insulation resistance - loss of charge method, measurement of earth resistance. Measurement of power and energy: Dynamometer type wattmeter – 1-phase and 3-phase power measurement – 1-phase and 3-phase energy meters (induction type) – electronic energy meter, TOD meter.</td>
<td>10</td>
<td>15%</td>
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<tr>
<td>FIRST INTERNAL EXAMINATION</td>
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<tr>
<td>III</td>
<td>Introduction to high voltage and high current measurements: Measurement of high DC voltages - measurement of high AC voltages - electrostatic voltmeters – sphere gaps - DC Hall effect sensors - high current measurements. Study of Phasor Measurement Units (PMU). Current transformers and potential transformers – principle working, ratio and phase angle errors – numerical problems, Clamp on meters.</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Magnetic Measurements: Measurement of flux and permeability - flux meter - hall effect Gaussmeter - BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses Measurement of rotational speed using proximity sensors and optical sensors.</td>
<td>9</td>
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<tr>
<th>SECOND INTERNAL EXAMINATION</th>
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<tbody>
<tr>
<td>V</td>
<td>DC &amp; AC potentiometers - General Principle - calibration of ammeter, voltmeter and wattmeter using potentiometer. AC Bridges: Maxwell’s bridge- Schering bridge and Wien’s bridge Oscilloscopes – Basic principle of signal display - Block diagram and principle of operation of general purpose CRO - vertical deflecting system - horizontal deflection system - basic sweep generator - XY mode and Lissajous patterns - applications of CRO - dual trace oscilloscope. digital storage oscilloscope</td>
<td>9</td>
</tr>
<tr>
<td>VI</td>
<td>Transducers - Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.</td>
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<tr>
<th>END SEMESTER EXAM</th>
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<tbody>
<tr>
<td>QUESTION PAPER PATTERN (End semester exam)</td>
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<tr>
<td>Part A: 8 questions.</td>
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<td>One question from each module of Module I - IV; and two each from Module V &amp; VI.</td>
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<tr>
<td>Student has to answer all questions. (8 x5)=40</td>
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<tr>
<td>Part B: 3 questions uniformly covering modules I&amp;II</td>
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<tr>
<td>Student has to answer any 2 questions: (2 x 10) =20</td>
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<tr>
<td>Part C: 3 questions uniformly covering modules III&amp;IV</td>
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<tr>
<td>Part D: 3 questions uniformly covering modules V&amp;VI</td>
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<td>Student has to answer any 2 questions: (2 x 10) =20</td>
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<tr>
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</table>
### Course Objectives

To learn the working and testing methods of DC machines and transformers.

### List of Exercises/Experiments:

#### Part A – DC Machines

1. **Open circuit characteristics of DC shunt generator**
   
   **Objectives:**
   
   a) Predetermine the OCC at different speeds
   
   b) Determine the critical field resistance
   
   c) Obtain maximum voltage built up with given shunt field resistance
   
   d) Obtain critical speed for a given shunt field resistance

2. **Load test on DC shunt generator**
   
   **Objectives:**
   
   a) Determine the external & internal characteristics
   
   b) Deduce the armature reaction curve

3. **Load test on DC compound generator**
   
   **Objectives:**
   
   a) Determine the external characteristics cumulative compound condition
   
   b) Determine the external characteristics differential compound condition

4. **Brake test on DC shunt motor**
   
   **Objectives:**
   
   Plot the following characteristics
   
   i) Efficiency Vs Output
   
   ii) Line current Vs Output
   
   iii) Speed Vs Output
   
   iv) Speed Vs Torque
   
   v) Line current Vs Torque

5. **Brake test on DC series motor**
   
   **Objectives:**
   
   Plot the following characteristics
   
   i) Efficiency Vs Output
   
   ii) Line current Vs Output
   
   iii) Speed Vs Output
   
   iv) Speed Vs Torque
   
   v) Line current Vs Torque

6. **Swinburne’s test on a DC shunt machine**
   
   **Objectives:**
   
   Predetermine the armature current and percentage efficiency when the machine operates as a motor and as a generator for various load conditions and plot efficiency Vs output curves.

7. **Hopkinson’s test on a pair of DC machines**
   
   **Objectives:**
   
   Determination of the efficiency of the given dc shunt machine working as a motor and
generator
under various load conditions.

8. Retardation test on a DC machine

**Objectives:**
- a) Separation of hysteresis, eddy current, friction & windage losses
- b) Find the moment of inertia of the rotating system

9. Separation of losses in a DC shunt motor

**Objectives:**
- a) Separation of hysteresis, eddy current, friction & windage losses
- b) Plot the losses vs speed curves

**Part B – Transformers**

10. O.C. & S.C. tests on the single phase transformer

**Objectives:**
Predetermination of the following
- a) Efficiency at different load conditions and different power factors
- b) Regulation at different load conditions and different power factors
- c) Equivalent circuit referred to HV and LV sides
- d) UPF load at which efficiency is maximum
- e) Power factors at which regulation is maximum and zero
- f) Regulation vs. power factor curves

11. Load test on the single phase transformer

**Objectives:**
- a) Determination of the efficiency at different load conditions and unity power factor
- b) Determination of the regulation at different load conditions and unity power factor
- c) Plot efficient vs. output & regulation Vs output curves

12. Separation of losses in a single phase transformer

**Objectives:**
Separate the hysteresis & eddy current losses at different voltages & different frequencies keeping V/f constant & plot losses vs. frequency curves. Hence
- i) Separate the hysteresis & eddy current losses at normal voltage & different frequencies & plot losses vs. frequency curves
- ii) Separate the hysteresis & eddy current losses at normal frequency & different voltages & plot losses vs. voltage curves.

13. Sumpner’s test

**Objective:**
- a) Predetermination of efficiency at different load conditions and power factors
- b) Predetermination of regulation at different load conditions and power factors
- c) Plot efficiency vs. output & regulation vs. power factor curves
- d) Obtain the equivalent circuit referred to LV & HV sides

14. Scott connection of single phase transformers

**Objectives:**
Determine the efficiency at different load conditions when
- a) Main transformer alone loaded
- b) Teaser transformer alone loaded
- c) both transformers loaded under balanced conditions
- d) both transformers loaded under unbalanced conditions
- e) Plot efficiency vs. output curves for each case.
15. Parallel operation of single phase transformers
   **Objectives:**
   a) To determine the load sharing of each transformer by their equivalent impedances
   b) To verify the load sharing by actual measurements

16. Three phase connection of single phase transformers
   **Objectives:**
   a) Determine the polarity of single phase transformers
   b) Connect three single phase transformers in star-star configuration
   c) Connect three single phase transformers in star-delta configuration
   d) Determine the transformation ratio in the above cases

17. O.C. & S.C. tests on the Three phase transformer
   **Objectives:**
   Predetermination of the following
   a) Efficiency at different load conditions and different power factors
   b) Regulation at different load conditions and different power factors
   c) Equivalent circuit referred to HV and LV sides

18. Load Test on V connected Transformers
   **Objectives:**
   Connect two single phase transformers in V-V connection and conduct a load test to plot the efficiency curve.

**Out of the above experiments, minimum twelve experiments should be done in lab taking at least six experiments from both Part A and Part B.**

**Expected outcome:**

After the successful completion of the course, the students will be able to test and validate DC generators, DC motors and transformers

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

1. Analyse the characteristics of different dc generators
2. Separate the losses in dc motors
3. Analyse the performance of different types of dc motors
4. Determine the performance characteristics of single phase transformers
5. Compare the performance of transformers in different modes of operations and connections

**Text Book:**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE23</td>
<td>CIRCUITS AND MEASUREMENTS LAB</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

To develop measurement systems for various electrical circuits and systems and to use different transducers for measurement of physical variables.

**List of Exercises/Experiments**: (18 experiments are listed, out of which 12 experiments are mandatory).

1. Verification of Superposition Theorem in dc circuits.
2. Verification of Thevenin’s Theorem in dc circuits.
3. Determination of impedance, admittance, power factor and real/reactive/apparent power drawn in RLC series/parallel circuits.
4. 3-phase power measurement using one wattmeter and two-wattmeter method.
5. Determination of B-H curve, μ-H curve and μ-B curve of an iron ring specimen.
6. Measurement of voltmeter and ammeter resistances using Wheatstone’s bridge and Kelvin’s double bridge and extension of range of voltmeters and ammeters.
7. Measurement of self/mutual inductance and coupling co-efficient of iron cored coil and air-cored coil.
8. Calibration of meters and measurement of unknown resistance using slide-wire potentiometer.
9. Calibration of single phase energy meter by direct and phantom loading at various power factors.
13. Extension of instrument range by using Instrument transformers(CT and PT).
15. Characteristics of LVDT.
16. Characteristics of strain gauge/Load cell.
18. Current measurement using Clamp on meter.

**Expected Outcome:**

After the completion of the course student will be able to:

1. Analyze RLC circuits and coupled circuit to obtain the voltage -current relations.
2. Verify DC network theorems by setting up various networks.
3. Calibrate the single phase and three phase energy meter at various power factors.
4. Measure power in a single and three phase circuits by various methods.
5. Determine magnetic characteristics of iron ring specimen.
6. Measure high and low resistances using various bridges.
7. Use Electronic energy meter, TOD meter and clamp on meter.

**Text Book:**

Course code | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
EE301 | POWER GENERATION, TRANSMISSION AND PROTECTION | 3-1-0-4 | 2016

Prerequisite : Nil

**Course Objectives**

- To set a foundation on the fundamental concepts of Power System Generation, Transmission, Distribution and Protection.

**Syllabus**

Power Generation-conventional-hydrothermal, nuclear - non conventional solar and wind-economics of power generation-Power factor Improvement-Power transmission -line parameters -resistance- inductance and capacitance- Transmission line modelling- classifications -short line, medium line, long line- transmission line as two port network-parameters- derivation -Overhead lines- types of conductors-volume of conductors- Kelvin's law- Types of Towers-calculation of Sag and tension-Insulators- types -corona-underground cables-H V DC transmission-Flexible A C transmission- need for protection-circuit breakers-protective relay types -Types of protection causes of over voltages - insulation coordination – Power Distribution system

**Expected outcome**

The students will be able to

- Know the basic aspects in the area of power generation, transmission, distribution and protection.
- Design power factor correction equipment, transmission line parameters, and decide upon the various protection schemes to be adopted in various cases.

**Text Books:**


**References:**

5. Stevenson Jr. Elements of Power System Analysis, TMH

**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>Introduction: Typical layout of Power system Network Generation of Electric Power: Overview of conventional (Hydro, Thermal and Nuclear) and Nonconventional Sources (Solar and Wind) (Block Diagram and Brief Description Only) Economics of Generation: Load factor, diversity factor, Load curve (Brief description only) Numerical Problems. Methods of power factor improvement using capacitors</td>
<td>9</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Power Transmission Transmission Line Parameters: Resistance, inductance and capacitance of 1-Φ, 2 wire lines-composite conductors</td>
<td>10</td>
<td>15%</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>III</th>
<th>Introduction of Overhead transmission and underground transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conductors -types of conductors -copper, Aluminium and ACSR conductors -Volume of conductor required for various systems of transmission-Choice of transmission voltage, conductor size -Kelvin's law. Mechanical Characteristics of transmission lines – configuration-Types of Towers. Calculation of sag and tension-supports at equal and unequal heights -effect of wind and ice-sag template</td>
</tr>
<tr>
<td></td>
<td>Insulators -Different types -Voltage distribution, grading and string efficiency of suspension insulators. Corona -disruptive critical voltage -visual critical voltage -power loss due to corona -Factors affecting corona - interference on communication lines.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IV</th>
<th>Underground Cables -types of cables -insulation resistance - voltage stress -grading of cables -capacitance of single core and 3 -core cables -current rating.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>HVDC Transmission:</strong> Comparison between AC &amp; DC Transmission ,Power flow equations and control, Types of DC links</td>
</tr>
<tr>
<td></td>
<td><strong>Flexible AC Transmission systems:</strong> Need and Benefits, SVC, Configuration of FC + TCR, Series compensation: Configuration of TCSC</td>
</tr>
</tbody>
</table>

### SECOND INTERNAL EXAMINATION


### Modelling of Transmission Lines:
Classification of lines-short lines-voltage regulation and efficiency-medium lines-nominal T and Π configurations-ABCD constants- long lines- rigorous solution- interpretation of long line equation-Ferranti effect.
| **VI** | **PROTECTIVE RELAYS**- Zones of Protection, Essential Qualities- Classification of Relays -Electro mechanical, Static Relays, Microprocessor Based Relay. Electromechanical Relays- Attracted Armature, Induction disc, Thermal Relays (Brief Description only) Static Relays-Merits and Demerits, Basic components, Comparison and duality of Amplitude and Phase comparators. Static overcurrent, Differential, Distance Relays, Directional Relay-(principle and Block diagram only) Microprocessor Based Relay- Block diagram and flow chart of Over current Relay, Numerical Relay (Basics Only) | 10 |
| **PROTECTION OF ALTERNATOR**: Stator inter turn, Earth fault Protection and Differential protection **PROTECTION OF TRANSFORMERS**: Percentage Differential Protection-Buchholz Relay **PROTECTION OF TRANSMISSION LINES**: Differential Protection-carrier current protection **PROTECTION AGAINST OVER VOLTAGES**: Causes of over voltages - Surge diverters - Insulation co-ordination **POWER DISTRIBUTION SYSTEMS**: Radial and Ring Main Systems - DC and AC distribution: Types of distributors- bus bar arrangement -Concentrated and Uniform loading -Methods of solving distribution problems. | 20% |

**END SEMESTER EXAM**
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: EE302
### Course Name: ELECTROMAGNETICS
### L-T-P - Credits: 2-1-0-3
### Year of Introduction: 2016

**Prerequisite:** Nil

### Course Objectives
- To develop a conceptual basis of electrostatics, magnetostatics, electromagnetic waves
- To understand various engineering applications of electromagnetics

### Syllabus
Introduction to vector calculus, Electrostatics, Electrical potential, energy density and their applications. Magnetostatics, magnetic flux density, scalar and vector potential and its applications, Time varying electric and magnetic fields, Electromagnetic waves

### Expected outcome
The students will be able to:
- i. Analyze fields and potentials due to static charges
- ii. Explain the physical meaning of the differential equations for electrostatic and magnetic fields
- iii. Understand how materials are affected by electric and magnetic fields
- iv. Understand the relation between the fields under time varying situations
- v. Understand principles of propagation of uniform plane waves.
- vi. Be aware of electromagnetic interference and compatibility

### Text Book:

### Data Book (Approved for use in the examination):

### 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>II</td>
<td>Coulomb’s Law, Electric field intensity. Field due to a line charge, Sheet Charge and Continuous Volume Charge distribution. Electric Flux and Flux Density; Gauss’s law and its application. Electric Potential-The Potential Gradient. The Electric dipole. The Equipotential surfaces. Capacitance - capacitance of co-axial cable, two wire line. Poisson’s and Laplace’s equations</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**
| III | STATIC MAGNETIC FIELD: Biot-Savart Law, Amperes Force Law.—Magnetic Field intensity due to a finite and infinite wire carrying a current—Magnetic field intensity on the axis of a circular and rectangular loop carrying a current —Magnetic vector potential, Magnetic flux Density and Ampere’s circuit law and simple applications. | 6 | 15% |
| IV | ELECTRIC AND MAGNETIC FIELDS IN MATERIALS—Electric Polarization—Nature of dielectric materials-Electrostatic energy and energy density—Boundary conditions for electric fields and magnetic fields—Conduction current and displacement current densities—continuity equation for current. Maxwell’s Equation in Differential and integral form from Modified form of Ampere’s circuit law, Faraday's Law and Gauss Law | 8 | 15% |
| VI | Plane waves propagation in loss less and lossy dielectric medium and conducting medium. Plane wave in good conductor, surface resistance, Skin depth, Intrinsic Impedance and Propagation Constant in all medium. Phase and group velocity. Transmission lines: waves in transmission line –solution for loss less lines –characteristic impedance – VSWR – impedance matching. Introduction to Electromagnetic interference and compatibility. | 7 | 20% |

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hourrs.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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: EE303
Course Name: Linear Control Systems
L-T-P - Credits: 2-1-0-3
Year of Introduction: 2016

Prerequisite: Nil

Course Objectives:
- To provide a strong foundation on the analytical and design techniques on classical control theory and modelling of dynamic systems

Syllabus:
Open loop-and closed loop control systems- Transfer function - Control system components-Steady stare error- static error coefficient- dynamic error coefficient-Stability Analysis- Root locus- Frequency domain analysis-Bode plot-polar plot-Nyquist stability criterion- Non-minimum phase system - transportation lag.

Expected outcome.
The students will have the ability to
i. develop mathematical models of various systems.
ii. analyse the stability aspects of linear time invariant systems.

Text Books:
4) Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.

References:

Course Plan

<table>
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<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Open loop-and closed loop control systems: Transfer function of LTI systems-Mechanical and Electromechanical systems – Force voltage and force current analogy - block diagram representation - block diagram reduction - signal flow graph - Mason's gain formula - characteristic equation.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Control system components: DC and AC servo motors – synchro - gyroscope - stepper motor - Tacho generator. Time domain analysis of control systems: Transient and steady state responses - time domain specifications - first and second order systems - step responses of first and second order systems.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Error analysis - steady state error analysis - static error coefficient of type 0,1, 2 systems - Dynamic error coefficients. Concept of stability: Time response for various pole locations - stability of feedback system - Routh's stability criterion</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Root locus - General rules for constructing Root loci – stability from 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: Frequency domain specifications- Analysis based on Bode plot - Log magnitude vs. phase plot,</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION

SECOND INTERNAL EXAMINATION
VI  Polar plot- Nyquist stability criterion-Nichols chart - Non-minimum phase system - transportation lag. | 7 | 20%

END SEMESTER EXAM

QUESTION PAPER PATTERN:
Maximum Marks: 100  Exam Duration: 3Hours.

Part A: 8 compulsory questions.
One question from each module of Modules 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.

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<table>
<thead>
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<th>Course code</th>
<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE304</td>
<td>Advanced Control Theory</td>
<td>3-1-0-4</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE303 Linear control systems

**Course Objectives:**
- To provide a strong concept on the compensator design and on advanced control system analysis and design techniques
- To analyse the behaviour of discrete time systems and nonlinear control systems.

**Syllabus:**

**Expected outcome.**
On successful completion, students will have the ability to
  i. design compensators using classical techniques.
  ii. analyse both linear and nonlinear system using state space methods.
  iii. analyse the stability of discrete system and nonlinear system.

**Text Book:**
5. Ogata K., Modern Control Engineering, Prentice Hall of India, New Delhi, 2010.

**Data Book (Approved for use in the examination):**

**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>Types of controller- Feedforward-feedback-cascade-P, PI and PID. Compensator design: Realization of compensators – lag, lead and lag-lead -Design of compensator using bode plot.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Compensator design: Realization of compensators – lag, lead and lag-lead. Design of compensator using rootlocus. Design of P, PI and PID controller using Ziegler-Nichols tuning method.</td>
<td>7</td>
<td>15%</td>
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</table>

**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>State space analysis of systems: Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation-controllable, observable, diagonal</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

| IV | State feedback controller design: Controllability & observability. State feed-back design via pole placement technique. Sampled data control system: Pulse Transfer function-Stability of sampled data system -Routh Hurwitz criterion and Jury's test. Introduction to state-space representation of sampled data systems. | 7 | 15% |

**SECOND INTERNAL EXAMINATION**

| V | Nonlinear systems: Introduction - characteristics of nonlinear systems. Types of nonlinearities. Analysis through harmonic linearisation - Determination of describing function of nonlinearities (relay, dead zone and saturation only) - application of describing function for stability analysis of autonomous system with single nonlinearity. | 7 hrs | 20% |
| VI | Phase Plane Analysis: Concepts- Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities - Singular points – Classification of singular points. Definition of stability- asymptotic stability and instability Liapunov methods to stability of linear and nonlinear, continuous time systems. | 7 hrs | 20% |

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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 -Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE305</td>
<td>Power Electronics</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

Course Objectives
- To get an overview of different types of power semiconductor devices and their switching characteristics
- To study the operation and characteristics of various types of power electronic converters

Syllabus:
Structure and characteristics of various power semiconductor devices – turn-on methods – controlled rectifiers – inverters – AC voltage controllers – cycloconverters – DC choppers and switching regulators

Expected outcome.
The students who successfully complete this course will be able to:

i. Choose appropriate power semiconductor device in converter circuits and develop their triggering circuits.
ii. Analyze various types of power electronic converters and apply different switching techniques.
iii. Select appropriate power converter for specific applications.
iv. Interpret and use datasheets of power semiconductor devices for design.

Text Book:
Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education

References:
3. P.S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi
4. L. Umanand, Power Electronics – Essentials & Applications, Wiley-India

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>SCR-Structure, static characteristics &amp; switching (turn-on &amp; turn-off) characteristics - di/dt &amp; dv/dt protection – turn-on methods of SCR - two transistor analogy - series and parallel connection of SCRs Structure and principle of operation of power diode, TRIAC, GTO, Power MOSFET &amp; IGBT – Comparison</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td><strong>Gate triggering circuits</strong> – R, RC, UJT triggering circuits – natural and forced commutation (concept only). Requirements of isolation and synchronisation in gate drive circuits- Opto and pulse transformer based isolation. <strong>Controlled rectifiers</strong> – half-wave controlled rectifier with R load – 1-phase fully controlled bridge rectifier with R, RL and RLE loads (continuous &amp; discontinuous conduction) – output voltage</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>equation – 1-phase half controlled bridge rectifier with R, RL and RLE loads – displacement power factor – distortion factor.</td>
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<tr>
<td>FIRST INTERNAL EXAMINATION</td>
<td>3-phase half-wave controlled rectifier with R load - 3-phase fully controlled &amp; half-controlled converter with RLE load (continuous conduction, ripple free) – output voltage equation-waveforms for various triggering angles (no analysis) – 1-phase &amp; 3-phase dual converter with &amp; without circulating current – four-quadrant operation</td>
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<td>7</td>
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</tr>
<tr>
<td>Inverters</td>
<td>1-phase half-bridge &amp; full bridge inverter with R &amp; RL loads – THD in output voltage – 3-phase bridge inverter with R load – 120° &amp; 180° conduction mode – current source inverters.</td>
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<td>7</td>
<td>15%</td>
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</tr>
<tr>
<td>SECOND INTERNAL EXAMINATION</td>
<td>Voltage control in inverters – Pulse Width Modulation – single pulse width, multiple pulse width &amp; sine PWM – modulation index &amp; frequency modulation ratio.</td>
<td></td>
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<tr>
<td>AC voltage controllers (ACVC)</td>
<td>1-phase full-wave ACVC with R, &amp; RL loads – waveforms – RMS output voltage, input power factor with R load – sequence control (two stage) with R load</td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td>20%</td>
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</tr>
<tr>
<td>DC-DC converters</td>
<td>step down and step up choppers – single-quadrant, two-quadrant &amp; four quadrant chopper – pulse width modulation &amp; current limit control in dc-dc converters. Switching regulators – buck, boost &amp; buck-boost - continuous conduction mode only – waveforms – design of filter inductance &amp; capacitance</td>
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</tbody>
</table>

END SEMESTER EXAM

QUESTION PAPER PATTERN:
Maximum Marks: 100
Exam Duration: 3 Hours.

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 x 5) = 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 - Credits | Year of Introduction
--- | --- | --- | ---
EE306 | POWER SYSTEM ANALYSIS | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives
- To enable the students to analyse power systems under normal and abnormal conditions.
- To understand the need for load flow analysis and different methods
- To understand power system modeling
- To understand the need for stability studies and their analysis

Syllabus
Per unit quantities - modeling of power system components - methods of analyzing faults in symmetrical and unsymmetrical case - load flow studies - Automatic Generation Control - Automatic voltage control – Economic load dispatch - Unit commitment - Power system stability - Solution of swing equation - Methods of improving stability limits

Expected outcome.
The students will be able to:
- Analyse power systems under normal and abnormal conditions.
- Carry out load flow studies under normal and abnormal conditions

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Per unit quantities-single phase and three phase-selection of base quantities -advantages of per unit system –changing the base of per unit quantities-Simple problems. Modelling of power system components - single line diagram – per unit quantities. Symmetrical components- sequence impedances and sequence networks of generators, transformers and transmission lines.</td>
<td>2</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Methods of analyzing faults in symmetrical and unsymmetrical case- effects of faults - Power system faults - symmetrical faults - short circuit MVA - current limiting reactors-</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>
Unsymmetrical faults - single line to ground, line to line, double line to ground faults - consideration of prefault current problems.

FIRST INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>III</td>
<td>Load flow studies - Introduction - types - network model formulation - formation of bus impedance and admittance matrix, Gauss-Siedel (two iterations), Newton-Raphson (Qualitative analysis only) and Fast Decoupled method (two iterations) - principle of DC load flow.</td>
<td>8</td>
<td>15%</td>
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<tr>
<td>IV</td>
<td>Automatic Generation Control: Load frequency control: single area and two area systems - Automatic voltage control.</td>
<td>6</td>
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</table>

SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Economic Operation - Distribution of load between units within a plant - transmission loss as a function of plant generation - distribution of load between plants - Method of computing penalty factors and loss coefficients.</td>
<td>5</td>
<td>20%</td>
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<tr>
<td></td>
<td>Unit commitment: Introduction — Constraints on unit commitments: Spinning reserve, Thermal unit constraints - Hydro constraints.</td>
<td>2</td>
<td>20%</td>
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<tr>
<td>VI</td>
<td>Power system stability - steady state, dynamic and transient stability - power angle curve - steady state stability limit</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Mechanics of angular motion - Swing equation – Solution of swing equation - Point by Point method - RK method - Equal area criterion application - Methods of improving stability limits.</td>
<td>5</td>
<td>20%</td>
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</table>

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hours.

Part A: 8 compulsory questions.

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

Student has to answer all questions. (8 x 5)=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 - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE307</td>
<td>SIGNAL AND SYSTEMS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

Course Objectives
- To impart knowledge about the representation and properties of signal and systems and applications in engineering

Syllabus:
Classification of signals - Basic operations on signals- properties of systems- Convolution-Laplace transform-applications-Fourier series and Fourier transforms- properties- Discrete time systems-sampling- ZT-properties-applications- DFS-DFT-properties-Basics of Nonlinear systems

Expected Outcome:
After the completion of the course student will be able to:
  i. Represent various signals and systems
  ii. Analyse the continuous time system with Laplace transform
  iii. Represent and analyse signals using Fourier representation
  iv. Analyse the discrete time system using ZT
  v. Analyse the DT systems with DFS
  vi. Acquire basic knowledge in nonlinear systems

Text books:

References:
2. Farooq Husain , Signals and Systems, Umesh pub.

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>Introduction to signals and systems - Classification of signals - Basic operations on signals – Elementary signals – Concept of system - Properties of systems - Stability, inevitability- time invariance- Linearity -Causality – Memory-Convo loneliness - Impulse response- Representation of LTI systems - Differential equation representations of LTI systems</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Laplace transform analysis of systems - Relation between the transfer function and differential equation –Causality and stability - Inverse system - Determining the time domain and frequency response from poles and zeros</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Fourier representation of continuous time signals –Fourier</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Topics</td>
<td>Marks</td>
<td>Weightage</td>
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<td>------------------------------------------------------------------------</td>
<td>-------</td>
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</tr>
<tr>
<td>IV</td>
<td>Series-Harmonic analysis of common signals- Fourier transform - Existence –properties of FT - Energy spectral density and power spectral density - Frequency response of LTI systems - Sampled data systems- Sampling process-sampling theorem-signal re construction- Zero order and First order hold circuits-Difference equation representations of LTI systems - Discrete form of special functions- Discrete convolution and its properties</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Z Transform - Region of convergence- Properties of the Z transform – Inverse ZT-methods Z-transfer function- Analysis of difference equation of LTI systems – Basic idea on Stability and causality conditions-</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Fourier representation of discrete time signals - Discrete Fourier series–properties- Frequency response of simple DT systems Basics of Non linear systems-types and properties Introduction to random signals and processes (concepts only)</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hours.

**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 Credits | Year of Introduction  
---|---|---|---
EE308 | Electric Drives | 3-0-0-3 | 2016  

**Prerequisite:** EE202 & EE205  

**Course Objectives**  
- To provide fundamental knowledge in dynamics and control of Electric Drives.  
- To justify the selection of Drives for various applications.  
- To familiarize the various semiconductor controlled drives employing various motors.  

**Syllabus**  

**Expected outcome.**  
The students will be able to select a drive for a particular application. They will familiarize with the various control techniques employed for controlling drives with ac and dc motors.  

**Text books**  

**References:**  
2. Dr. P. S. Bimbra “Power electronics”, Khanna publishers  
3. J. M. D. Murphy “Thyristor control of AC drives”  
6. Pillai S. K. “A first course on electric drives”, Wieley Eastern Ltd, New Delhi  

**Course Plan**  

| Module | Contents | Hours | Sem. Exam Marks  
---|---|---|---
I | Introduction to electric drives – Block diagram – advantages of electric drives – Dynamics of motor load system, fundamental equations, and types of load – classification of load torque, four quadrant operation of drives. Steady state stability. Introduction to closed loop control of drives. | 7 | 15%  
II | DC motor drives- constant torque and constant power operation, separately excited dc motor drives using controlled rectifiers, single phase semi converter and single phase fully controlled converter drives. Three phase semi converter and fully controlled converter drives. Dual converters, applications of dual converter for speed control of DC motor. Closed loop control of separately excited dc motor drive. DC series motor drive for traction application. | 7 | 15%  

**FIRST INTERNAL EXAMINATION**
III  Chopper controlled DC drives. Analysis of single quadrant chopper drives. Regenerative braking control. Two quadrant chopper drives. Four quadrant chopper drives. Cycloconverters for drive applications – different types – basic principle.  7  15%

IV  Three phase induction motor speed control. Using semiconductor devices. Stator voltage control – stator frequency control - Stator voltage and frequency control (v/f). Rotor chopper speed control - slip power recovery control schemes – sub synchronous and super synchronous speed variations.  7  15%

SECOND INTERNAL EXAMINATION

V  Voltage source inverter fed induction motor drives, Current source inverter fed induction motor drives. Concept of space vector – Basic transformation in reference frame theory – field orientation principle.  7  20%

VI  Synchronous motor drives – introduction to v/f control. Permanent Magnet synchronous motor drives – different types – control requirements, converter circuits, modes of operation. Microcontroller based permanent magnet synchronous motor drives (schematic only).  7  20%

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100  Exam Duration: 3 Hours.

Part A: 8 compulsory questions.

One question from each module of Modules 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.
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<th>L-T-P-Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 309</td>
<td>Microprocessor and Embedded Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Course Objectives**

To provide a strong foundation about the principles, programming and various applications of different microprocessors and microcontrollers.

**Syllabus:**

Internal architecture, instruction set, assembly language programming, Sample Programs in assembly language of 8085 and 8051 microcontroller-internal architecture.

**Expected Outcome:**

The students will be able to:

1. Apply the fundamentals of assembly level programming of 8085 microprocessor and 8051 microcontroller.
2. Work with standard microprocessor real time interfaces.
3. Develop skill for writing C programs for 8051 microcontroller.
4. Design microprocessors/microcontrollers-based systems.

**Text books:**

5. Ramesh Gaonkar, Microprocessor, Architecture, Programming and Applications, Penram

**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>Internal architecture of 8085 microprocessor–Instructionset-Addressing modes–Classification of instructions. Assembly language programming–standard programs in assembly language–code conversion, sorting–binary and BCD arithmetic.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNALEXAMINATION
<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>IO and memory interfacing – Address decoding – interrupt Structure of 8085. I/O ports – Programmable peripheral interface PPI8255 - Modes of operation. Interfacing of LEDs, ADC and DAC with 8085</td>
</tr>
<tr>
<td>IV</td>
<td>Introduction to Embedded Systems - Application domain of embedded systems, features and characteristics, System model, Microprocessor Vs Microcontroller, current trends and challenges, hard and soft real time systems, Embedded product development, Life Cycle Management (water fall model), Tool Chain System, Assemblers, Compilers, linkers, Loaders, Debuggers, Profilers &amp; Test Coverage Tools</td>
</tr>
<tr>
<td>V</td>
<td>8051 Microcontrollers Hardware: Microcontroller Architecture: IO Port structure, Register organization, general purpose RAM, Bit Addressable RAM, Special Function Registers (SFRs). Instruction Set, addressing modes, Instruction Types.</td>
</tr>
<tr>
<td>VI</td>
<td>8051 - assembly language programming, data types and directives, Time delay and I/O port programming, Embedded Programming in C, data type and time delay in C, I/O port programming, Timer / counter programming, serial port programming, Interfacing – LCD, ADC, Stepper motor, and DAC.</td>
</tr>
</tbody>
</table>

**ENDSEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours.

**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 x 5) = 40

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 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 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 questions:  
(2 x 10) = 20. Each question can have maximum of 4 sub questions (a, b, c, d), if needed.
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<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE331</td>
<td>Digital Circuits and Embedded Systems Lab</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE309 Microprocessor and embedded systems

**Course Objectives**
- To impart practical experience in the design and setup of digital circuits and embedded systems.

**List of Exercises/Experiments:** (Out of 18 experiments listed, 12 experiments are mandatory.)

**DIGITAL CIRCUITS EXPERIMENTS:** (at least 7 experiments are mandatory)
1. Realisation of SOP & POS functions after K map reduction
2. Half adder & Full adder realization using NAND gates
3. 4-bit adder/subtractor & BCD adder using IC 7483
4. BCD to decimal decoder and BCD to 7-segment decoder & display
5. Study of multiplexer IC and Realization of combinational circuits using multiplexers.
6. Study of counter ICs (7490, 7493)
7. Design of synchronous up, down & modulo N counters
8. Study of shift register IC 7495, ring counter and Johnsons counter
9. VHDL implementation of full adder, 4 bit magnitude comparator

**EMBEDDED SYSTEM EXPERIMENTS:** (Out of first six, any two experiments using 8085 and any two using 8086. Out of the last 3 experiments, any two experiments using 8051 or any other open source hardware platforms like PIC, Arduino, MSP430, ARM etc) (at least 5 experiments are mandatory)
1. Data transfer instructions using different addressing modes and block transfer.
2. Arithmetic operations in binary and BCD-addition, subtraction, multiplication and division
3. Logical instructions- sorting of arrays in ascending and descending order
4. Binary to BCD conversion and vice versa.
5. Interfacing D/A converter- generation of simple waveforms-triangular wave, ramp etc
6. Interfacing A/D converter
7. Square wave generation.
8. LED and LCD display interfacing
9. Motor control

**Expected outcome.**
The students will be able to
i. design, setup and analyse various digital circuits.
ii. design an embedded system for a particular application
<table>
<thead>
<tr>
<th>Course code</th>
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<th>L-T-P - Credits</th>
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</tr>
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<tbody>
<tr>
<td>EE332</td>
<td>Systems and Control laboratory</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE303 Linear control systems

**Course Objectives**
- To develop mathematical models for electrical systems, analyse the systems and implement compensators for systems based on system performance.

**List of Experiments:**
1. Predetermination and verification of frequency response characteristics of Lag and Lead networks.
2. Transfer Function of AC and DC servomotors
3. Step and frequency response of R-L-C circuit
5. Study of performance characteristics and response analysis of a typical temperature/ Flow/ Level control system.
6. MATLAB: Use of control system Tool box for the Time domain and frequency domain methods of system analysis and design
7. SIMULINK: Simulation and control of real time systems using SIMULINK
8. Compensator design using Bode plot with MATLAB control system Tool box
9. Simple experiments using Programmable Logic Controller- Realization of AND, OR logic, concept of latching, experiments with timers and counters- using ladder diagrams
11. Realization of Lag & lead compensator using active components

**End examination shall be based on design of a controller for the given system**

**Course Outcome:**
After successful completion of this course, students will be able to:
1. Develop mathematical models for servomotors and other electrical systems
2. Performance analysis of different process control systems
3. Performance analysis of different types of controllers
4. Use MATLAB and SIMULINK to design and analyze simple systems and compensators
<table>
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<tr>
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<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE333</td>
<td>Electrical Machines Lab II</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE202 Synchronous and induction machines

**Course Objectives**
- To give hands on experience in testing Alternators, Three phase and Single phase Induction Motors and induction generators

**List of Exercises/Experiments:**

1. Regulation of alternator by direct loading
   
   **Objectives:**
   - a) Determine the regulation of three phase alternator
   - b) Plot the regulation vs load curve

2. Regulation of three phase alternator by emf and mmf methods
   
   **Objectives:**
   - Predetermine the regulation of alternator by emf and mmf method

3. Regulation of alternator by Potier and ASA methods
   
   **Objectives:**
   - a) Synchronize the alternator by dark lamp method
   - b) Plot ZPF characteristics and determine armature reactance mmf and potier reactance
   - c) Predetermine the regulation by ZPF method
   - d) Predetermine the regulation by ASA method

4. Regulation of alternator by Potier method using inductive load
   
   **Objectives:**
   - a) Plot ZPF characteristics using a variable inductive load
   - b) Predetermine the regulation by ZPF method

5. Regulation of salient pole alternator using two reaction theory
   
   **Objectives:**
   - a) Determine the direct and quadrature axis reactances.
   - b) Predetermine the regulation of alternator

6. Active and reactive power control in grid connected alternators
   
   **Objectives:**
   - a) Synchronize the alternator by bright lamp method
   - b) Control the active and reactive power
   - c) Plot the v-curve and inverted v curve for generator operation

7. Study of induction motor starters
   
   **Objectives:**
   - a) Start an induction motor using star delta starter and determine the starting current
   - b) Plot the dynamic characteristic during IM starting

8. Variation of starting torque with rotor resistance in slip-ring induction motors
   
   **Objectives:**
   - a) Plot the variation of starting torque against rotor resistance in a three phase slip ring induction motor
   - b) Find the external rotor resistance for which maximum starting torque is obtained.

9. Speed control of slip ring induction motor by varying rotor resistance
   
   **Objectives:**
   - a) Run the slip ring induction motor with constant load torque
   - b) Plot the variation of speed against change in rotor resistance

10. Load test on three phase squirrel cage induction motor
    
    **Objectives:**
    - a) Start the motor using star delta starter
    - b) Plot efficiency, line current and power factor against output power

11. Load test on three slip ring induction motor
    
    **Objectives:**
    - a) Start the motor using auto transformer or rotor resistance starter
b) Plot efficiency, line current and power factor against output power

12. No load and block rotor test on three phase induction motor
   Objectives:
   a) Predetermination of performance characteristics from circle diagram
   b) Determination of equivalent circuit

13. Performance characteristics of pole changing induction motor
   Objectives:
   a) Run the motor in two different pole combinations (example 4 pole and 8 pole)
   b) Determine the performance in the two cases and compare

14. V curve of a synchronous motor
   Objectives:
   a) Run the motor in two different load conditions
   b) Determine v-curve for each load condition

15. Performance characteristics of induction generator
   Objective:
   a) Run the induction generator with a dc motor prime mover.
   c) Plot the performance characteristics of the generator

16. Equivalent circuit of single phase induction motor
   Objectives:
   a) Conduct no load and blocked tor test on the motor
   c) Find the equivalent circuit

17. Electrical braking of slip ring induction motor
   Objectives:
   a) Dynamic braking
   b) Plot the speed variations at different conditions

18. Separation of hysteresis loss in a three phase slip ring induction motor
   Objective:
   Determine the hysteresis loss in a slip ring induction motor

Out of the above experiments, minimum twelve experiments should be done.

Expected outcome:
- After the successful completion of the course, the students will be able to test and validate DC generators, DC motors and transformers

Text Book:
<table>
<thead>
<tr>
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<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE334</td>
<td>Power Electronics and Drives Lab</td>
<td>0-0-3-1</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE305 Power electronics

**Course Objectives**

- Impart practical knowledge for the design and setup of different power electronic converters and its application for motor control
- Simulate the various power electronics converters, AC drives and DC drives.

**List of Exercises/Experiments:** (12 experiments are mandatory)

**HARDWARE EXPERIMENTS:**

1. Static characteristics of SCR
   - Aim: Determine latching current, holding current and static characteristics of SCR
2. R and RC firing circuits
   - Aim: Design and set up R and RC firing circuits and observe waveforms across load resistance and SCR
3. UJT Trigger circuit with Single phase controlled Rectifier
   - Aim: Design & Set up UJT Triggering Circuit and observe waveforms across load resistance, SCR, capacitance and pulse transformer output.
4. Line Synchronised Triggering Circuits
   - Aim: Design and set-up line synchronized Ramp Trigger and Digital Trigger circuits and observe the waveforms
5. Static characteristics of MOSFET
   - Aim: Plot the characteristics of a Power MOSFET
6. AC Voltage Controller using TRIAC
   - Aim: Set a 1-phase AC voltage controller & observe waveforms across load resistance, TRIAC and capacitor for different firing angles
7. Single Phase fully Controlled SCR Bridge circuit
   - Aim: Set up a 1-phase full converter with RL load & with and without freewheeling diode
8. Single-phase half bridge/full bridge inverter using power MOSFET/IGBT
   - Aim: Design and set up a single phase half-bridge/full-bridge inverter and observe the waveforms across load and firing pulses.
9. Single-phase sine PWM inverter with LC filter
   - Aim: Design and set up a single phase sine PWM inverter with LC filter using microcontroller
10. Chopper controlled DC motor
    - Aim: Control the speed of a DC motor using a step-down chopper
11. Speed control of 3-phase induction motor
    - Aim: Control the speed of 3-phase induction motor using V/f control
12. IGBT based three phase PWM Inverter
    - Aim: Set up a 3-phase PWM Inverter with RL load and observe the waveforms
13. Closed Loop Control of Single Phase Fully Controlled Rectifier
    - Aim: Design and set-up a closed loop control circuit for a 1ph Fully Controlled Rectifier such that it keeps the load voltage constant irrespective of the load variations (use R load)

**SIMULATION EXPERIMENTS:**

14. Simulation of 1-phase fully-controlled and half-controlled rectifier fed separately excited DC motor
    - Aim: Simulate 1-phase fully-controlled and half-controlled rectifier fed SEDC motor and observe the speed, torque, armature current, armature voltage, source current waveforms and find the THD in source current and input power factor.
15. Simulation of closed loop speed control of DC motor with different control schemes (PID, hysteresis current control, Fuzzy, ANFIS etc)
16. Simulation of open loop or closed loop speed control of 3-phase induction motor using V/f control and using sine PWM
17. Design and simulation of buck, boost and buck-boost converters
18. Simulation of Dual Converter – 4 quadrant operation – separately excited DC motor
19. Simulation of Regenerative Braking – Bidirectional Power Transfer
20. Simulation of Switched Mode Rectifiers – keeping load voltage constant irrespective of line and load variations – closed loop circuit simulation

Minimum of EIGHT hardware experiments and FOUR simulation experiments from the above list are to be done

Expected outcome:
- Students will be able to design, setup and analyse various power electronic converters and apply these converters for the implementation of various motor control applications.

Text Book:
1) L. Umanand, *Power Electronics – Essentials & Applications*, Wiley-India
3) Muhammad H. Rashid, *Power Electronics Circuits, Devices and Applications*, Pearson Education
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
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<tbody>
<tr>
<td>EE361</td>
<td>Object Oriented Programming</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE207 Computer programming

**Course Objectives**
- To familiarize the student with the Object Oriented Programming Concepts
- To give a fair idea about Programming in Java and its use as an Application development tool

**Syllabus**
Review of Object Oriented Concept, Components of Object oriented programming, File management concepts, Database programming, Application development concepts

**Expected outcome.**
- The students will be able to develop simple application programs using object oriented concepts and Java

**Text Books:**

**References:**
1. Doug Lea, Concurrent programming in Java Design Principles and Patterns, Pearson Education.
3. Timothy Budd, “Understanding Object-oriented programming with Java”, Pearson Education.

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Review of Object Oriented Concepts - Objects and classes in Java – defining classes – methods – access specifiers</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>– static methods– constructors, Arrays – Strings -Packages – JavaDoc comments,</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Streams and Files -Use of Streams, Object Streams, , Applet Basics-The Applet HTML Tags and Attributes, Multimedia, The Applet Context, JAR Files.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>File Management. Multithreaded programming– Thread properties – Creating a thread -Interrupting threads –Thread priority- thread synchronization – Synchronized method -Inter thread communication</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Database Programming -The Design of JDBC, The Structured Query Language, JDBC Installation, Basic JDBC Programming Concepts, Query Execution</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**
QUESTION PAPER PATTERN:

Maximum Marks: 100  Exam Duration: 3 Hours

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 x 5) = 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 - Credits | Year of Introduction
---|---|---|---
EE362 | Data Structures and Algorithms | 3-0-0-3 | 2016

**Prerequisite:** EE207 Computer programming

**Course Objectives**
- To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms
- To impart knowledge about algorithm specification

**Syllabus**
Linear Structures, Tree Structures, Applications of trees, Balanced Search Trees and Indexing, Graphs, Shortest-path algorithms, Applications of graphs, Algorithm Design, Algorithm Analysis, Dynamic programming

**Expected outcome.**
The students will be able to:
- Describe how arrays, records, linked structures, stacks, queues, trees, and graphs are represented in memory and used by algorithms
- Describe common applications for arrays, records, linked structures, stacks, queues, trees, and graphs
- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
- Demonstrate different methods for traversing trees
- Compare alternative implementations of data structures with respect to performance
- Compare and contrast the benefits of dynamic and static data structures implementations
- Describe the concept of recursion, give examples of its use, describe how it can be implemented using a stack

**Text Book:**
1. Robert Kruse, Data Structures and program design in C, Pearson Education Asia
2. Samanta, Classic Data Structures, PHI

**References:**
2. Langsam, Augenstein & Tanenbaum, Data Structures using C & C++: Pearson, 1995
3. N.Wirth, Algorithms + Data Structures & Programs:, PHI
5. Thomas Standish, Data structures in Java:, Pearson Education Asia

**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>Linear Structures : Abstract data types(ADT), List ADT, Array based implementation, Linked list implementation, Cursor based linked lists, Doubly linked lists, Applications of lists, Stack ADT, Queue ADT, Circular queue implementation, Applications of stacks and queues</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
II  Tree Structures : Need for nonlinear structures, Tree ADT, Tree traversals, Left child right sibling data structures for general trees, Binary tree ADT, Expression trees, Applications of trees, Binary search tree ADT  7  15%

FIRST INTERNAL EXAMINATION

III  Balanced Search Trees and Indexing : AVL trees, Binary heaps, B-trees, Hashing, Separate chaining, Open addressing, Linear probing  7  15%

IV  Graphs : Definitions, Topological sort, Breadth-first traversal, Shortest-path algorithms, Minimum spanning tree, Prim’s and Kruskal’s algorithms, Depth-first traversal, Bio connectivity, Euler circuits, Applications of graphs  7  15%

SECOND INTERNAL EXAMINATION

V  Algorithm Design: Greedy algorithm, Divide and conquer, Dynamic programming, Backtracking, Branch and bound, Randomized algorithms  7  20%

VI  Algorithm Analysis : Asymptotic notations, Recurrences, NP complete problems  7  20%

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100  Exam Duration: 3Hours.

Part A: 8 compulsory questions.
One question from each module of Modules 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.

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<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE363</td>
<td>Computer Organization and Architecture</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite: Nil**

**Course Objectives**
- To lay the foundation for the study of hardware organization of digital computers.
- To impart the knowledge on interplay between various building blocks of computer

**Syllabus**
Basic operational concepts, CPU structure, Arithmetic, Memory hierarchy, Input Output interfacing, Performance analysis, Design

**Expected outcome.**
- The students will gain general idea about the functional aspects of each building blocks in computer design

**Text Book:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem.E xamM arks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Basic Structure of computers – functional units – Historical Perspective -Basic operational concepts – bus structures, Measuring performance: evaluating, comparing and summarizing performance</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Memory locations and addresses – memory operations – instructions and instruction sequencing ,Instruction sets- RISC and CISC paradigms, Addressing modes</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Computer arithmetic - Signed and unsigned numbers - Addition and subtraction - Logical operations - Constructing an ALU - Multiplication and division – faster versions of multiplication-floating point representation and arithmetic</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>The processor: Building a data path - Simple and multi-cycle implementations - Microprogramming – Exceptions</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Introduction to pipelining-pipeline Hazards, Memory hierarchy - Caches - Cache performance - Virtual memory - Common framework for memory hierarchies</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Input/output - I/O performance measures – I/O techniques - interrupts, polling, DMA; Synchronous vs. Asynchronous I/O; Controllers. Types and characteristics of I/O devices - Buses - Interfaces in I/O devices - Design of an I/O system</td>
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<td>20%</td>
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<th>Sem.E xamM arks</th>
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<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>The processor: Building a data path - Simple and multi-cycle implementations - Microprogramming – Exceptions</td>
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**SECOND INTERNAL EXAMINATION**

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<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem.E xamM arks</th>
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</thead>
<tbody>
<tr>
<td>V</td>
<td>Introduction to pipelining-pipeline Hazards, Memory hierarchy - Caches - Cache performance - Virtual memory - Common framework for memory hierarchies</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Input/output - I/O performance measures – I/O techniques - interrupts, polling, DMA; Synchronous vs. Asynchronous I/O; Controllers. Types and characteristics of I/O devices - Buses - Interfaces in I/O devices - Design of an I/O system</td>
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</table>

**END SEMESTER EXAM**
QUESTION PAPER PATTERN:

Maximum Marks: 100  
Exam Duration: 3 Hours.

**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. \((8 \times 5) = 40\)

**Part B**: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). Each question can have maximum of 4 sub questions \((a,b,c,d)\), if needed.
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<thead>
<tr>
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<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE364</td>
<td>Switched Mode Power Converters</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite : Nil**

**Course Objectives**
- To study and analyze various types of switched mode dc-dc converters, inverters and resonant converters and its switching techniques.

**Syllabus**
- DC-DC convertors without isolation – switched mode power supply – DC-DC converters with isolation – switched mode DC-AC converter – sine PWM and space vector PWM - resonant converter

**Expected outcome.**
The students will have
- ability to analyze and design switched mode power converters
- proper understanding about soft switching and its applications
- deep knowledge in pulse width modulated techniques

**Text Book:**

**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>Switched Mode DC-to-DC Converter - buck converters – boost Converter – buck-boost converter - Continuous Conduction mode – design of filter inductance &amp; capacitance - boundary between continuous and discontinuous conduction – critical values of inductance/load resistance - discontinuous conduction mode with constant output voltage - Output voltage ripple</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Switched Mode DC to AC converter – 1-phase square wave full-bridge inverter – square wave switching scheme - sine PWM switching scheme – PWM with bipolar &amp; unipolar voltage switching - harmonic analysis of output voltage – output control by voltage cancellation - 3-phase voltage source inverter – 3-phase sine PWM inverter – RMS line to line voltage &amp; RMS fundamental line-to-line voltage – square wave operation -</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>
Switching utilisation ratio of 1-phase & 3-phase full-bridge inverters

SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Concept of space vector – space vector modulation – reference vector &amp;</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>switching times – space vector sequence – comparison of sine PWM &amp;</td>
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<tr>
<td></td>
<td>space vector PWM - programmed (selective) harmonic elimination</td>
<td></td>
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<td></td>
<td>switching – current controlled voltage source inverter - hysteresis</td>
<td></td>
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<tr>
<td></td>
<td>current control</td>
<td>20%</td>
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<tr>
<td>VI</td>
<td>Resonant Converters - Basic resonant circuit concepts – series resonant</td>
<td>7</td>
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<tr>
<td></td>
<td>circuit – parallel resonant circuit – load resonant converter - ZCS</td>
<td></td>
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<tr>
<td></td>
<td>resonant converter - L type &amp; M type - ZVS resonant converter –</td>
<td></td>
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<tr>
<td></td>
<td>comparison of ZCS &amp; ZVS Resonant Converters</td>
<td>20%</td>
</tr>
</tbody>
</table>

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hourrs.

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 - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE365</td>
<td>Digital System Design</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

**Course Objectives**
- To enable designing and building of real digital circuits
- To implement VHDL programming in digital system design

**Syllabus**

**Expected outcome**
After completing the course, the students will be able to

i. Design any Digital Circuit for practical application
ii. Implement any digital system using VHDL
iii. Program any VHDL code for practical implementation
iv. Hardware realization of any complex VHDL system.

**Text Book:**

**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>Introduction: Modern Digital Design, CMOS Technology, Programmable Logic, Electrical Properties</td>
<td>4</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Combinational Logic Design: Boolean Algebra, Logic Gates, Combinational Logic Design, Timing, Number codes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Combinational Logic using VHDL Gate Models: Entities and Architectures, Identifiers, Spaces and Comments, Net lists, Signal Assignments, Generics, Constant and Open Ports, Test benches, Configurations</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Combinational Building Blocks: Three-Stat Buffers, Decoders, Multiplexers, Priority Encoders, Adders, Parity Checkers, Test benches for Combinational blocks</td>
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</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

<p>| III    | Synchronous Sequential Design: Synchronous Sequential Systems, Models of Synchronous Sequential Systems, Algorithmic State Machines, Synthesis from ASM chart, State Machines in VHDL, VHDL Test benches for State Machines | 7     | 15%             |</p>
<table>
<thead>
<tr>
<th>Module</th>
<th>VHDL Models of Sequential Logic Blocks: Latches, Flip-Flops, J K and T Flip Flop, Registers and Shift Registers, Counters, Memory, Sequential Multiplier, Test benches for Sequential Building Blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>Complex Sequential Systems: Data path / Control Partitioning, Instructions, A Simple Microprocessor, VHDL model of a Simple Microprocessor</td>
</tr>
<tr>
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<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
</tr>
<tr>
<td></td>
<td>VHDL Synthesis: RTL Synthesis, Constraints, Synthesis for FPGAs, Behavioural Synthesis, Verifying Synthesis Results</td>
</tr>
<tr>
<td></td>
<td>Design for Testability: Ad Hoc Testability improvements, Structured Design for Test, Built-in-Self-Test, Boundary scan (IEEE 1149.1)</td>
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<td><strong>END SEMESTER EXAM</strong></td>
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<td><strong>QUESTION PAPER PATTERN:</strong></td>
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<td></td>
<td>Maximum Marks: 100</td>
</tr>
<tr>
<td>Part A:</td>
<td>8 compulsory questions.</td>
</tr>
<tr>
<td></td>
<td>One question from each module of Module I - IV; and two each from Module V &amp; VI.</td>
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<tr>
<td></td>
<td>Student has to answer all questions. (8 x 5) = 40</td>
</tr>
<tr>
<td>Part B:</td>
<td>3 questions uniformly covering Modules I &amp; 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.</td>
</tr>
<tr>
<td>Part C:</td>
<td>3 questions uniformly covering Modules III &amp; 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.</td>
</tr>
<tr>
<td>Part D:</td>
<td>3 questions uniformly covering Modules V &amp; 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.</td>
</tr>
</tbody>
</table>
Course code: EE366
Course Name: Illumination Technology
L-T-P -Credits: 3-0-0-3
Year of Introduction: 2016

Prerequisite: Nil

Course Objectives
- To provide an introduction to the fundamentals of illumination engineering and architectural lighting design.
- To impart lighting fundamentals, measurement, and technology and their application in the analysis and design of architectural lighting systems.

Syllabus
Introduction of Light, Types of illumination, Lighting systems, Lighting Scheme, Measurement of Light, Laws of illumination, Design of Interior Lighting, Determination of Lamp Lumen output taking into account voltage and temperature variations, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building, Design of Outdoor Lighting, Special Features of Aesthetic Lighting

Expected outcome.
The students will be able to:

i. Identify the criteria for the selection of lamps and lighting systems for an indoor or outdoor space
ii. Perform calculations on photometric performance of light sources and luminaires for lighting design
iii. Evaluate different types of lighting designs and applications

Text Books

References:
1. IS CODE 3646
2. IS CODE 6665

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>Introduction of Light : Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localised</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Measurement of Light : Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert’s Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source</td>
<td>7</td>
<td>15%</td>
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</table>

FIRST INTERNAL EXAMINATION
<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>8</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Design of Interior Lighting: Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilisation and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination such as DLOR and ULOR, Selection of lamp and luminance, Selection of utilisation factor, reflection factor and maintenance factor, Determination of Lamp Lumen output taking into account voltage and temperature variations, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaire, Calculation of space to mounting height ratio, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Design of Outdoor Lighting: Street Lighting: Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio, Calculation of illumination level available on road</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Design of Outdoor Lighting: Flood Lighting: Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio, Recommended method for aiming of lamp</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting</td>
<td>7</td>
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**SECOND INTERNAL EXAMINATION**

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<th>Topic</th>
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**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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: EE367
#### Course Name: New and Renewable Energy Systems
<table>
<thead>
<tr>
<th>Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives:**
- To give sufficient knowledge about the promising new and renewable sources of energy
- To equip students in working with projects and to take up research work in connected areas.

**Syllabus:**
- Solar energy
- Solar radiation measurements
- Applications of solar energy
- Energy from oceans
- Tidal energy
- Wind energy
- Small Hydro Power (SHP) Stations
- Biomass and bio-fuels
- Geothermal energy
- Power from satellite stations
- Hydrogen energy.

**Expected Outcome:**
The students will be able to design and analyse the performance of small isolated renewable energy sources.

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction, Classification of Energy Resources; Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario. ENERGY STORAGE: Sizing and Necessity of Energy Storage.</td>
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<td>15%</td>
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<tr>
<td>Module</td>
<td>Topic</td>
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<tr>
<td>III</td>
<td><strong>SOLAR ELECTRIC SYSTEMS:</strong> Solar Thermal Electric Power Generation –; Solar Photovoltaic – Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems – stand-alone and grid connected; Applications – Street lighting, Domestic lighting and Solar Water pumping systems.</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td><strong>ENERGY FROM OCEAN:</strong> Tidal Energy – Principle of Tidal Power, Components of Tidal Power Plant (TPP), Classification of Tidal Power Plants, Advantages and Limitations of TPP. Ocean Thermal Energy Conversion (OTEC): Principle of OTEC system, Methods of OTEC power generation Open Cycle (Claude cycle), Closed Cycle (Anderson cycle) and Hybrid cycle (block diagram description of OTEC); Site-selection criteria, Biofouling, Advantages &amp; Limitations of OTEC.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>VI</td>
<td><strong>BIOMASS ENERGY:</strong> Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants – KVIC and Janata model; Biomass program in India. Small hydro power: Classification as micro, mini and small hydro projects - Basic concepts and types of turbines - Design and selection considerations. EMERGING TECHNOLOGIES: Fuel Cell, Small Hydro Resources, Hydrogen Energy, alcohol energy, nuclear fusion and power from satellite stations.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours.

**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 x 5) = 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: EE368
Course Name: SOFT COMPUTING
L-T-P - Credits: 3-0-0-3
Year of Introduction: 2016

Prerequisite: Nil

Course Objectives
- To provide the students with 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 an idea on:
- Artificial Intelligence, Various types of production systems, characteristics of production systems.
- Neural Networks, architecture, functions and various algorithms involved.
- Fuzzy Logic, Various fuzzy systems and their functions.
- Genetic algorithms, its applications and advances
- The unified and exact mathematical basis as well as the general principles of various soft computing techniques.

Text Book:
1. Digital Neural Network - S.Y Kung, Prentice-Hall of India

References:
5. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Prentice Hall,

Course Plan

<table>
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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>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>
<tr>
<td>IV</td>
<td>Data Clustering Algorithms – Rulebase Structure Identification Neuro-Fuzzy Control.</td>
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**SECOND INTERNAL EXAMINATION**

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</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: 3 Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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.

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<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE369</td>
<td>High Voltage Engineering</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To understand generation and measurement techniques of high voltage DC, AC and impulse voltages
- To understand various types of testing techniques used in power equipments and design of high voltage lab and the grounding of impulse testing laboratories.

**Syllabus**:
Generation of HVDC, HVAC and impulse wave forms, measurement techniques, non destructive testing techniques, testing of power equipments, design of testing lab and grounding of laboratories.

**Expected outcome.**
- The students will know several of methods of generating different test voltages, testing methods used in power equipments and design of high voltage laboratories.

**Text Book:**
- C.L. Wadhwa *High voltage Engineering*, New age international (P) Ltd, 2007

**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>Generation and transmission of electric energy – voltage stress – testing voltages-A to DC conversion – rectifier circuits – cascaded circuits – voltage multiplier circuits – Cockcroft-Walton circuits – voltage regulation – ripple factor – Van de-Graaff generator.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>II</td>
<td>Generation of high AC voltages-Testing transformer – single unit testing transformer, cascaded transformer – equivalent circuit of cascaded transformer – generation of high frequency AC voltages-series resonance circuit – resonant transformer – voltage regulation.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| IV     | Peak voltage measurements by sphere gaps – Electrostatic voltmeter – generating voltmeters and field sensors – Chubb-Fortescue method | 7     | 15%             |
SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Topics</th>
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</thead>
<tbody>
<tr>
<td>V</td>
<td>Objectives of high voltage testing, Classification of testing methods-self restoration and non-self restoration systems-standards and specifications, Measurement of dielectric constant and loss factor, Partial discharge measurements-Basic partial discharge(PD) circuit – PD currents- PD quantities - Corona and RIV measurements</td>
</tr>
<tr>
<td>VI</td>
<td>Testing of insulators, bushings, air break switches, isolators, circuit breakers, power transformers, surge diverters, cables -testing methodology. Classification of high voltage laboratories, Voltage and power rating of test equipment, Layout of high voltage laboratories, Grounding of impulse testing laboratories.</td>
</tr>
</tbody>
</table>

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100          Exam Duration: 3 Hourrs.

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 x 5)=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 | EE372  
---|---  
Course Name | Biomedical Instrumentation  
L-T-P - Credits | 3-0-0-3  
Year of Introduction | 2016  
Prerequisite: Nil  

**Course Objectives**  
- To give a brief introduction to human physiology and various instrumentations system for measurement and analysis of physiological parameters.

**Syllabus:**  
Development of biomedical instrumentation, Sources of bioelectric potentials, Bio potential electrodes, Electro-conduction system of the heart, Measurement of blood pressure, Measurement of heart sounds, Cardiac pacemakers, defibrillators, Electro encephalogram, Muscle response, Respiratory parameters, Therapeutic Equipments, Imaging Techniques, Instruments for clinical laboratory, Electrical safety, tele- medicine

**Expected outcome.**

**Text Book:**
1. J. G. Webster, Medical Instrumentation, Application and Design, John Wiley and Sons  

**References:**
1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata Mc Graw Hill  

**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>Development of biomedical instrumentation, biometrics, man instrument system components block diagram, physiological systems of the body (brief discussion on Heart and cardio vascular system, Anatomy of nervous system, Physiology of respiratory systems) problems encountered in biomedical measurements. Sources of bioelectric potentials – resting and action potentials - propagation of action potentials – bio electric potentials example (ECG, EEG, EMG, ERG, EOG,EGG etc.)</td>
<td>7</td>
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</tr>
<tr>
<td>III</td>
<td>Measurement of blood pressure – direct and indirect measurement – oscillometric measurement –ultrasonic method, measurement of blood flow and cardiac output, plethysmography –photo electric and impedance plethysmographs Measurement of heart sounds –phonocardiography.</td>
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<tr>
<td>V</td>
<td>Ventilators, heart lung machine, hemodialysis, lithotripsy, infant incubators. X-rays- principles of generation, uses of X-rays- diagnostic still picture, fluoroscopy, angiography, endoscopy, diathermy. Basic principle of computed tomography, magnetic resonance imaging system and nuclear medicine system – radiation therapy. Ultrasonic imaging system - introduction and basic principle.</td>
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<td>20%</td>
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<tr>
<td>VI</td>
<td>Instruments for clinical laboratory – test on blood cells – chemical tests - Electrical safety– physiological effects of electric current – shock hazards from electrical equipment – method of accident prevention, introduction to tele- medicine.</td>
<td>6</td>
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</table>

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.

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

Student has to answer all questions. (8 x 5) = 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.

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<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE401</td>
<td>Electronic Communication</td>
<td>3-0-0-3</td>
<td>2016</td>
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</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce the applications of communication technology.
- To understand the methods and techniques used in communication field.

**Syllabus:**
AM and FM fundamentals-AM and FM transmitters and receivers-Television and radar systems-Digital communication-Satellite communication-Cellular telephone.

**Expected outcome**
The students will
- Understand the need of modulation in transferring a signal through either wireless or wired communication systems
- Be able to apply analog modulation techniques and receiver fundamentals in analog communication.
- Be to apply baseband digital encoding & decoding techniques in the storage / transmission of digital signal through wired channel
- Understand the performance of communication systems in the presence of noise and interference

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>AM and FM fundamentals&lt;br&gt;AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB&lt;br&gt;FM – frequency spectrum – power relations</td>
<td>6</td>
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<tr>
<td>II</td>
<td>AM and FM transmitters and receivers&lt;br&gt;Block diagrams of low power and high power AM transmission - AM receivers: straight receivers super heterodyne receiver - choice of intermediate frequency - simple AVC circuit&lt;br&gt;Block diagrams of direct FM transmitter and Armstrong transmitter - FM receivers (balanced - slope detector and Foster-Seely discriminator only).</td>
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FIRST INTERNAL EXAMINATION
### III Television and radar systems

Principles of television engineering - Requirements and standards – need for scanning - types of camera tubes and picture tubes - B/W and colour systems - PAL - CCTV - Cable TV-high definition television.

Radar and navigation: principle of radar and radar equation, block schematics of pulsed radar.

<table>
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<tr>
<th>Requirements and standards</th>
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<td>CCTV</td>
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<td>Cable TV</td>
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<td>high definition television.</td>
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<td>block schematics of pulsed</td>
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<td>radar</td>
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### IV Digital communication:

Principles of digital communication – - Sampling process-pulse modulation Techniques- sampling process-PAM, PWM and PPM concepts - PCM encoder and decoder

Applications of data communication

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<td>data communication</td>
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<tr>
<td>- PCM encoder and decoder</td>
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<td>- PAM, PWM and PPM concepts</td>
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### SECOND INTERNAL EXAMINATION

#### V Satellite communication

Multiple access (MA) techniques-FDMA, TDMA, CDMA, SDMA - applications in satellite communication wire, MA techniques applications in wired communication, in satellite communication, earth station;

Fibers – types: sources, detectors used, digital filters, optical link

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<tr>
<th>Applications in satellite communication</th>
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<tr>
<td>applications in wired communication</td>
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<td>in satellite communication earth station</td>
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<tr>
<td>Fibers – types</td>
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<td>sources, detectors used, digital filters, optical link</td>
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</table>

#### VI Cellular telephone - Basic concepts, frequency reuse, interference cell splitting, sectoring, cell system layout, cell processing. Fibers – types: sources, detectors used, digital filters, optical link:

Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication

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<tr>
<th>Applications in satellite communication</th>
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<tr>
<td>Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication</td>
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### END SEMESTER EXAM

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hourrs.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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.

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**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.
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<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE402</td>
<td>Special Electrical Machines</td>
<td>3-0-0-3</td>
<td>2016</td>
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</tbody>
</table>

**Prerequisite: Nil**

**Course Objectives**
- To get an overview of some of the special machines for control and industrial applications

**Syllabus**

**Expected outcome.**
- The students will gain knowledge in the construction and principle of operation of certain special electrical machines having various applications.

**Text Book:**
E. G. Janardhanan, ‘Special Electrical Machines’ PHI Learning Private Limited.

**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>AC Servomotors- Construction-principle of operation – performance characteristics – damped AC servomotors – Drag cup servomotor – applications. DC servomotors – field and armature controlled DC servomotors – permanent magnet armature controlled – series split field DC servomotor.</td>
<td>7</td>
<td>15%</td>
</tr>
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</table>

**FIRST INTERNAL EXAMINATION**


| IV     | Reluctance motors – principle of operation – torque equation – torque slip characteristics-applications. Switched reluctance motors – principle of operation – power converter circuits – torque equation – different types – comparison – applications. | 7     | 15%             |
SECOND INTERNAL EXAMINATION

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END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hourrs.

**Part A**: 8 compulsory questions.
One question from each module of Modules I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5)=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.
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<th>COURSE NAME</th>
<th>L-T-P-CREDITS</th>
<th>YEAR OF INTRODUCTION</th>
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<tr>
<td>EE403</td>
<td>DISTRIBUTED GENERATION AND SMART GRIDS</td>
<td>3-0-0-3</td>
<td>2016</td>
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</tbody>
</table>

Prerequisite: Nil

Course objective:
- To develop a conceptual introduction to various distributed generation systems, micro grids, smart grids and their control

Syllabus:
Introduction to distributed generation and smart grids - Distributed Energy Resources – Micro Grids and their control – Protection issues for Microgrids - Smart Grids: Components – NIST Reference architecture – Smart meters - Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU) - demand response- Demand Side Management - Smart Substations, HAN, NAN, SANET, Cloud computing in smart grid – Power Quality issues with smart grid

Expected Outcome:
The students will be able to:
  i. Explain various distributed generation systems
  ii. Understand the microgrids and their control schemes
  iii. Understand various developments happening in the field of Smart Grids.

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>Distributed generation – Introduction - Integration of distributed generation to Grid – Concepts of Micro Grid - Typical Microgrid configurations - AC and DC micro grids - Interconnection of Microgrids - Technical and economical advantages of Microgrid -</td>
<td>7</td>
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<td>Section</td>
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<tr>
<td>I</td>
<td>Challenges and disadvantages of Microgrid development</td>
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<td></td>
<td>Smart Grid: Evolution of Electric Grid - Definitions and Need for Smart Grid, Opportunities, challenges and benefits of Smart Grids</td>
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<tr>
<td>II</td>
<td>Distributed energy resources: Introduction - Combined heat and power (CHP) systems - Solar photovoltaic (PV) systems – Wind energy conversion systems (WECS) - Small-scale hydroelectric power generation - Storage devices: Batteries: Lead acid, nickel metal hydrate, and lithium ion batteries , ultra-capacitors, flywheels</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Control of Microgrids: Introduction to Central Controller (CC) and Microsource Controllers (MCs) - Control functions for microsource controller, Active and reactive power control, Voltage control, Storage requirement for fast load tracking, Load sharing through power-frequency control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Protection issues for Microgrids: Introduction, Islanding, Different islanding scenarios, Major protection issues of stand-alone Microgrid - Impact of DG integration on electricity market, environment, distribution system, communication standards and protocols.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Smart Grid: Components – NIST Smart Grid Reference Architecture - Introduction to Smart Meters, Electricity tariff – one part tariff, two tariff and maximum demand tariff - Dynamic pricing: time-of-use (TOU) pricing, critical-peak pricing (CPP) and Real Time Pricing- Automatic Meter Reading(AMR), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home &amp; Building Automation.</td>
<td></td>
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<tr>
<td></td>
<td>Intelligent Electronic Devices (IED) and their application for monitoring &amp; protection, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).</td>
<td></td>
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</tr>
<tr>
<td>IV</td>
<td>Smart energy efficient end use devices-Smart distributed energy resources- Load Curves-Load Shaping Objectives-Methodologies - Peak load shaving - Energy management-Role of technology in demand response- Demand Side Management – Numerical Problems</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood-Area Networks (NANs), Sensor and Actuator Networks (SANETs) Smart Substations, Substation Automation, IEC 61850 Substation Architecture, Feeder Automation.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>
Cloud computing in smart grid: Private, public and Hybrid cloud.
Cloud architecture of smart grid.
Power quality: Introduction - Types of power quality disturbances
- Voltage sag (or dip), transients, short duration voltage variation,
Long duration voltage variation, voltage imbalance, waveform
distortion, and voltage flicker - Harmonic sources: SMPS, Three
phase power converters, arcing devices, saturable devices,
fluorescent lamps, harmonic indices (THD, TIF, DIN, C –
message weights)
Power quality aspects with smart grids.

**QUESTION PAPER PATTERN:**

Maximum Marks: 100
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.
One question from each module of Modules I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 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 - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE404</td>
<td>INDUSTRIAL INSTRUMENTATION AND AUTOMATION</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

Course Objectives

- To impart knowledge about Industrial instrumentation and automation

Syllabus:

Dynamic characteristic of instrumentation - Transducers: Characteristics, Applications – Nano instrumentation - signal conditioning, MEMS, Virtual instrumentation-Automation system - actuators – sequence control, PLC

Expected Outcome:

After the completion of the course, the students will be able to:

i. Select instruments and transducers for various physical variables.
ii. Get an insight on data acquisition, processing and monitoring system
iii. Design various signal conditioning systems for transducers.
iv. Analyze dynamic responses of various systems.
v. Get the concepts of virtual instrumentation
vi. Understand the programming realization of PLC

Text books:


References:


Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
</table>
## Applications of Transducers

- Displace measurement: Resistance potentiometer, Capacitive and Inductive. Capacitive differential pressure measurement
- Torsional, shearing stress and rotating shaft Torque measurement using strain gauge.
- Flow measurement: Hotwire anemometer, constant resistance, Constant current type sensors, Variable reluctance tachometers
- Phase measurement: Analog and digital phase detectors
- Nano Instrumentation

### FIRST INTERNAL EXAMINATION

| III | Signal conditioning circuits-Instrumentation amplifiers- Unbalanced bridge. Bridge linearization using op amp
|     | Precision rectifiers, Log amplifiers, Charge amplifiers, Isolation amplifier, Switched capacitor circuits, Phase sensitive detectors, Noise problem in instrumentation and its minimisation |

### SECOND INTERNAL EXAMINATION

|     | Introduction to Sequence Control, PLCs - Working, Specifications of PLC Onboard/Inline/Remote IO’s, Comparison of PLC & PC, Relay Ladder Logic- PLC Programming- realization of AND, OR logic, concept of latching, Introduction to Timer/Counters, Exercises based on Timers, Counters. Basic concepts of SCADA, DCS and CNC |

### END SEMESTER EXAM
QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3 Hours.

Part A: 8 compulsory questions.
One question from each module of Modules I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 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 - Credits | Year of Introduction
---|---|---|---
EE405 | Electrical System Design | 3-1-0-4 | 2016

Prerequisite : Nil

**Course Objectives**
- To gain the knowledge of acts and rules used for regulating the electrical supply in our country.
- To impart sound knowledge in the design and estimation of low voltage and medium voltage electrical installations.
- To gain the knowledge of selection of distribution transformers and their installations.
- To gain the knowledge of Earthing designs in different installations and the standard dimensions of earthing systems.

**Syllabus**
Electrical system design practices – general awareness of IS Codes, Electricity Acts & Rules, NEC etc. Domestic Installations, Motor Installations, 11 kV substation installations, Cinema theatre, auditorium and high rise building installations, Standby generator selection and their Installations. Underground cable installations and their accessories. Types of earthing, lightning arresters, fire fitting and lifts.

**Expected outcome**
The students will
i. Know the basic Rules and regulations in electrical installations.
ii. To prepare the schematic diagram, installation plan, quantity of materials and estimate for different electrical installations.

**Text Book:**

**Data Book (Approved for use in the examination):**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>General awareness of IS Codes (IS 3043, IS 732, IS 2675, IS 5216-P1-2, IS 2309), The Indian Electricity Act 1910, The Indian Electricity supply Act 1948, Indian Electricity Rules 1956, The Electricity Regulatory Commission Act 1998, Electricity Act 2003, Bureau of Energy Efficiency (BEE) and its labeling, National Electric Code (NEC) - scope and safety aspects applicable to low and medium (domestic) voltage installations, Electric services in buildings, Classification of voltages, standards and specifications.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Safety aspects applicable to low and medium voltage installations. General aspects of the design of electrical installations for domestic dwellings (low and medium voltage installations)–connected load calculation, sub circuit determination, selection of main distribution board, sub distribution board, MCB, ELCB, MCCB and cables for sub</td>
<td>10</td>
<td>15%</td>
</tr>
<tr>
<td>Circuits. Pre-commissioning tests of domestic installations.</td>
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<tr>
<td><strong>FIRST INTERNAL EXAMINATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>Air-conditioning loads and its specifications. Energy conservation techniques. Selection of standby generator – installation and its protection. Introduction to Automatic Main Failure (AMF) System. Pre-commissioning tests of cables, transformers and generators.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td><strong>SECOND INTERNAL EXAMINATION</strong></td>
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<td></td>
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<tr>
<td><strong>V</strong></td>
<td>Design of earthing system for an HT consumer, Dimensions and drawings of typical earth electrodes (1) Pipe Earthing, (2) Plate Earthing. Touch, Step and Transfer potentials at EHT Sub-Station. Earth-mat, installations of special equipment like X-Ray, Neon-Sign, Basics of lightning arresters.</td>
<td>8</td>
<td>20%</td>
</tr>
<tr>
<td><strong>VI</strong></td>
<td>Design of illumination systems – Yard lighting, street lighting and flood lighting. Kerala Cinema Regulation Act – 1958, design and layout of installation for recreational or assembly buildings, cinema theatre and high rise building. Design of Electrical system related to firefighting, lifts and escalators.</td>
<td>10</td>
<td>20%</td>
</tr>
<tr>
<td><strong>END SEMESTER EXAM</strong></td>
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**QUESTION PAPER PATTERN:**

Maximum Marks: 100
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.

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

Student has to answer all questions. (8 x 5) = 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.
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<tbody>
<tr>
<td>EE407</td>
<td>DIGITAL SIGNAL PROCESSING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

**Course Objectives**
- To impart knowledge about digital signal processing and its applications in engineering

**Syllabus**
Introduction to signals and systems – Discrete Fourier Transforms – Fast Fourier Transforms - Introduction to FIR and IIR systems - FIR filter design - Finite word length effects in digital Filters - Introduction to FDA Toolbox in MATLAB - Introduction to TMS320 Family - Design & Implementation and Filter Structures - Introduction to Code Composer Studio

**Expected outcome**
The students will be able to:
- i. Analyse DT systems with DFT
- ii. Design digital filters IIR and FIR filters
- iii. Analyse finite word length effects in signal processing
- iv. Design filters using Matlab FDA tool box
- v. Understand Digital Signal Controllers and their Applications

**Text Books:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem. Exam Marks</th>
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<tbody>
<tr>
<td>I</td>
<td>Introduction to signals and systems - Discrete Fourier transform: Frequency domain sampling, Discrete Fourier transform (DFT): DFT pair, properties of DFT, frequency response analysis of signals using the DFT, circular convolution using DFT, linear filtering based on DFT. Fast Fourier transform (FFT): Introduction, Radix -2 decimation in time FFT algorithm, Radix-2 decimation in frequency algorithm.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Introduction to FIR and IIR systems : Structures for realization of discrete time systems – structures for FIR and IIR systems – signal flow graphs, direct-form, cascade-form, parallel form, lattice and transposed structures and linear Phase FIR filters.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Design of digital filters – general considerations – causality and its</td>
<td>7</td>
<td>15%</td>
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</table>

**FIRST INTERNAL EXAMINATION**

<table>
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</thead>
<tbody>
<tr>
<td>EE407</td>
<td>DIGITAL SIGNAL PROCESSING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>
implications, characteristics of practical frequency selective filters
IIR filter design: Discrete time IIR filter (Butterworth and Chebyshev) from analog filter – IIR filter (LPF, HPF, BPF, BRF) design by Impulse Invariance, Bilinear transformation, Approximation of derivatives. filter design

<table>
<thead>
<tr>
<th>IV</th>
<th>FIR filter design: Structures of FIR filter - Linear phase FIR filter – Filter design using windowing techniques, frequency sampling techniques</th>
</tr>
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<tbody>
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</table>

SECOND INTERNAL EXAMINATION

| V  | Finite word length effects in digital Filters: Fixed point and floating point number representations - Comparison - Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error - Product quantization error - Overflow error - Round-off noise power - limit cycle oscillations due to product round-off and overflow errors - signal scaling
Introduction to FDA Toolbox in MATLAB: Design of filters using FDA toolbox (Demo/Assignment only) |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------| 7 | 20% |

| VI | Introduction to TMS320 Family: Architecture, Implementation, C24x CPU Internal Bus Structure, Memory Central Processing unit , Memory and I/O Spaces , Overview of Memory and I/O Spaces, Program control Address Modes System Configuration and Interrupts clocks and low Power Modes Digital input / output (I/O), Assembly language Instruction , Instruction Set summary , Instruction Description, Accumulator, arithmetic and logic Instruction , Auxiliary Register and data page Pointer Instructions , TREG, PREG, and Multiply Instruction ,Branch Instructions , Control Instructions I/O and Memory Instruction
Design & Implementation and Filter Structures: MATLAB functions and TMS320 Implementation (Demo/Assignment only)
Introduction to Code Composer Studio (Demo only) |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------| 7 | 20% |

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hourrs.

Part A: 8 compulsory questions.

One question from each module of Modules 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.
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<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE409</td>
<td>Electrical Machine Design</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE202 & EE205

**Course Objectives**
- To impart knowledge on principles of design of static and rotating electrical machines.
- To give a basic idea about computer aided design (CAD) and finite element method.

**Syllabus**

**Expected outcome**
- The students will be able to design transformers, DC machines, synchronous machines and induction motors.

**Text Book:**

**References:**

**Course Plan**

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Principles of electrical machine design - General design considerations - specifications of machines - types of enclosures - types of ventilation - heating - short time rating - overload capacity - temperature rise time curve - hot spot rating. Magnetic circuit calculation - calculation of field ampere turns - air gap mmf - effect of slot and ventilating duct - active iron length - mmf for teeth - real and apparent flux densities - mmf per pole Magnetic Leakage Calculation- Effects of Leakage. Armature Leakage –Components. Unbalanced Magnetic Pull-Practical aspects of unbalanced magnetic pull</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Design of transformers - single phase and three phase transformers - distribution and power transformers - output equation - core design - window area - window space factor - overall dimensions of core. Windings – no. of turns - current density - conductor section - Cooling of transformers</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Design of DC machines - output equation - specific loading - choice of speed and no of poles - calculation of main dimensions - choice of type of winding - number of slots - number of conductors per slot-current density - conductor section - slot insulation - | 8     | 15%             |
### IV
Length of air gap - Design of field winding - Conductor cross section - Height of pole - Design of inter pole - Flux density under inter pole - Calculation of turns of inter polar winding – Design of compensating winding – Brushes and commutators.

### Design of Synchronous Machines
- Specific loading
- Output equation
- Main dimensions
- Types of winding
- Number of turns
- Number of slots and slot design
- Field design for water wheel and turbo alternators
- Cooling of alternators

### Design of Synchronous Machines

**IV**

Design of synchronous machines - Specific loading - Output equation - Main dimensions - Types of winding - Number of turns - Number of slots and slot design - Field design for water wheel and turbo alternators - Cooling of alternators.

**V**

Design of three phase induction motors - Main dimensions - Stator design - Squirrel cage and slip ring types - Number of stator and rotor slots - Rotor bar current - Design of rotor bar - End ring current - Design of end ring - Design of slip ring rotor winding.

**VI**

Introduction to computer aided design. Analysis and synthesis methods - Hybrid techniques.

Introduction to Finite element method - Historical background, applications, advantages. Study of new computer aided machine software using Finite Element.

Case study: Complete design of an AC machine – Steps. (Assignment only)

### QUESTION PAPER PATTERN:

**Maximum Marks:** 100  
**Exam Duration:** 3 Hours.

**Part A:** 8 compulsory questions.

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

Student has to answer all questions. (8 x 5) = 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.

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**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 - Credits | Year of Introduction
--- | --- | --- | ---
EE431 | Power Systems Lab | 0-0-3-1 | 2016

Prerequisite : EE306 Power System Analysis

Course Objectives
- Impart practical knowledge about various power system equipment
- Get a knowledge about the operation of power systems and the philosophy behind the relay settings, fault calculations etc.
- Simulate the power system operations which will be helpful in the design of power systems

List of Exercises/Experiments: (At least 12 experiments out of 18 experiments listed are mandatory)

1. Visit a local Substation.
   Aim: To see firsthand apparatus that will be studied in this course and learn about their role in operation and protection of power systems.

2. Introduction to PSCAD/MATLAB/MIPOWER
   Aim: 1). Learn the usage of PSCAD/MATLAB/MIPOWER in modeling of ac circuits and plotting of results.
   2). Understanding reactive power and power factor in single-phase and three-phase circuits.

   Aim: Obtaining the parameters of a 345 kV transmission line and modeling it in PSCAD/MATLAB/MIPOWER

4. Power Flow
   Aim: To carry out power flow calculations.

5. Transformers in Power Flow.
   Aim: To look at the influence of including a tap-changer and a phase-shifter on power flow and bus voltages.

   Aim: 1). To include an HVDC transmission line and see its effect on power transfer on other transmission line.
   2). To understand the operating principle of 12-pulse thyristor converters used in HVDC transmission systems.

7. Power Quality.
   Aim: To obtain the current harmonics drawn by power electronics interface.

8. Synchronous Generators.
   Aim: To obtain the effect of sudden short-circuit on a synchronous generator output.

   Aim: 1). To study the effect of real and reactive powers on bus voltages.
   2). Understanding the operation of a Thyristor Controlled Reactor (TCR).

10. Transient Stability.
    Aim: To simulate transient stability in a 3-bus example power system.

10. A. Making a Power System Reliable.
    Aim: 1). To understand the planning/design process that goes into making a power system reliable.
11. AGC and Economic Dispatch.
   Aim: Study the dynamic interaction between two control areas using Simulink modeling and economic dispatch.

   Aim: To study the effect of short-circuit faults and overloading of transmission lines.

   Aim: To study a power system with faults and determine relay settings based on calculated fault currents.

   Aim: To study over-voltages resulting from switching of transmission lines and limiting them by ZnO arresters.

14. Power Factor improvement:
   Aim: To calculate rating of capacitors for power factor correction for a load and verifying it experimentally.

15. Solar Power Calculations:
   Aim: To calculate the rating of solar panel required for a given area on rooftop or for a given load.

16. Demonstration of Ferranti Effect on a transmission line

17. Methods of Insulation Testing

18. Modern Energy Meter calibration schemes

Expected outcome.
- Students will be able to design, setup and analyse various power systems and its simulations.

Text Book:
<table>
<thead>
<tr>
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<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE461</td>
<td>Modern Operating Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite :** Nil

**Course Objectives**
- To impart the knowledge on the need and requirement of an interface between Man and Machine.
- To teach the features of operating systems and the fundamental theory associated with process, memory and file management components of operating systems.

**Syllabus :**
Operating System Structure, Operating system services, Process management, Memory management, File management, Storage structure, security issues.

**Expected outcome.**
The students will be able to
- i. describe the general architecture of computers
- ii. describe, contrast and compare differing structures for operating systems
- iii. understand and analyse theory and implementation of: processes, resource control (concurrency etc.), physical and virtual memory, scheduling, I/O and files

**Text Book:**

**References:**
2. Silberschatz, Galvin, & Gagne, Operating System Concepts, 8 th Ed., Wiley

**Course Plan**

<table>
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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
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<tbody>
<tr>
<td>II</td>
<td>Computing Environments- Open Source Operating Systems- Operating-System Services- User Operating-System Interface- System Calls- Types of System Calls- System Programs</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Memory Management-Swapping- Contiguous Memory Allocation- Paging Segmentation- Virtual Memory- Demand Paging</td>
<td>6</td>
<td>15%</td>
</tr>
</tbody>
</table>
SECOND INTERNAL EXAMINATION

|---|---|

8 20%

END SEMESTER EXAM

QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3Hours.

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

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<th>Year of Introduction</th>
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<tbody>
<tr>
<td>EE462</td>
<td>Design of Digital Control Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce the need and concept of digital control system.
- To impart knowledge about different strategies adopted in the design of digital controllers.
- To familiarize with the design of different types of digital controllers.

**Syllabus**
Basic digital control system-Pulse transfer function-Digital PID controller design- compensator design using frequency response - compensator design using root locus - Direct design-method of Ragazzini - Dead-beat controller design - State space analysis and controller design.

**Expected outcome:**
On successful completion, the students will have the ability to
- design digital controllers.
- analyse discrete time system using state space methods.
- analyse the stability of discrete time system.

**Text Books:**

**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>Basic digital control system- Examples - mathematical model-ZOH and FOH- choice of sampling rate-principles of discretization - Mapping between s-domain and z-domain</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Pulse transfer function- Different configurations for the design- Modified z-transform-Time responses of discrete data systems-Steady state performance.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Digital PID and Compensator Design: Design of digital PID controller, Design of lag, lead compensators - based on frequency response method. | 7     | 15%             |
| IV     | Digital Controller Design: Design based on root locus in the z-plane, direct design - method of Ragazzini. Dead-beat response design- Deadbeat controller. | 7     | 15%             |

**SECOND INTERNAL EXAMINATION**

| V      | State variable model of discrete data systems -Various canonical form representations-controllable, observable, diagonal and Jordan forms-Conversion from state space to transfer function -Computation of state transition matrix using Cayley-Hamilton theorem and z-transform method | 7     | 20%             |
Digital state feedback controller design: Complete state and output controllability, observability, stabilizability and reachability - Loss of controllability and observability due to sampling. Pole placement design using state feedback for SISO systems.

END SEMESTER EXAM

QUESTION PAPER PATTERN:
Maximum Marks: 100
Exam Duration: 3 Hours.

Part A: 8 compulsory questions.
One question from each module of Modules I - IV; and two each from Module V & VI.
Student has to answer all questions. (8 x 5) = 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>
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<th>Course code</th>
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<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE463</td>
<td>Computer Aided Power Systems Analysis</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** EE306 Power system analysis

**Course Objectives**
- To introduce computer applications in the analysis of power systems
- To understand the solution methods and techniques used in power system studies

**Syllabus:**
Development of network matrices from Graph theory-Formulation of Bus Impedance matrices-Load Flow Analysis-Optimal Power Flow-Network fault calculations-Contingency analysis in Power systems.

**Expected outcome:**
- The students will gain the ability to critically analyse the solution methods used in power system studies.

**Text Books:**

**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>Overview of Graph theory - tree, co-tree and incidence matrix, Development of network matrices from Graph theoretic approach. Review of solution of Linear System of equations by Gauss Jordan method, Gauss elimination, LDU factorization.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Bus Reference Frame: Injections and Loads. Zbus and Y bus. Formulation of Bus Impedance matrix for elements without Mutual Coupling.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Adjustment of network operating conditions, Optimal power flow: concepts, active/reactive power objectives (Economic dispatch, MW and MVAr loss minimization) – applications- security constrained optimal power flow.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Network fault calculations using ZBUS and YBUS Table of Factors, Algorithm for calculating system conditions after fault – three phase short circuit, three phase to ground, double line to ground, line to line and single line to ground fault.</td>
<td>7</td>
<td>20%</td>
</tr>
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<td>----------</td>
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<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>VI</td>
<td>Contingency analysis in Power systems : Contingency Calculations using ZBUS and YBUS Table of Factors. State estimation – least square and weighted least square estimation methods for linear systems.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

| Maximum Marks: 100 | Exam Duration: 3Hours. |

**Part A:** 8 compulsory questions. One question from each module of Modules I - IV; and two each from Module V & VI. Student has to answer all questions. (8 x 5) = 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>
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<th>Course code</th>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE464</td>
<td>Flexible AC Transmission Systems</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To introduce various Power Electronics controllers used in the Power Systems for the fast real and reactive power control.

**Syllabus**

**Expected outcome**

The students will be able to:
- Understand various power electronics based FACTS devices for the control of active and reactive power in the system
- Understand the control schemes of various FACTS devices.

**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>Power flow in Power Systems – Steady-state and dynamic problems in AC systems – Voltage regulation and reactive power flow control in Power Systems – control of dynamic power unbalances in Power System Power flow control -Constraints of maximum transmission line loading - Benefits of FACTS - Transmission line compensation: Compensation by a series capacitor connected at the midpoint of the line, Shunt Compensation connected at the midpoint of the line -Phase angle control</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Reactive power compensation – shunt and series compensation principles – reactive compensation at transmission and distribution level – Static versus passive VAr Compensators</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Static shunt Compensator - Objectives of shunt compensations, Methods of controllable VAR generation</td>
<td></td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**
| Variable impedance type VAR Generators - TCR, TSR, TSC, FC-TCR Principle of operation, configuration and control |
|---------------------------------------------------------------|----------|
| Static Series compensator - Objectives of series compensations, Variable impedance type series compensators - TCSC - Principle of operation, configuration and control. | 8 |
| Static Voltage and Phase Angle Regulators (TCVR & TCPAR): Objectives of Voltage and Phase angle regulators Thyristor controlled Voltage and Phase angle Regulators | 7 |
| Switching converter type shunt Compensators.- Principle of operation, configuration and control , Comparison between SVC and STATCOM- Applications Switching converter type Series Compensators-(SSSC)- Principle of operation, configuration and control | 7 |
| Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPFC General Equivalent Circuit for Facts Controllers (Shunt-series) Introduction to interline power flow controller. | 7 |

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM QUESTION PAPER PATTERN:**

Maximum Marks: 100
Exam Duration: 3Hourrs.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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 - Credits | Year of Introduction
--- | --- | --- | ---
EE465 | Power Quality | 3-0-0-3 | 2016

**Prerequisite:** Nil

**Course Objectives:**
- To discuss various power quality issues and different methods to control them.

**Syllabus:**
Power quality issues in distribution systems, Need for power quality monitoring, IEEE guides, standards and recommended practices, Modelling of networks and components under non sinusoidal conditions, Harmonic Analysis, Effects of Power System harmonics on Power System equipment and loads, Harmonic elimination, Power Quality Management in Smart Grid, Electromagnetic Interference.

**Expected Outcome:**
- The students will be able to identify the power quality problems, causes and suggest suitable mitigating techniques.

**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>Power quality phenomenon - Sources and Effects of power quality problems, types of power quality disturbances - Voltage sag (or dip), Swell, Transients, short duration voltage variation, Long duration voltage variation, voltage imbalance, waveform distortion, and voltage flicker</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Harmonic Analysis - Fourier series and coefficients, the Fourier transforms, discrete Fourier transform, fast Fourier transform, Window function- numerical problems. .</td>
<td>5</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Power quality Monitoring considerations: Power line disturbance analyzer, power quality measurement equipment, harmonic spectrum analyzer, flicker meters, disturbance analyzer</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**
<table>
<thead>
<tr>
<th>Module</th>
<th>Topic</th>
<th>Marks</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Harmonic elimination - Design and analysis of filters to reduce harmonic distortion – Power conditioners , passive filter , active filter - shunt , series , hybrid filters,</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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.
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<th>Course Name</th>
<th>L-T-P -Credits</th>
<th>Year of Introduction</th>
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</thead>
<tbody>
<tr>
<td>EE466</td>
<td>Digital Image Processing</td>
<td>3-0-0.3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**
- To study the image fundamentals and mathematical transforms necessary for image processing.
- To impart the image enhancement, image restoration and image compression procedures.
- To know about morphological image processing.
- To study the image segmentation and representation techniques.

**Syllabus**
Elements of visual perception, Basic geometric transformations, Separable Image Transforms, Spatial Domain methods, Frequency domain filters, Model of Image Degradation/restoration process, Compression Techniques, Morphological Processing, Segmentation, Representation and Description

**Expected Outcomes.**
The students will be able to
i. Demonstrate understanding of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
ii. Demonstrate understanding of spatial filtering techniques, including linear and nonlinear methods.
iii. Demonstrate understanding of 2D Fourier transform concepts, including the 2D DFT and FFT, and their use in frequency domain filtering.
iv. Apply programming skills in digital image processing related problems

**Text Book:**
Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education

**References:**
2. Chanda Dutta Magundar, Digital Image Processing and Applications, PHI

**Course Plan**

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<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh –Hadamard – Discrete Cosine Transform, Haar transforms</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**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 – Singular value decomposition | 7 | 15% |

### SECOND INTERNAL EXAMINATION

| V | Morphological Image Processing-Dilation, Erosion, Morphological Reconstruction- Gray Scale Morphology Edge detection – Thresholding - Region Based segmentation | 7 | 20% |
| VI | Boundary representation: chair codes- Polygonal approximation –Boundary segments – boundary descriptors: Simple descriptors Fourier descriptors - Regional descriptors –Simple descriptors | 7 | 20% |

### END SEMESTER EXAM

**QUESTION PAPER PATTERN:**

- **Maximum Marks:** 100
- **Exam Duration:** 3 Hours.

**Part A:** 8 compulsory questions.

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

Student has to answer all questions: \((8 \times 5) = 40\)

**Part B:** 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). Each question can have maximum of 4 sub questions (a,b,c,d), if needed.
Course code | Course Name | L-T-P -Credits | Year of Introduction
---|---|---|---
EE467 | Nonlinear Control Systems | 3-0-0-3 | 2016

Prerequisite: Nil

Course Objectives:
- To introduce the need and concept of nonlinear system.
- To impart knowledge about different strategies adopted in the analysis of nonlinear systems.
- To familiarize with the design of different types of nonlinear controllers.

Syllabus:

Expected outcome
The students will be able to
i. design controllers for nonlinear systems.
ii. analyse the stability of nonlinear systems using various approaches.

Text Books:

References:

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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<th>Hours</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction - Characteristics of nonlinear systems - Classification of equilibrium points- analysis of systems with piecewise constant inputs using phase plane analysis.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Periodic orbits - limit cycles-Poincare-Bendixson criterion-Bendixson criterion. Existence and uniqueness of solutions, Lipschitz condition.</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION

| IV | Centre manifold theorem - region of attraction - Feedback Control and Feedback Stabilisation-Analysis of feedback systems- Circle Criterion – Popov Criterion. | 7 | 15% |

SECOND INTERNAL EXAMINATION
<table>
<thead>
<tr>
<th>V</th>
<th>Feedback linearization- Design via linearization- stabilization - regulation via integral control- gain scheduling.</th>
<th>7</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI</td>
<td>Exact Feedback Linearization - Input state linearization - input output linearization - state feedback control - stabilization - tracking - integral control.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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: EE468  
Course Name: Computer Networks  
L-T-P -Credits: 3-0-0.3  
Year of Introduction: 2016

Prerequisite: Nil

Course Objectives
- To impart the mode of operation of different types of computer networks that are used to interconnect a distributed community of computers and various interfacing standards and protocols.

Syllabus
Introduction on Computer Networks, Network Hardware, Protocol architecture, functionalities, MAC protocols, Network layer, Transport layer, Application Layer

Expected Outcome.
The students will be able to:
- i. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
- ii. Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols.
- iii. Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure.

Text Book:

References:
1. Andrew S, Computer Networks by Tanenbaum, Prentice Hall of India, New Delhi
2. Foronzan, Data Communications and Networking, Tata McGraw Hill, New Delhi
3. Neil Jenkins, Understanding Local area Network, SAMS Publishers
4. Peter Hudson, Local area Networks by, Thomson Learning

Course Plan

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<tr>
<th>Module</th>
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<th>Hours</th>
<th>Sem.ExamMarks</th>
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</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction-Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks,</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Network Standardization. The Medium Access Control Sublayer- The Channel Allocation Problem, Multiple Access Protocols, Ethernet, Wireless LANs, Broadband Wireless, Bluetooth.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>The Transport Layer - The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol,</td>
<td>7</td>
<td>15%</td>
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</tr>
<tr>
<td>V</td>
<td>The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance Issues.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>The Application Layer - DNS-The Domain Name System, Electronic Mail, The World Wide Web, Multimedia</td>
<td>8</td>
<td>20%</td>
</tr>
</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100  
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.  
One question from each module of Modules I - IV; and two each from Module V & VI.  
Student has to answer all questions. (8 x 5) = 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 -Credits | Year of Introduction
---|---|---|---
EE469 | Electric and Hybrid Vehicles | 3-0-0-3 | 2016

Prerequisite : Nil

Course Objectives
- To present a comprehensive overview of Electric and Hybrid Electric Vehicles

Syllabus

Expected outcome.
The students will be able to
i. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
ii. Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
iii. Choose proper energy storage systems for vehicle applications
iv. Identify various communication protocols and technologies used in vehicle networks.

Text Book:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

References:

Course Plan

<table>
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<th>Contents</th>
<th>Hours</th>
<th>Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>
Communications, supporting subsystems: In vehicle networks- CAN,
Energy Management Strategies: Introduction to energy management
strategies used in hybrid and electric vehicles, classification of different
energy management strategies, comparison of different energy
management strategies

7  20%
<table>
<thead>
<tr>
<th>Course code</th>
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<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE472</td>
<td>Internet of Things</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite:** Nil

**Course Objectives**

- To introduce IoT and impart its Vision
- To understand IoT Market perspective.
- To know data and knowledge Management and use of devices in IoT Technology.
- To understand State of the Art – IoT Architecture.
- To understand real world IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

**Syllabus**

Internet in general and Internet of Things, IoT Technology Fundamentals, Communication Technology for IoT, Data Management, Sensors and security of IoT, Standardisation and Protocol, IoT architectures, Embedded design for IoT, Case Studies and smart applications

**Expected outcome.**

The students will be able to

i. Explain in a concise manner how the general Internet as well as Internet of Things work.

ii. Understand constraints and opportunities of wireless and mobile networks for Internet of Things.

iii. Use basic measurement tools to determine the real-time performance of packet based networks.


**Text Books:**


**References:**

1. Ovidu Vermesan and Peter Friess (Ed) Internet of Things - From Research and Innovation to Market Deployment - RIVER PUBLISHERS
2. Ovidu Vermesan and Peter Friess (Ed), The Internet of Things : Converging Technologies for Smart Environments and Integrated Ecosystems,. River Publishers.

**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>Introduction : Definition , Internet of Things Vision, Internet of Things Today, Internet of Things Tomorrow , Potential Success Factors of Internet of Things , IoT Application Areas , IoT Functional View</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>IoT Technology Fundamentals : Internet of Things Layered Architecture , IoT Related future Internet Technologies: Cloud computing , IoT and Semantic Technologies; Networking Technology , Communication Technology : Devices and gateways , Local and wide area networking , WIRELESS AND</td>
<td>8</td>
<td>15%</td>
</tr>
</tbody>
</table>
### FIRST INTERNAL EXAMINATION

**III** - Data management, DCA, Big Data, Semantic Sensor Networks and Semantic Annotation of Data, Virtual Sensors; Security, Privacy and Trust for Internet of Things; Security for Internet of Things, Privacy for Internet of Things, Trust for Internet of Things;

8  
15%

**IV** - IoT related Standardisation: Role of Standardisation, Current Situation, Interoperability of IoT, Standards considerations and Protocols, IoT Protocols Convergence: MQTT, CoAP, AMQP, DDS, API, REST, XMPP

IoT Architectural Overview: Building an IoT architecture, Main design principles and needed capabilities, IoT Architecture Outline;

8  
15%

### SECOND INTERNAL EXAMINATION

**V** - Embedded Design for IoT: CPU, I/O devices, clock, memory, address and data buses, Tristate Logic, Embedded System Definition & Real time applications, CISC vs. RISC, OS vs. RTOS, Application Software vs. Embedded Software (Drivers & BSPs)

8  
20%

**VI** - Case Study & Advanced IoT Applications: Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / ARM Cortex/ Arduino)

Internet of Things SMART Applications: Energy management, Traffic management, IoT for Home, Cities, Smart Energy and Smart Grid, Smart Logistics and Retails

8  
20%

### END SEMESTER EXAM

IoT: Overview, Broadcast, Sensor Networks, Wi-Fi, Bluetooth, Other Low Power Radios
QUESTION PAPER PATTERN:

Maximum Marks: 100
Exam Duration: 3 Hours

Part A: 8 compulsory questions.
One question from each module of Modules I - IV; and two each from Module V & VI.
Student has to answer all questions. \((8 \times 5) = 40\)

Part B: 3 questions uniformly covering Modules I & II. Student has to answer any 2 from the 3 questions: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). 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: \((2 \times 10) = 20\). Each question can have maximum of 4 sub questions (a, b, c, d), if needed.
Course code | Course Name | L-T-P - Credits | Year of Introduction
---|---|---|---
EE474 | ENERGY MANAGEMENT AND AUDITING | 3-0-0-3 | 2016

Prerequisite : Nil

Course Objectives
- To enable the students to understand the concept of energy management and energy management opportunities
- To understand the different methods used to control peak demand
- To know energy auditing procedure
- To understand the different methods used for the economic analysis of energy projects.

Syllabus

Expected outcome :
- The students will be able to understand the different methods used to reduce energy consumption

Data Book (Approved for use in the examination):

References:
6. IEEE recommended practice for energy management in industrial and commercial facilities,

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>General principles of Energy management and Energy management planning. Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load scheduling-Case studies.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>III</td>
<td>Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Module</td>
<td>Topic</td>
<td>Weightage</td>
<td></td>
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<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>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.</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>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.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>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.</td>
<td>6</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

**QUESTION PAPER PATTERN:**

Maximum Marks: 100   
Exam Duration: 3 Hours.

**Part A:** 8 compulsory questions.

One question from each module of Modules 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 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
  1. Get idea about Intel 8085 Microprocessor
  2. Be able to do assembly language programming
  3. Gain an overview of embedded systems
  4. 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**
<table>
<thead>
<tr>
<th>IV</th>
<th>Overview of Embedded System: Embedded System, Categories of Embedded System, Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, Major application areas of embedded system.</th>
<th>7</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Intel 8051 microcontroller: Architecture, Memory organization, Registers and I/O ports, Addressing modes, Instruction sets, Assembly language programming.</td>
<td>7</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>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.</td>
<td>7</td>
<td>20%</td>
</tr>
</tbody>
</table>

**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
- Understand the sources, effects, prediction, control techniques, measurement techniques of noise, vibration pertain to an automobile.
- Know about reduction of noise and vibration from an automobile.

### Text Books:

### References:

### Course Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>III</strong></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>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>Reduction of noise and vibrations I: Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application of dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.</td>
</tr>
<tr>
<td><strong>V</strong></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>
</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.
Course Code: CE482  
Course Name: ENVIRONMENTAL IMPACT ASSESSMENT  
L-T-P-Credits: 3-0-0-3  
Year of Introduction: 2016

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>
<tr>
<td>PART A</td>
<td>MODULES</td>
<td>QUESTIONS AND TOPICS</td>
<td>MARKS</td>
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<tr>
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</tr>
<tr>
<td>III</td>
<td>SOLID WASTE: Classification and sources of Solid Waste, Characteristics of Solid Waste, e waste, Radioactive wastes</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>LAND/SOIL POLLUTION: Effects of urbanization on land degradation, Impact of Modern Agriculture on Soil, pesticide pollution, Effect on Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>NOISE POLLUTION: Sources of Noise, Effects of Noise, measurement of noise, Equivalent sound pressure level, Control measures</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>SECOND INTERNAL EXAMINATION</td>
<td></td>
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</tr>
<tr>
<td>V</td>
<td>Impacts of pollutants, types, scale of impact-Global, local pollutants. Climate change, Ozone layer depletion, Deforestation, land degradation Environmental impact assessment, Need for EIA</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>VI</td>
<td>EIA Procedure-Screening, Scoping, EIA procedure in India, Impact analysis- checklists, matrix methods, overlay analysis, Case studies of EIA</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>END SEMESTER EXAMINATION</td>
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<tr>
<td></td>
<td>QUESTION PAPER PATTERN (External Evaluation) :</td>
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<tr>
<td></td>
<td>Maximum Marks : 100</td>
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<td></td>
<td>Exam Duration: 3 Hrs</td>
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<tr>
<td></td>
<td>Part A -Module I &amp; II : 2 questions out of 3 questions carrying 15 marks each</td>
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<tr>
<td></td>
<td>Part B - Module III &amp; IV: 2 questions out of 3 questions carrying 15 marks each</td>
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<td></td>
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<tr>
<td></td>
<td>Part C - Module V &amp;VI : 2 questions out of 3 questions carrying 20 marks each</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note</td>
<td>1. Each part should have at least one question from each module</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2. Each question can have a maximum of 4 subdivisions (a,b,c,d)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Name</td>
<td>L-T-P-Credits</td>
<td>Year of Introduction</td>
</tr>
<tr>
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</tr>
<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:**
## OURSE 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>Fundamental concepts of equilibrium. Geomorphic agents and processes. 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 ideas about their causes and effects.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>II</td>
<td>Weathering- relevance, influence of and on earth systems, types and controlling factors Fluvial processes-hydrological cycle, fluvial erosion, transportation and deposition, fluvial landforms. Stages of stream development; Drainage patterns.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>III</td>
<td>Soil- formation and controls, soil profile, soil erosion and conservation methods. Deserts-distribution and controls.</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>IV</td>
<td>Wagner’s ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements.</td>
<td>7</td>
<td>15</td>
</tr>
</tbody>
</table>

### FIRST INTERNAL EXAMINATION

<table>
<thead>
<tr>
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<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Soil- formation and controls, soil profile, soil erosion and conservation methods. Deserts-distribution and controls.</td>
</tr>
<tr>
<td>IV</td>
<td>Wagner’s ideas of continental drift, Plate Tectonics- seafloor spreading. Plate boundaries and their features, mechanisms of plate movements.</td>
</tr>
</tbody>
</table>

### SECOND INTERNAL EXAMINATION

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks %</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Basics of oceanography: coastal upwelling and downwelling. Outlines of ocean floor topography, Brief account of marine sediments, turbidity currents, basic outlines of origin and circulation of deep sea surface currents (Atlantic and Pacific Oceans), coral reefs- types and concepts about their formation. Basic ideas about plankton and primary productivity.</td>
<td>7</td>
<td>20</td>
</tr>
</tbody>
</table>

### END SEMESTER EXAMINATION

#### 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 | Course Name | L-T-P-C | Year of Introduction  
--- | --- | --- | ---  
CE486 | GEOINFORMATICS FOR INFRASTRUCTURE MANAGEMENT | 3-0-0-3 | 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 Spatialanalysis.  
- Apply Geoinformatics techniques in various engineering applications and for infrastructure development.  

**Text Books / References:**  

**COURSE PLAN**  
| Module | Contents | Hours | End Sem Exam Marks %  
| --- | --- | --- | ---  
<p>| I | Remote Sensing: Energy sources and radiation principles- Interaction of EM energy with atmosphere and surface features, | 7 | 15 |</p>
<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>spectral reflectance patterns, Data acquisition - Multistage and multispectral remote sensing concept</td>
</tr>
<tr>
<td>II</td>
<td>Classification of Remote sensing systems - Optical, Thermal and Microwave remote sensing. Image Interpretation: Elements of visual image interpretation – Image interpretation keys - Introduction to Digital Image processing.</td>
</tr>
<tr>
<td>III</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.</td>
</tr>
<tr>
<td>IV</td>
<td>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>
</tr>
<tr>
<td>VI</td>
<td>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>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

**SECOND INTERNAL EXAMINATION**

**END SEMESTER EXAMINATION**

**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:

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>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>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>
ideas about their causes and effects.

<table>
<thead>
<tr>
<th>II</th>
<th>Types of Natural Disasters I- Earth quakes, Landslides. Nature of impacts.</th>
<th>7</th>
<th>15%</th>
</tr>
</thead>
</table>

**FIRST INTERNAL EXAMINATION**

| III | Types of Natural Disasters II- Floods, Coastal disasters- Cyclones, Tsunamis. Nature of impacts. | 7 | 15% |

| IV  | Types of Anthropogenic Disasters I- soil and soil degradation, desertification. | 7 | 15% |

**SECOND INTERNAL EXAMINATION**

| V   | Types of Anthropogenic Disasters II- Fundamental concepts of water and atmospheric pollution. | 7 | 20% |

| VI  | Hazard and disaster management plans for floods, tidal waves. | 7 | 20% |

**END SEMESTER EXAMINATION**

**QUESTION PAPER PATTERN (End Semester Examination)**

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>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>
<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>Occupational Health And Toxicology: occupational related diseases,</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>silicosis, asbestosis, pneumoconiosis, etc. lead, nickel, chromium and</td>
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<tr>
<td></td>
<td>manganese toxicity, effects and prevention – Industrial toxicology,</td>
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<tr>
<td></td>
<td>local, systemic and chronic effects, temporary and cumulative effects,</td>
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<tr>
<td></td>
<td>Industrial Hygiene.</td>
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<tr>
<td>Module</td>
<td>Content</td>
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</tr>
<tr>
<td>III</td>
<td>Radiation and Industrial Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effects on human health, animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>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,</td>
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**FIRST INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
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</thead>
<tbody>
<tr>
<td>III</td>
<td>Radiation and Industrial Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effects on human health, animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone</td>
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<tr>
<td>IV</td>
<td>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,</td>
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</tbody>
</table>

**SECOND INTERNAL EXAMINATION**

<table>
<thead>
<tr>
<th>Module</th>
<th>Content</th>
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</thead>
</table>

**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-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>
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<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.  
|    | Instrumentation for clinical laboratory: Bio potential amplifiers-instrumentation amplifiers, carrier amplifiers, isolation amplifiers, chopper amplifiers | 1 |
|    | 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.  
|    | Measurement of blood pressure: Direct, indirect and relative methods of blood pressure measurement, auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.  
|    | Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters. | 3 |

**FIRST INTERNAL EXAM**

| III | The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, placement of electrodes, evoked potential, EEG recording, analysis of EEG.  
|     | Electromyography: Nerve conduction velocity, instrumentation system for EMG.  
|     | Physiology of respiratory system (brief discussion). Respiratory parameters, spirometer, body plethysmographs, gas exchange and distribution.  
|     | Instruments for clinical laboratory: Oxymeters, pH meter, blood cell counter, flame photometer, spectrophotometer | 2 |

**SECOND INTERNAL EXAM**

| V  | Medical Imaging systems (Basic Principle only): X-ray imaging - Properties and production of X-rays, X-ray machine, applications of X-rays in medicine.  
|    | Computed Tomography: Principle, image reconstruction, scanning system and applications.  
|    | 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. | 2 |
| VI | Magnetic Resonance Imaging – Basic NMR components, Biological effects and advantages of NMR imaging | 3 |
| Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG and temperature | 2 |
| Patient Safety: Electric shock hazards, leakage current, safety codes for electro medical equipments | 1 |

**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>ME471</td>
<td>Optimization Techniques</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite - ME372 Operations Research**

**Course Objective:**
- To learn the various optimization techniques for effective decision making.

**Syllabus:**

**Expected Outcome:**
- The students will be able to understand optimization techniques and apply them in solving practical problems

**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>Review of linear programming– revised simplex method</td>
<td>1</td>
<td>15%</td>
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<tr>
<td></td>
<td>Dual simplex method</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Sensitivity analysis – changes affecting feasibility – changes affecting optimality</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integer programming – importance – applications</td>
<td>1</td>
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<tr>
<td></td>
<td>Branch and bound technique</td>
<td>1</td>
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<tr>
<td></td>
<td>Gomory’s cutting plane method</td>
<td>1</td>
<td></td>
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<tr>
<td></td>
<td>Solution to travelling salesman problem</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III | Network models – minimal spanning tree problem | 1 |
|     | PRIM’s algorithm | 1 |
|     | Kruskal’s algorithm | 1 |
|     | Shortest route problem – applications | 1 |
|     | Systematic method | 1 |
|     | Dijkstra’s algorithm | 1 |
|     | Floyd’s algorithm | 1 |

**SECOND INTERNAL EXAMINATION**

| IV | Goal programming – goal programming formulation-application | 1 |
|    | Simplex method for solving goal programming | 1 |
|    | Dynamic programming – terminologies – forward and backward recursion – applications | 1 |
|    | Shortest path problems | 1 |

| V | Nonlinear programming – convex, quasi-convex, concave and unimodal functions – theory of constrained optimization | 1 |
|   | Lagrangean method | 1 |
|   | Kuhn-Tucker conditions | 1 |

| VI | Nontraditional optimization – computational complexity - Introduction to metaheuristics – areas of application | 1 |
|    | Genetic algorithm (GA) – terminologies – steps and examples | 1 |
|    | Tabu search (TS) – steps and examples | 1 |
|    | Simulated annealing (SA) – steps and examples | 1 |
|    | Ant colony optimization (ACO) – steps and examples | 1 |
|    | Particle Swarm Optimization (PSO)-Steps and examples | 1 |
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 |
-------------|--------------------------------|---------------|----------------------|
ME482        | Energy Conservation and Management | 3-0-0-3      | 2016                 |

Prerequisite : Nil

Course Objectives:
1. To enable analysis of the energy data of industries, energy accounting and balancing
2. To know energy audit and methodologies for energy savings
3. To understand utilization of the available resources in optimal ways

Syllabus:

Expected Outcomes:
The students will be able to
i. carry out energy accounting and balancing
ii. suggest methodologies for energy savings

Text books:

References:

Module | Contents                                                                                                                                                                                                                                                                                                                                 | Hours | End Sem. Exam. Marks |
-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------|
II  Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.  7  15%

FIRST INTERNAL EXAMINATION

III  Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage; Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories  7  15%

IV  Energy efficiency in Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets  7  15%

SECOND INTERNAL EXAMINATION

V  Energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering  7  20%

V1  Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concepts  7  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.
<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>ME484</td>
<td>Finite Element Analysis</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite : Nil

Course Objectives: :
1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEA to a range of Engineering Problems.

Syllabus:
Historical Background, Mathematical Modeling of field problems in Engineering, Governing Equations, Basic concepts of the Finite Element Method, Solution of problems from solid mechanics and heat transfer, Fourth Order Beam Equation, Second Order 2D Equations involving Scalar Variable Functions, Equations of elasticity, Natural co-ordinate systems

Expected Outcomes:
- The students will be able to understand different mathematical techniques used in FEM analysis and use them in Structural and thermal problems

Text books:

Reference books:

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam. Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Basic concepts of the Finite Element Method. One Dimensional</td>
<td>7</td>
<td>15%</td>
</tr>
<tr>
<td>Module</td>
<td>Content</td>
<td>Marks</td>
<td>Percentage</td>
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<tr>
<td>--------</td>
<td>-------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>III</td>
<td>Solution of problems from solid mechanics and heat transfer</td>
<td>7</td>
<td>15%</td>
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<tr>
<td></td>
<td>Longitudinal vibration frequencies and mode shapes. Fourth Order Beam</td>
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<td></td>
<td>Equation – Transverse deflections and Natural frequencies of beams.</td>
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<tr>
<td>IV</td>
<td>Second Order 2D Equations involving Scalar Variable Functions</td>
<td>7</td>
<td>15%</td>
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<tr>
<td></td>
<td>– Variational formulation – Finite Element formulation – Triangular</td>
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<tr>
<td></td>
<td>elements – Shape functions and element matrices and vectors. Application</td>
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<td></td>
<td>to Field Problems – Thermal problems – Torsion of Non circular shafts</td>
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<td></td>
<td>– Quadrilateral elements – Higher Order Elements.</td>
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<tr>
<td>V</td>
<td>Equations of elasticity – Plane stress, plane strain and axisymmetric</td>
<td>7</td>
<td>20%</td>
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<tr>
<td></td>
<td>problems – Body forces and temperature effects – Stress calculations</td>
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<td></td>
<td>- Plate and shell elements.</td>
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<td>V1</td>
<td>Natural co-ordinate systems – Isoparametric elements – Shape functions</td>
<td>7</td>
<td>20%</td>
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<tr>
<td></td>
<td>for iso parametric elements – One and two dimensions – Serendipity</td>
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<td></td>
<td>elements – Numerical integration and application to plane stress</td>
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<td></td>
<td>problems - Matrix solution techniques – Solutions Techniques to Dynamic</td>
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<td>problems – Introduction to Analysis Software.</td>
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<tr>
<td>END SEMESTER EXAMINATION</td>
<td><strong>Question Paper Pattern</strong></td>
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<tr>
<td></td>
<td>Maximum marks: 100</td>
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<td></td>
<td>The question paper should consist of three parts</td>
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<tr>
<td></td>
<td><strong>Part A</strong></td>
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<td></td>
<td>There should be 2 questions each from module I and II</td>
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<td></td>
<td>Students will have to answer any three questions out of 4 (3X10 marks</td>
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<td>=30 marks)</td>
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<td><strong>Part B</strong></td>
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<td></td>
<td>There should be 2 questions each from module III and IV</td>
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<td>Each question carries 10 marks</td>
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<td><strong>Part C</strong></td>
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<td></td>
<td>There should be 3 questions each from module V and VI</td>
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<tr>
<td></td>
<td>Each question carries 10 marks</td>
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<tr>
<td></td>
<td>Students will have to answer any four questions out of 6 (4X10 marks</td>
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<tr>
<td></td>
<td>=40 marks)</td>
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<td>Note: Each question can have a maximum of four sub questions, if needed.</td>
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</tbody>
</table>
## Course Code: **341

<table>
<thead>
<tr>
<th>Course Name</th>
<th>L-T-P - Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESIGN PROJECT</td>
<td>0-1-2-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite : Nil**

### Course Objectives
- To understand the engineering aspects of design with reference to simple products
- To foster innovation in design of products, processes or systems
- To develop design that add value to products and solve technical problems

### Course Plan

**Study:** Take minimum three simple products, processes or techniques in the area of specialisation, study, analyse and present them. The analysis shall be focused on functionality, strength, material, manufacture/construction, quality, reliability, aesthetics, ergonomics, safety, maintenance, handling, sustainability, cost etc. whichever are applicable. Each student in the group has to present individually; choosing different products, processes or techniques.

**Design:** The project team shall identify an innovative product, process or technology and proceed with detailed design. At the end, the team has to document it properly and present and defend it. The design is expected to concentrate on functionality, design for strength is not expected.

*Note:* The one hour/week allotted for tutorial shall be used for discussions and presentations. The project team (not exceeding four) can be students from different branches, if the design problem is multidisciplinary.

### Expected outcome

The students will be able to

1. Think innovatively on the development of components, products, processes or technologies in the engineering field
2. Analyse the problem requirements and arrive workable design solutions

### Reference:


### Evaluation

- First evaluation (Immediately after first internal examination) 20 marks
- Second evaluation (Immediately after second internal examination) 20 marks
- Final evaluation (Last week of the semester) 60 marks

*Note:* All the three evaluations are mandatory for course completion and for awarding the final grade.
**Course Code:** **352  
**Course Name:** Comprehensive Examination  
**L-T-P - Credits:** 0-1-1-2  
**Year of Introduction:** 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 student 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
<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><strong>451</strong></td>
<td>Seminar and Project Preliminary</td>
<td>0-1-4-2</td>
<td>2016</td>
</tr>
</tbody>
</table>

Prerequisite: Nil

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

**Course Plan**

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

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

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

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

**Expected outcome.**
The students will be able to
- i. Analyse a current topic of professional interest and present it before an audience
- ii. Identify an engineering problem, analyse it and propose a work plan to solve it.

**Evaluation**

Seminar: 50 marks
(Distribution of marks for the seminar is as follows: i. Presentation: 40% ii. Ability to answer questions: 30% & iii. Report: 30%)

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

**Note:** All evaluations are mandatory for course completion and for awarding the final grade.
<table>
<thead>
<tr>
<th>Course code</th>
<th>Course Name</th>
<th>Credits</th>
<th>Year of Introduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>492</strong></td>
<td>PROJECT</td>
<td>6</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Prerequisite**: Nil

**Course Objectives**
- To apply engineering knowledge in practical problem solving
- To foster innovation in design of products, processes or systems
- To develop creative thinking in finding viable solutions to engineering problems

**Course Plan**
- In depth study of the topic assigned in the light of the preliminary report prepared in the seventh semester
- Review and finalization of the approach to the problem relating to the assigned topic
- Preparing a detailed action plan for conducting the investigation, including team work
- Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed
- Final development of product/process, testing, results, conclusions and future directions
- Preparing a paper for Conference presentation/Publication in Journals, if possible
- Preparing a report in the standard format for being evaluated by the dept. assessment board
- Final project presentation and viva voce by the assessment board including external expert

**Expected outcome**
The students will be able to
- iii. Think innovatively on the development of components, products, processes or technologies in the engineering field
- iv. Apply knowledge gained in solving real life engineering problems

**Evaluation**

Maximum Marks: 100

(i) Two progress assessments 20% by the faculty supervisor(s)
(ii) Final project report 30% by the assessment board
(iii) Project presentation and viva voce 50% by the assessment board

*Note*: All the three evaluations are mandatory for course completion and for awarding the final grade.
### Course Details

<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>HS300</td>
<td>Principles of Management</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**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

1. manage people and organisations
2. critically analyse and evaluate management theories and practices
3. plan and make decisions for organisations
4. do staffing and related HRD functions

**Text Book:**

**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>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.)</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>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)</td>
<td>6</td>
<td>15%</td>
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<tr>
<td>III</td>
<td>Planning: Nature and importance of planning, -types of plans (3 Hrs.)- Steps in planning, Levels of planning - The Planning Process, – MBO (3 Hrs.).</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>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 uncertainty, uncertainty and risk-creative process and innovation (3 Hrs.)</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>V</td>
<td>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.)</td>
<td>9</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>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.)</td>
<td>9</td>
<td>20%</td>
</tr>
</tbody>
</table>

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 Plan

<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
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<tbody>
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</table>

**Course Plan**

**Course code**: CS482

**Course Name**: DATA STRUCTURES

**L-T-P-Credits**: 3-0-0-3

**Year of Introduction**: 2016

**Pre-requisite**: A course on C or C++ in the B-Tech level with emphasis on pointers and functions.

**Course Objectives**:
- To introduce linear data structures such as stacks, queues and their applications.
- To introduce non-linear data structures such as trees, graphs and their applications.
- To impart various sorting, searching and hashing techniques and their performance comparison.

**Syllabus**:
Introduction to various programming methodologies, terminologies and basics of algorithms analysis, Basic Abstract and Concrete Linear Data Structures, Non-linear Data Structures, Sorting Algorithms, Searching Algorithms, Hashing.

**Expected Outcome**:
The Student will be able to:
- i. compare different programming methodologies and define asymptotic notations to analyze performance of algorithms
- ii. choose appropriate data structures like arrays, linked list, stacks and queues to for practical scenarios
- iii. represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications
- iv. illustrate and compare various techniques for searching and sorting
- v. illustrate various hashing techniques

**Text Books**:

**References**:
<table>
<thead>
<tr>
<th>I</th>
<th>Introduction to programming methodologies – structured approach, stepwise refinement techniques, programming style, documentation – analysis of algorithms: frequency count, definition of O notation, asymptotic analysis of simple algorithms. Recursive and iterative algorithms.</th>
<th>06</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Abstract and Concrete Data Structures- Basic data structures – Arrays, Linked lists- singly linked list, doubly linked list, Circular linked list, operations on linked list, linked list with header nodes, applications of linked list: polynomials,.</td>
<td>07</td>
<td>15%</td>
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<tr>
<td>III</td>
<td>Implementation of Stacks and Queues using arrays and linked lists, Applications. Trees: - m-ary Tree, Binary Trees – level and height of the tree, complete-binary tree representation using array, tree traversals (Recursive only), applications.</td>
<td>07</td>
<td>15%</td>
</tr>
<tr>
<td>IV</td>
<td>Binary search tree – creation, insertion and deletion and search operations, applications. Heaps- Min-max heaps, Graphs – representation of graphs, BFS and DFS (analysis not required) applications.</td>
<td>06</td>
<td>15%</td>
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<tr>
<td>V</td>
<td>Minimum Spanning Trees – Prim’s and Kruskal algorithms. Shortest path algorithms – Dijkstra and Warshall algorithms Sorting techniques – Bubble sort, Selection Sort, Insertion sort, Merge sort, Quick sort, Searching algorithms (Performance comparison expected. Detailed analysis not required)</td>
<td>07</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Linear and Binary search. (Performance comparison expected. Detailed analysis not required) Hash Tables – Hashing functions – Mid square, division, folding, digit analysis, collision resolution and Overflow handling techniques.</td>
<td>07</td>
<td>20%</td>
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</table>

Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – **A, B, C, D**
2. **Part A**
   a. **Total marks : 40**
   b. **TEN** questions, each have **4 marks**, covering all the SIX modules (**THREE** questions from **modules I & II; THREE** questions from **modules III & IV; FOUR** questions from **modules V & VI**). **All the TEN** questions have to be answered.
3. **Part B**
   a. **Total marks : 18**
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly** covers **modules I & II**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. Part C
   a. Total marks : 18
   b. THREE questions, each having 9 marks. One question is from module III; one question is from module IV; one question uniformly covers modules III & IV.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.

5. Part D
   a. Total marks : 24
   b. THREE questions, each having 12 marks. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.
   c. Any TWO questions have to be answered.
   d. Each question can have maximum THREE subparts.

6. There will be AT LEAST 60% analytical/programming/numerical questions in all possible combinations of question choices.
<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>CS484</td>
<td>COMPUTER GRAPHICS</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

**Pre-requisite:** A course on C or C++ in the B-Tech level with emphasis on pointers and functions.

**Course Objectives**
- To introduce concepts of graphics input and display devices.
- To introduce and discuss line and circle drawing algorithms.
- To introduce 2D and 3D transformations and projections.

**Syllabus**

**Expected Outcome:**
The Student will be able to:-
  i. compare various graphics devices  
  ii. analyze and implement algorithms for line drawing, circle drawing and polygon filling  
  iii. apply geometrical transformation on 2D and 3D objects  
  iv. analyze and implement algorithms for clipping  
  v. apply various projection techniques on 3D objects  
  vi. summarize visible surface detection methods

**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>Basic concepts in Computer Graphics – Types of Graphic Devices – Interactive Graphic inputs – Raster Scan and Random Scan Displays.</td>
<td>6</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Line Drawing Algorithm- DDA, Bresenham’s algorithm – Circle Generation Algorithms –Mid point circle algorithm, Bresenham’s algorithm-</td>
<td>7</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAM**
| III | Scan Conversion-frame buffers – solid area scan conversion – polygon filling algorithms Two dimensional transformations. Homogeneous coordinate systems – matrix formulation and concatenation of transformations. | 7 | 15% |
| IV | Windowing concepts – Window to Viewport Transformation- Two dimensional clipping-Line clipping – Cohen Sutherland, Midpoint Subdivision algorithm | 6 | 15% |
| V | Polygon clipping- Sutherland Hodgeman algorithm, Weiler-Atherton algorithm, Three dimensional object representation- Polygon surfaces, Quadric surfaces – Basic 3D transformations | 7 | 20% |

**SECOND INTERNAL EXAM**

**END SEMESTER EXAM**

Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering all the SIX modules (**THREE** questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI). All the TEN questions have to be answered.
3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module I; one question is from module II; one question uniformly covers modules I & II.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.
4. **Part C**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from module III; one question is from module IV; one question uniformly covers modules III & IV.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.
5. **Part D**
   a. Total marks : 24
   b. **THREE** questions, each having **12 marks**. One question is from module V; one question is from module VI; one question uniformly covers modules V & VI.
   c. **Any TWO** questions have to be answered.
   d. Each question can have maximum **THREE** subparts.
6. There will be **AT LEAST 50%** analytical/numerical questions in all possible combinations of question choices.
Course code | Course Name                  | L-T-P - Credits | Year of Introduction |
------------|------------------------------|----------------|---------------------|
CS486       | OBJECT ORIENTED PROGRAMMING | 3-0-0-3        | 2016                |

Pre-requisite: A course on C or C++ in the B-Tech level with emphasis on pointers and functions.

Course Objectives:
- To impart the basic concepts of object oriented design techniques.
- To introduce the concepts and constructs of Java language.
- To introduce the basics of multithreading, network programming, database connectivity etc.
- To impart the techniques of creating GUI based applications.

Syllabus:
Object oriented concepts-Java Overview, Classes and objects, Parameter passing, Overloading, Inheritance, Overriding, Packages, Exception Handling, Input/Output, Threads and multithreading, Network programming using stream and datagram sockets, Applets, Event Handling mechanism, Working with frames and graphics, AWT Controls, Swings, Java database connectivity.

Expected Outcome:
The Student will be able to:
1. apply object oriented principles in software design process
2. develop multithreaded client/server applications using socket programming
3. create GUI based applications with database at back end

Text Book:

References:
2. Flanagan D., Java in A Nutshell, 5/e, O'Reilly, 2005.
4. Sierra K., Head First Java, 2/e, O'Reilly, 2005.

Course Plan

<table>
<thead>
<tr>
<th>Module</th>
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</table>

<table>
<thead>
<tr>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Object oriented concepts- Features of Object oriented programming – Encapsulation -data hiding , polymorphism, inheritance – types of inheritance – Dynamic linking-Introduction to Java- bytecodes- Java virtual machine,- Salient features of Java, Java programming -Data types, operators, control statements, Arrays,</td>
<td>06</td>
</tr>
<tr>
<td>II</td>
<td>Classes fundamentals, objects, methods, constructors, parameter passing, overloading, access control keywords, static variables and methods, nested classes.</td>
<td>07</td>
</tr>
</tbody>
</table>

FIRST INTERNAL EXAMINATION
### III
Inheritance basics, method overriding, abstract classes, interfaces. Defining and importing packages. Exception handling fundamentals, multiple catch and nested try statements.  

#### IV
Input/Output: files, stream classes, reading console input. Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading.  

#### SECOND INTERNAL EXAMINATION

#### V
Strings in Java. Applet basics and methods. Event Handling: delegation event model, event classes, sources, listeners.  

#### VI
Introduction to AWT: working with frames, graphics, color, font. AWT Control fundamentals. Swing overview. Java database connectivity: JDBC overview, creating and executing queries.  

### END SEMESTER EXAM

Question Paper Pattern (End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D

2. **Part A**
   
a. Total marks : 40  
b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** (*THREE* questions from modules I & II; **THREE** questions from modules III & IV; **FOUR** questions from modules V & VI).  
   
   *All the TEN questions have to be answered.*

3. **Part B**
   
a. Total marks : 18  
b. **THREE** questions, each having **9 marks**. One question is from module I; one question is from module II; one question **uniformly covers modules I & II**.
   
   *Any TWO questions have to be answered.*

d. Each question can have **maximum THREE** subparts.

4. **Part C**
   
a. Total marks : 18  
b. **THREE** questions, each having **9 marks**. One question is from module III; one question is from module IV; one question **uniformly covers modules III & IV**.
   
   *Any TWO questions have to be answered.*

d. Each question can have **maximum THREE** subparts.

5. **Part D**
   
a. Total marks : 24  
b. **THREE** questions, each having **12 marks**. One question is from module V; one question is from module VI; one question **uniformly covers modules V & VI**.
   
   *Any TWO questions have to be answered.*

d. Each question can have **maximum THREE** subparts.

6. There will be **AT LEAST 60%** analytical/programming/numerical questions in all possible combinations of question choices.
### Course Code and Name

<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>CS488</td>
<td>C# AND .NET PROGRAMMING</td>
<td>3-0-0-3</td>
<td>2016</td>
</tr>
</tbody>
</table>

#### Pre-requisite:
A course on C or C++ in the B-Tech level with emphasis on pointers and functions.

#### Course Objectives:
- To introduce C# and learn how object oriented programs can be developed using C#.
- To introduce the .NET framework and learn how web based applications can be designed and developed on it.

#### Syllabus:
- Introduction To C#, Object Oriented Aspects of C#, Application Development On .NET, The CLR and The .NET Framework

#### Expected Outcome:
The Student will be able to:
1. apply principles of C# in object oriented programming
2. develop programs in C# for implementing solutions
3. develop web applications using the .NET framework

#### 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>Introducing C#, Understanding .NET, Overview of C#, Literals, Variables, Data Types, Operators, Expressions</td>
<td>06</td>
<td>15%</td>
</tr>
<tr>
<td>II</td>
<td>Branching, Looping, Methods, Arrays, Strings, Structures, Enumerations, Classes, Objects, Inheritance, Polymorphism, Interfaces</td>
<td>07</td>
<td>15%</td>
</tr>
</tbody>
</table>

**FIRST INTERNAL EXAMINATION**

| III    | Operator Overloading, Delegates, Events, Errors and Exceptions. Building Windows Applications Accessing Data with ADO.NET. | 06    | 15%                 |

| IV     | Programming Web Applications with Web Forms, Programming Web Services, Assemblies, Versioning, Attributes, Reflection, Viewing MetaData | 06    | 15%                 |

**SECOND INTERNAL EXAMINATION**
<table>
<thead>
<tr>
<th>Module</th>
<th>Contents</th>
<th>Hours</th>
<th>End Sem. Exam Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Type Discovery, Reflecting on a Type, Marshaling, Remoting, Understanding Server Object Types,</td>
<td>07</td>
<td>20%</td>
</tr>
<tr>
<td>VI</td>
<td>Specifying a Server with an Interface, Building a Server, Building the Client, Using Single Call, Threads.</td>
<td>08</td>
<td>20%</td>
</tr>
</tbody>
</table>

**END SEMESTER EXAM**

Question Paper Pattern End semester exam)

1. There will be **FOUR** parts in the question paper – A, B, C, D
2. **Part A**
   a. Total marks : 40
   b. **TEN** questions, each have **4 marks**, covering **all the SIX modules** *(THREE questions from modules I & II; THREE questions from modules III & IV; FOUR questions from modules V & VI)*. *All the TEN questions have to be answered.*
3. **Part B**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module I**; one question is from **module II**; one question **uniformly covers modules I & II**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
4. **Part C**
   a. Total marks : 18
   b. **THREE** questions, each having **9 marks**. One question is from **module III**; one question is from **module IV**; one question **uniformly covers modules III & IV**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
5. **Part D**
   a. Total marks : 24
   b. **THREE** questions, each having **12 marks**. One question is from **module V**; one question is from **module VI**; one question **uniformly covers modules V & VI**.
   c. **Any TWO** questions have to be answered.
   d. Each question can have **maximum THREE** subparts.
6. There will be **AT LEAST 60%** analytical/programming/numerical questions in all possible combinations of question choices.