ALAGAPPA UNIVERSITY, KARAIKUDI
SYLLABUS UNDER CBCS PATTERN FOR AFFILIATED COLLEGES
WITH EFFECT FROM THE ACADEMIC YEAR 2022-23 ONWARDS

B.Sc. ELECTRONICS
Programme Structure

Sem.	Part	Course Code	Courses	Title of the Paper	T/P	Credit	Hours/ Week	Max. Marks		
								Int.	Ext.	Total
I	I	2211T	T/OL	Tamil /Other Languages -I	T	3	6	25	75	100
	II	712CE	E	Communicative English - I	T	3	6	25	75	100
	III	22BEL1C1	CC	Electronic Devices and Network Analysis	T	5	5	25	75	100
		22BEL1P1	CC	Practical-Electronic Devices and Network Analysis	P	4	4	40	60	100
		-	AL - IA	Mathematics/IT/ Physics/ Chemistry/ Computer Science/BCA	T	3	3	25	75	100
		-	AL - IA	Practical - Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BVE1	SEC -I	Value Education	T	2	2	25	75	100
		-	-	Library	-	-	2	-	-	-
				Total		**22**	**30**	**205**	**495**	**700**
II	I	2221T	T/OL	Tamil /Other Languages -II	T	3	6	25	75	100
	II	722CE	E	Communicative English - II	T	3	6	25	75	100
	III	22BEL2C1	CC	Electronic Circuits	T	5	5	25	75	100
		22BEL2P1	CC	Practical - Electronic Circuits	P	4	4	40	60	100
		-	AL - IB	Mathematics/IT/ Physics/ Chemistry/ Computer Science/BCA	T	3	3	25	75	100
		-	AL - IB	Practical - Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BES2	SEC -II	Environmental Studies	T	2	2	25	75	100
		Naan Mudhalvan Course		Language Proficiency for Employability(Effective English)	-	2	2	25	75	100
				Total		**24**	**30**	**230**	**570**	**800**
III	I	2231T	T/OL	Tamil /Other Languages -III	T	3	6	25	75	100
	II	2232E	E	English for Enrichment - I	T	3	6	25	75	100
	III	22BEL3C1	CC	Analog IC's and its Applications	T	3	3	25	75	100
		22BEL3C2	CC	Digital Electronics and its Applications	T	3	3	25	75	100
		22BEL3P1	CC	Practical-Analog and Digital Electronics	P	3	3	40	60	100
		-	AL - IIA	Mathematics/IT/ Physics/ Chemistry/ Computer Science/ BCA	T	3	3	25	75	100
		-	AL - IIA	Practical - Respective Allied Theory Course	P	2	2	40	60	100
	IV	22BE3	SEC -III	Entrepreneurship	T	2	2	25	75	100
		-	NME- I	1.Adipadai Tamil (or) 2.Advance Tamil (or) 3.IT Skills for Employment(or) MOOC'S	T	2	2	25	75	100
				Total		**24**	**30**	**255**	**645**	**900**

IV	I	2241T	T/OL	Tamil /Other Languages -IV	T	3	6	25	75	100
	II	2242E	E	English for Enrichment - II	T	3	6	25	75	100
	III	22BEL4C1	CC	Electronic Communication Systems	T	4	4	25	75	100
		22BEL4C2	CC	Microprocessors Programming and Interfacing Techniques	T	4	4	25	75	100
		22BEL4P1	CC	Practical-Communication and Microprocessor	P	3	3	40	60	100
		-	AL - IIB	Mathematics/IT/ Physics/ Chemistry/Computer Science/BCA	T	3	3	25	75	100
		-	AL - IIB	Practical - Respective Allied Theory Course	P	2	2	40	60	100
	IV	-	NME- II	1.Adipadai Tamil (or) 2.Advance Tamil (or) 3. Small Business Management (or) MOOC'S	T	2	2	25	75	100
		Naan Mudhalvan Course		Digital Skills for Employability – (Microsoft-Office Fundamentals)	-	2	3	25	75	100
				Total		**26**	**30**	**255**	**645**	**900**
V	III	22BEL5C1	CC	Embedded System Design	T	4	4	25	75	100
		22BEL5C2	CC	Power Electronics	T	4	4	25	75	100
		22BEL5C3	CC	Computer Networking	T	4	4	25	75	100
		22BEL5C4	CC	Advanced Communication Systems	T	4	4	25	75	100
		22BEL5P1	CC	Practical-Embedded System Design	P	4	6	40	60	100
		22BEL5P2	CC	Practical-Power Electronics and Computer Networking	P	4	6	40	60	100
	IV	-	-	Career development/ employability skills	-	-	2	-	-	-
VI				**Total**		**24**	**30**	**180**	**420**	**600**
	III	22BEL6I	DSE	Internship		24	26	150	250	400
	IV	Naan Mudhalvan Course		Advanced Platform Technology for Employability* (Project-based learning)/ Data Analytics with Advanced Tools for Employability** (Project-based learning-Data Analytics & Visualization)	-	2	4	25	75	100
				Total		**26**	**30**	**175**	**325**	**500**
				(or)						
	III	22BEL6E1	DSE	Photonics and Optoelectronics	T	6	6	25	75	100
		22BEL6E2		Computer Hardware and System Assembling	T	6	6	25	75	100
		22BEL6E3		Electronic Instrumentation	T	6	6	25	75	100
		22BEL6E4		Biomedical Instrumentation	T	6	6	25	75	100
	IV			Library / Yoga etc		-	2	-	-	-
		Naan Mudhalvan Course		Advanced Platform Technology for Employability* (Project-based learning)/ Data Analytics with Advanced Tools for Employability** (Project-based learning-Data Analytics & Visualization)	-	2	4	25	75	100
				Total		**26**	**30**	**125**	**375**	**500**
		(or)								

	III	22BEL6PR	DSE	Project		6	8	25	75	100
		22BEL6E1		Medical Electronics	T	6	6	25	75	100
		22BEL6E2		Java Programming	T	6	6	25	75	100
		22BEL6E3		Internet of Things with Arduino	T	6	6	25	75	100
	IV	Naan Mudhalvan Course		Advanced Platform Technology for Employability* (Project-based learning)/ Data Analytics with Advanced Tools for Employability** (Project-based learning-Data Analytics & Visualization)	-	2	4	25	75	100
				Total		**26**	**30**	**125**	**375**	**500**
				Grand Total		**146**	**--**	**--**	**--**	**4400**

* Advanced Platform Technology for Employability – Government Colleges

** Data Analytics with Advanced Tools for Employability – Government Aided and Self financing Colleges

Sem.	Part	Course Code	Title of the Paper	Credits	Hours/ Week	Marks		
						Int.	Ext.	Total
I	III	71BEPP - I	Professional English for Physical Science -I	4	5	25	75	100
II		72BEPP - II	Professional English for Physical Science -II	4	5	25	75	100
III		*	Professional English for Physical Science –III	4	5	25	75	100
IV			Professional English for Physical Science -IV	4	5	25	75	100

*The Syllabus of Professional English for III & IV Semester will be provided after Receiving the syllabus from TANSCHE.

As per TANSCHE, the Professional English course will be taught to all four streams apart from the existing hours of teaching/ additional hours of teaching (1hour/day) as a 4 credit paper as an add on course on par with Major paper and completion of the paper is a must to continue his/her studies further.

- TOL-Tamil/Other Languages,
- E – English
- CC-Core course –Core competency, critical thinking, analytical reasoning, research skill & teamwork
- Allied -Exposure beyond the discipline
- AECC- -Ability Enhancement Compulsory Course (Professional English & Environmental Studies) - Additional academic knowledge, psychology and problem solving etc.,
- SEC-Skill Enhancement Course - Exposure beyond the discipline (Value Education , Entrepreneurship Course, Computer application for Science, etc.,
- NME -Non Major Elective – Exposure beyond the discipline
- DSE – Discipline specific elective – -Student choice – either or
    - Internship
    - If internship – Marks = Internal =150 (75+75) two midterm evaluation through Viva voce and External 250 marks (Report =150 +Viva Voce=100) =Total 400 marks
    - Theory papers or
    - Project + 3 theory papers.
- MOOCs – Massive Open Online Courses

*T-Theory, P- Practical

Semester - I				
Course Code 22BEL1C1	**Core Course I**	**T/P**	**C**	**H/W**
	ELECTRONIC DEVICES AND NETWORK ANALYSIS	T	5	5

Objectives	➢ To acquire knowledge and develop the skill in circuit analysis. ➢ To acquire knowledge on charge transport in semiconductors and to understand the current constituted in semiconductors. ➢ To understand the construction and working function of various semiconductor devices.
Unit - I	**Passive Devices, Network and Theorems**: Resistance – Inductance –Capacitance-KVL – KCL -Superposition Theorem– Thevenin's Theorem– Norton's Theorem– Maximum power transfer Theorem - **Resonance**: Series resonance and parallel resonance RLC circuits – Resonant frequency – Q factor – Band width – Selectivity.
Unit - II	**Semiconductor**: Classification of semiconductors – Conductivity of semiconductor – Energy distribution of electrons – Carrier concentration in intrinsic semiconductor – Mass action Law – Drift and diffusion currents – Carrier Life time – Continuity Equation.
Unit - III	**Semiconductor diodes** : PN junction diode in equilibrium with no applied voltage – PN junction diode under forward bias condition – PN junction diode under reverse bias condition –Diode current equation - Space Charge Capacitance - Zener Diode – Avalanche and Zener Break down mechanism.
Unit – IV	**Bipolar Junction Transistor**: Bipolar Junction Transistor construction -Transistor biasing- Operation of NPN and PNP Transistor - Transistor current components - CE configuration - CB Configuration - CC configuration – Comparison of different configurations - h parameter Model.
Unit - V	**Field Effect Transistor**: Construction of N – Channel JFET – Operation of N-Channel JFET – Characteristic Parameters of the JFET – Expression for Saturation Drain Current –JFET as VVR- Enhancement MOSFET – Depletion MOSFET – Comparison of MOSFET with JFET- UJT construction and working – V- I Characteristics.

Text Book:

Salivahanan, S. (2016). *Electronic Devices*. McGraw Hill Education, 2nd Edition.

Reference Books:

Jacob Millman, & Halkias, C. *Electronic Devices and Circuits*. Tata McGraw Hill

Salivahanan, S., Sureshkumar, N., & Vallavaraj, A. (2008). *Electronic Devices and Circuits*. Tata McGraw Hill Second Edition.

Sedha, R.S.(2013). *A Text Book of Applied Electronics (Revised Edition).* S.Chand and Co Ltd,

Outcomes	➢ The skill will be developed in circuit analysis ➢ The skill will be developed to choose proper semiconductor devices for specific applications.

Semester - I				
Course Code	**Core Practical I**	**T/P**	**C**	**H/W**
22BEL1P1	**ELECTRONIC DEVICES AND NETWORK ANALYSIS LAB**	P	4	4

Objectives	➢ To know how to Handling Multimeter, CRO to check the components and measure various parameters like continuity, resistance value, Voltage, Current, Frequency, Time, and how to use the instruments for troubleshooting. ➢ To apply the knowledge gained from theory to analyze various dc and ac circuits and apply various theorems to minimize and find the equivalent circuit ➢ To study the characteristics of diodes, BJT, FET, and UJT

1. Familiarization with
   a) Resistance in series, parallel and series – Parallel.
   b) Capacitors & Inductors in series & Parallel.
   c) Multimeter – Checking of components.
   d) Voltage sources in series, parallel and series – Parallel
   e) Voltage and Current dividers
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Laws.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. Study of the Frequency Response of a Series LCR Circuit and determination of its (a) Resonant Frequency(b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
9. Study of the Frequency Response of a Parallel LCR Circuit and determination of its (a) Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width.
10. V-I Characteristics of PN Junction Diode
11. Reverse Bias Characteristics of Zener Diode
12. V-I Characteristics of CB Configuration of BJT
13. V-I Characteristics of CE Configuration of BJT
14. V-I Characteristics of JFET
15. JFET as Voltage variable Resistance
16. V-I Characteristics of MOSFET
17. V- I Characteristics of UJT

Outcomes	➢ Students will be able to handle Multimeter, CRO, Power Supply, and Function generator to measure the parameters. ➢ Acquired knowledge of the device operation and to measure various parameters using multimeter, voltmeter, ammeter and CRO ➢ With the knowledge of parameters one can select the device for circuit design for various applications

Semester - II

Course Code	Core Course II	T/P	C	H/W
22BEL2C1	**ELECTRONIC CIRCUITS**	T	5	5

Objectives	➢ To apply the knowledge acquired to select various semiconductor diodes to design a rectifier and regulated circuits. ➢ To know the various biasing techniques to operate the transistor in various modes to design an amplifier, oscillator, and wave-shaping circuits. ➢ To study and analyze various types of amplifiers for various applications and to acquire knowledge to design an amplifier circuit. ➢ To study various types of Oscillators and acquire knowledge to design an oscillator for a particular frequency.
Unit - I	**Rectifiers, Filters and Regulators:** Transformer –Rectifier - Half wave rectifier – Full Wave rectifier – Bridge Rectifier – average value- RMS value- PIV- ripple factor-Efficiency – Comparison of Rectifiers – Filter – Inductor Filter – Capacitor Filter – L-section filter (LC filter) - π-section filter – Types of voltage regulators – Zener voltage regulator – Transistor voltage regulator – Linear Mode Power supply.
Unit - II	**Transistor Biasing:** Need for biasing –Load Line Analysis - Fixed Bias – Emitter Feed Back Bias – Collector to Base Bias – Collector-Emitter Feedback Bias – Voltage Divider Bias – Common Base Stability - Stabilization Factor – Thermal Runaway – Thermal Stability. FET biasing – Fixing the Q point – Self Bias – Voltage Divider Bias – Fixed bias.
Unit - III	**Small Signal Low Frequency Transistor Amplifier:** Analysis of Transistor amplifier using h-Parameters – Single Stage CE amplifiers – Single Stage CC Amplifier – Single stage CB Amplifier – CE amplifier with fixed bias – CE amplifier with Emitter resistor – CE amplifier with Voltage divider – CB amplifier – CC or Emitter follower. Analysis of small signal FET Common Source Amplifier.
Unit – IV	**Large Signal, Feedback and Tuned Amplifiers:** Class A Amplifier - Class B Push Pull Amplifier and its efficiency - Basic concept of feedback - Effects of Negative Feedback-Types of Feedback Connection - Stability of Feedback Amplifiers - RC coupled Amplifier - Transformer Coupled Amplifier - Direct Coupled Amplifier -Small Signal Tuned Amplifier-RF Amplifier - Video Amplifier.
Unit - V	**Oscillators and Wave Shaping Circuits:** Classification of Oscillators - Condition for Oscillation (Barkhausen Condition) - General form of LC Oscillator - Hartley Oscillator - Colpitts Oscillator - RC oscillator - Wien Bridge Oscillator - Crystal Oscillator - Oscillators using FET - UJT Relaxation Oscillator - Clipping and Clamping Circuits - Multivibrators.

Text Book:

Salivahanan, S.,Sureshkumar,N., & Vallavaraj, A.(2008). Electronic Devices and Circuits. Tata McGraw Hill Second Edition.

Books for Reference:

Jacob Millman, & Christos C. Halkias.(1967).Electronic Devices and Circuits McGraw-Hill.
JacobMillman, & Christos C. Halkias. Integrated Electronics and its Applications. Tata McGraw Hill.
Sedha, R.S.(2013). A Text Book of Applied Electronics, S.Chand and Co Ltd, Revised Edition

Outcomes	➢ Students will be able to design and troubleshoot rectifiers and regulators, ➢ Students will be able to design and troubleshoot various types of amplifiers using BJT and FET. ➢ Students will be able to design and troubleshoot various types of oscillators and waveform generators

Semester - II				
Course Code	**Core Practical II**	**T/P**	**C**	**H/W**

22BEL2P1	**ELECTRONIC CIRCUITS LAB**	P	4	4

Objectives	➢ To understand the working function of various types of rectifiers, measure its parameters to compare the efficiency of the rectifiers. ➢ To develop the skill to apply the biasing technique to construct regulators using zener and transistor. ➢ To develop the skill to construct various types of amplifier for different bandwidth and gain for various frequency range. ➢ To develop the skill to construct an oscillators using different tank circuit

1. Construct of Half wave rectifier and study its parameters.
2. Construct of Full wave rectifier and study its parameters.
3. Construct of Bridge Rectifier and study its parameters.
4. Construct 6Volt Power supply with filter using Zener diode voltage regulator.
5. Construct Transistor voltage regulator.
6. Construct RC coupled CE Amplifier and study its frequency response.
7. Construct feedback CE Amplifier and study its frequency response.
8. Construct PUSH-PULL Amplifier using transistors.
9. Construct FET Common Source Amplifier and Study its Frequency response.
10. Construct RF Amplifier and study its frequency Response.
11. Construct Tuned Transformer Coupled Amplifier and Study its Frequency Response.
12. Construct Video Amplifier and Study its Frequency Response.
13. Construct Phase shift Oscillator and calculate its frequency
14. Construct Hartley Oscillator and calculate its frequency
15. Construct Collpitt's Oscillator and calculate its frequency
16. Construct Diode Clipper and Clamper circuits and study its waveforms using CRO.
17. Construct Astable Multivibrator using transistor and study its wave form using CRO.
18. Construct Monostable Multivibrator using transistor and study its wave form using CRO.
19. Construct UJT relaxation Oscillator and study its wave form using CRO.

Outcomes	➢ Students will be able to design various types of rectifiers and choose which rectifier circuit is more suitable for a specific power supply design. ➢ Students will be able to design and troubleshoot rectifiers, filters and regulators. ➢ Students will be able to design and troubleshoot various types and frequency range of amplifiers. ➢ Students will be able to design and troubleshoot various types of oscillators and wave shaping circuits

Semester - III				
Course Code 22BEL3C1	**Core Course III**	**T/P**	**C**	**H/W**
	ANALOG IC'S AND ITS APPLICATIONS	T	3	3

Objectives	➢ To study IC fabrication techniques ➢ To know the pin details, power supply connection and various applications of OP-AMP to perform mathematical operations ➢ To design various function generation techniques using Op-Amp ➢ To design voltage regulators and filter circuits using Op-Amp ➢ To know 555 timer and its applications
Unit - I	**Planar Ic Fabrication Processes :** Classification of IC's – Silicon Wafer Preparation – Epitaxial Growth – Oxidization – Photolithography – Diffusion – Ion Implantation – Isolation Techniques – Metallization – Assembly Processing and Packaging – Fabrication of NPN Transistor ,Diode and JFET.
Unit - II	**Operational Amplifiers:** IC 741 Op-Amp Terminals – Power Supply Connections – Voltage Follower - Inverting Amplifier – Non inverting Amplifier – Inverting Summing Amplifier – Non inverting Summing Amplifier – Differential Amplifier – Integrator – Differentiator - CMRR – Instrumentation Amplifier- Sample and Hold Amplifier.
Unit - III	**Comparators and Waveform Generators:** Comparator – Zero Crossing Detector – Schmitt trigger – Phase Shift Oscillator – Wien Bridge Oscillator – Square Wave Generator (Astable Multivibrator) –Monostable Multivibrator- Triangular wave Generator
Unit - IV	**Voltage Regulator and Active Filters :**Voltage Regulator using 78xx – Dual Voltage Regulator using IC– RC Active Filter: First order Low Pass Filter- Second Order Active Filter – Higher Order Low Pass Filter –High pass Active Filter-Band pass Filter – Band Reject Filter – All Pass Filter,
Unit - V	**555-TIMER and PLL:**555 Timer Pin Details – Description of Functional Block Diagram – Monostable Operation – Astable Operation – FSK Generator – Pulse Position Modulator – Schmitt Trigger – PLL.

Text Book:

RoyChoudhury, D., & Shail B. Jain.(2010). *Linear Integrated Circuits.* New Age International Publishers, Fourth Edition.

Books for Reference:

Coughlin, R.F., & Driscoll, F. F. (2001).*Operational amplifiers and Linear Integrated circuits*. Pearson Education.

Kishore, K.L. (2011). *OP-AMP and Linear Integrated Circuits*. Pearson.

Millman, J., & Halkias, C.C. (2001). *Integrated Electronics.* Tata McGraw-Hill.

Malvino, A.P. (2003). *Electronic Principles, 6th Edition*. Tata McGraw-Hill.Ramkant A.Gayakward. (2005). *Op-Amps and Linear Integrated Circuits*. PHI.

Outcomes	➢ Students will be able to handle 741 IC's for various applications ➢ Students will be able to design a circuit for wave form generation, voltage regulation and filter ➢ Students will be able to handle 555 timer for square wave and pulse generation. ➢ Students will understand the function of PLL

Semester - III				
Course Code 22BEL3C2	**Core Course IV**	**T/P**	**C**	**H/W**
	DIGITAL ELECTRONICS AND ITS APPLICATIONS	T	3	3
Objectives	➢ To know how the computer performs arithmetic operations using 1's and 2's			

	complement system. ➢ Apply theorems and algebra to design and minimize the logical circuit using karnaugh map ➢ To develop the skill to handle and design combinational logical circuits ➢ To understand the function of flip-flops and to know how to design sequential logical circuits using flip-flops
Unit - I	**Minimization Techniques:** Number Systems – Floating Point Representation – 1's and 2's Complements – Signed number Addition and Subtraction – Codes – Boolean Algebra – Demorgan's Theorem – Canonical and Standard Forms – Minimization Techniques – Simplification of Boolean Functions using Karnaugh Map.
Unit - II	**Combinational Logic Design:** Logic Gates – Universal Gates – Half Adder – Full Adder – Half Subtractor – Full Subtractor – BCD Adder – Binary Multiplier and Divider – Multiplexers – De multiplexers –(74138) 3 to 8 Decoder – 74148 Priority Encoder – BCD to Seven Segment Decoder 7447/48 – Parity Generator and Checkers
Unit - III	**Flip-Flops:** Basic Latch circuits – S-R Flip-Flop – D Flip-Flop – J-K Flip-Flop – T Flip-Flop – Triggering of Flip-Flops – Asynchronous Inputs in Flip-Flops – Master Slave J-K Flip Flops – Racing Condition .
Unit - IV	**Counters And Registers: Asynchronous Counters**: Ripple Counter – Decade Counter –**Synchronous Counters:** Up/Down Counter – Design of MOD- n Counters – BCD Decade Counter – Ring Counter -**Registers:** 4- bit Shift Register – SISO Shift Register – SIPO Shift Register – PISO Shift Register – PIPO Shift Register.
Unit - V	**D/A and A/D Convertors:** Basic DAC Techniques – Weighted Resistor DAC – R-2R Ladder Type DAC -Monolithic DAC 0808 –Successive Approximation ADC – ADC 0808.

Text Book:

Digital Electronics, S.Salivahanan, S.Arivazhagan, Vikas Publishing -2012

Books for Reference:

Digital Design - M. Morris Mano - Pearson Education (3rd Edition)

Digital Principles – Leach, Malvino, TMH (6th Edition).

Fundamental of Digital Circuits- Anand Kumar- Prentice Hall of India Pvt. Ltd.

Digital Electronics – Dr. R. S. Sedha – S. Chand Publications.(3rd Revised Edition).

Outcomes	➢ Students will be able to use logical gates, universal gates to design logical circuits. ➢ Students will be able to use mux,dmux,encoder and decoder to design digital circuit using microprocessors and microcontrollers ➢ Students will be able to develop the skill to design combinational and

Semester - III				
Course Code	**Core Practical III**	**T/P**	**C**	**H/W**
22BEL3P1	**ANALOG AND DIGITAL ELECTRONICS LAB**	P	3	3

Objectives	**Analog IC's Any 12 Experiments (6 from each IC's)** ➢ Get knowledge to connect Op-Amp with power supply ➢ To understand how the Op-Amp is used for various applications ➢ To understand how the 555 timer operates in various modes ➢ To know how the Op-Amp perform filter operations ➢ To Understand the pin details of digital IC's and function of each logic gates with the help of the verification of truth table. ➢ To understand how the universal gates are used to design various logic gates ➢ To design combinational and sequential logical circuits using logical devices and various flip-flops respectively

1. Inverting and Inverting Summing Amplifier
2. Non Inverting and Non Inverting Summing Amplifier
3. Differential Amplifier
4. Voltage Follower and Instrumentation Amplifier
5. Differentiator and Integrator using OP-Amp
6. Schmitt Trigger
7. Construct Op-Amp Square Wave Generator
8. Construct Op-Amp Wien Bridge Oscillator
9. Construct Voltage regulator using 78XX]
10. Construct Dual Voltage Regulator using 78XX and 79XX
11. Construct AstableMultivibrator using 555 Timer
12. Construct Monostable Multivibrator using 555 Timer
13. Construct VCO using NE 566
14. RC Low Pass Filter using Op_Amp
15. RC High Pass Filter using Op_Amp

Digital IC's

16. Logic Gates Using IC's and verify its truth table
17. Design Logic gates using Universal NAND gate and verify its truth table
18. Design Logic gates using Universal NOR gate and verify its truth table.
19. Design and Implementation of Code conversion using logic gates
20. Implementation of Half Adder and Full Adder using logic gates.
21. Implementation of Half Subtractor and Full Subtractor using Logic Gates
22. Verification of Functionality of Multiplexer
23. Verification of Functionality of De multiplexer
24. Verification of functionality of Decoder.
25. Verification of functionality of Encoder.
26. Verification of the functionality of BCD to Seven segment Decoder/driver.
27. Implement S-R, D, J-K, T flip flops using logic Gates/IC's
28. Functional verification of universal shift registers using IC 7495.
29. Design and implementation of Ring counter using shift register.
30. Mod Counter

Outcomes	➢ Students will be able to develop their skill to handle Op-Amp for various applications and its circuit design. ➢ Students will be able to use digital IC's using their pin details and operating voltage

	➢ Students will be able to use mux, demux, encoder and decoder where ever it is required in digital circuit design. ➢ Students will be able to design combinational logical circuits and sequential logical circuits

Semester - IV				
Course Code	**Core Course V**	**T/P**	**C**	**H/W**
22BEL4C1	**ELECTRONIC COMMUNICATION SYSTEMS**	T	4	4

Objectives	➢ To understand electromagnetic wave propagation and study various types of propagations ➢ To understand how does an antenna transmit and receive the electromagnetic waves and study various types of antenna and its applications. ➢ To understand Analog communication, need for modulation, different types of AM modulation generation. ➢ To understand the function of AM transmitters and receivers ➢ To understand FM and PM, Generation of FM, Detection of FM, FM transmitter and receiver. ➢ To understand digital communication, digital transmission and reception and various shift keying in digital communication.
Unit – I	**Wave Propagation**: Block diagram of Communication system- Radio Frequency Spectrum – Electromagnetic Waves - Frequency and Wave length – The atmosphere – Radio wave Propagation – Ground wave – ionosphere wave – Space wave – Troposphere Wave – Maximum Unusable Frequency (MUF) – Lowest Unusable Frequency (LUF)
Unit – II	**Antenna:** The isotropic radiator – The Half wave dipole – Impedance and radiation resistance – Radiated Power and Efficiency – Antenna gain – The Yagi Beam antenna – Directional Characteristics – Other practical antenna – Feeders – Connectors – Standing wave ratio – Wave Guide.
Unit – III	**Amplitude Modulation:** Need for Modulation –Amplitude Modulation, modulation index and frequency spectrum - Generation of AM (Emitter Modulation)- Amplitude Demodulation (diode detector)- Double Side Band Suppressed Carrier generation Balanced Modulator – SSBSC generation Filter Method – SSB Detection – VSB modulation – AM Transmitter – AM Super Heterodyne Receiver.
Unit – IV	**Angle modulation:** Frequency and Phase modulation, modulation index and frequency spectrum, equivalence between FM and PM- Generation of FM (direct and indirect methods)- FM detector (Balanced Slope Detector, PLL). Block diagram of FM Transmitter and Receiver Comparison between AM, FM and PM.
Unit – V	**Digital Carrier Modulation Techniques**: Channel capacity- Sampling theorem- PAM- PDM –PPM modulation and detection techniques- Multiplexing- TDM and FDM- Block diagram of digital transmission and reception- Information capacity, Bit Rate, Baud Rate and M-ary coding- Amplitude Shift Keying (ASK)- Frequency Shift Keying (FSK)-Phase Shift Keying (PSK)- Binary Phase Shift Keying (BPSK) - Quadrature Phase Shift Keying (QPSK)

Reference Books

Couch, L.W. (2005). *Digital and analog communication systems*. Pearson Education.

Frenzel, L. E. (2002). *Communication electronics: Principles and applications*. TMH.

Hsu, H.P. (2006). *Analog and Digital Communication*. Tata McGraw-Hill.

Kennedy, G., & Davis, B. (1999). *Electronic communication systems*. TMH.

<table>
<tr><td colspan="2">Singh, R. P., & Sapre, S. D. (2008). Communication Systems, 2E. Tata McGraw-Hill Education.

Thomas, T.G., & Chandra Sekhar, S. (2006). Communication theory. Tata McGraw Hill.

Tomasi,W.(2007). Electronic communication systems: Fundamentals through Advanced. Pearson Education.</td></tr>
<tr><td>Outcomes</td><td>➢ Students will be able to know EM wave and its various propagation
➢ Student will be able to choose which type of antenna should be used in different transmission and detection applications.
➢ Student will be able to choose which type AM modulation is required for radio, TV and other applications.
➢ Student will be able to differentiate AM, FM and PM modulation and know FM transmission and reception.
➢ Student will be able to understand the advantage of digital communication and analog communication and also sampling and shift keying techniques used in digital communication.</td></tr>
</table>

Semester – IV				
Course Code 22BEL4C2	**Core Course VI**	**T/P**	**C**	**H/W**
	MICROPROCESSORS PROGRAMMING AND INTERFACING TECHNIQUES	T	4	4
Objectives	➢ To know the architecture, pin details and programming model, how to get control signals using logical digital circuits. ➢ To develop assembly language programs for simple applications and develop the skill to interface peripheral devices using programmable peripheral devices with 8085 microprocessor. ➢ To study various programmable interfacing peripheral devices for DMA, interrupt and serial communication. ➢ To know the 8086 16 bit microprocessor and its internal architecture to develop 8086 programming skill.			
Unit – I	**8085 Architecture And Programming:** The 8085 Microprocessor Pin Details – 8085 Architecture –, Microprocessor initiated operations and bus Organization - Demultiplexing AD0-AD7 – Generation of control Signals –Programming Model of 8085 – Instructions and timing – addressing modes – Instruction Set – Programming techniques – Simple Programs.			
Unit – II	**Interfacing I/O Devices Using 8255:** Basic Interfacing concept – Memory Mapped I/O – I/O mapped I/O – Memory Interfacing – Programmable I/O 8255A – LED interfacing – DIP Switch Interfacing – Seven Segment Display Interfacing Stepper Motor –interfacing – Hex Key Board –ADC Interfacing – DAC Interfacing – Temperature controller.			
Unit – III	**Programmable Interfacing Peripherals:** DMA Data Transfer – Interfacing 8257 DMA Controller-8085 Interrupts – Interfacing 8259 – Serial Data Communication – Interfacing 8251 and RS 232 – 8253/54 Timer and Counter			
Unit – IV	**8086 Hardware Architecture:** Pin Description – Operating Modes of 8086 – Pin Description for Minimum Mode – Pin Description for Maximum Mode – Register Organization of 8086 – BIU – EU – External Memory Addressing –Minimum Mode Bus Cycles – Memory Interfacing – Minimum Mode System Configuration – Interrupt Processing – Direct Memory Access.			
Unit – V	**Programming The 8086:** 8086 Addressing modes – Instruction set – Data Transfer Group – Control Transfer Group – Arithmetic Group –Logical Group – Control Transfer Group – Miscellaneous Instruction Groups – Simple Programs.			

Text Books:

Badri Ram. (2008). *Advanced Microprocessors and Interfacing.* Tata McGraw Hill (Unit IV and V).

Krishna Kant. (2013). *Microprocessors and Microcontrollers Architecture, Programming and System Design 8085,8086,8051,8096.* PHI learning Pvt. Ltd (Unit IV and V).

Ramesh S. Goanker. *Microprocessor Architecture, programming and Applications with the 8085*. Penram International Publishing, 5th Edition (Units I, II, and III).

Books for Reference:

Doughles V. Hall. *Microprocessor and interfering programming and Hardware* By Tata Mc Hill.

Rafiquzzaman, M. (2021). *Microprocessors and microcomputer-based system design*. CRC press.

Outcomes	➢ Students will be able to develop the skills to write an own assembly language programming ➢ Students will be able to understand the interfacing concept and develop the skill to interface the programmable interfacing peripherals and programming the various programmable devices to perform data transfer and control the I/O devices. ➢ Students will be able to develop the hardware and assembly Language Programming skill for 8085 and 8086 microprocessor system

Semester – IV				
Course Code 22BEL4P1	**Core Practical IV**	**T/P**	**C**	**H/W**
	COMMUNICATION AND MICROPROCESSOR LAB	P	3	3

Objectives	**Any Twelve Experiments (6 from each)** ➢ To design modulation and demodulation circuits for AM, FM and Shift keying. ➢ To develop assembly level language programming techniques to perform mathematical and logical operations. ➢ To develop interfacing and programming skill to interface incompatible I/O devices with 8085 and 8086 microprocessors.

1. DSB Amplitude Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Pulse Amplitude Modulation
4. Pulse Width Modulation
5. Amplitude Shift Keying
6. Frequency Shift Keying
7. Binary Phase Shift Keying
8. PLL Parameters using NE 565.
9. Study of TDM using IC 7475.
10. Frequency Multiplier using PLL.
11. .Block of data transfer
12. Addition and subtraction
13. Multiplication and division
14. Logical operations
15. Interfacing LED
16. Interfacing with DIP switches and LED
17. Interfacing with Seven Segment LED
18. Interfacing with Traffic Light controller.
19. Interfacing with Stepper Motor
20. Interfacing with HEX Keyboard

Outcomes	➢ Students will be able to design various modulation and demodulation circuits and measure its modulation index ➢ Students will be able to develop their skills on assembly language programming and interfacing techniques to design a microprocessor based system

Semester – V				
Course Code	**Core Course VII**	**T/P**	**C**	**H/W**
22BEL5C1	**EMBEDDED SYSTEM DESIGN**	T	4	4

Objectives	➢ To understand embedded system , embedded hardware and software ➢ To know the difference between microprocessor and microcontroller and its architecture ➢ To study the features, architecture, Programming model, how to develop an embedded coding using embedded C ➢ To acquire knowledge to programming I/O ports, Timers, Serial communication and interrupt ➢ To acquire skill to interface I/O devices with 8051 microcontroller
Unit – I	**8051 Architecture :** Features of 8051 – Pin description of 8051 – 8051 Microcontroller Architecture – 8051 oscillator and clocks – Program counter and data pointer – A and B Registers – Bank Registers –Flags –PSW - Internal RAM – Stack and Stack pointer – special Function Registers - memory organization – External Memory Interface.
Unit – II	**Programming Parallel I/O Ports and Interrupts:** Programming with Embedded C- 8051 Parallel I/O Ports – Port 0 – Port 1- Port 2 – Port 3- I/O Port Programming – I/O bit manipulation Programming - 8051 Interrupts – Initializing 8051 Interrupts – Interrupt Priority.-
Unit – III	**Programming Timers/Counters And Ext. Interrupts:** Timers and Counters – Timer and Counter Modes – Mode 0- Mode 1 –Mode 2 – Mode 3 Programming 8051 Timers – Counter Programming – Programming Timers 0 and 1 in 8051 – Programming Timer Interrupts – Programming External Hardware Interrupts.
Unit – IV	**Programming Serial Communication:** Serial Communication – Serial Communication Modes – Basics of serial communication – 8051 connection to RS232 - 8051 serial Port Programming – Programming the serial communication interrupt- AT commands
Unit – V	**Interfacing Techniques:** LED Interfacing – DIP switch Interfacing – Seven Segment Display Interfacing – Traffic controller interfacing – Stepper Motor Interfacing – DC motor Interfacing and PWM - Key board interfacing – LCD display Interfacing - Interfacing LM 35 temperature sensor DAC Interfacing – ADC Interfacing– sensor interfacing – GSM interfacing.

Text Books:

Kenneth J. Ayala. (2004). *The 8051 Microcontroller Architecture, Programming and Applications,* Penram International Publication, Second Edition -2004.

Mohammed Ali Maszidi. (2006). *The 8051 Microcontroller and Embedded Systems using Assembly and C.* Prentice Hall of India, Second Edition.

Outcomes	➢ able to handle various IDE for embedded programming ➢ Able to design hardware ➢ Able to enable I/O ports, serial communication using timers and interrupt by embedded programming ➢ Able to develop embedded software ➢ Able to download the firmware in flash memory of the microcontroller to operate their own embedded system

Semester –V				
Course Code	**Core Course VIII**	**T/P**	**C**	**H/W**
22BEL5C2	**POWER ELECTRONICS**	T	4	4

Objectives	➢ To study the construction, working function, modes of operations and its characteristics of the power electronics devices and its turn on mechanisms. ➢ To study various types of commutation techniques to turn off the thyristors ➢ To learn how thyristors operates as a rectifier and used to design inverter, chooper and SMPS circuits.
Unit – I	**Power Electronic Devices :** SCR Characteristics – Two Transistor Analogy – Series and Parallel connections of SCRs – Gate Characteristics of SCR – DIAC construction and working –V-I Characteristics – TRIAC Construction and Working – Modes of Operations –Thyristors Turn ON Methods.
Unit – II	**Firing Circuits**: Diode-Resistance Firing Circuit.- Diode-Resistance-Capacitance Firing Circuit.- UJT Firing Circuit. – Pulse Transformer Firing Circuit- Diac Firing Circuit.
Unit – III	**Commutating Circuits:** Line Commutation- Load Commutation- Forced Commutation- Gate Turn-off.- Voltage Commutation- Current Commutation- Pulse Commutation – Overvoltage Protection –Over current Protection –Gate Protection – Over temperature Protection.
Unit – IV	**Controlled Rectifiers:** Half-Wave Controlled Rectifier with Resistive Load – Half Wave Controlled Rectifier with Resistive and Inductive Load- Half-Wave Controlled Rectifier with Inductive Load and Flywheel Diode–Full-Wave Controlled Bridge Rectifiers.
Unit – V	**Inverter, Chopper and Switch Mode Regulator:** -Sine Wave Inverter – Square Wave Inverter Bridge Inverters –**Pulse**-Width Modulated Inverters**.** **Choppers:** Principle of a Chopper voltage commutated Chopper–**Switch Mode Regulator:** Buck Regulator – Boost Regulator- Buck-Boost Regulator- Switch Mode Power Supply (SMPS)

Text Book:

Alok Jain. *Power Electronics and its Applications*. Penram International

Books for Reference:

Mohan, N., Undeland, T. M., & Robbins, W. P. (2003). *Power electronics: converters, applications, and design.* John wiley & sons.

O.P. Arora. (2007). *Power electronics Laboratory: theory , Practice & Organization*. Narosa Publishing house.

Rashid, M.H. (2004). *Power electronics: Circuits, Devices and Applications, third Edition.* Pearson Education

Sen, P. C. (1987). *Power electronics*. Tata McGraw-Hill Education.

Outcomes	➢ Able to design circuit to turn on and turn off the thyristors. ➢ Able to use thryristors to design rectifier, inverter, chopper and SMPS circuits and get idea to trouble shooting the power electronics circuits.

Semester – V				
Course Code 22BEL5C3	**Core Course IX**	**T/P**	**C**	**H/W**
	COMPUTER NETWORKING	T	4	4
Objectives	➢ To study OSI layers and understand digital data communication and its requirements ➢ To study various data link control protocols ➢ To understand LAN with various topology and various protocols ➢ To understand WAN, switch, ATM protocol and internetworking devices			
Unit – I	**Data Communication:** The OSI Model – Digital data Transmission – MODEM – Signal Encoding and Decoding – Transmission Modes – Types of Error – Error Detection and Correction (CRC) – Line Configuration – DTE and DCE Interface – Multiplexing.			
Unit – II	**Data Link Control Protocol:** Flow control and Error Control – Stop and Wait Flow Control – Automatic Repeat Request ARQ – Stop and Wait ARQ – Go Back N ARQ – Selective Reject ARQ – Asynchronous Protocols – X Modem – Y Modem – Z Modem – Synchronous Protocol – Character Oriented Protocol (BSC) – Bit Oriented Protocol (HDLC).			
Unit – III	**Local Area Networks (LAN):** IEEE 802 Standards – Logical Link Control (LLC) – Media Access Layer Protocol (MAC) – CSMA CD Ethernet – Token Bus Control – Token Ring Control – FDDI – Distributed Queue Dual Bus – Switched Multimegabit Bit Data Service			
Unit – IV	**Wide Area Networks (WAN):** Circuit Switch – Packet Switch – Message Switching – X 2.5 – Frame Relay – ISDN – ATM Protocol – Internet Working Device – Repeater – Bridge – Routers – Gateways – Routing Algorithm.			
Unit – V	**Upper OSI Layers:** Session Layer Protocol – Presentation Layer protocol – Data Security – Encryption – Decryption – Authentication – Data Composition – Application Layer Protocol – MHS – File Transfer – Virtual Terminal – CMIP.			

Text and Reference Books:

BehrouzA.Forouzan. (2003). *Data Communications and Networking, – 2nd Edition*. TATA McGraw Hill

Brijendra Singh. (2006). *Data Communication and Computer Networks– 2nd Edition*. PHI.

William Stallings. (2004). *Data and Computer Communications-– 7th Edition*. PHI.

Outcomes	➢ Identify components required to design computer networks ➢ Able to use various protocols to design LAN with various topologies using various protocols ➢ Identify components and protocols required to design WAN network , ATM and internet

Semester – V				
Course Code 22BEL5C4	**Core Course X**	**T/P**	**C**	**H/W**
	ADVANCED COMMUNICATION SYSTEMS	T	4	4

Objectives	➢ To understand the basic principle, theory and medium required for optical communication system ➢ To understand cellular communication ➢ To understand Mobile network architecture ➢ To understand satellite communication and its signal transmission and reception
Unit – I	**Optical Communication**: Basic Optical Communication System – Classification of Fibers – Ray theory – NA and Multipath Dispersion of SI and GI Fibers – Attenuation – Optical Sources and Detectors – Point – Point Link System – Link Power Budget – Rise Time Budget – Wave Length Division Multiplexing – Optical Fiber Network – Bus Topology – Ring Topology – Star Topology.
Unit – II	**Cellular Communication:** Concept Of Cellular Mobile Communication – Cell and Cell Splitting- Frequency Bands Used in Cellular Communication – Absolute RF Channel Numbers(ARFCN) – Frequency Reuse- Roaming and Hand off – Authentication of the SIM Card of the Subscribers- IMEI Number, Concept of Data Encryption.
Unit – III	**Mobile Network Architecture:** Block Diagram of Cellular Mobile Communication Network- CDMA Technology,-CDMA Overview- Simplified Block Diagram of Cellular Phone Handset- Comparative Study of GSM and CDMA-2G, 3G and 4G Concepts.
Unit – IV	**Satellite Communication:** Introduction- Need- Satellite Orbits- Advantages and Disadvantages of Geostationary Satellites- Satellite Visibility- Satellite System – Space Segment- Block Diagrams of Satellite Sub Systems- Up Link- Down Link- Cross Link- Transponders (C- Band)- Effect of Solar Eclipse- Path Loss- Ground Station- Simplified Block Diagram of Earth Station.
Unit – V	**Satellite Access:** TDMA, FDMA,CDMA Concepts- Comparison of TDMA And FDMA- Satellite Antenna (Parabolic Dish Antenna) – GPS-Services Like SPS & PPS.-Concept of Bluetooth, Wi-Fi And Wimax.

Books for Reference:

Andrea Goldsmith.(2015). *Wireless communications.* Cambridge University.

Lathi, B. P. (2009). *Modern digital and analog Communication systems- 4rd Edition*. Oxford University press.

Martin S. Roden. *Analog & Digital Communication Systems-3rd Edition.* Prentice Hal. Englewood Cliffs.

Theodore S. Rappaport.(2001). *Wireless Communications Principles and Practice, 2nd Edition.* Pearson Education Asia.

Thiagarajan Vishwanathan. *Telecommunication Switching Systems and Networks*. Prentice Hall of India.

Tomasi, W. *Electronic Communication Systems: Fundamentals through Advanced-3rd Edition*. Pearson Education.

Outcomes	➢ Identify what are the components required to design optical communication

	system. And how the optical signal carries the information through the various types of optical fibers. ➢ Understand the mobile communication, and its network architecture ➢ Understand satellite communication and how it does access the information and working of GPS

Semester – V				
Course Code 22BEL5P1	**Core Practical V**	**T/P**	**C**	**H/W**
	EMBEDDED SYSTEM DESIGN LAB	P	4	6

Objectives	Any Twelve Experiments ➢ To learn the logics how to write a programme for code conversion ➢ To learn the interfacing techniques to design a hardware ➢ To learn how to work on various IDE ➢ To develop embedded C programme ➢ To know how to down load firmware in the flash memory using programmer

1. BCD to ASCII and ASCII to BCD.
2. Decimal to Hexa and Hexa to Decimal.
3. Interfacing with DIP switches and LED
4. Interfacing with Seven Segment LED
5. Interfacing with Traffic Light controller.
6. Interfacing with Stepper Motor
7. Interfacing with DC Motor speed control using PWM
8. Interfacing with HEX Keyboard
9. Interfacing with LCD
10. Interfacing with DAC
11. Generate wave forms using DAC
12. Interfacing with ADC.
13. Serial communication using RS232
14. Interfacing LM35 with LCD
15. Interfacing sensor with LCD
16. Interfacing GSM with LCD
17. Interfacing Blue tooth module with Android App

Outcomes	➢ Able to work on IDE and generate the firmware ➢ Able to download the firmware in the flash memory of the controller ➢ Identify the required components to design the embedded system and able to design the hardware. ➢ Able to develop embedded software for the given hardware to enable the embedded system.

Semester – V				
Course Code 22BEL5P2	**Core Course - VI**	**T/P**	**C**	**H/W**
	POWER ELECTRONICS AND COMPUTER NETWORKING LAB	P	4	6

Objectives	Any Twelve Experiments ➢ To study the characteristics of thristors ➢ To study turn on triggering circuits ➢ To study forced commutation ➢ To design halfwave and full wave rectifiers using SCR ➢ To design SCR application circuits ➢ To check the IP address and know file sharing concept using network and to check firewall and internet connectivity

1. SCR Characteristics
2. DIAC Characteristics
3. TRIAC Characteristics
4. UJT relaxation oscillator
5. R and RC Gate triggering circuit
6. UJT Firing circuit
7. Study of Forced commutation
8. Design half wave rectifier with R and RL load
9. Design full wave bridge rectifier using SCR
10. Design a voltage controller using SCR
11. SCR is used as a Relay
12. SCR Fire alarm circuit

Testing:

13. File sharing for each other system
14. File Sharing Enable and Disable
15. Ethernet Color Coding for Straight and Cross cables
16. IP Address Check
17. Systems Connectivity Check through Ping command
18. File sharing for each other system
19. File Sharing Enable and Disable
20. Firewall Status check
21. Windows Firewall Enable and Disable
22. Allow Port in Windows Firewall
23. Installing/uninstalling Basic software like Adobe Reader
24. Internet connectivity check
25. Setup Static/Dynamic IP Configuration
26. Test IP Scanning
27. Remote Desktop Connectivity Check
28. Listening Ports Number Check
29. Public and Private IP Check in the System
30. Internet speed check

Outcomes	➢ Able to understand turn on and turn off using gate current control using V_i characteristics of thyristors. ➢ Able to turn on and turn off SCR using firing and commutation circuit ➢ Able to design half wave and full wave rectifiers

	➢ Able to design circuit to use SCR for some applications ➢ Identify IP address, handling, enabling and disabling file sharing using network ➢ Able to check Fire wall status, internet connectivity and internet speed

Semester – VI			
Course Code 22BEL6I	**Internship**	**C** 24	**H/W** 30
Objectives	➢ To get industrial exposure ➢ To learn new techniques from the industrial experts ➢ To know the machineries requirement and operation ➢ To develop the skill and external resources		
Outcomes	➢ Able to enrich skill using hands on approach make a confident to become an entrepreneur or good hardware and software developer.		

<table>
<tr><th colspan="6">Semester – VI</th></tr>
<tr><td rowspan="2">Course Code
22BEL6E1</td><td colspan="2">DSE-I</td><td>T/P</td><td>C</td><td>H/W</td></tr>
<tr><td colspan="2">PHOTONICS AND OPTOELECTRONICS</td><td>T</td><td>6</td><td>6</td></tr>
<tr><td>Objectives</td><td colspan="5">➢ To understand the principles, terminologies of LASER and conditions for LASER
➢ To understand types of semiconductors and how the LASER action is obtained
➢ To Understand types of semiconductors used to design LED and study its working function and how to improve the wavelength of emission
➢ To study the various types of optical detectors and photovoltaic system</td></tr>
<tr><td>Unit - I</td><td colspan="5">Introduction to LASER: Basic principle of lasers – Absorption – Spontaneous Emission - stimulated emission - Einstein’s Relation – Condition for Stimulated Emission – Condition for Light Amplification – Population Inversion – Pumping – Pumping Methods – Metastable State – The Principle Pumping Scheme - Laser rate equations for Two, Three and Four level Laser Systems.</td></tr>
<tr><td>Unit - II</td><td colspan="5">SemiconductorLASER: LASER Diode Principle – LASER mode -Threshold current – Heterojunction Lasers –Modulation Response of ILD- ILD Structures- Distributed Feedback Laser - Quantum Well Laser -. Lasik Surgery and Holography.</td></tr>
<tr><td>Unit - III</td><td colspan="5">LED. LCD and Plasma Display: LED- Basic Principle of Operation - Radiative Recombination Process -Double Hetrostructure, Response time of LED - Carrier Configuration and Modulation Bandwidth – ELED - SLED . Liquid Crystal Display - Construction - Basic principle of emission - Plasma Display- Construction - Basic principle of emission.</td></tr>
<tr><td>Unit - IV</td><td colspan="5">Optical Detector: Basic Principle of optoelectronic Detection - Optical absorption Coefficient and Photo Current -Quantum Efficiency - Responsivity - Long Wave Length Cut-off - silicon P-N photodiodes- Hetrojunction photodiodes - Schottkey barrier diode - P-I-N photodiodes- Avalanche Photo diode -Photo conducting Detectors</td></tr>
<tr><td>Unit - V</td><td colspan="5">Photovoltaic Systems Analysis and Design: P-N Junction and formation of Solar Cells – Solar Cell Characteristics and Measurement – General Photo Voltaic Systems – PV Module – PV Array – The Diode – The Power Conditioning Unit – MPPT – Battery Charger/ Discharger – Inverter for AC Loads – Mounting of Panels for an Array – Sun Tracking – Concept of MPPT – Topology of MPPT.</td></tr>
<tr><td colspan="6">Text Books:
Khare, R.P.(2004). Fiber Optics and Optoelectronics (Unit-III and IV). Oxford University Press
Mukerjee, A.K., & Nivedita Thakur. (2011). Photovoltaic System Analysis and Design (Unit -V). Prentice Hall of India.
Nityanand Choudhary Richa Verma.(2011). Laser Systems and Applications (Unit-I&II. Prentice Hall of India.
Pallab Bhattacharya.(2005). Semiconductor Optoelectronic Devices (Unit III and IV)- Second Edition. Prentice Hall of India.</td></tr>
<tr><td>Outcomes</td><td colspan="5">➢ Knowledge will acquire to get LASER action in semiconductors and how to improve the optical wavelength by selecting the various semiconductor alloys.
➢ knowledge will acquire about hetrojunction semiconductor alloys to fabricate LED and LASER diode which will be useful for research
➢ Identify various types of optical detectors and know how it convert optical energy into electrical energy
➢ It will give knowledge to design photovoltaic system.</td></tr>
</table>

Semester - VI				
Course Code 22BEL6E2	**DSE-II**	**T/P**	**C**	**H/W**
	COMPUTER HARDWARE AND SYSTEM ASSEMBLING	T	6	6
Objectives	➢ To know the fundamentals of a computer. ➢ To know about mother boards and types of microprocessor used in the mother board ➢ To know types of memories used in the computer and to know the applications of memory to store the type of data and operating systems ➢ To study about various I/O devices used in the computer, how they are interfaced with the computer and its working principle ➢ To understand system assembling procedures in detail to assemble a system			
Unit - I	**Fundamentals of Computer:** Brief introduction with block diagram- SMPS – ATX/NLX Power Supply – display adapter – alphanumeric character generation system – MDA,CGA, HGA, EGA, VGA, SVGA, AGP.			
Unit - II	**Organization of motherboard** : Form factors – AT, ATX motherboards – different sections of mother boards – Latest Intel microprocessor – Comparison – co-processor – numeric processor – cache memory - chipsets – Bus mastering – ISA, EISA, VESA, PCI,EPCI, PCM CIA- comparison -USB architecture.			
Unit - III	**Memories:** RAM, DRAM –RAM – Refreshing – SIMM, DIMM, DDR technologies memory mapping –conventional memory, upper memory, Extended memory, expanded memory –Hard disk – construction– low level and high level formatting – HDD interfaces – HDC			
Unit - IV	**Input and Output :** Keyboard – organization – matrix – keyboard controllers – interfacing of keyboard – key switches – types -keyboard connectors – PS/2 connector, USB – mouse – working principles — opto electronic mouse, optical mouse , wireless Keyboard , wireless mouse, laser printers –LCD -LED monitors introduction.			
Unit - V	**System assembling procedure:** BIOS - CMOS setup - preventive maintenance – viruses -data recovery tools - safety precautions - troubleshooting tools - error codes – beep codes - POST sequences - diagnostic software - procedure of installing internet – UPS- latest system specifications Desktop-Laptop-Notebook – Palmtop.			

Books for Reference:

Bigelow, S. J. (2000). *Troubleshooting, maintaining & repairing PCs (p. 1448)*. Osborne/McGraw-Hill.

Craig Zacker, & John Rourke. (2017). *PC Hardware: The Complete Reference*. McGraw Hill.

Govinda Rajulu, B. *IBM PC clones*.

Manohar Lottia. (2006). *Modern Computer Hardware Course*. BPB Publications.

Mueller, S. (2003). *Upgrading and repairing PCs.* Que Publishing.

Outcomes	➢ Identify components used in a computer to form CPU ➢ Knowledge will be acquired the configuration of the processor, memories and hard disk. ➢ Knowledge will be acquired about types of processors used in a mother board ➢ Knowledge will acquired how the I/O devices are interfaced with mother board using various ports ➢ Skill will be developed to assemble a personal computer using the above knowledge.

Semester - VI				
Course Code	**DSE-III**	**T/P**	**C**	**H/W**
22BEL6E3	**ELECTRONIC INSTRUMENTATION**	T	6	6

Objectives	➢ To understand how to design a system to give high accuracy and minimize various errors ➢ To understand types of bridge circuits used for various physical parameter measurements. ➢ To understand design and working principles of important measuring instruments used to measure the parameters in an electronic circuit.
Unit - I	**Measurement Principles**: Measurement of physical parameters- Measurement system block diagram- Measurement Characteristics like Accuracy, Precision, Sensitivity, Linearity, Resolution, Reliability, Repeatability - Errors.
Unit - II	**Bridges and Transducers :** DC Bridge: Wheatstone Bridge – AC Bridges and Their Applications – Maxwell Bridge – Hay Bridge – Wien Bridge – Strain Gages –LVDT- Piezoelectric - Thermocouple – Thermistor – PN Junction Transducer - Photo resistors - Photodiodes - Photovoltaic cell.
Unit - III	**Test and Measuring Instruments:** Working Principle, Block diagram, Specification and Operating procedure for: Voltmeter -Ammeter - Analog Multimeter - Electronic Voltmeter- LCR Meter-DMM – DFM **-** Introduction to Oscilloscopes - Cathode ray tube- vertical and horizontal deflection system- delaylines - oscilloscope probes - elementary ideas about storage and sampling oscilloscope- Applications of oscilloscope.
Unit - IV	**Signal Generation And Test Systems**: Audio Oscillator- Function Generators- Pulse Generator -RF Generator - Sweep generator- Random Noise Generator. **Probes and Connectors:** Test leads, shielded cables, connectors, low capacitance probes, high voltage probes, RF demodulator probes, special probes for IC's, current probes. Testing an Audio Amplifier – Testing a Radio Receiver
Unit - V	**Special Measurement Systems: Wave Analyzers:** Operation of frequency selective wave analyzers and heterodyne wave analyzers and their application. Spectrum analyzer. Digital Thermometer- Lux meter –Tachometer – Speedometer- pH meter - Humidity meter.

Books for Reference:

Alber D. Helfrick, & William D.Cooper. (2012). *Modern Electronic Instrumentation and measurement techniques*. PHI.

Bouwens, *Digital Instrumentations*. TMH

Kalasi, H. S. *Electronic Instrumentation*.TMH

Rangan, C. S., Sarma, G. R., & Mani, V. S. V. (1983). *Instrumentation: devices and systems*. TMH.

Sawhney, A. K., & Sawhney, P. (2016). *A course in Electrical and Electronic Measurements and Instrumentation.* Dhanpat Rai & Company.

Outcomes	➢ Skill will be developed to handle various measuring instruments to measure the physical parameters and wave form generators to trouble shoot an electronic instrument. ➢ Skill will be developed to design an electronic instrument with minimum error. And high accuracy.

Semester - VI				
Course Code 22BEL6E4	**DSE -IV**	**T/P**	**C**	**H/W**
	BIOMEDICAL INSTRUMENTATION	T	6	6

Objectives	➢ To know types of clinical Laboratory instruments and its applications ➢ To get knowledge about X-ray computer tomography and Image processing application used in computer tomography ➢ To know and understand Nuclear medical imaging, MRI and ultrasonic imaging systems and its clinical applications
Unit - I	**Clinical Laboratory Instruments:** Operations of the Clinical Laboratory – Chemical Electrodes – Blood Gas Analyzer – Blood Cell Counter – Radiation Detector – Computer in the Chemical Laboratory – Selection of a Computer System
Unit - II	**X- Ray Computer Tomography:** CT Scanners and Detectors – Image Processing for Computer Tomography – Spiral/Helical Computed Tomography – Clinical Applications of Computer Tomography
Unit - III	**Nuclear Medical Imaging Systems :** Instrumentation the Gamma Camera – Image Characteristics – Clinical Application of Nuclear Medicine - Positron Emission Tomography – Radio Isotopes and Radio Pharmaceuticals – Radiation Dose.
Unit - IV	**Magnetic Resonance Imaging:** Nuclear Magnetism – Vector Description of Magnetic Resonance – Signal Excitation and Detection – NMR Spectrum
Unit - V	**Ultrasonic Imaging Systems:** Therapeutic Ultrasonic Equipment – Ultrasonic Imaging Equipment – Ultrasonic Blood Flow Meter – Applications of Ultrasound – Obstetrics and Gynecology – Breast Imaging – Cardiac Disease.

Text / Reference Books:

R.S.Khandpur, (2003). *Hand Book of Biomedical Instrumentation*. Tata McGraw Hill.

Rakesh Kumar, (2007). *Bio-Medical Electronics & Instrumentation*. S. K. Kataria& Sons.

Scott, K.N. (2007). *Text Book of Biomedical Instrumentation*. CBS Publishers.

Outcomes	➢ Identify different clinical Laboratory instruments and get knowledge about its working principle and applications. ➢ Knowledge will be acquired about x-ray computer tomography, Nuclear medical imaging, MRI and ultrasonic imaging systems in clinical applications.

Semester - VI			
Course Code 22BEL6PR	**PROJECT**	**C** 6	**H/W** 10
Objectives	➢ To identify the problem ➢ To learn data Collection and literature review ➢ To design circuits and develop the coding ➢ To learn how to prepare a project report		
Outcomes	➢ Able to design a project ➢ Able to write the report		

Semester - VI				
Course Code 22BEL6E5	**DSE-V**	**T/P**	**C**	**H/W**
	(A) MEDICAL ELECTRONICS	T	6	6
Objectives	➢ To understand the origin of bioelectric signals and electrodes used to pick up the signal for analysis. ➢ To understand ecg signal recording system and identified various components required to design ECG recorders using various lead system ➢ To understand the origin of EEG wave and study its characteristics and know how to fix the electrodes to pick up the EEG signals. ➢ To understand function of pacemaker fibrillators and to identify electronic components required to design various types of pacemakers ➢ To understand the concept of biotelemetry system design and communication.			
Unit - I	**Bio Electric Signals and Electrodes:** Origin of Bio Electric Signals – Transport of Ions through Cell Membrane – Resting Potential – Action Potential – Electrodes – Half Cell Potential – Electrode Jelly Interface – Micro Electrode – Needle Electrode – Surface Electrode.			
Unit - II	**Bio Potential Recorders:** ECG- ECG Lead Configuration – Bipolar Limb Leads – Augmented Unipolar Limb Leads – Uni Polar Chest Leads – ECG Recorder Design Setup – ECG wave form and its Characteristics - EEG – Origin of EEG – Action and Evoked Potential – Brain waves – Placement of Electrodes – EEG Recording Setup			
Unit - III	**Physiological Assist Devices:** Pacemakers – Energy Requirements to Excite Heart Muscle – Methods of Stimulation – Modes of Operations – Ventricular Asynchronous Pacemaker – Ventricular Synchronous pacemaker –Defibrillators – Types of Defibrillators – DC Defibrillator – Synchronized Defibrillator – Square Wave Defibrillator.			
Unit - IV	**Non Electrical Parameter Measurement:** Temperature measurement – Respiratory Measurement – Heart Rate and Pulse rate Measurement – Blood Pressure Measurement – Ultrasonic Blood flow meter – Hearing Aids.			
Unit - V	**Bio-Telemetry:** Elements of Bio Telemetry System- Design of Bio-Telemetry System – Radio Telemetry System–Single Channel Telemetry System: Transmission of Bioelectrical Signals– Hartley Type FM Transmitter – Pulsed Hartley Oscillator – Radio Telemetry with Sub Carrier – Multiple Channel Telemetry System			

Text Books:

Arumugam, M.(1997). *Bio Medical Instrumentation*. Anuraha Publications.

Khanpur, R.S. (2003). *Hand Book of Bio Medical Insturmentation - Second Edition*. Tata McGraw Hill

Rakesh Kumar. (2007). *Bio-Medical Electronics & Instrumentation*. S. K. Kataria& Sons.

Venkata Ram, S.K. (2000). *Biomedical Electronics and Instrumentation-First Edition*. Galgotia Publications Pvt.Ltd.

Books for Reference:

Joseph J.Carr. (2001). *Introduction to Biomedical Equipment Technology- Fourth Edition*. Pearson Education.

Leslie Cromwell. (2013). *Biomedical Instrumentation and Measurements- Second Edition*. PHI

Pvt. Ltd.	
Outcomes	➢ Knowledge will be acquired the origin of bioelectric signals ECG, EEG and identify the types of electrodes used to pick up the signal for analysis. ➢ Knowledge will be acquired the characteristics of ECG and EEG signal for analysis and identified the electronics components and circuits needed. ➢ Able to design pacemaker and defibrillator circuits ➢ Able to design a biotelemetry system

Semester - VI				
Course Code 22BEL6E6	DSE-VI	**T/P**	**C**	**H/W**
	JAVA PROGRAMMING	T	6	6
Objectives	➢ To acquire knowledge on features of Java, structure of java programming and basics of java ➢ To acquire knowledge about conditional, looping and I/O statements and its syntax ➢ To develop the knowledge to handling the array and user defined methods ➢ To develop the knowledge on exception, inheritance, polymorphism, abstraction and encapsulation			
Unit - I	**Introduction to Java Programming:** Java Features - Java Program Structure - Java Syntax-,Java keywords- Data Types in Java- Types of Variables in Java, Java Local Variables, Java Instance variables, and Java Static Variables or Class Variables - Types of Operators in Java,			
Unit - II	**Java Control Flow Decision Making, Looping and Branching Statements:** if – else if structure and nested if structure – for loop – while loop – do while loop – enhanced for loop – break, continue and return - Java Input and Output Operations			
Unit - III	**Array and User defined methods:** Arrays in Java- Create an Array in Java- define Array Size, and Assign values to Array elements. Creating different types of Arrays – Array of Strings - Array of Integers-Array of characters, Operations on Arrays like Find Array Size- copy Arrays- and print Arrays- Java User defined Methods			
Unit - IV	**Exception and Inheritance:** Java Arithmetic Exception, Java Null Pointer Exception, Java Number Format Exception, and Java Array Index Out of bounds Exception. Inheritance, Types of Inheritance – single level Inheritance, Multilevel Inheritance, and Multiple Inheritance. Java Class members, and Reuse Class Members with Inheritance.			
Unit - V	**Polymorphism, Abstraction and Encapsulation:** Types of Polymorphism in Java, Compile Time Polymorphism / Method Over Loading and Run-Time Polymorphism / Method Overriding -Abstraction- Create concrete and incomplete methods,-creates Abstract classes and reuse Abstract Classes- Encapsulation - Create getter and setter methods.			
Reference Books: Balagurusamy, E.(2019). *Programming with Java- VI th Edition*. Mc Graw Hill India. Bloch Joshaua,.(2012). *Effective Java- Second Edition*. Wesley Professional. Kathy Sierra. (2019). *Head First Java- Second Edition*. O'Reilly. Krishna Rungta, (2019). *Learn Java in 1 Day- 1st Edition*. UdayKamath, & Krishna Choppella. (2019). *Java Machine Learning, 1st Edition Ingram Short title*.				
Outcomes	➢ Able to develop simple programs to develop the java programming skills ➢ Able to handle arrays and user defined methods ➢ Able to handle exception and inheritance, polymorphism, abstraction and Encapsulation. ➢ Skill will be developed on java programming			

Semester - VI				
Course Code 22BEL6E7	**DSE -VII**	**T/P**	**C**	**H/W**
	INTERNET OF THINGS WITH ARDUINO	T	6	6

Objectives	➢ To understand Smart Objects and IoT Architectures ➢ To learn about various IOT-related protocols ➢ To build simple IoT Systems using Arduino ➢ To understand data analytics and cloud in the context of IoT ➢ To develop IoT infrastructure for popular applications
Unit - I	**Introduction**: **Introduction to Internet of Things:** Characteristics of IoT- Design principles of IoT - IoT Architecture and Protocols - Enabling Technologies for IoT- IoT levels - IoTvs M2M
Unit - II	**Sensors and IoT Design Methodology**: Classification of Sensors - Working Principle of Sensors - Criteria to choose a Sensor -Generation of Sensors- Design methodology- Challenges in IoT Design- IoT System Management - IoT Servers
Unit - III	**Basics of Arduino:** Introduction to Arduino **–** Arduino Uno –Arduino Mega - Arduino Nano –Steps to installArduino IDE– Steps to write a program with Arduino IDE – Basic commands for arduino
Unit - IV	Interfacing with Arduino **Arduino :** Interfacing LED – Interfacing LCD using various protocol – interfacing relay - Play with Digital Sensor - Play with Analog Sensor - Interfacing with DC motor – interfacing with Stepper motor – interfacing with Servo motor – Interfacing with GSM – Interfacing with Blue tooth – Interfacing with RF modem(2.4GHz)
Unit - V	**Connecting to the Cloud: Smart IoT Systems:** DHT11 Data Logger with Thing Speak Server- Ultrasonic Sensor Data Logger with Thing Speak Server - Air Quality Monitoring System and Data Logger with Thing Speak Server - Smart Motion Detector and Upload Image to gmail.com

Text and Reference Books:

Raspberry Pi and Arduino. CRC Press.

Singh, R., Gehlot, A., Gupta, L. R., Singh, B., & Swain, M. (2019). Internet of things with Singh,

R., Gehlot, A., Singh, B., & Choudhury, S. (2017). *Arduino-based embedded systems: interfacing, simulation, and LabVIEW GUI*. CRC Press.

Outcomes	➢ Analyze various protocols for IoT ➢ Develop web services to access/control IoT devices. ➢ Design a portable IoT using Arduino ➢ Deploy an IoT application and connect to the cloud. ➢ Analyze applications of IoT in real time scenario