COURSE NAME	**ELECTRONIC FUNDAMENTAL LABORATORY 1**
COURSE CODE	**BENC 1711**
CREDIT HOURS	1
COURSE SYNOPSIS	This course cover topics of subject Principle of Electric and Electric Circuit Analysis with the following items : laboratory safety procedure, laboratory report writing, use of laboratory power supply, multi-meter, oscilloscope, function generator, power supply, applications of passive components and basic circuit laws, working of magnetic circuits, capacitor and inductor, fundamental of AC circuit, transient RLC circuit and filter circuit (frequency response).
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Explain the theory of electric principle and circuit with expected outcome. **PO1,C2,K** 2 Analyze experimental data to solve problems. **PO2,C4, CTPS3** 3 Measure experimental performance using fundamental electronic equipment. **PO5,P4, CTPS2** 4 Work effectively in groups to perform experiments and report their given assignment clearly. **PO10,PO6,A3, TS2** 5 Present experimental findings in the form of standard engineering reports using various sources **PO11,A2,LL1**
REFERENCES	1. Boylestad R., Nashelsky L., "Electronic Devices and Circuit Theory", 11th Edition, Prentice Hall Inc., 2012 2. Floyd, "Electronic Devices", 9th Edition, Prentice Hall, 2010. 3. Kalsi, H.S., 'Electronic Instrumentation', 3rd edition, Tata McGraw-Hill, 2010.

COURSE NAME	**ELECTRONIC FUNDAMENTAL LABORATORY 2**
COURSE CODE	**BENC 1721**
CREDIT HOURS	1
COURSE SYNOPSIS	This course cover topic in Logic Circuit Electronic Instrumentation and Electronic Engineering Fundamental with the following items: logic circuit, combinational gates, MSI, measurement error, loading effects and insertion effects, oscilloscope phase and frequency measurement, diode application, transistor – BJT biasing and transistor – FET biasing.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Apply knowledge of fundamental electronic equipment to measure experimental performances. **PO1,C3,K** 2 Analyze experimental results with theoretical expected outcome. **PO2,C4,CTPS3** 3 Apply appropriate techniques, manipulate and analyze experimental data to solve complex engineering problems. **PO5,P4, TPS** 4 Apply safety procedure in laboratory work. **PO6,A3,EM2** 5 Present experimental findings in the form of standard engineering reports using various sources. **PO10,A3,LS2,TS3** 6 Recognize the needs for, and ability to engage in independent and life-long learning. **PO11,A3,LL2**
REFERENCES	1. Principle of Electric Circuits, Ninth Edition, Thomas L. Floyd, 2010. 2. Norizan M, Zahriladha Z, Zahariah M., Farid A. A. Fauzi A. W., Azdiana M. Y., Mazran E., Sharatul I. S., Norihan A. H., "Electronic Instrumentation", 1st Edition, FKEKK, UTeM, 2009. 3. "A module of Electronic instrumentation" Module 8 by Norizan Mohamad, Zahriladha Zakaria, Zahariah Manap, Farid Arafat Azidin, Fauzi Abd Wahab, Azdiana Md Yusop, Mazran Esro, Sharatul Izah Samsudin and Norihan Abdul HamidMorris, Alan S., 'Measurement and Instrumentation Principles', 3rd Edition.

COURSE NAME	**DIGITAL SIGNAL PROCESSING FUNDAMENTALS**
COURSE CODE	**BENC 2513**
CREDIT HOURS	3
COURSE SYNOPSIS	This course will cover introduction to DSP, discrete-time signals and systems, spectrum of representation of discrete- time signals, z-transform and its applications, analysis and design of digital filters and application of digital signal processing.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Apply and solve problems involving the basic theory in digital signal processing. **PO1, C3, K** 2 Analyze the concepts in digital signal processing such as discrete-time signals and systems and ability to apply the frequency- domain. **PO2,C4, CTPS3** 3 Analyze and investigate solution to the impulse response, signal flow graph using difference equations, stability determination and z-transform. **PO2, C4, CTPS3** 4 Design the digital filters based on basic filter concepts in various condition. **PO3,C5,CTPS4** 5 Work effectively in given tasks and assignments as individual or in group. **PO10, A3, LS 2/ TS 3**
REFERENCES	1. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th Edition, McGraw-Hill, 2011. 2. A. V. Oppeinheim, R. W. Schafer, Discrete-Time Signal Processing, 3th Edition, Pearson Prentice-Hall, 2010. 3. J. G. Proakis, D. G. Manolikas, Digital Signal Processing: Principles, Algorithm and Applications, 4th Edition, Pearson Prentice Hall, 2007. 4. S. Poornachandra, B. Sasikala, Digital Signal Processing, 3th Edition, McGraw-Hill, 2010.

COURSE NAME	**ELECTRONIC ENGINEERING LABORATORY 1**
COURSE CODE	**BENC 2731**
CREDIT HOURS	1
COURSE SYNOPSIS	This course cover topics in Control Principles, Digital Systems and Analog Electronics with the following items: modeling in frequency domain, transfer function and state space representation, asynchronous & synchronous counter, finite State Machine (FSM), shift register, reduction of multiple subsystems, BJT small signal amplifier, FET Small Signal Amplifier and Operational Amplifiers.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 apply components characteristics in simple electronic circuit design. **PO1,C3,K** 2 analyze experimental data to solve problem. **PO2,C4, CTPS3** 3 design systems through electronic equipment to find alternative solution of engineering problem. **PO3,C5,CTPS4** 4 measure experimental performance data using fundamental electronic equipment **PO5,P4,TPS** 5 demonstrate the experiment findings to society relevant to professional engineering practice. **PO6,A3, EM2** 6 work effectively as a team member and leader in managing groups to perform experiments. **PO10,A3, LS2,TS3** 7 report experimental findings in the form of standard engineering reports using various sources. **PO11,A3, LL2**
REFERENCES	1. Norman, S. Nise, *Control Systems Engineering*: 6th edition, Wiley Publishing 2011 2. Thomas L. Floyd, *Digital Fundamentals:* 10th Edition, Prentice Hall, 2009 3. Boylestad R., Nashelsky L., *Electronic Devices and Circuit Theory*: 11th Edition, Prentice Hall Inc., 2012

COURSE NAME	**ELECTRONIC ENGINEERING LABORATORY 2**
COURSE CODE	**BENC 2741**
CREDIT HOURS	1
COURSE SYNOPSIS	This course covers topics in Digital Systems and Microprocessor Technology with the following items: Basic and Combinational Logic Gates, Asynchronous and Synchronous Counter, Finite State Machine, Microprocessor Training Board and Applications of ARM Processor.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Apply knowledge of fundamental electronic equipment to measure experimental performances. **PO1, C3, K1** 2 Analyze experimental results with theoretical expected outcome **PO2, C4, CTPS3** 3 Construct and analyze experimental data to solve given problem in laboratory session **PO3, C5, CTPS4** 4 Construct and apply appropriate techniques to solve complex engineering problems **PO5, P4, TPS1** 5 Present experimental findings in the form of standard engineering reports using various sources. **PO10, A2, LS2, TS3** 6 Study the needs for, and ability to engage in independent and life-long learning. **PO11, A3, LL2** 7 Follow safety procedure in laboratory work. **PO6, A3, EM2**
REFERENCES	1. Boylestad R., Nashelsky L., "Electronic Devices and Circuit Theory", 11th Edition, Prentice Hall Inc., 2012 2. Floyd, "Electronic Devices", 9th Edition, Prentice Hall, 2010. 3. Kalsi, H.S., 'Electronic Instrumentation', 3rd edition, Tata McGraw-Hill, 2010.

COURSE NAME	**DATA STRUCTURE**
COURSE CODE	**BENC 3123**
CREDIT HOURS	3
COURSE SYNOPSIS	This course will expose the students to the fundamental knowledge of data structures and algorithm analysis. The topics that will be covered in the course include the introduction to data structures and algorithm analysis, revision of C++ programming language, Array, List, Stack, Queue, Trees, Sorting and Searching algorithms. Apart from the theory, students are asked to apply the data structures and algorithms through a small application that is developed in a team.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Illustrate the concept of data structures, algorithm analysis and efficiency. **PO1 , C2, K** 2 Experiment the problems of computer data performance by using appropriate data structures algorithms. **PO2, C4, CTPS3** 3 Design a program and evaluate the benefits and drawbacks of data structure in terms of memory and run time efficiency. **PO3, C5, CTPS 4** 4 Work effectively as a team member and leader in managing projects in a multidisciplinary environment. **P09, A3, CS3**
REFERENCES	1. Michael Main and Walter Savitch, Data Structures and Other Objects Using C++, Fourth Edition, Pearson, 2010. 2. Jeffrey S. Childs, C++ Classes & Data Structures, Pearson Prentice Hall, 2008. 3. Jeff Frank M. Carrano, Data Abstraction and Problem Solving with C++, Fifth Edition, Addison Wesley, 2007. 4. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Third Edition, Addison Wesley, 2006. 5. John R. Hubbard, Schaum's Outlines, Data Structures With C++, McGraw-Hill, 2000.

COURSE NAME	**COMPUTER NETWORKS AND SYSTEMS**
COURSE CODE	**BENC 3173**
CREDIT HOURS	3
COURSE SYNOPSIS	Topics covered: The concept of Computer Communication, Computer Networking. Network: Models, Components, Topology. Data Communications, Analogue and Digital Signals, Coding Schemes, Transmission, Bandwidth, Digital Signal Encoding, Error Detection Methods, Switching, Multiplexing. Interconnection, Standard Organizations And OSI Model, Error And Flow Control, Networking Equipments, Transmission medium, Network services, RS232, CAN ISO 11898, IEEE 802.3x Local Area Network (LAN), IEEE 802.11x Standard, Packet switching networks, Internetworking, Internet Protocols: IPv4 & IPv6, Transport Protocols: TCP & UDP, Network Security.
LEARNING OUTCOMES	At the end of the subject, students should be able to: 1. explain the fundamental concepts in computer networks and systems. **PO1, C2, K1** 2. distinguish the differences, in physical and data link layer, behind various protocol standards (RS-232, ISO11898-CAN Bus, IEEE 802.3, IEEE 802.11). **PO1, C4, CTPS2** 3. construct routing table in each of the routers to interconnect multiple Local Area Networks for datagram forwarding. **PO2, C3, CTPS3** 4. analyze the content of the captured packets (Ethernet, WLAN, IPv4, IPv6, TCP, UDP, service models, connection establishments) defined by the respective OSI layers. **PO2, C4, CTPS3** 5. design an experiment to measure and analyze the network performance with a given scenario. **PO3, C5, CTPS4** 6. work effectively in given tasks and assignment as individual or in group. **PO10, A3, LL2**
REFERENCES	1. B. A. Forouzan, “Data Communication & Networking”, tth Ed. McGraw Hill, 2013 2. Y.D. Lin, R.H. Hwang, F. Baker, “Computer Networks An Open Source Approach”, McGRAW-Hill, 2012. 3. J.F. Kurose and K. W. Ross, “Computer Networking a Top-Down Approach”, 5th Ed. Pearson, 2010. 4. B. A. Forouzan, “TCP/IP Protocol Suite”, 4th Ed. McGraw Hill, 2010. 5. W. Stallings, “Data and Computer Communication”, 8th Ed. Prentice Hall, 2007.

COURSE NAME	**COMPUTER ENGINEERING LABORATORY 1**
COOURSE CODE	**BENC 3751**
CREDIT HOURS	3
COURSE SYNOPSIS	This course covers topics in Communication Principles, Electronic Systems and Data Structure with the following items: AM modulator, AM demodulator, SSB modulation and demodulation, FM modulation and demodulation, voltage regulator, power amplifier, oscillator and filter, array, stack & queue and sorting & searching.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 **Express** the experimental results with theoretical expected outcome — **PO1 C2, K** 2 **Analyze** experimental performance using communication & electronic equipment and also computer programming — **P02 C3, CTPS 3** 3 **Investigate** and analyze experimental data to solve given problem in laboratory session — **PO3 C4, CTPS 4** 4 **Construct** an experiment using laboratory equipments and tools — **PO5 P4, TPS** 5 **Practise** societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice — **P06 A2, EM 2** 6 **Work** effectively as a team member and leader in managing projects in a laboratory session — **P10 A3, LS 2** 7 **Demonstrate** and design the suitable given designing situation and problem — **P11 A3, LL2**
REFERENCES	NONE

COURSE NAME	**COMPUTER ENGINEERING LABORATORY 2**
COURSE CODE	**BENC 3761**
CREDIT HOURS	1
COURSE SYNOPSIS	This course cover topics in Microcontroller Technology, Computer System & Network and IC Design Technology with the following items: introduction to PIC microcontroller, keypad scanning & LCD display, DC motor control using PWM, modeling and simulation of packet switching network, simulation of wireless network, TCP/IP packet dump analysis by using Wireshark, CMOS Inverter Schematic, CMOS Inverter Layout and Design of CMOS Combinational Logic (Schematic & Layout) by using Silvaco EDA tools.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Apply the theoretical in class onto the experimental work in lab. **PO1 C3 K1** 2 Analyse the given design with respect to the given design criteria. **PO2 C4 CPTS3** 3 Construct experiments to solve computer engineering related problem. **PO3 C5 CPTS4** 4 Construct experiments with microcontroller development kit, computer network devices and IC simulation tool. **PO5 P4 TPS** 5 Justify experimental findings using various sources **PO6 A3 EM2** 6 Work effectively in groups to perform experiments **PO10 A3 LS2** 7 Demonstrate skills learnt in experiments and prepare report on the designed project in the form of standard engineering reports. **PO11 A3 LL2**
REFERENCES	None

COURSE NAME	**COMPUTER ORGANIZATION AND ARCHITECTURE**
COURSE CODE	**BENC 4113**
CREDIT HOURS	3
COURSE SYNOPSIS	This course aims primarily to give the students a general understanding of how computer system work, both internally (ALU, control unit, registers, etc.) and externally (I/O interfaces, networking, etc.). Such understanding will enable the graduates to make intelligent decisions when confronted with computer-related problems at their workplace. The knowledge and skills gained in this course will also enable the graduates to further their studies in the field of computer architecture, organization, and design
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Explain advanced concepts, structures and functions in computer systems. **PO1,C3,K** 2 Distinguish the characteristics, addressing modes, and formats of any typical instructions sets. **PO2,C4, CTPS 3** 3 Develop and evaluate assembly language program segments to accomplish simple tasks for any given instruction set. **PO3,C5, CTPS 4** 4 Complete task and assignments effectively as instructed with the use of modern technology through research and case studies. **PO11,A3,LL2**
REFERENCES	1. Stalling, William, Computer Organization & Architecture: Designing for Performance, 9th Edition, Pearson Education, 2012. 2. Hammacher Carl, Vranesic Zvonko, Zaky Safwat, Naraig Manjikian, Computer Organization and Embedded Systems, 6th Edition,2011. 3. Shuangbao Paul Wang, Robert S. Ledley, Computer Architecture and Security: Designing Secure Computer Systems, 1st Edition, John Wiley & Sons, 2012. 4. Irv Englander, The Architecture of Computer Hardware and System Software: An Information Technology Approach, 4th Edition 2010.

COURSE NAME	**DIGITAL SIGNAL PROCESSING**
COURSE CODE	**BENC 4133**
CREDIT HOURS	3
COURSE SYNOPSIS	This course covers introduction to DSP, discrete-time signals and systems, representation of signals in frequency domain, z-transform and its applications, digital filter structures, analysis and design of digital filters and application of digital signal processing.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Explain the basic theory in digital signal processing. PO1,C2,K1 2 Apply the concepts in digital signal processing such as discrete-time signals and systems and spectrum representations. PO2,C3, CTPS3 3 Analyze and formulate solution to the problems related to impulse response, signal flow graph using difference equations, stability determination and z-transform PO2,C4, CTPS3 4 Design digital filters based on given specifications. PO3,C5, CTPS4 5 Complete tasks and assignment effectively as individual or in a group. PO10,A3,LS2
REFERENCES	1. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th Edition, McGraw-Hill, 2011. 2. V. Oppeinheim, R. W. Schafer, Discrete-Time Signal Processing, 3th Edition, Pearson Prentice-Hall, 2010. 3. J. G. Proakis, D. G. Manolikas, Digital Signal Processing: Principles, Algorithm and Applications, 4th Edition, Pearson Prentice Hall, 2007. 4. S. Poornachandra, B. Sasikala, Digital Signal Processing, 3th Edition, McGraw-Hill, 2010.

COURSE NAME	**USER INTERFACE DESIGN AND PROGRAMMING**
COURSE CODE	**BENC 4153**
CREDIT HOURS	3
COURSE SYNOPSIS	In this course, the student will expose to hardware integration and graphical user interface on Android platform. Hardware interface such as Bluetooth, Wifi, touchscreen, 3D motion sensor, and serial communication will also be applied in the curriculum. The computer languages that will be taught in this course are C, C++, C#, and JAVA.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Describe the concept of user interface design and programming using the lifecycle of software development method. **PO1, C3, K1** 2 Analyze the problem and prepare user interface system using UML diagrams and other modeling language based on the user requirement. **PO2, C4, CTPS3** 3 Investigate the suitable embedded system architecture, based on the sustainability, system requirement and the impact of engineering solutions on society and environment. **PO4, C4, CTPS5 PO7, A3, EM2** 4 Work and communicate effectively in group to develop system with suitable user interface using software development tools. **PO3, C5, CTPS4 PO9, A3, CS4**
REFERENCES	1. IEEE Standards Association, "IEEE Std 12207-2008 Systems and software engineering – Software life cycle processes", 2008. 2. CMMI Product Team, "CMMI for Development, Version 1.2", August 2008. 3. Robert C. Martin, James W. Newkirk, Robert S. Koss, "Agile Software Development, Principles, Patterns, and Practices", Pearson Education, 2011. 4. P.A. Laplante, S.J. Ovaska "Real-Time Systems Design and Analysis: Tools for the Practitioner", Wiley Interscience, 2011. 5. Tony Loton, "UML Software Design with Visual Studio 2010: What you need to know, and no more!", LOTONtech, 2010. 6. Rick Rogers, John Lombardo, Zigurd Mednieks & Blake Meike "Android Application Development", O'Reilly 2009 7. Stephen Prate, "C++ Primer Plus Sixth Edition," Sams Publishing 2011 8. Ron Penton, "Beginning of C# Game Programming", Course Technology Cencage Learning 2008 9. Andrew Stellman, "Head First C#," O'Reilly 2010 10. Kathy Sierra, Bert Bates, "Head First Java," O'Reilly 2012

COURSE NAME	**EMBEDDED SOFTWARE DESIGN**
COURSE CODE	**BENC 4163**
CREDIT HOURS	3
COURSE SYNOPSIS	The applications of embedded systems in different environments (e.g. television, medical equipment, smart phones) differentiate the designs and developments embedded software from desktop software, especially in terms of user requirements, operating system, real-time and concurrent system, and software development tools. The aim of this course is to experience hands-on practical embedded system software design and development, from modeling the user requirements with modeling languages, designing the embedded applications, to the developing the final embedded system.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Describe the concept of embedded system design using the lifecycle of software development method. **PO1, C3, K1** 2 Analyze the problem and model the embedded software using UML diagrams and other modeling languages based on the user requirement. **PO2, C4, CTPS3** 3 Investigate the suitable embedded system architecture, e.g. hardware and embedded software stacks. **PO4, C4, CTPS5** 4 Design and develop the embedded system using the suitable toolset in group. **PO3, C5, CTPS4** **PO9, A3, CS4**
REFERENCES	1. IEEE Standards Association, "IEEE Std 12207-2008 Systems and software engineering – Software life cycle processes", 2008. 2. CMMI Product Team, "CMMI for Development, Version 1.2", August 2008. 3. Robert C. Martin, James W. Newkirk, Robert S. Koss, "Agile Software Development, Principles, Patterns, and Practices", Pearson Education, 2011. 4. P.A. Laplante, "Real-Time Systems Design and Analysis; Tools for the Practitioner, 4th Ed", Wiley-Ieee Press, 2011. 5. Tony Loton, "UML Software Design with Visual Studio 2010: What you need to know, and no more!", LOTONtech, 2010. 6. Elecia White, "Making Embedded Systems: Design Patterns for Great Software", O'reilly Media, 2011. 7. A. Silberschatz, P.B. Galvin, and G. Gagne, "Operating System Concepts, 8th Edition", J. Wiley & Sons, 2012. 8. Peter Marwede, "Embedded System Design, 2nd Ed,", Springer, 2010. 9. Jean J. Labrosse, "MicroC OS II: The Real Time Kernel," Elsevier/Shroff Publishers, 2011. 10. Rick Rogers, John Lombardo, Zigurd Mednieks & Blake Meike "Android Application Development", O'Reilly 2009

COURSE NAME	**COMPUTER ENGINEERING LABORATORY 3**
COURSE CODE	**BENC 4771**
CREDIT HOURS	1
COURSE SYNOPSIS	This course covers topics in Embedded Software Design, Computer Organization and Architecture and Digital Signal Processing with these following topics: Embedded Software Design (Task management in UCOS-II RTOS, Inter-process communication in UCOS-II RTOS, Development of Android 2.2 Application); Computer Organization and Architecture (simulation and assembly language programming of a simple hypothetical computer, learning and upgrading a simple hypothetical computer, stack pointer in call subroutine & reverse polish notation); Digital Signal Processing (Introduction to TMS320C6713 Input and Output, TMS320C6713 Fast Fourier Transform (FFT) and Real-Time IIR Filtering Using TMS320C6713).
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Explain experimental results with theoretical expected outcome. **PO1,C2,K1** 2 Measure experimental performance using UML software tool & embedded software tools, computer system & programming and TMS320C6713 DSP board. **PO5, P4, TPS** 3 Manipulate and analyze experimental data to solve given problem in laboratory session. **PO2,C4, CTPS3** 4 Classify and design the suitable design given situation and problem. **PO3,C5, CTPS4** 5 Present experimental findings in the form of standard engineering reports using various sources ethically. **PO11, A3,LL2** **PO6,A3,EM2** 6 Work effectively in groups to perform experiments. **PO10,A3,TS3**
REFERENCES	None

COURSE NAME	**COMPUTER ENGINEERING LABORATORY 4**
COURSE CODE	**BENC 4781**
CREDIT HOURS	1
COURSE SYNOPSIS	This course covers topics in Multimedia Application & Technology, Digital IC Design and Design and Programming with the following items Image Editing , Multimedia Audio and Video Editing, Creating a Website, combinational circuit design with Xilinx integrated software environment (ISE) & ModelSim simulatior,Xilinx Hardware verification, sequence detector design using Mealy and Moore ASM, introduction to basic user interface design environment, software interface design and interfacing software & hardware.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 demonstrate experimental results with theoretical expected outcome **PO1,C3** 2 distinguish experimental performance using several multimedia softwares, Xilinx ISE and ModelSim simulator and user interface programming. **PO2,C4** 3 construct and analyze experimental data to solve given problem in laboratory session **PO3,C5** 4 organize the suitable given designing situation and problem **PO5,P4** 5 report experimental findings in the form of standard engineering reports using various sources **PO6,PO11,A3** 6 work effectively in groups to perform experiments **PO10,A3**
REFERENCES	1. 1. K. S. Thyagarajan, ”Still Image and Video Compression with MATLAB”, Wiley, 2011. 2. 2. Jeniffer Burg, ”The Science of Digital Media”, Pearson, 2009. 3. 3. Yue Ling Wong, ”Digital media Primer”, Pearson, 2009.

COURSE NAME	**IC DESIGN AND PROCESS**
COURSE CODE	**BENM 3133**
CREDIT HOURS	3
COURSE SYNOPSIS	Introduction to IC Design Technology, Complementary Metal Oxide Semiconductor (CMOS) Circuits and Logic Design, IC Layout and Design, IC Fabrication and Process Technology, CMOS Characteristics and Analysis.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Explain the basic operation and structure of MOSFET devices. **PO1 C2 K1** 2 Distinguish the primary steps in the integrated circuit design and fabrication process. **PO2 C4 CPTS3** 3 Analyze a MOS circuits in term of the design considerations of static characteristics, dynamic characteristics, power, area, and fabrication. **PO3 C4 CPTS4** 4 Design transistor-level logic circuits in several different logic families (e.g. NMOS, CMOS). **PO3 C5 CTPS4** 5 Work with team to design and simulate using Silvaco EDA, and prepare report on a digital circuit design project. **PO11 A3 LL2**
REFERENCES	1. Muhammad H. Rashid, *Microelectronic Circuit: Analysis and Design*, Cengage Learning, 2010. 2. Wayne Wolf, *Modern VLSI Design: IP-Based Design,* Prentice Hall, 2009. 3. B. L. Anderson, R. L. Anderson, *Fundamentals of Semiconductor Devices*, McGraw Hill, 2006. 4. Sung-Mo Kang, Yusuf Leblebici, *CMOS Digital Integrated Circuits,* McGraw Hill, 2005. 5. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, Mc Graw Hill, 2005.

COURSE NAME	**MICROCONTROLLER TECHNOLOGY**
COURSE CODE	**BENM 3233**
CREDIT HOURS	3
COURSE SYNOPSIS	This subject will provide the students both solid theoretical and practical applications to the microprocessors/microcontrollers based system. Extensive practical-oriented sessions will be given using PIC microcontroller involving program development software, chip programming and debugging. Topics covered are microcomputer system & peripheral design, software and hardware integration; interrupt control system, analog interfacing, subsystem of microcontroller, microcontroller applications and peripheral devices and system control design.
LEARNING OUTCOMES	At the end of this course, students should be able to: 1 Describe and differentiate the architecture and sub-system of a microcontroller. **PO1,C2,K1** 2 Identify suitable peripheral devices and its interface to the microcontroller-based system for a specific application. **PO2,C4, CTPS3** 3 Design, develop, and evaluate a microcontroller-based system including hardware and software. **PO3,C5, CTPS4** 4 Work effectively as individual or in-group to complete tasks and assignment. **PO10,A3, LS2**
REFERENCES	1. Mazidi, Muhammad Ali, Rolin McKinlay, and Danny Causey. Pic microcontroller and embedded systems. Prentice Hall, 2005. 2. Ibrahim, Dogan. Advanced PIC microcontroller Projects in C: from USB to RTOS with the PIC18F series. Newnes, 2008. 3. Barnett, Richard H., Larry O'Cull, and Sarah Alison Cox. Embedded C programming and the microchip PIC. Vol. 1. Cengage Learning, 2004.

COURSE NAME	**DIGITAL IC DESIGN**
COURSE CODE	**BENM 4123**
CREDIT HOURS	3
COURSE SYNOPSIS	This course aims to introduce students to the basics of logic design, hardware description languages (HDL) and logic synthesis tools, and help them develop technical skills to design, simulate, and analyze and verify complex digital circuits.
LEARNING OUTCOMES	At the end of this course, students should be able to:: 1 Describe the role of hardware description language (HDL) in design flows for FPGA and ASIC. **PO1,C3,K** 2 Develop program codes for synthesis-friendly combinational and sequential logic. **PO2,C4,CTPS3** 3 Design a controller for a data-path relating to a simple RISC CPU. **PO2,C4,CTPS3** 4 Synthesize and model simple computer processors, RAM and ROM. **PO3, C5,CTPS4** 5 Work with team to design, simulate, and report on a digital circuit design project. **PO11,A3,LL2**
REFERENCES	1. M. Morris Mano, Digital Design, 5th Ed., Prentice-Hall, 2012. 2. Wayne Wolf, Modern VLSI Design: IP-Based Design, Prentice Hall, 2009. 3. Stephen Brown and Zconko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Ed., McGraw-Hall, 2008. 4. M. Rafiquzzaman, Fundamentals of Digital Logic and Microcomputer Design, 5th Ed., Wiley-Hill, 2005. 5. John F. Wakerly, Digital Design Principles and Practices, 4th Ed., Prentice-Hall, 2005.