LIST OF OPEN ELECTIVES
TO BE OFFERED IN THE ODD SEMESTER (MIT CAMPUS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
Faculty of Electrical Engineering								
Department of Instrumentation Engineering								
B.E. Electronics and Instrumentation Engineering								
1.	EI7791	Introduction to MEMS and Nanotechnology	OE	3	3	0	0	3
2.	EI7792	Introduction to Programmable Logic Controller	OE	3	3	0	0	3
Faculty of Mechanical Engineering								
Department of Production Technology								
3.	PR7791	Industrial Operations Research	OE	3	3	0	0	3
4.	PR7792	Optimisation Techniques in Management	OE	3	3	0	0	3
Department of Automobile Engineering								
5.	AU7791	Vehicle Drive System	OE	3	3	0	0	3
6.	AU7792	Introduction to Two-Wheelers	OE	3	3	0	0	3
Faculty of Information and Communication Engineering								
Department of Electronics Engineering								
B.E. Electronics and Communication Engineering								
7.	EC7791	Internet of Things	OE	3	3	0	0	3
8.	EC7792	VLSI System Design	OE	3	3	0	0	3
Department of Information Technology								
B.Tech. Information Technology								
9.	IT7792	Introduction to Software Engineering Methodologies	OE	3	3	0	0	3

EI7791 INTRODUCTION TO MEMS AND NANOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To increase student awareness on emerging trends in micro and nanotechnology.
- To understand the fundamentals of micro and nanotechnology.
- To impart basic knowledge on various synthesis, design and characterization techniques involved in micro and nanotechnology.
- To make the learner familiarize with the potential applications of nanotechnology.
- To understand the fundamentals of Micro and Nano-sensing.

UNIT I INTRODUCTION TO MICRO AND NANOTECHNOLOGY 9

Introduction to miniaturization technology – Comparison of Microstructures and Nanostructures - Micromachining – Materials for MEMS - Classifications of Nano-structured materials – Properties of Nano-materials - Safety aspects.

UNIT II SYNTHESIS OF NANOMATERIALS 9

Bottom up and Top down approaches: Physical vapour deposition – Inert gas condensation, Laser ablation, wire explosion techniques - Chemical vapour deposition - Self-assembly - Mechanical milling.

UNIT III FABRICATION TECHNIQUES 9

Lithography: Photolithography – UV lithography – X-ray lithography – Electron beam lithography – Ion beam lithography - AFM based lithography - STM based lithography - Dip pen lithography – Epitaxy:- Molecular Beam Epitaxy - Atomic Layer Epitaxy.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique - Scanning Electron Microscopy - Transmission Electron Microscopy – Atomic Force Microscopy – Scanning Tunneling Microscopy – Nano-indentation.

UNIT V MICRO AND NANOSENSING TECHNIQUES 9

MEMS sensors: Pressure sensors - Mass flow sensors - Acceleration sensors - Gas sensors. Nano sensing: Nanowire sensors - Nanotube sensors - Nano cantilever sensors - Nano-biosensors.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Knowledge of contemporary technologies in MEMS and nanotechnology.
- Ability to function on multidisciplinary teams.
- Ability to design micro and Nano systems.
- Ability to transfer interdisciplinary engineering approaches to the field of micro and nanotechnology.

TEXT BOOKS

1 Maluf.N. & Williams.K., Introduction to micro-electromechanical systems Engineering, Artech House, 2004.

2 Gad-el-Hak, M. (Ed.)., MEMS: Introduction and Fundamentals, CRC Press, 2005.

3 Madou.M. Fundamentals of Micro-fabrication and Nanotechnology, Vol. 3: From MEMS to Bio-MEMS and Bio-NEMS: Manufacturing Techniques and Applications, (2011).

4 Bhushan.B. (Ed.). Springer Handbook of Nanotechnology. Springer Science & Business Media, 2010.

5 Murty.B.S., Shankar.P., Raj.B., Rath.B. B., and Murday.J., Textbook of Nano-science and Nanotechnology, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1 Jackson, M. J. (Ed.)., Micro-fabrication and Nano-manufacturing, CRC Press, 2005.

2 Elwenspoek.M. and Wiegerink.R. Mechanical Micro-sensors, Springer Science & Business Media, 2012.

3 Baltes.H., Brand.O., Fedder.G. K., Hierold.C., Korvink.J. G. & Tabata.O. (Eds.)., Enabling Technologies for MEMS and Nano-devices: Advanced Micro and Nano-systems. John Wiley & Sons, 2013.

4 G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.

5 N John Dinardo, Nanoscale characterization of surfaces & Interfaces, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

EI7792	INTRODUCTION TO PROGRAMMABLE LOGIC CONTROLLER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide an over view on the role of PLC in an Industrial Automation.
- To introduce the basics of PLC Programming Languages.
- To expose the IEC 61131-3 standard for PLC Programming
- To teach the Ladder Diagram and Function Block Diagram based PLC Programming with examples.
- To teach typical applications of PLC.

UNIT I INTRODUCTION 9

Introduction to Hardwired Relay Logic and Solid-state Logic - Examples – Introduction to Programmable Logic - Examples - Role of PLC in an Industrial automation.

UNIT II PLC ARCHITECTURE 9

Architecture of PLC - Input/output modules:- Analog/Digital Input/output modules - Scan cycle of PLC. Introduction to PLC Programming languages:- Ladder Diagram(LD), Function Block Diagram(FBD), Sequential Function Charts(SFC), Instruction List(IL), Structured Text(ST).

UNIT III IEC 61131-3 PLC PROGRAMMING STANDARD 9

IEC 61131-3 Standard Building Blocks of IEC 61131-3 - Elements of Program Organization Unit: - Variables, Data types and Common elements - Standard Functions.

UNIT IV PLC PROGRAMMING 9

Ladder Logic Programming: - Relay Logic Instructions, Timer, Counter, Math and Program Control instructions - Function Block Diagram – Examples.

UNIT V CASE STUDIES 9

Case studies: Burner Management System in a Thermal Power Plant - Traffic Light Control System - Bottle filling application - Elevator Control – Robotic Arm Control.

TOTAL : 45 PERIODS

COURSE OUTCOMES

- Ability to understand the role of PLC in the Factory Automation and Process Automation
- Get exposed to different ways of Programming PLC.
- Get exposed to IEC 61131-3 standard
- Ability to develop Ladder Diagram and Functional Block Diagram for typical Industrial applications.

REFERENCE BOOKS

1. Petruzella.F.D. "Programmable Logic Controllers", 3rd Edition, Tata McGraw-Hill, 2010.
2. Hughes.T.A. "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. Karl-Heinz John, Michael Tiegelkamp, "IEC 61131–3: Programming Industrial Automation Systems", 2001.
4. Gary Dunning and Thomson Delmar, "Programmable Logic Controller", 3rd Edition, Ceneage Learning, 2005.

PR7791 INDUSTRIAL OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

OBJECTIVE:

To introduce the various optimization techniques and quantitative techniques and to make the students apply these techniques for modeling and solving many engineering situations in general and manufacturing situations in particular.

UNIT I LINEAR PROGRAMMING 9

Problem formulation - Graphical method – simplex method – Special cases – transportation and assignment method – applications.

UNIT II REPLACEMENT MODELS AND GAME THEORY 9

Basic replacement model – individual and group replacement problems – applications – game theory – terminology – decision criteria – solution to a 2 x 2 and 2 x n games – applications of LP in game theory – applications.

UNIT III QUEUING MODELS AND SIMULATION 9

Elements of queue – queue discipline – Poisson arrival and exponential service – queue length – waiting time – steady state conditions – applications – concept of simulation – Monte Carlo method – applications.

UNIT IV FORECASTING, SEQUENCING AND LINE BALANCING 9

Forecasting – purpose – methods – measures of forecast error; scheduling – priority rules - sequencing – methods of sequencing – Johnson's rule – Heuristic approach, line balancing – applications.

UNIT V PROJECT NETWORK ANALYSIS AND DECISION TREE ANALYSIS 9

Network – CPM/PERT – Project time estimation – critical path – crashing of network, Decision tree analysis – applications

TOTAL: 45 PERIODS

OUTCOME:

The students shall able to select and apply techniques for typical engineering and industrial situations.

TEXT BOOKS:

1. Panneerselvam R., "Operation Research", Prentice Hall of India, 2008.
2. Hamdy A.Taha, "Operations Research – An Introduction", Prentice Hall of India, 8th edition 2008.

REFERENCES:

1. Guptha. P.K. and Man-Mohan, "Problems in Operations Research", Sultan chand and Sons, 2014.
2. Monks. J.G, "Operations Management theory and Practice", McGraw Hill, 2nd edition 1996.
3. Ravindran, Philips and Sojberg, "Operations Research Principles and Practice", John Wiley and Sons, Singapore, 2nd edition,2007.
4. Sharma J.K., "Operations Research Theory and Applications", Macmillan India Ltd., 4th edition, 2009.

PR7792 OPTIMIZATION TECHNIQUES IN MANAGEMENT L T P C
3 0 0 3

AIM: To introduce the various optimization techniques and their advancements.

OBJECTIVES:

- To make use of the above techniques while modeling and solving the engineering problems of different fields.

UNIT I INTRODUCTION 9

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT II QUEUING MODELS AND SIMULATION 9

Elements of queue – queue discipline – Poisson arrival and exponential service – queue length – waiting time – steady state conditions – applications – concept of simulation – Monte Carlo method – applications.

UNIT III REPLACEMENT MODELS AND GAME THEORY 9

Basic replacement model – individual and group replacement problems – applications – game theory – terminology – decision criteria – solution to a 2 x 2 and 2 x n games – applications of LP in game theory – applications.

UNIT IV FORECASTING, SEQUENCING AND LINE BALANCING 9

Forecasting – purpose – methods – measures of forecast error; scheduling – priority rules - sequencing – methods of sequencing – Johnson's rule – Heuristic approach, line balancing – applications.

UNIT V ADVANCES IN SIMULATION 9

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to study a given problem, formulate and model it suitably, select an appropriate optimisation technique, solve, find and implement the optimal solution.

REFERENCES:

1. R. Panneerselvam, —Operations Researchll, Prentice Hall of India Private Limited, New Delhi 1 – 2005
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
4. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

AU7791 **VEHICLE DRIVE SYSTEM** **L T P C**
3 0 0 3

OBJECTIVE:
To understand the basics of vehicle transmission system and impart comprehensive knowledge on vehicle clutch, gear box, automatic transmission and final drive units.

UNIT I INTRODUCTION
Layout with reference to power plant, steering location and drive. Layout and function of steering system, drive system, braking system and suspension system.

UNIT II CLUTCH
Requirements of Transmission system. Clutches – Functions, objectives, Types. Principle of friction clutches. Principle and operation of single plate coil spring and diaphragm spring clutches. Construction and operation of Multiplate clutches.

UNIT III GEAR BOX
Purpose of gear box, requirement of gear box. Construction and working principle of sliding mesh and constant mesh gear boxes. Principle of Synchronisers, Construction of different synchronisers. Construction and operation of synchromesh gear boxes.

UNIT IV AUTOMATIC TRANSMISSION
Principle and operation of Fluid Coupling. Advantages and limitation of fluid coupling. Principle and operation of Torque Converter, Converter coupling. Multistage and Polyphase Torque converter. Wilson Gear box, Chevrolet Turboglide transmission. Introduction to CVT.

UNIT V FINAL DRIVE AND DIFFERENTIAL
Propeller shaft, Universal joint. Final Drive – Types. Rear Axle – Construction – Full floating, semi-floating and Three quarter floating. Principle and construction of Differential. Differential lock.

TOTAL: 45 PERIODS

TEXT BOOKS

1. K.Newton, W.Steeds and T.K. Garret, "The Motor Vehicle", 13th Edison, Butterworth Heinemann, India 2004.
2. Heinz Heisler, "Advanced Vehicle Technology ", 2nd Edison, Butterworth-HEINEMANN, New York, 2002.

REFERENCES:

1. HELDT P.M, "Automotive Chassis", Chilton Book Co, 1992.
2. HELDT P.M, "Torque Converters", Chilton Book Co, 1992.
3. Ramalingam K.K, " Automobile Engineering", Sci-Tec Book, 2005.

AU7792 **INTRODUCTION TO TWO-WHEELERS** **L T P C**
3 0 0 3

OBJECTIVES:
- Expose to evolution of two wheelers
- Selection of power plants
- Identify various engine and chassis subsystems
- Analyze the need of various running systems
- Evaluate the current two- wheeler technological advancements

UNIT I POWER PLANT 9

Two stroke and four stroke SI engine Construction and Working, limitations of CI engines in two wheelers, Valve & port timing diagrams. Scavenging in engines, Rotary valve engine.

UNIT II FUEL SYSTEM AND IGNITION SYSTEM 9

Fuel system – carburetor system, fuel injection system. Types of lubrication system. Ignition systems Magneto coil and battery coil spark ignition system, Electronic ignition System. Starting system. Starting system manual starting system, self starter system.

UNIT III STRUCTURE AND SUB – SYSTEMS 9

Types of frames and its layout, Transmission: Need of a transmission system, Types of clutches, Types of gear box and its controls, Chain type final drives. Front and rear suspension systems. Instrumentation and controls on handle bar, Need for freewheeling devices.

UNIT IV BRAKES AND WHEELS 9

Braking system: Need for braking system, Types of brakes Construction and Working of drum brakes, disc brakes. Types of wheels – construction of wire wheel, cast wheel, disc wheel. Types of tires – tubeless tires and tubed tires, radial tyres and cross ply tyres, speed and load rating. Steering system – Types of steering systems, construction, steering geometry.

UNIT V RECENT TRENDS IN TWO WHEELERS 9

Engines: Multi cylinder engines, supercharging of race sports bikes, Liquid cooling of engines. Transmission: Overdrives, Drive shafts. Electricals: Types of head lamps – LED, HID. Brakes: Antilock braking systems, Suspension: Monoshock suspension system, Emission: catalytic converters, emission norms in India. Importance of head gear.

TOTAL: 45 PERIODS

OUTCOMES

On successful completion of this course students will be able to:

- Explain the working of two and four stroke engines
- Illustrate the functioning of clutch and gear box
- Demonstrate the wheels, tyres, suspensions and braking systems
- Identify the latest models of two wheelers

TEXT BOOK:

1. Irving,P.E., Motor cycle Engineering, Temple Press Book, London, 1992.
2. K. K. Ramalingam, Two Wheelers, Scitech publications, Chennai
3. Srinivasan.S., ‘Motor cycle, Scooter, Mopeds’, New century book house, 1988.

REFERENCES:

1. Marshal Cavandedish, ‘Encyclopedia of Motor cycling’, New York, 1989

EC7791 INTERNET OF THINGS L T P C
3 0 0 3

OBJECTIVES :

- To understand the fundamentals of Internet of Things.
- To apply the concept of Internet of Things in the real world scenario.
- To learn the various case study of IoT systems.

UNIT I INTRODUCTION AND APPLICATIONS 9

Introduction to IoT – Definition, Characteristics, functional requirements, motivation, Physical design - things in IoT, IoT protocols, Logical Design - functional blocks, communication models, Communication APIs, Applications – Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.

UNIT II M2M AND SYSTEM MANAGEMENT 9

Introduction -M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management – need, SNMP, NETCONF, YANG.

UNIT III DEVELOPNG INTERNET OF THINGS 9

IoT methodology - Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.

UNIT IV USAGE OF PYTHON 9

IoT systems logical design using python - python data types & data structures, control flow, functions or modules, remote access enablement using cloud.

UNIT V CASE STUDY ON IoT SYSTEM 9

Case study for weather monitoring system- modules & package of python, python packages of interest for IoT -JSON,XML,HTTP &URLLib, SMTPLib. Exemplary device - Rasberry pi, Linux on Rasberry pi.

TOTAL: 45 PERIODS

OUTCOMES:

Upon the completion of the course the student will be able to

- Design a portable IoT using Arduino/ equivalent boards and relevant protocols.
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario.

TEXT BOOKS:

1. Arhdeep Bahga, madisetti, "Internet of Things" A hands-on approach, Universities Press (india) Private Limited, 2014.
2. Olivier Hersent, Omar Elloumi, and david boswarthick, "The internet of things: Applications to the smart grid and building automation, Wiley 2012.

REFERENCES:

1. Olivier Hersent, David boswarthick, Omar Elloumi, "The internet of things-key applications and protocols, Wiley 2012.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.

EC7792 VLSI SYSTEM DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To study and analyse the digital circuits with HDL
- To provide in-depth understanding of logic and system design
- To design hardware architecture systems

UNIT I INTRODUCTION TO DIGITAL VLSI SYSTEMS DESIGN 9

Evolution of VLSI Systems - Applications of VLSI Systems - Programmable Logic Devices - ROM, PAL, PLA - CPLD and FPGA Architectures - FPGA Based Systems - Digital System Design Using FPGAs - Reconfigurable Systems Using FPGAs.

UNIT II HARDWARE DESCRIPTION LANGUAGES 9

Verilog - Lexical Conventions - Ports and Modules – Operators - Gate Level Modeling - System Tasks & Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling - Tasks & Functions.

UNIT III COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Design of Combinational circuits - Multiplexers/Demultiplexers, Magnitude comparators, Adders. Design of Sequential circuits - Flip flops, Registers/Shift registers, State machines - Pattern sequence detector design.

UNIT IV PIPELINING 9

Digital Pipelining - Partitioning of a Design - Partition of Data Width - Partition of Functionality - Signed Adder Design - Multiplier Design.

UNIT V ARCHITECTURAL DESIGN 9

Architecture of Discrete Cosine Transform and Quantization Processor - Architecture of a Video Encoder Using Automatic Quality Control Scheme and DCTQ Processor - Architecture for the FOSS Motion Estimation Processor.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of this course, students will be able to:

- Design and optimize combinational and sequential digital circuits.
- Model digital circuits with HDL at behavioural, structural, and RTL Levels
- Realize architecture level designs.

TEXT BOOK:

1. Seetharaman Ramachandran**,** Digital VLSI systems design - A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog, Springer, 2007.

REFERENCES:

1. Roger Woods, John McAllister, Gaye Lightbody, Ying Yi, FPGA-based Implementation of Signal Processing Systems, A John Wiley and Sons, 2008.
2. J.Bhasker, Verilog HDL Synthesis - A Practical Primer, Star Galaxy Publishing, 1998.

IT7792 INTRODUCTION TO SOFTWARE ENGINEERING METHODOLOGIES L T P C
3 0 0 3

UNIT I SOFTWARE PROCESS MODELS 9

A Generic View of Process – Process Models-The Waterfall Model-Incremental Model-Evolutionary Model-Specialized Model-The Unified Process–Agile Process – Agile Models – Planning – Software Project Scheduling.

UNIT II REQUIREMENT ENGINEERING 9

System Engineering Hierarchy – System Modeling – Requirements Engineering: Tasks- Initiating The Process-Eliciting Requirements-Developing Use Cases- Negotiating Requirements-Validating requirements

UNIT III ANALYSIS MODELING AND DESIGNING 9

Building the Analysis Models: Concepts - Design Concepts – Design Models – Pattern Based Design – Architectural Design – Component Level Design – User Interface – Analysis And Design.

UNIT IV TESTING 9

Software Testing – Strategies: Conventional - Object Oriented – Validation Testing – Criteria – Alpha – Beta Testing- System Testing – Recovery – Security – Stress – Performance - Testing Tactics – Testing Fundamentals-Black Box – While Box – Basis Path-Control Structure

UNIT V QUALITY MANAGEMENT 9

Software Configuration And Management - Risk management - Software quality Assurance - Software Reviews

TOTAL : 45 PERIODS

TEXT BOOK

1. Roger Pressman.S., “Software Engineering: A Practitioner’s Approach”, 6th Edition, Mc graw Hill, 2005.

REFERENCES

1. P. Fleeger, “Software Engineering”, Prentice Hall, 1999.
2. Carlo Ghezzi, Mehdi Jazayari, Dino Mandrioli, “Fundamentals Of Software Engineering”, Prentice Hall Of India, 1991.
3. I. Sommerville, “Software Engineering”, 5th Edition: Addison Wesley, 1996.