### KANNUR UNIVERSITY
#### FACULTY OF ENGINEERING

Curricula, Scheme of Examinations & Syllabi for B.Tech Degree Programme (III-IV Semesters) in APPLIED ELECTRONICS AND INSTRUMENTATION

With effect from 2007 Admissions

#### THIRD SEMESTER

<table>
<thead>
<tr>
<th>Code</th>
<th>Subject</th>
<th>Hours/Week</th>
<th>Sessional Marks</th>
<th>University Examination</th>
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<tbody>
<tr>
<td>2K6AEI 301</td>
<td>Engineering Mathematics II</td>
<td>3 L 1 T</td>
<td>50</td>
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<td>2K6AEI 302</td>
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<td>Solid State Devices</td>
<td>3 L 1 T</td>
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<td>2K6AEI 305</td>
<td>Network Theory</td>
<td>3 L 1 T</td>
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<td>2K6AEI 306</td>
<td>Electronic Circuits I</td>
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<td>2K6AEI 307(P)</td>
<td>Basic Electronics Lab</td>
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<td>Electrical Engineering Lab</td>
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#### FOURTH SEMESTER

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<tr>
<th>Code</th>
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<th>University Examination</th>
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<tr>
<td>2K6AEI 401</td>
<td>Engineering Mathematics III</td>
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<tr>
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<td>Computer Programming</td>
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<td>Electrical Measurements and Measuring Instruments</td>
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<td>Signals &amp; Systems</td>
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<td>Electronic Circuits II</td>
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Module III: Vector Integral Calculus: Evaluation of line integral, surface integral and volume integrals – Line integrals independent of the path, conservative force fields, scalar potential- Green’s theorem- Gauss’ divergence theorem- Stoke’s theorem (proof of these not required).


References:

Sessional work assessment
Assignments 2x10 = 20
2 tests 2x15 = 30
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
Module I (20 hours)

**Functional English Grammar:** Sentence Analysis - Basic Patterns - Noun Group, Verbal Group, and Adverbial Group - Tenses – Conditionals - Active and Passive Voice - Reported Speech

Module II (14 hours)

**Technical Communication**
2. Barriers to effective communication – improper encoding, bypassing inter-cultural differences etc.
3. Organization in technical communication – spatial, chronological etc.
4. Style in technical communication - objectivity, accuracy, brevity, clarity etc.
5. Technical reports – types and format

**Professional Ethics:**
1. Ethics in Engineering, copyright – IPR- patents

Module III (10 hours)

**Humanities, Science and Technology**
1. Importance of humanities to technology, Education and Society
2. Relevance of a scientific temper
3. Relation between science, society and culture – the views of modern thinkers
4. The development of science and technology in society – science and technology in ancient Greece and India – the contribution of the Arabs to science and technology – recent advances in Indian science.

**Reference books**
2. Pennyor, Grammar Practice Activities, Cambridge University Press
5. Vesilind; Engineering, Ethics and the Environment, Cambridge University Press
6. Larson E; History of Inventions, Thompson Press India Ltd.
9. Encyclopedia Britannica, History of Science, History of Technology
10. Subrayappar; History of Science in India, National Academy of Science, India

**Sessional work assessment**

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**University examination pattern**

**Q I** - 10 short type questions of 2 marks, from Module 1

**Q II** - 10 questions of 5 marks, from module II and III for writing short notes with choice to answer any seven

**Q III** - 2 questions A and B of 15 marks from module I for writing essay with choice to answer any one

**Q IV** - 2 questions A and B of 15 marks from module II for writing essay with choice to answer any one

**Q V** - 2 questions A and B of 15 marks from module III for writing essay with choice to answer any one
26K AEI 303 : ELECTRICAL ENGINEERING

3 hours lecture and 1 hour tutorial per week

MODULE - I

MODULE –II
Parallel operations of single phase and three phase transformers- three phase transformer connections- star to star- star to delta- delta to delta-applications

MODULE –III
Alternators- E.M.F. equation-effects of harmonics on pitch factor and distribution factor- voltage regulation- mmf and emf method- parallel operation – synchronization
Synchronous motor- starting method- power developed by synchronous motor- applications- synchronous condenser

MODULE – IV
Three phase Induction motor- types – torque equations- torque slip and torque speed characteristics- power flow diagram – efficiency – equivalent circuit- induction generator
Special machines – single phase FHP motor starting methods- double field revolving theory-types and applications – stepper motor – classifications and applications – servomotors – classifications and applications –shaded pole motors -applications

Text book
1. Hughes E., Electrical Technology, ELBS
2. P.S. Bimbra., Electrical Machines, Khanna Publishers

Reference books
1. Cotton H., Electrical Technology Pitman
2. Golding, Electrical measurements and measuring instruments, ELBS

Sessional work assessment
Assignments   2x10 = 20
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Total marks            = 50

University examination pattern
Q I    -  8 short type questions of 5 marks, 2 from each module
Q II   -  2 questions A and B of 15 marks from module I with choice to answer any one
Q III  - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV  - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V   - 2 questions A and B of 15 marks from module IV with choice to answer any one
Module I (13 hours)
Energy bands and charge carriers in semiconductors - Direct and indirect band gap semiconductors - Concept of effective mass - Intrinsic and extrinsic semiconductors - Fermi level - Electron and hole concentrations at equilibrium - Temperature dependence of carrier concentrations - Conductivity and mobility - Quasi Fermi level - Diffusion and drift of carriers - Einstein relation - Continuity equation

Module II (13 hours)
PN junctions - Contact potential - Space charge at a junction - Current flow at a junction - Carrier injection - Diode equation - Minority and majority carrier currents - Capacitance of pn junctions - Reverse bias breakdown - Zener and avalanche breakdown - Abrupt and graded junctions - Schottky barrier - Rectifying and ohmic contacts - Tunnel diode - Varactor diode - Zener diode

Module III (13 hours)
Charge transport in a bipolar junction transistor - Current and voltage amplification - Concept of load line - Analysis of transistor currents - Ebers-Moll model - Early effect - Concept of Early voltage - Avalanche breakdown in transistors - Transit time effects - Hetero junction GaAs BJTs

Module IV (13 hours)
Junction FET - Pinch off and saturation - Gate control - VI characteristics - MOS capacitor - Accumulation, depletion and strong inversion - threshold voltage - MOSFET - p channel and n channel MOSFETs - Depletion and Enhancement mode MOSFETs - Substrate bias effects - Floating gate MOSFETs - Short channel effects - Hot carrier effect - MESFET - CMOS inverter-characteristics

Text books
2. Sze S.M., Physics of Semiconductor Devices, Wiley Eastern
3. Michael A.Shur, Physics of Semiconductor Devices, Prentice Hall of India

Reference books

Sessional work assessment
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Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
2K6 AEI 305: NETWORK THEORY

Module I (10 hours)

Module II (13 hours)
S-Domain Analysis of Circuits - Review of Laplace transform - Convolution theorem and convolution integral - Transformation of a circuit into S-domain - Transformed equivalent of inductance, capacitance and mutual inductance - Impedance and admittance in the transform domain - Node analysis and mesh analysis of the transformed circuit - Nodal admittance Matrix - mutually coupled circuits - Input and transfer immittance functions - Transfer functions - Impulse response and Transfer function - Poles and Zeros - Pole Zero plots - Sinusoidal steady state from Laplace transform inversion - Frequency response by transform evaluation on j-axis - Frequency response from pole-zero plot by geometrical interpretation

Module III (16 hours)
Two port networks: Two port networks - Characterization in terms of impedance - Admittance - Hybrid and transmission parameters - Inter relationships among parameter sets - Reciprocity Theorem - Interconnection of two port networks - Series, parallel and cascade - Network functions - Pole zero plots and steady response from pole - zero plots
Symmetrical two port networks: T and π Equivalent of a two port network - Image impedance - Characteristic impedance and propagation constant of a symmetrical two port network - Properties of a symmetrical two port network
Symmetrical Two Port Reactive Filters: Filter fundamentals - Pass and stop bands - Behavior of iterative impedance - Constant - k low pass filter - Constant - k high pass filter - m-derived T and π sections and their applications for infinite attenuation and filter terminations - Band pass and band elimination filters

Module IV (13 hours)
Synthesis: Positive real functions - Driving point functions - Brune's positive real functions - Properties of positive real functions - Testing driving point functions - Application of maximum module theorems - Properties of Hurwitz polynomials - Even and odd functions - Strum's theorem - Driving point synthesis - RC elementary synthesis operations - LC network synthesis - Properties of RC network functions - Foster and Cauer forms of RC and RL networks

Text books
3. Van Valkenberg, Network Analysis, Prentice Hall of India

Reference books
1. Desoer C.A. & Kuh E.S., Basic Circuit Theory, McGraw Hill
3. Ryder J.D., Networks, Lines and Fields, Prentice Hall
5. Huelsman L.P., Basic Circuit Theory, Prentice Hall of India
## Sessional work assessment

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Assignments</td>
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<td>$2 \times 15 = 30$</td>
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</table>

## University examination pattern

| Q I             | 8 short type questions of 5 marks, 2 from each module |
| Q II            | 2 questions A and B of 15 marks from module I with choice to answer any one |
| Q III           | 2 questions A and B of 15 marks from module II with choice to answer any one |
| Q IV            | 2 questions A and B of 15 marks from module III with choice to answer any one |
| Q V             | 2 questions A and B of 15 marks from module IV with choice to answer any one |
Module I (13 hours)
BJT circuit models - Hybrid π model - Small signal low frequency and small signal high frequency models of BJT - Effect of temperature on BJT model parameters - h parameter equivalent circuits of CC, CB and CE configurations - Current gain - voltage gain - input and output impedances BJT amplifiers: Biasing - Load line - Bias stabilization - Stability factor - Bias compensation - Analyses and design of CC, CE and CB configurations - RC coupled and transformer coupled multistage amplifiers - High frequency response

Module II (13 hours)
FET amplifiers: Biasing of JFET - Self bias and fixed bias - Biasing of MOSFETS - Feedback biasing and fixed biasing for enhancement and depletion mode MOSFETs - Analyses of common source - Common drain and common gate amplifier configurations

Module III (13 hours)
Feedback - Effect of feedback on amplifier performance - Voltage shunt - Voltage series - Current series and current shunt feedback configurations - Positive feedback and oscillators - Analysis of RC Phase Shift, Wein bridge, Colpitts, Hartley and crystal oscillators - Stabilization of oscillations

Module IV (13 hours)
Power amplifiers - Class A, B, AB, C, D & S power amplifiers - Harmonic distortion - Efficiency - Wide band amplifiers - Broad banding techniques - Low frequency and high frequency compensation - Cascode amplifier - Broadbanding using inductive loads

Text books

Reference books
3. Horenstein M.N., Microelectronic Circuits & Devices’, Prentice Hall of India

Sessional work assessment
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University examination pattern
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Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
1. Series resonant and parallel resonant circuits - voltage and current amplification
2. Diode & Zener diode characteristics - dc and dynamic resistance
3. Constant -k low pass and high pass filters
4. First and second order LPF/HPF/BPF with R and C for a given cut-off frequency
5. Clipping circuits with diodes
6. Clamping circuits & voltage multipliers
7. Half wave rectifier with C, LC & CRC filters
8. Full wave rectifiers with C, LC & CRC filters
9. Zener diode regulator with emitter follower output - regulation curves
10. UJT characteristics & the relaxation oscillator
11. CB configuration - determination of h parameters
12. CE configuration - determination of h parameters
13. MOSFET characteristics in CS and CD modes

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Lab Practicals and Record</td>
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<tr>
<td>Test</td>
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<table>
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<tbody>
<tr>
<td>1. Bhargava et.al., Basic Electronic Circuits and Linear Circuits, Tata McGraw Hill</td>
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</table>

University evaluation will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparing the circuit diagram/algorithm/flow chart, conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments. 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination.
2K6 AEI 308(P) : ELECTRICAL ENGINEERING LAB

3 hours Practical per week

1. Plot open circuit characteristics of DC shunt generator for rated speed - Predetermine O.C.C. for other speeds - Determine critical field resistance for different speeds
2. Load test on DC shunt generator - Plot external characteristics - Deduce internal characteristics
3. Load test on DC series motor - Plot the performance characteristics
4. OC and SC tests on single phase transformer - Determine equivalent circuit parameters - Predetermine efficiency and regulation at various loads and different power factors - verify for unity power factor with a load test
5. Load test on 3 phase cage induction motor - Plot performance curves
6. Resistance measurement using a) Wheatstone's bridge b) Kelvin's double bridge
7. Measurement of self inductance, mutual inductance and coupling coefficient of a) Transformer windings b) air cored coil
8. Power measurement
9. Three voltmeter method b) three ammeter method
10. Power measurement in 3 phase circuit - Two wattmeter method
11. Extension of ranges of ammeter and voltmeter using shunt and series resistances

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| Text books | 1. Hughes E., Electrical Technology, ELBS |

University evaluation will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparing the circuit diagram/algorithm/flow chart, conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments. 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination
2K6 AE 401 : ENGINEERING MATHEMATICS III

Module I: (13 hours)
Complex analytic functions and conformal mapping: Complex functions – limits, derivative, analytic function- Cauchy-Riemann equations- elementary complex functions such as powers, exponential function, logarithmic, trigonometric and hyperbolic functions- Conformal mapping – Linear fractional transformations- mapping by elementary functions

Module II: (13 hours)
Complex integration: Line integral, Cauchy’s integral theorem - Cauchy’s integral formula – Taylor’s series, Laurent series – residue theorem – evaluation of real integrals using integration around unit circle, around semicircle, integrating contours having poles on the real axis

Module III: (13 hours)
Jointly Distributed Random Variables: Joint distribution functions, independent random variables , covariance and variance of sums of random variables, joint probability distribution functions of random variables, conditional probability and conditional expectations. Curve fitting: Method of least squares, correlation and regression, line of regression.

Module IV: (13 hours)
Vibrating strings: One dimensional wave equation – D’ Alembert’s solution – solution by method of separation of variables One dimensional heat equation - solution of the equation by the method of separation of variable Solutions of Laplace’s equation over a rectangular region and a circular region by the method of separation of variable

Reference books

Sessional work assessment
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2 tests  2x15 = 30
Total marks  = 50

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2K6 AEI 402 : COMPUTER PROGRAMMING

<table>
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<th>Module I (15 hours)</th>
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<tbody>
<tr>
<td>Overview of C – Variables, Expressions and assignments, Lexical Elements, Fundamental Data Types, Operators Control Statements – if, switch-case, for, while, do, goto, break, switch Functions- Parameter passing, scope rules, recursion</td>
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<tr>
<th>Module II (12 hours)</th>
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<tbody>
<tr>
<td>Arrays – One dimensional and Multi Dimensional, Pointer-Linked List, Arrays of Pointers, Dynamic Memory Allocations, Strings – Operations and functions, Bitwise Operators and Enumeration Types, Structures and Unions, Files and File Operations</td>
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<table>
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<tr>
<th>Module III (13 hours)</th>
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<tbody>
<tr>
<td>Overview of Java Language- Constants, Variables and Data Types, Operators and Expressions Control Structures – Decision Making, Branching and Looping, Object Oriented Programming – Concept of Classes, Objects and Methods, Benefits Java and OOP- Polymorphism and Overriding of methods, Inheritance</td>
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<table>
<thead>
<tr>
<th>Module IV (12 hours)</th>
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<tbody>
<tr>
<td>Arrays and Strings, Interfaces, Multiple Inheritance, Packages – Putting Classes together – Managing Errors and Exceptions – Applet Programming and Graphics Programming (Basics only) – Managing Input/Output Files in Java</td>
</tr>
</tbody>
</table>

**Text books**

**Reference books**
2. Eckel, Bruce., *Thinking in Java*, 2nd Ed, Pearson Education

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| Q V | 2 questions A and B of 15 marks from module IV with choice to answer any one |
Module I (13 hrs)

**General Principles of Measurements:** Absolute and Working Standards- Calibration of Meters- Qualities of Measurements - Characteristics - Errors in Measurement and its Analysis - Essentials of indicating instruments- deflecting, damping, controlling torques- Moving Coil , Moving Iron, Dynamo Meter, Induction, Thermal, Electrostatic and Rectifier Type meter; Shunts and Multipliers-Various Types of Galvanometers- Accuracy class.

Module II (13 hrs)


Module III (13 hrs)

**Potentiometers:** General Principle- Direct Current Potentiometer- AC potentiometer- Application of DC and AC potentiometers

**Bridges:** Wheatstone’s Bridge – Kelvin’s Double Bridge - Carry Foster Slide Wire Bridge - Bridge Current Limitations - Maxwell’s bridge- Schering bridge- Anderson’s bridge and Wein’s bridge

Module IV (13 hrs)

**Digital Measurements:** Oscilloscope – Basic principle of Signal display - Triggered Sweep CRO- Trigger pulse circuit- Delay Line in triggered Sweep - Sync Selector for Continuous Sweep CRO- Dual Beam CRO- Dual Trace Oscilloscope- Applications- Digital storage oscilloscope - Digital Cable fault locators.

**Magnetic Measurements:** Classification - Measurement of Flux and Permeability - Flux Meter - Hall Effect Gaussmeter -. B.H. Curve and Permeability measurement - Hysteresis measurement

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**Text books**
2. Sawhney AK: A course in Electrical and Electronic Measurements & instrumentation, Dhanpat Rai .

**Reference Books**
2. Stout M.B: Basic Electrical Measurements, Prentice Hall.

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- Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
Module I (12 hours)
Introduction to signals and systems - Classification of signals - Basic operations on signals - Elementary signals - Concept of system - Properties of systems - Stability, invertibility, time invariance - Linearity - Causality - Memory - Time domain description - Convolution - Impulse response - Representation of LTI systems - Differential equation and difference equation representations of LTI systems

Module II (15 hours)
Fourier representation of continuous time signals - Fourier transform - Existence of the Fourier integral - FT theorems - Energy spectral density and power spectral density - Frequency response of LTI systems - Correlation theory of deterministic signals - Condition for distortionless transmission through an LTI system - Transmission of a rectangular pulse through an ideal low pass filter - Hilbert transform - Sampling and reconstruction

Module III (13 hours)
Fourier representation of discrete time signals - Discrete Fourier series and Discrete Fourier transform - Laplace transform analysis of systems - Relation between the transfer function and differential equation - Causality and stability - Inverse system - Determining the frequency response from poles and zeros

Module IV (12 hours)
Z Transform - Definition - Properties of the region of convergence - Properties of the Z transform - Analysis of LTI systems - Relating the transfer function and difference equation - Stability and causality - Inverse systems - Determining the frequency response from poles and zeros

Text books

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Module I (13 hours)
RC circuit as integrator and differentiator - Compensated attenuators - Pulse transformer - Pulse response
Switching characteristics of a BJT - BJT switches with inductive and capacitive loads - Non saturating
switches - Emitter follower with capacitive loading - Switching characteristics of a MOS inverter -
Resistive load & active load configurations - CMOS inverter - Dynamic power dissipation

Module II (13 hours)
Monostable and astable multivibrators - Collector coupled monoshot - Emitter coupled monoshot -
triggering the monoshot - Collector coupled and emitter coupled astable multivibrator - Astable -
monostable and bistable operations using negative resistance devices - Multivibrators with 555 IC timer-
Astable, monostable, bistable circuits with logic gates

Module III (13 hours)
Phase Locked Loops - Phase detector (XOR & phase frequency detectors) - Voltage Controlled Oscillator
(Current starved & source coupled CMOS configurations) - Loop filter - Analysis of PLL - Typical
applications of PLL - Voltage and current time base generators - Linearization - Miller & bootstrap
configurations

Module IV (13 hours)
Digital to analog converters - R-2R ladder - Binary weighted - Current steering - Charge scaling - Cyclic &
pipeline DACs - Accuracy - Resolution - Conversion speed - Offset error - Gain error - Integral and
differential nonlinearity - Analog to digital converters – Track and hold operation - Track and hold errors -
ADC conversion techniques - Flash converter - Two step flash - Pipeline – Integrating - Staircase converter
- Successive approximation converter - Dual slope & oversampling ADCs

Text books

Reference books

Sessional work assessment
Assignments 2x10 = 20
2 tests 2x15 = 30
Total marks = 50

University examination pattern
Q I - 8 short type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
**Module I (12 hours)**
Basic digital circuits - Review of number systems and Boolean algebra - Simplification of functions using Karnaugh map and Quine McCluskey methods - Boolean function implementation - Code converters - Encoders and decoders - Multiplexers and demultiplexers - ROMs - Combinational logic design using decoders - Multiplexers and ROMs

**Module II (12 hours)**
Hazards in combination circuits – static and dynamic. Arithmetic circuits - Half and full adders and subtractors - Carry look ahead adders - BCD adder - Multiplier and divider circuits - Sequential circuits - Latches and flipflops (RS, JK, D, T and Master Slave) - Design and analysis of ripple counters - Shift registers - Johnson and ring counters

**Module III (14 hours)**
Design and analysis of sequential circuits - General model of sequential networks – Hazards in sequential networks - synchronous design method - clock skew - asynchronous inputs - synchroniser failure and metastability - State diagrams – Synchronous counter design - Analysis of sequential networks - Derivation of state graphs and tables - Reduction of state table - Sequential network design

**Module IV (14 hours)**
Logic families - Fundamentals of RTL, IIL, DTL and ECL gates - TTL logic family - TTL transfer characteristics - TTL input and output characteristics - Tristate logic - Shottkey and other TTL gates - MOS gates - MOS inverter - CMOS inverter - Rise and fall time in MOS and CMOS gates - Speed power product - Interfacing BJT and CMOS gates.

**Text books**

**Reference books**

**Sessional work assessment**
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Total marks = 50

**University examination pattern**
Q I - **8 short** type questions of 5 marks, 2 from each module
Q II - 2 questions A and B of 15 marks from module I with choice to answer any one
Q III - 2 questions A and B of 15 marks from module II with choice to answer any one
Q IV - 2 questions A and B of 15 marks from module III with choice to answer any one
Q V - 2 questions A and B of 15 marks from module IV with choice to answer any one
1. Feed back voltage regulator with short circuit protection
2. Biasing circuits- fixed bias-self bias- voltage divider.
3. Emitter follower with & without complementary transistors – Frequency and phase response for a capacitive load
4. Single stage RC coupled amplifier – Frequency response
5. Phase shift oscillator using BJT/FET
6. Hartley / Colpitts oscillator using BJT/FET
7. Power amplifier – Class A
8. Power amplifier – Class AB
9. Cascode amplifier – Frequency response
11. Active load MOS amplifier
12. Wide band single BJT/MOS voltage amplifier with inductance
13. Single BJT crystal oscillator

### Sessional work assessment

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### Reference books


University evaluation will be for 100 marks of which 70 marks are allotted for writing the procedure/formulae/sample calculation details, preparing the circuit diagram/algorith/prom flow chart, conduct of experiment, tabulation, plotting of required graphs, results, inference etc., as per the requirement of the lab experiments. 20 marks for the viva-voce and 10 marks for the lab record.

Note: Duly certified lab record must be submitted at the time of examination.
**2K6 AEI 408(P) : DIGITAL ELECTRONICS LAB**

3 hours practicals per week

**List of experiments:**
1. Familiarization with TTL ICs
2. Characteristics of TTL NAND gate
3. Arithmetic circuits
4. Flip-Flops
5. Counters and Sequence generators
6. Twisted counters
7. Registers
8. Encoders and Decoders
9. Multiplexers and Demultiplexers
10. ADC and DAC
11. CMOS logic circuits
12. Multivibrators using logic gates

**Sessional work assessment**

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Careers in Electronics & Instrumentation Engineering: After B.tech. Engineering Technologies: Electrical/Electronics and Instrumentation Engineering. Experimentation using basic electronics instrumentation. This environment includes: a function generator, chargers, reliability of electronic systems, control applied to power converters, and educational innovation. He is a Chapter Coordinator of the IEEE Spanish Section. Technologies from the University of Vigo, Vigo, Spain, in 1999 and 2007, respectively, where he is currently an Associate Teacher with the Department of Telematic Engineering. Applied Electronics & Instrumentation Engineering is an advanced branch of engineering which deals with the application of existing or known scientific knowledge in electronics, instrumentation, measurements and control for any process, practical calibration of instruments, automation of processes etc. It is a combination of Electronics and Instrumentation Engineering. This branch is an industry-oriented engineering branch which needs more knowledge and experience in industrial applications to excel.