MANGALORE UNIVERSITY

Curriculum
for B.Sc. / B.Sc.(Hons.)

as per

NEP 2020

2021-22
and onwards

SUBJECT: ELECTRONICS

Department of Electronics

Mangalagangotri. 574 199

Preamble

This model curriculum content for B.Sc (Honours) Electronics as per NEP-2020, is intended to enable the graduates to respond to the current needs of the industry and equip them with skills relevant for national and global standards. The framework encourages innovation in teaching-learning process and appropriate assessment of student learning levels.

Introduction

B.Sc (Honours) Electronics is a program which needs to develop a specialized skill set among the graduates to cater to the need of industries.

The curriculum is designed to help learners to analyze, appreciate, understand and critically engage with learning of the subject and also to provide better learning experience to the graduates. Apart from imparting disciplinary knowledge, the curriculum is aimed to equip the graduates with competencies like problem solving and analytical reasoning which provide them high professional competence.

The Department/Institute/University is expected to encourage its faculty concerned to make suitable pedagogical innovations, in addition to teaching/learning processes suggested in the model curriculum, so that the Course/Programme learning outcomes can be achieved.

Significance of Electronics

In recent years, Electronics has made unprecedented growth in terms of new technologies, new ideas and principles. The research organizations and industries that work in this frontier area are in need of highly skilled and scientifically oriented manpower. This manpower can be available only with flexible, adaptive and progressive training programs and a cohesive interaction among the institutions, universities, and industries. The key areas of study within subject area of Electronics comprise of Semiconductor Devices, analog and digital circuit design, microprocessors & Microcontroller systems, computer coding/programming in high level languages etc. and also modern applied fields such as embedded systems, data communication, robotics, control systems, etc.

Eligibility criteria

Students who have passed PUC Science of Karnataka Pre University Education Board or equivalent 10+2, ITI or Diploma in any stream are eligible for the B.Sc. / B.Sc. (Hons.) UG programme in Electronics.

Program Objectives

The overall Objectives of the B.Sc (Honours) Electronics programme are to:

1. Provide students with learning experiences that develop broad knowledge and understanding of key concepts of electronics and equip students with advanced scientific / technological capabilities for analyzing and tackling the issues and problems in the field of electronics.
2. Develop ability in students to apply knowledge and skills they have acquired to solve specific theoretical and applied problems in electronics.
3. Develop abilities in students to design and develop innovative solutions for benefits of society.

4. Provide students with skills that enable them to get employment in industries or pursue higher studies or research assignments or become entrepreneurs.

Program outcome

1. Ability to apply knowledge of Logic thinking and basic Science for solving electronics related problems
2. Ability to perform electronics experiments, as well as to analyse and interpret data.
3. Ability to design and manage electronic systems or processes that conforms to a given specification within ethical and economic constraints.
4. Ability to identify, formulate, solve and analyze the problems in various sub disciplines of electronics.
5. Ability to use Modern Tools / Techniques.

Tentative Program Structure
(Major Discipline: ELECTRONICS)

Semester	Discipline Core(DSC)	Title of the Paper	Open Elective(OE)
1	DSC1	Electronic Devices and Circuits	OE1.1:Domestic Equipment Maintenance OE1.2: Renewable Energy and Energy Harvesting OE1.3:Power Systems and E-Vehicles OE 1.4: PCB Design and Fabrication
2	DSC2	Analog and Digital Electronics	OE 2.1: Consumer Electronics OE2.2: Electronics for everyone OE2.3: Mobile communication OE2.4:Mobile Application Programming
3	DSC3	Digital Design Using Verilog and Programming in C	OE3.1: Robotics OE 3.2: Introduction to Nano Science & Nano Electronics OE3.3: Medical Electronics OE3.4: Solar Energy, Devices and Applications OE 3.5: IC Fabrication Techniques
4	DSC4	Electronic Communications –I	OE 4.1:App Developments OE 4.2: MEMS and Sensors OE4.3:IoT and Applications OE4.4:Virtual Reality & Real Time Applications
			Discipline Specific Elective (DSE)
5	DSC5 DSC6	Microcontroller 8051 and PIC Electronic Communications - II	DSE 1: Computer organization DSE2:RFIDTechnology DSE3: Photonics

6	DSC7 DSC8	Power Electronics, PLCs, Sensors, Transducers, and Instrumentation IOT and 5G communications	DSE 4: Cryptography DSE5:ControlSystems DSE6: Project work(0+1+2)
7	DSC9 DSC10 DSC11	Signal sand Systems Embedded Systems Microwave Communications	DSE7:Wireless communication DSE 8: Python Programming DSE9:Mechatronics
8	DSC12 DSC 13 DSC14	Digital Signal Processing VLSI Designing Image Processing	DSE 10: ARM Processor DSE 11: Computer Network DSE 12: AI, ML and Python Research Project

Proposed Curriculum Frame work for Multidisciplinary Four-Year Under graduate Programme / Five-year Integrated Master's Degree Programme

YEAR	OBJECTIVES	NATURE OF COURSES	OUT COME	NO. OF COURSES
1st year– (1st and 2nd Semesters)	Understanding the basic concepts	1.Major Core Courses		1+1
		2. Minor/Related Discipline	Understanding of Disciplines	1+1
		3. Languages	Language Competency	2+2
		4. Ability Enhancement Compulsory Courses	Gaining perspective of context/Generic skills	1+1
		5.SkillEnhancement / Development Courses	Basic skills sets to pursue any certificate level jobs	1+1
EXIT OPTION WITH CERTIFICATE				
2nd Year (3rd and 4th Semesters)	Focus and Immersion	1. Major Core Courses	Understanding of disciplines	2+2
		2. Minor/Related Discipline	Gaining perspective of context	1+1
		3.AbilityEnhancement	Skill sets to pursue vocation	1+1
		4.SkillbasedVocational	Development of various Domains of mind & Personality	1+1
		5.Extra-curricularActivities		1+1
EXIT OPTION WITH DIPLOMA				
3rd Year (5th & 6th Semesters)	Real time Learning	1. Major Discipline Core and Elective Courses	In depth learning of major and minor disciplines,	2+2
		2. Minor Discipline/ Generic or Vocational Electives/	Skill Sets for employability.	
		Field based Learning / Research Project	Exposure to discipline beyond the chosen Subject	1+1
			Experiential learning/Research.	1+1

EXIT OPTION WITH BACHELOR DEGREE				
4thYear (7^{th} & 8^{th} Semesters)	Deeper Concentration	Major Discipline Core and Elective Courses Research/Project Work with Dissertation	Deeper and Advanced Learning of Major Discipline Foundation to pursue Doctoral Studies & Developing Research competencies	4+4 4+4
EXIT OPTION WITH HONOURS DEGREE				
5thYear (9^{th}&10^{th} Semesters)	Master of the subject	Major Discipline Core and Elective course / Research / Project Work with Dissertation	Deeper and Advanced Learning of the Major Discipline towards Gaining proficiency over the subject	4+4 /6+6
MASTERS DEGREE				

COURSE PATTERN AND SCHEME OF EXAMINATION for B.Sc. / B.Sc. (Hons.) as per NEP (2021-22 and onwards)

SUBJECT: ELECTRONICS

Sl No	Semester	Title of the Paper	Teaching Hours	Hours /week		Examination Pattern Max.Marks /Paper				Duration of Exam (hours)		Total Marks / paper	Theory Credits	Practical Credits
						Theory		Practical						
				Theory	Practical/ Demo	Exam	IA	Exam	IA	Theory	Practical			
1	I	**ELE-CT1:**Electronic Devices and Circuits	**56**	**4**	**4**	**60**	**40**	**25**	**25**	**2**	**4**	**150**	**4**	**2**
		ELE-OE 1.1/1.2/1.3	**45**	**2**	**1**	**30**	**20**	**-**	**-**	**2 ***	**-**	**50**	**2**	**1**
2	II	**ELE-CT2:** Analog and Digital Electronics	**56**	**4**	**4**	**60**	**40**	**25**	**25**	**2**	**4**	**150**	**4**	**2**
		ELE-OE 2.1/2.2/2.3/2.4	**45**	**2**	**1**	**30**	**20**	**-**	**-**	**2***	**-**	**50**	**2**	**1**

***Questions from practicals have to be included in theory examinations of Open Electives (Since electronics is a practical oriented subject)**

Question paper pattern:

The theory question paper be set for 60 marks and shall have 4 units of 15 marks each covering all the syllabus. Each Unit can have sub questions along with choice.

Basis for Awarding Theory Internal Assessment Marks:

Sl No	Particulars	IA Marks
1	Minimum of Two internal Tests	**25**
2	Assignments /Seminar / Case Study / Project work / Reports on - visits to industries/exhibitions/science centres / active participation in Electronics competitions, etc.	**15**
TOTAL Theory IA Marks		**40**

Basis for Awarding Practical Internal Assessment Marks:

Sl No	Particulars	IA Marks
1	Practical Test	**10**
2	Report on datasheet of electronic devices / Seminar on electronics experiments, etc.	**08**
3	Active participation in practical classes	**07**
TOTAL Practical IA Marks		**25**

Basis for Awarding Practical Marks:

Sl No	Particulars	IA Marks
1	Records	**05**
2	Circuit Diagram/ Porgram	**05**
3	Conduct of Practical	**05**
4	Results and Graphs	**05**
5	Viva	**05**
TOTAL Practical Marks		**25**

Syllabus

Semester- I

ELE-CT1: ELECTRONIC DEVICES AND CIRCUITS

(Credits: Theory – 04, Practical – 02) Total Teaching hours: 56

Course Objectives

Upon completing the course, ELE-CT1, the student will be able to understand various fundamental principles of network analysis, number systems and Boolean algebra and become familiar with the basic operation of electronic devices and circuits which are the building blocks of all electronic circuits, devices and gadgets.

UNIT-1 **14 Hours**

Electronic Components: Electronic passive and active components, types and their properties, Concept of Voltage and Current Sources, electric energy and power.(Qualitative only)

Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer theorems. DC analysis of RC and RL circuits.AC analysis of RLC series and parallel Resonant Circuits.

PN Junction Diode: Ideal and practical diodes, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, Zener diode, Reverse saturation current, Zener and avalanche breakdowns . **Rectifiers**-Half wave and Full wave (center tap and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable).

UNIT-2 **14 Hours**

Voltage regulator: Block diagram of regulated power supply, Line and Load regulation, Zener diode as voltage regulator – circuit diagram, load and line regulation, disadvantages. Fixed and Variable IC Voltage Regulators (78xx, 79xx, LM317), Biased Clippers (shunt type) and clampers (Qualitative analysis only), **Bipolar Junction Transistor:** Construction, types, CE,CB and CC configurations (mention only), VI characteristics of a transistor in CE mode, Regions of operation (active, cut off and saturation), leakage currents (mention only), Current gains α , β and and their inter-relations, dc load line and Q point. Applications of transistor as a switch - circuit and working.(Numerical examples wherever applicable).

UNIT-3 **14 Hours**

Transistor biasing and Stabilization circuits- Fixed Bias and Voltage Divider Bias.Thermal runaway, stability and stability factor.Transistor as a two-port network, h-parameter equivalent circuit.

Amplifier: Small signal analysis of single stage CE amplifier using h-parameters. Input and Output impedances, Current and Voltage gains. Advantages of CE amplifier. Class A, B and C Amplifiers (qualitative).

Types of coupling, Two stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product, Darlington transistor, Current gain.

Special semiconductor diodes: Varactor diode, LED, LCD and solar cell – construction, operation and applications, 7-segment display, concept of common anode and common cathode types.(Numerical problems, wherever applicable)

UNIT-4 **14 Hours**

Number System: Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, Binary arithmetic; addition, subtraction by 1"s and 2"s complement method, BCD code (8421code), Gray code -error checking and correction codes (Only parity check).

Boolean Algebra: Constants, variables, operators, basic logic gates-AND, OR, NOT, Positive and negative logic, Boolean laws, Duality Theorem, De Morgan"s Theorem, simplification of Boolean expressions-SOP and POS. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. (Numerical examples wherever applicable).

Course Outcomes: At the end of this course, students will be able to
1.Study and analyze basic networks using network theorems in a systematic manner.
2. Build simple electronic circuits used in various applications.
3. Describe the behaviour of basic semiconductor devices
4. Reproduce the I-V characteristics of diode/BJT devices
5. Describe the frequency response of BJT amplifiers.
6. Explain the behaviour, characteristics and applications of Varactor diode, LED, LCD and solar cells.
7. Apply standard device models to explain/calculate critical internal parameters of semiconductor devices.
8. Understand and represent numbers in powers of base and converting one from the other, carry out simple arithmetic operations.
9. Understand the basic knowledge of Digital system building blocks, effectively can construct simple digital designs with the knowledge of Boolean algebra.

Reference Books:
1. Robert L Boylestad, "Introductory circuit analysis", 5th edition., Universal Book 2003.

2. R.S.Sedha, “A Text book of Applied Electronics”, 7th edition., S. Chand and Company Ltd. 2011
3. A.P. Malvino, “Principles of Electronics”, 7th edition .TMH, 2011. 4. Electronic devices and circuit theory by Boylestad, Robert Nashelsky
5. David A. Bell “ Electronic Devices and Circuits”, 5th Edition, Oxford Uni. Press, 2015
6. Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994) 7
7. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
8. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
9. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
10. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
11. M. Nahvi& J. Edminister, “Electrical Circuits”, Schaum‟s Outline SeriesTMGH2005
12. S. A. Nasar,” Electrical Circuits”, Schaum‟s outline series, Tata McGraw Hill, 2004.
13. J. Millman and C. C. Halkias, “Integrated Electronics”, Tata McGraw Hill, 2001
14. A.S. Sedra, K.C. Smith, A.N. Chandorkar “Microelectronic circuits”, 6th Edn., Oxford University Press, 2014
15. J. J. Cathey, “2000 Solved Problems in Electronics”, Schaum‟s outline Series, TMG1991

ELE-CP1: Electronic Devices and Circuits – Lab
(Hardware and Circuit Simulation Software)

Minimum of TEN Experiments to be performed excluding demonstration experiments

1. Demonstration Experiment: Familiarization with
a) Electronic components
b) Resistance in series, parallel and series-parallel
c) Capacitors and inductors in series and parallel
d) Multimeter and LCR meter – checking of components / measurements.
e) Voltage sources in series, parallel and series-parallel
f) Voltage and current dividers
g) Measurement of Amplitude, Frequency & Phase difference using Oscilloscope
2. Verification of Thevenin’s and Maximum Power Transfer Theorem.
3. Verification of SuperpositionTheorem.
4. Study of the I-V Characteristics of (a) p-n junction Diode, and (b) Zener diode.
5. Study of the I-V Characteristics of LEDs of two different colours and 7-segment display.
6. Study of Half wave rectifier without and with shunt capacitor filter– ripple factor for different values of filter capacitors.
7. Study of full wave bridge rectifier without and with shunt capacitor filter – ripple factor for different values of filter capacitors.
8. Study of Zener diode as a Voltage Regulator using bridge rectifier with shunt capacitor filter [Load and line regulation].
9. Study of Clipping, Clamping and Voltage Multiplier circuits.
10. Designing and testing of fixedpositive and negative voltage regulators using 78xx and 79xx series ICs (Using bridge rectifier and shunt capacitor filter).
11. Designing and testing of variable voltage regulator using IC LM317 (Using bridge rectifier and shunt capacitor filter).

12. Study of Transistor characteristics in CE configuration – determination of h-parameters.

13. Study of Fixed Bias and Voltage divider bias circuits – comparison for different β values.

14. Study of single stage CE amplifier (frequency response, input and output impedances in mid-band)

15. Study of two-stage RC-coupled CE amplifier (AV1, AV2, AV) at mid-band frequency.

16. Study of Series and Parallel Resonance circuits – determination of its

(a) Resonant frequency

(b) Impedance at resonance

(c) Bandwidth

(d) Quality Factor

17. Verification of truth tables of OR, AND, NOT, NAND, NOR, XOR and XNOR gates using respective ICs. Realization of XOR and XNOR using basic gates.

18. Universal property of NAND and NOR gates.

19. Binary to Gray and Gray to Binary code conversion and parity checker using XOR gates IC 7486.

ELE-OE1.1: DOMESTIC EQUIPMENT MAINTENANCE

Course Outcomes(COs):

Atthe end ofthe coursethestudent should beableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving in various fields of electronics both in industries andresearch.
2. To acquire experimental skills, analyzing the results and interpret data.
3. Ability to design / develop / manage /operation and maintenance of sophisticated electronic gadgets /Systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formula to solve the electronic related issues and analyze the problems in various sub disciplines of electronics.
5. Capability to use the Modern Tools / Techniques for the operation and maintenance of the domestic electrical / electronic gadgets
6. Capability to use the Modern Tools/ Techniques.

UNIT – 1 **15 Hrs**

Geyser: Construction and working, parts and manufacturing process, types. Common faults and their troubleshooting: Dripping geyser overflow, overheating, steam or hot water escaping from overflow, water leaking through the ceiling, no hot water, water not hot enough, poor hot water pressure. Induction cooker: Construction and working, parts and manufacturing process, types. Common faults and their troubleshooting: Cooker fuse blown, cooker buttons not working, cook top shuts off while cooking, food not get cooked or heated properly, over heating and uneven heating, display keep flashing, weird noises–crackling, fan noise, humming sound, clicking.

UNIT– 2 **15 Hrs**

MicrowaveOven: Working, raw material and manufacturing process, types, Common faults and their troubleshooting: Microwave does not heat, runs then stops, buttons do not work, plate do not spin, bulb does not turn ON during operation, sparking inside, shuts OFF after few seconds.

Refrigerator: Working, raw material and manufacturing process, electrical wiring diagram, types of refrigerator. Common faults and their troubleshooting: fridge not cooling, fridge not defrosting, leaking water, freezing food light not working, freezer is cooled but fridge stays warm, dead refrigerator, not enough cooling, keeps running, leakage, makes noise. Replacement procedure for:seal(gasket), evaporator fan motor, PTC relay, thermostat, compressor,bulb.

Demonstration Experiments: 1.Working of Geyser.

2. Working of Microwave Oven.

3.Working of Induction Cooker.

UNIT– 3 **15Hrs**

AirConditioner: Working, raw material and manufacturing process, electrical wiring diagram, types. Common Faults and their trouble shooting: Faults in following parts of AC: Filter, thermostat, refrigerant leaks, breakers, capacitors, compressor, evaporator coils, condenser coils, warm contactor. General faults: AC UNIT has an odour, shuts ON and OFF repeatedly, does not blow cold air, repeatedly tripping a circuit breaker, indoor UNIT is leaking water inside the room, outdoor UNIT is making an unusually loud sound, room is not getting cold enough, AC not turning ON.

Demonstration Experiments: 1.WorkingofAir Conditioner. 2. Working of Refrigerator.

References

1. Electronic Instruments and Systems: Principles, Maintenance and Troubleshooting, R.G. Gupta TMH, 2001.
2. Modern Electronic Equipment: Troubleshooting, Repair and Maintenance, R S Khandpur, TMH, 1987.
3. Electronic fault diagnosis by G.C. Loveday, A.H. Longman , 4th Edition,1994.

ELE-OE1.2:RENEWABLEENERGYANDENERGYHARVESTING

CourseOutcomes(COs):

At the end of the course the student should beableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving invariousfields of electronics both in industriesand research.
2. Toacquireexperimentalskills, analyzing theresultsandinterpretdata.
3. Ability to design / develop / manage / operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within

ethical andeconomicconstraints.

4. Capacity to identify and implementation of the formula to solve the electronic relatedissuesand analyzethe problemsin various sub disciplines ofelectronics.
5. Capabilityto usethe Modern Tools / Techniquesof theenergydemands

UNIT – 1 **15 Hrs**

Fossil fuels and Alternate Sources of energy: Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Solar energy: Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models, equivalent circuits, and sun tracking systems.

UNIT – 2 **15 Hrs**

Wind Energy harvesting: Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid inter connection topologies.

Demonstration Experiments: 1.Demonstration of training modules on solar energy, wind energy etc.

Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics, and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power ,Ocean Bio-mass.

Geo thermal Energy: Geo thermal Resources, Geothermal Technologies.

UNIT – 3 **15 Hrs**

Hydro Energy: Hydro power resources, hydro power technologies, environmental impact of hydro power sources.

Piezo electric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezo electricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications; Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

DemonstrationExperiments:1. Conversion of vibration to voltage using piezo electric voltages.
2. Conversion of thermal energy into voltage using thermoelectric module.

References

1. Non-conventional energy sources, B.H. Khan, McGraw Hill., 3rdEdition,2017
2. Solar energy-Principles of Thermal collection and Storage. Suhas P Sukhatme, 15th Edition, TMH., 2006
3. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University

Press. 3rd edition, 2012
4. Renewable Energy Source sand Emerging Technologies, Kothari D P, Singhal K C, Ranjan Rakesh,2nd Edition, PHI Learning, New Delhi,2011
5. Solar Energy: Resource Assessment Handbook, P.Jayakumar, e-book.,2009.

ELE-OE1.3:POWER SYSTEMS AND E-VEHICLES

CourseOutcomes (COs):

Atthe end ofthe coursethestudent should beableto:

1. Acquire the knowledge of generation and electricity distribution systems
2. Understand working of Electric Vehicles and recent trends
3. Analyse different power converter topology used for electric vehicle application
4. Develop the electric propulsion Unit and its control for application of electric vehicles

UNIT – 1 **20 Hrs**

Generation of and Distribution of Electricity: Mention of hydroelectric generator, diesel generator, thermal generator, wind power, solar, ocean waves. Generation of DC power– Mention of batteries. Single phase, Two phase and Three phase. Transformers, Power transmission and distribution. Domestic electrical wiring– connection from AC line to the meter, sockets, mention of phase neutral and the need of earthing. Mention of electric shock and safety. Mention of power type (ac or dc) and current ratings for home appliances. Mention of tester. Electric motor working principle.Inverter, Uninterrupted Power supply (UPS)–online and offline UPS, SMPS.

DemonstrationExperiments: SMPS:Blockdiagram andworking of Inverter

UNIT – 2 **25 Hrs**

E-Vehicles: Electric and Hybrid Electric Vehicles Configuration of Electric Vehicles, Performance of Electric Energy storage for EV and HEV Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Super Capacitors. Power Electronic Converter for Battery Charging, charging methods for battery, Termination methods, charging from grid.

DemonstrationExperiments: 1.Typesof motors and transformers used in household appliances. 2. SMPS:Block diagram andworking Inverter.

Simulation and analysis of electrical systems using MATLAB.

References

1. Electrica Circuits, K.A.Smith and R.E.Alley,Cambridge University Press,2012.
2. AText Book in Electrical Technology- BL Theraja-S Chand &Co., 2005
3. Performance and design of AC machines-MGSay,CBS Publishers and Distributers

Pvt Ltd.,3rd Edition, 2002, e-book edition 2017.
4. Basic Electrical Engineering- v k Mehta and Rohit Mehta, 6th Edition, S Chand and Company, 2006
5. M.Ehsani,Y.Gao,S.Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, 1stedition, CRC Press, 2004
6. IqbalHusain,Electric and Hybrid Vehicles: Design Fundamentals, 3rd Edition, CRC Press, 2021
7. SheldonS.Williamson,Energy Management Strategies for Electricand Plug-in Hybrid Electric Vehicles,Springer, 2013.
8. C.C.Chan and K.T.Chau ,Modern Electric Vehicle Technology, OXFORD University Press,2001
9. Chris MiM.AbulMasrur, David WenzhongGao, Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Wiley Publication, 2011.

ELE-OE 1.4- PCB DESIGN AND FABRICATION

Course Outcomes(COs):

Upon the completion of this course, students will demonstrate the ability to:

1. Understand basics of PCB designing.
2. Apply advanced techniques, skills and modern tools for designing and fabrication of PCBs.
3. Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
4. Understand concepts of Packaging.

UNIT – 1 **15 Hrs**

Introduction to Printed circuit board: Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

Design rules for PCB: Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

UNIT – 2 **15 Hrs**

Introduction to Electronic design automation (EDA) tools for PCBdesigning: Brief Introduction of various simulators, SPICE and PSPICE Environment,Selecting the Components Footprints as per design, Making New Footprints, AssigningFootprint to components, Net listing, PCB Layout Designing, Auto routing and manualrouting. Assigning specific text (silkscreen) to design, creating report of design, creatingmanufacturingdata (GERBER) for design.

Introduction printed circuit board production techniques: Photoprinting, film- master production, reprographic camera, basic process for double sided PCBs photoresists, Screen printing process, plating, relative performance and quality control, etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. Demonstration.

UNIT -3 **15 Hrs**

PCB design for EMI/EMC: Subsystem / PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to IntegratedCircuit Packaging and footprints, NEMA and IPC standards

PCB Technology Trends: Multilayer PCBs. Multi wire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

Demonstration : Demonstration on the PCB designing and etching experiments.

References

1. Printed Circuit Board Design, Fabrication AssemblyandResting.R.S.Khandpur,TMH,2006
2. Printed circuit Board Design and technology,Walter C.Bosshart,TMH,1983
3. Printed Circuits Handbook .Clyde F. Coombs ,Jr, Happy T .Holden, 6thEdn., TMH Education,2016.
4. Complete PCB Design Using OrCAD Capture and PCB. Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2ndEdition.,2019.
5. Introduction to System-on-Package–miniaturization of entire system, Rao R Tummala & Madhavan Swaminathan,TMH, 2008.
6. EMC and Printed Circuit Board Design –Theory and Layout, Mark I Montrose., IEEEPress.,2010

Semester II

ELECT2: ANALOG AND DIGITAL ELECTRONICS

(Credits: Theory – 04, Practical – 02) Total Teaching hours: 56

Course Objectives :

Upon completing the syllabus contents of ELE-CT2, the student will become familiar with various working principles of widely used electronic devices, linear and digital ICs which help the students to build small projects and also be able to answer some basic questions that appear in competitive examinations.

UNIT-1 **14 HOURS**

JFET–Types - p-channel and n-channel, working and I-V characteristics - n-channel JFET, parameters and their relationships, Comparison of BJT and JFET. MOSFET:E – MOSFET, D – MOSFET – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, CMOS logic, CMOS – inverter, circuit and working, CMOS characteristics.

UJT - basic construction, working, equivalent circuit and I-V characteristics, intrinsic stand-off ratio, relaxation oscillator.

SCR - Construction, VI characteristics, working, symbol, and applications – HWR and FWR.

Diac and Triac-construction, working, characteristics, applications, (Numerical examples wherever applicable)

UNIT-2 **14 HOURS**

Op-Amp: Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and PracticalOp-Amp, Open and closed loop configuration, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.

Applications of op-amps: Concept of feedback, negative and positive feedback, advantages of negative feedback(Qualitative Study). Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector,

Filters: First and second order active low pass, high pass Butterworth filters. Oscillators: Barkhausen criterion for sustained oscillations, Colpitt‟s oscillator and crystal oscillators using transistor, Phase Shift oscillator,Wien-bridge oscillator – (no derivation for each)

IC 555Timer: Introduction, Block diagram, Astable and Monostablemultivibrator circuits. (Numerical Examples wherever applicable)

UNIT-3 **14 HOURS**

Logic Families: classification of digital ICs. Characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector. CMOS NAND, comparison of TTL and CMOS families.

Combinational Logic Circuits: Minimisation techniques using K-maps - SOP and POS, Minterm, Maxterm, SSOP, SPOS, Simplification of Boolean expressions, K-Map for 3 and 4 variable.

Digital to Analog converter- DAC with binary weighted resistor and R-2R resistor ladder network. Analog to Digital converter: Successive approximation methodperformance characteristic

Design of Arithmetic logic circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor. 4-bit parallel binary adder, Encoder, decimal to BCD priority encoder. Decoder, 2:4 decoder using AND gates, 3:8 decoder using NAND gates, BCD to 7-Segment decoder, Multiplexer - 4:1 and 8:1 multiplexer, Demultiplexer - 1:4 and 1:8 demultiplexer - logic diagram and truth table of each, Realization of Full adder and Full subtractor using Mux and Decoder.

UNIT 4 **14 HOURS**

Sequential Logic Circuits: Flip-Flops - SR Latch, RS, D and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master- Slave JK and T Flip-Flops. Applications of Flip-Flops in semiconductor memories, RAM, ROM and types. Registers and Counters: Types of Shift Registers, Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits), applications. Ring counter, Johnson counter applications. Asynchronous Counters: Logic diagram, Truth table and timing diagrams of 4 bit ripple counter, 4bit Up-Down counter, Synchronous Counter: 4-bit counter, Design of decade Counters using K-maps.

Course Outcomes

At the end of this course, students will be able to

1. Reproduce the I-V characteristics of various MOSFET devices,
2. Apply standard device models to explain/calculate critical internal parameters ofsemiconductor devices.
3. Explain the behavior and characteristics of power devices such as UJT, SCR, Diac, Triac etc.
4. Perform experiments for studying the behavior of semiconductor devices.
5. Calculate various device parameters‟ values from their IV characteristics.
6. Interpret the experimental data for better understanding the device behaviour. 7. Understand basic logic gates, concepts of Boolean algebra and techniques toreduce/simplify Boolean expressions
8. Analyze combinatorial and sequential circuits

Reference Books:

(1) Electronic devices and circuit theory by Boylestad, Robert Nashelsky
(2) Electronic Devices Conventional Current Version by Thomas L. Floyd 15 (3) David A. Bell " Electronic Devices and Circuits", 5th Edition, Oxford Uni. Press, 2015
(4) OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn, 2000, Prentice Hall
(5) Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011, Oxford University Press.
(6) R.S.Sedha, "A Text book of Applied Electronics", 7th edition.,S.Chand and Company Ltd. 2011
(7) Thomas L. Floyd, Digital Fundamentals, Pearson Education Asia (1994)
(8) Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
(9) Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
(10) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
(11) Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.
(12) R. L. Tokheim, Digital Principles, Schaum‟s Outline Series, Tata McGraw- Hill (1994)
(13) Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill ELE-

ELE-CP2: ANALOG AND DIGITAL ELECTRONICS - Lab

(Hardware and Circuit Simulation Software)

PART A (Any FIVE)

1. Study of JFET/MOSFET characteristics – determination of parameters.
2. Study of single stage JFET amplifier.(frequency response and band width)
3. UJT characteristics and relaxation oscillator
4. SCR characteristics – determination of IH and firing voltage for different gate currents.
5. Design of inverting and non-inverting amplifier using Op-amp & study of frequency response.
6. Op-amp inverting and non-inverting adder,subtractorand averaging amplifier.
7. Study of the zero-crossing detector and comparator.
8. Design and study of differentiator and integrator using op-amp for different input waveforms.
9. Design and study of Wien bridgeand RC phase shift oscillator using op-amp.
10. Design and study of first order high-pass and low-pass filters using op-amp.
11. Study of Colpitt's and crystal oscillator using transistor.
12. Astablemultivibrator using IC555 timer.
13. Monostablemultivibrator using IC555 timer.

PART B (Any SEVEN)

14. Half Adderand Full Adder using (a) logic gates (b) using only NAND gates.
15. HalfSubtractor and Full Subtractor(a) logic gates (b) using only NAND gates.
16. 4 bit parallel binary adder and subtractor using IC7485.
17. Study of BCD to decimal decoder using IC7447
18. Study of the Encoders and priority encoders.
19. Study of Multiplexer and Demultiplexer using ICs.
20. Study of 2-bit and 4-bit magnitude comparators.
21. Study of Clocked RS, D and JKFlip-Flops using NAND gates.
22. Study of 4-bit asynchronous counter using JK Flip-Flop IC7476, modify to decade counter and study their timing diagrams.
23. Study of 4-bit Shift Register – SISO, modification to ring counter using IC 7495.
24. Digital to Analog converter using binary weighted resistor method, determination of resolution, accuracy and linearity error.

ELE-OE2.1: Consumer Electronics

(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 45

CourseOutcomes(COs):

Atthe end ofthe coursethestudent should beableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving

invariousfields of electronics both in industriesand research.
2. Toacquireexperimentalskills, analyzing theresultsandinterpretdata.
3. Abilitytodesign/develop/manage/operationandmaintenanceofsophisticatedelectronicg adgets / systems / processes that conforms to a given specification within ethical andeconomicconstraints.
4. Capacity to identify and implementation of the formulate to solve the electronic relatedissuesand analyzethe problemsin various sub disciplines ofelectronics.
5. Capabilityto usethe Modern Tools / Techniques.

Unit – 1

Audio Systems: PA system, Microphones, Amplifier, Loudspeakers, Radio Receivers, AM/FM, Audio Recording, and reproduction, Cassettes, CD and MP3.

Unit – 2

TV and Video Systems: Television standards, BW/Colour, CRT/HDTV, video system, VCR/VCD/DVD players, MP4 players, set top box, CATV and Dish TV, LCD, Plasma and LED TV, Projectors: DLP, Home Theatres, Remote controls.

Unit – 3

Landline and Mobile Telephony: Basic landline equipment, CL1, cordless intercom/EPABX system, mobile phones: GPRS and Bluetooth, GPS Navigation system, smart phones, Office Equipment: Scanners, Barcode / flat bed, printers, Xerox, Multifunction units (Print, Scan, fax, and copy)

Unit – 4

Electronic gadgets and Domestic Appliances: Digital Clock, Digital Camera, Handicam, Home security system, CCTV, Air conditioners, Refrigerators, washing machine / Dish washer, Microwave oven, Vacuum cleaners.

Suggested Books:

1. R.P.Bali, Consumer Electronics, Pearson Education (2008)

2. R.G. Gupta, Audio and Video systems, Tata McGraw Hill (2004)

Consumer Electronics Lab:

1. Study of PA systems for various situations – Public gathering, Closed theatre / Auditorium, Conference room, Prepare bill of material (Costing)
2. Installation of Audio/Video systems – site preparation, electrical requirements, cables and connectors
3. Market survey of products (at least one from each module)
4. Identification of block and tracing the system, Assembly and Disassembly of system using toolkit.

ELE-OE 2.2: Electronics For Everyone
(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 45

CourseOutcomes(COs):
Atthe end ofthe coursethestudent should be ableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving invariousfields of electronics both in industriesand research.
2. Toacquireexperimentalskills, analyzing theresultsand interpret data.
3. Ability to design / develop/ manage/ operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formula to solve the electronic related issues and analyze the problems in various sub disciplines ofelectronics.
5. Capability to use the Modern Tools/ Techniques.

Unit-1
Timer and PLL: Functional block diagram of 555 timer, Monostable operation and its Application, Astable operation and its Applications, **Phase Locked Loop**: Functional block diagram – Phase detector / Comparator, Voltage Controlled Oscillator, Low pass filter, Applications: Frequency multiplier/ Division, AM detection

Unit-2
Operational Amplifier: Inverting and non-inverting amplifier, Op-amp parameters, Summing Amplifier, Difference Amplifier, Integrator, Differentiator, Instrumentation Amplifier, Audio Amplifier(LM386), Voltage to current converter, Current to Voltage converter, Sample and Hold circuits.
First order active filters (Circuit diagram and formula only): low pass, high pass, band pass, band reject and all pass filters. Phase-shift and Wein bridge oscillator using op-amp.

Unit-3
Transducers (Basic Working): Displacement transducers - Resistive (Potentiometric, Strain Gauges – Types, Gauge Factor, bridge circuits, Semi-conductor strain gauge) Capacitive (diaphragm), Hall effect sensors, magneto-strictive transducers, Microphone, Touch Switch, Piezoelectric sensors, light(photo-conductive, photo emissive, photo voltaic, semiconductor, LDR), Temperature(electrical and non-electrical), Pressure sensor.
A-D and D-A Conversion: D-A conversion: 4 bit binary weighted resistor type, circuit and working. Circuit of R-2R ladder- Basic concept.A-D conversion characteristics, successive approximation ADC. (Mention the relevant ICs for all).

Unit-4
Data Acquisition using Arduino: Arduino: Birth, Open Source community, Functional Block Diagram, Functions of each Pin, Arduino Development Boards: IDE, I/O Functions, Looping Techniques, Decision Making Techniques, Designing of 1st sketch, Programming of an Arduino

(Arduino ISP) , Serial port Interfacing, Basic Interfacing and I/O Concept, Interfacing LED,Switch,7seg LED, different sensors.

Suggested Books:

1. B. C. Sarkar and S. Sarkar, Analog Electronics: Devices and Circuits (Revised edition), Damodar Group (Publishers),Burdwan, ISBN: 978-93-85775-15-4 (2019)
2. Measurement Systems, 4/e, Doeblin McGraw Hill, New York, 1992.
3. Electrical Measurements & Electronic Measurements by A.K. Sawhney
4. B. C. Sarkar and S. Sarkar, Digital Electronics: Circuits and Systems, S U T Prakashani ,Burdwan, ISBN:978-81-88391-57-8 (2018)
5. Instrumentation- Devices and Systems ByRangan, Sarma, and Mani, Tata-McGrawHill
6. Electronic Instrumentation by H.S Kalsi, McGraw Hill
7. Instrumentation measurements and analysis by Nakra&Choudhary
6. Measurement & Instrumentation- DVS Murthy
7. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003)
8. Electronic Sensor Circuits and Projects, III Volume, Forrest M Mims, Master Publishing Inc.
9. Timer, Op Amp, and Optoelectronic Circuits & Projects, Forrest M Mims, Master Publishing Inc.
10. Exploring Arduino, Jeremy Blum, Wiley
11. Beginning Arduino, Michael McRobetrs, Technology in Action
12. Beginning Arduino Programming, Brian Evans ,Technology in Action
13. Practical Arduino Engineering, Harold Timmis, Technology in Action
14. Practical Arduino : Cool Projects for open source hardware, Jonathan Oxer, Hugh Blemings, Technology in Action

Electronics For Everyone Demonstration Lab
(Hardware and Circuit Simulation Software) 15 hours

1. Study of basic monostable multivibrator
2. Study of basic Astable multivibrator
3. Light detection using 555 timer
4. Rain alarm using 555 timer
5. Motor control by PWM using 555 timer
6. LED flasher circuit using 555 timer
7. Analog light wave Transmitter/ Receiver using 555 timer
8. Study of basic inverting and non-inverting amplifier
9. Study of basic integrator circuit
10. Study of basic differentiator circuit
11. Design of first order LPF
12. Study of first order HPF
13. Designing of fiber optic based Transmitter /Receiver using LM386
14. Temperature to voltage converter using 741.
15. Shadow sensing using 741
16. Light based PWM using 741 and V-F converter
17. Test the different Arduino Boards, Open-Source and Arduino Shields.

18. Install Arduino IDE and its development tool.
19. Develop a program to Blink LED for 1second.
20. Develop a program to interface Input Switches and output LEDs with development board (arduino).
21. Interface 7 segment display with development board (arduino)
22. Interface LM35 temperature sensor with arduino and monitor temperature on serial monitor.
23. Interface DC motor using L293D Motor Driver.
24. Interfacing of various sensors with arduino development board

ELE-OE 2.3: Mobile Communication
(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 45

CourseOutcomes(COs):

Atthe end ofthe coursethestudent should beableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving invariousfields of electronics both in industriesand research.
2. Toacquireexperimentalskills, analyzing theresultsandinterpretdata.
3. Abilitytodesign/develop/manage/operationandmaintenanceofsophisticatedelectronicg adgets / systems / processes that conforms to a given specification within ethical andeconomicconstraints.
4. Capacity to identify and implementation of the formulate to solve the electronic relatedissuesand analyzethe problems invarious sub disciplines ofelectronics.
5. Capabilityto understandthe moderncommunicationdevicesand technology.

Unit 1

Evolution of mobile radio communication-Examples of wireless communication system: paging systems, cordless telephone system, cellular telephone system- Trends in cellular radio and personal communication systems

Unit 2

Frequencies for radio transmission- Basics of multiplexing and multiple access techniques-CDMA-Cellular system concepts- Frequency reuse- Channel assignment and handoff strategies-Improving capacity in cellular system: cell splitting, sectoring, repeaters for range extension, a microcell zone concept.

Unit 3

Introduction to telecommunicating system- GSM: mobile services (Bearer services, tele-services, supplementary services), system architecture (radio subsystem, network and switching subsystem, operation sub system)

Unit 4
Satellite system: history, application, basics, routing, localization and handover- Broadcast system: digital audio broadcasting, digital video broadcasting (basic concepts).

Unit 5
Wireless LAN-Infrared vs radio transmission- Bluetooth: user scenarios and architecture- Wimax: basic concepts and features- Wi-Fi - basic concepts.

Mobile Communication – Demonstration Lab 15 hours
1. Demonstration of keypad mobile handset
2. Demonstration of smartphone handset
3. Block diagram description

Reference Book
1. Rapapport T. S, 'Wireless Communication Principles and Practices', Pearson Education Asia, New Delhi, 3rd Ed.2003.
2. JochenSchiller,'Mobile communication 'Pearson Education,Asia.
3. Vijay K Garg, Joseph E Wilkes,' Principles and Applications of GSM', Pearson Edu.

ELE-OE 2.4: Mobile Application Programming
(Credits: Theory – 02, Demonstration Lab– 01) Total Teaching hours: 45

CourseOutcomes (COs):

Atthe end ofthe coursethestudent should beableto:

1. Aptitude to apply Logic thinking and Basic Science knowledge for problem solving invariousfields of electronics both in industriesand research.
2. To acquire experimental skills, analyzing the results and interpret data.
3. Ability to design/ develop/ manage/ operation and maintenance of sophisticated electronic gadgets / systems / processes that conforms to a given specification within ethical and economic constraints.
4. Capacity to identify and implementation of the formula to solve the electronic related issues and analyze the problems in various sub disciplines ofelectronics.
5. Capability to develop mobile app.

Unit 1
Introduction: What is mobile Application Programming, Different Platforms, Architecture and working of Android, iOS and Windows phone 8operating system, Comparison of Android, iOS and Windows phone 8.

Android Development Environment: What is Android, Advantages and Future of Android,Tools and about Android SDK, Installing Java, Eclipse, and Android, Android

SoftwareDevelopment Kit for Eclipse, Android Development Tool: Android Tools for Eclipse, AVDs:Smartphone Emulators, Image Editing.

Android Software Development Platform: Understanding Java SE and the Dalvik Virtual Machine, Directory Structure of an Android Project, Common Default Resources Folders, TheValues Folder, Leveraging Android XML, Screen Sizes, Launching Your Application: TheAndroidManifest.xml File, Creating Your First Android Application.

Unit 2

Android Framework Overview: The Foundation of OOP, The APK File, AndroidApplicationComponents, Android Activities: Defining the User Interface,

Android Services: Processing in the Background, Broadcast Receivers: Announcements and Notifications,Content Providers: DataManagement, Android Intent Objects: Messaging for Components,Android Manifest XML:Declaring Your Components.

Views and Layouts, Buttons, Menus, and Dialogs, Graphics Resources in Android: Introducing the Drawable, Implementing Images, Core Drawable Subclasses, Using Bitmap, PNG, JPEG and GIF Images in Android, Creating Animation in Android.

Handling User Interface(UI) Events: An Overview of UI Events in Android, Listening forand Handling Events , Handling UI Events via the View Class, Event call back methods, Handling Click Events, Touch screen Events, Keyboard Events, Context Menus, Controlling theFocus.

Unit 3

Content Providers: An Overview of Android Content Providers, Defining a Content Provider,Working with a Database.

Intents and Intent Filters: Intent, Implicit Intents and Explicit Intents, Intents with Activities, Intents with Broadcast Receivers

Advanced Android: New Features in Android 4.4**.**

iOS Development Environment: Overview of iOS, iOS Layers, Introduction to iOSapplication development.

Windows phone Environment: Overview of windows phone and its platform, Buildingwindows phone application.

Mobile Application Programming – Demonstration Lab 15 hours

Suggested Books:

1. Beginning Android 4, OnurCinar ,Apress Publication
2. Professional Android 4 Application Development, Reto Meier, Wrox
3. Beginning iOS 6 Development: Exploring the iOS SDK, David Mark, Apress
4. Beginning Windows 8 Application Development, IstvánNovák, ZoltanArvai, GyörgyBalássy and David Fulop.
5. Professional Windows 8 Programming: Application Development with C# and XML, Allen Sanders and Kevin Ashley, Wrox Publication.