Gondwana University, Gadchiroli

Instrumentation Engineering

Model Curriculum

V/VI Semesters (AY: 2021-22)

Syllabus

Board of Studies in Instrumentation Engineering

,

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
First Semester Common to GROUP-A branches of Engineering & Technology

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
										MSE	IE						
BSC	FE101	S&H	Physics	3	1	0	4	3	80	10	10	100	40	--	--	--	--
BSC	FE102	S&H	Mathematics –I	3	1	0	4	3	80	10	10	100	40	--	--	--	--
ESC	FE103	Electrical	Basic Electrical Engineering	3	0	0	3	3	80	10	10	100	40	--	--	--	--
ESC	FE104	Mechanical	Engineering Graphics & Design	2	0	0	2	4	80	10	10	100	40	--	--	--	--
HSMC	FE105	S&H	Soft Skill	2	0	0	2	-	-	40	10	50	20	--	--	--	--
Laboratory																	
BSC	FE106	S&H	Physics Lab	0	0	3	1	-	-	-	-	-	-	25	25	50	25
ESC	FE107	Electrical	Basic Electrical Engineering Lab	0	0	2	1	-	-	-	-	-	-	25	25	50	25
ESC	FE108	Mechanical	Engineering Graphics & Design Lab	0	0	4	2	-	-	-	-	-	-	25	25	50	25
		Total		**13**	**2**	**9**						**450**				**150**	
		Semester Total		**24**			**19**	**600**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Second Semester Common to GROUP-A branches of Engineering & Technology

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
										MSE	IE						
BSC	FE201	S&H	Chemistry-I	3	1	0	4	3	80	10	10	100	40	--	--	--	--
BSC	FE202	S&H	Mathematics – II	3	1	0	4	3	80	10	10	100	40	--	--	--	--
ESC	FE203	Computer	Programming for Problem Solving	3	0	0	3	3	80	10	10	100	40	--	--	--	--
HSMC	FE204	S&H	English	2	0	0	2	-	-	40	10	50	20	--	--	--	--
Laboratory																	
BSC	FE205	S&H	Chemistry-I Lab	0	0	3	1	-	-	-	-	-		25	25	50	25
ESC	FE206	Computer	Programming for Problem Solving Lab	0	0	2	1	-	-	-	-	-		25	25	50	25
ESC	FE207	Mechanical	Workshop/ Manufacturing Practices	1	0	4	3	-	-	-	-	-		50	50	100	50
HSMC	FE208	S&H	English	0	0	2	1							50	-	50	25
		Total		**12**	**2**	**11**						**350**				**250**	
		Semester Total		**25**			**19**	**600**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Third Semester Instrumentation Engineering

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
										MSE	IE						
BSC/ ESC/ HSMC	IN301M	S&H	Mathematics-III (Probability and Statistics)	3	1	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN302M	Instru. Engg.	Sensors & Transducers	4	0	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN303M	Instru. Engg.	Electronics Devices & Circuits	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN304M	Instru. Engg.	Electronic Measurement	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN305M	Instru. Engg.	Network Theory	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN306M	Instru. Engg.	Sensors & Transducers	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN307M	Instru. Engg.	Electronics Devices & Circuits	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN308M	Instru. Engg.	Electronic Measurement	0	0	2	1	-	-	-	-	-	-	25	25	50	25
MC	IN309M	Instru. Engg.	Environmental Sciences (Mandatory Course)	0	0	2	0										
		Total		**16**	**1**	**8**						**500**				**150**	
		Semester Total		**25**			**20**	**650**									

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Fourth Semester Instrumentation Engineering

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
										MSE	IE						
BSC/ ESC/ HSMC	IN401M	Instru. Engg.	Fundamentals of Optical Communication	3	0	0	3	3	80	10	10	100	40	--	--	--	--
BSC/ ESC/ HSMC	IN402M	Instru. Engg.	Digital Circuits and Fundamentals of Microprocessors	3	1	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN403M	Instru. Engg.	Automatic Control System	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN404M	Instru. Engg.	Industrial Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
PCC	IN405M	Instru. Engg.	Linear Integrated Circuits	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN406M	Instru. Engg.	Automatic Control System	0	0	2	1	-	-	-	-	-		25	25	50	25
PCC	IN407M	Instru. Engg.	Industrial Instrumentation	0	0	2	1	-	-	-	-	-		25	25	50	25
PCC	IN408M	Instru. Engg.	Linear Integrated Circuits	0	0	2	1	-	-	-	-	-		25	25	50	25
		Total		**16**	**1**	**6**						**500**				**150**	
		Semester Total		**23**			**20**	**650**									

Industrial Training /Internship/Case Studies:-It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code IN608M on submission of the certified relevant report at the end of sixth semester.

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Fifth Semester Instrumentation Engineering

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
										MSE	IE						
PEC-1	IN501M	Instru. Engg.	Programme Elective (PE) - I *	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-1	IN502M	Instru. Engg.	Professional Management & Entrepreneurship Skills	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN503M	Instru. Engg.	Industrial Drives & Control	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN504M	Instru. Engg.	Microcontroller and Interfacing	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN505M	Instru. Engg.	Control System Design	3	0	0	3	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN506M	Instru. Engg.	Control System Design	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN507M	Instru. Engg.	Industrial Drives & Control	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PCC	IN508M	Instru. Engg.	Microcontroller and Interfacing	0	0	2	1	-	-	-	-	-	-	25	25	50	25
PROJ-IN01	IN509M	Instru. Engg.	Seminar and Mini-Project	0	0	4	2							50		50	25
		Total		**15**	**0**	**10**						**500**				**200**	
		Semester Total		**25**			**20**	**700**									

* Any one from the following subjects will be offered by the Dept.:
1. Unit Operation & Power Plant Instrumentation 2. Industrial Data Communication 3. Mechatronics

Industrial Training /Internship/Case Studies:-It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code IN608M on submission of the certified relevant report at the end of sixth semester.

Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Model AICTE Curriculum
Sixth Semester Instrumentation Engineering

Course Category	Course Code	BoS	Subject	Teaching Scheme				Examination Scheme									
				Hours Per Week			Number of Credits	THEORY						PRACTICAL			
				L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional MSE	Max. Marks Sessional IE	Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min. Passing Marks
PEC-2	IN601M	Instru. Engg.	Programme Elective (PE)–II#	3	0	0	3	3	80	10	10	100	40	--	--	--	--
OEC-2	IN602M	Instru. Engg.	Biomedical Instrumentation	3	0	0	3	3	80	10	10	100	40	--	--	--	--
HSMC/BSC	IN603M	Instru. Engg.	Process Automation	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN604M	Instru. Engg.	Control System Components	3	0	0	3	3	80	10	10	100	40	--	--	--	--
PCC	IN605M	Instru. Engg.	Digital Signal Processing	3	1	0	4	3	80	10	10	100	40	--	--	--	--
Laboratory																	
PCC	IN606M	Instru. Engg.	Biomedical Instrumentation	0	0	2	1	-	-	-	-	-		25	25	50	25
PCC	IN607M	Instru. Engg.	Process Automation	0	0	2	1	-	-	-	-	-		25	25	50	25
PROJ-IN02	IN608M	Instru. Engg.	**# #** Industrial Training /Internship/Case Studies (2 to 4 Weeks)	0	0	4	2							50		50	25
		Total		**15**	**1**	**10**						**500**				**150**	
		Semester Total		**26**			**20**	**650**									

#Any one from the following subjects will be offered by the Dept.**:**
1. Introduction to Robotics 2. Automotive Instrumentation 3. Smart Sensors

Industrial Training /Internship/Case Studies:-It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code IN608M on submission of the certified relevant report at the end of sixth semester.

Model Curriculum

AY: 2021-22

Semester: V

Instrumentation Engineering

V Semester B.E. Instrumentation Engineering

Course Code : IN501M

Title of the Course : Unit Operation & Power Plant Instrumentation (PE-I-1)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

CO1 : Illustrate the applications of the modes of heat and mass transfer.

CO2 : Resemble the principle of unit operations in engineering applications.

CO3 : Distinguish between renewable and non- renewable energy sources.

CO4 : Identify the role of thermal power plant in national grid.

CO5 : Justify the importance of external and internal water treatment processes.

Units	Contents	Hours
1	**Introduction :** Concepts of unit operation and unit processes, Material balance and energy balance, significance of unit operations in power plant. Different modes of heat transfer and basic laws associated with it, significance of heat transfer, Heat exchangers and its classification.	09
2	**Evaporation:** Types of evaporators with its working principle and operation. **Distillation:** Flash Distillation , Batch Distillation , Continuous Distillation with its operational features, Construction and working. **Drying:** Classification of dryers , its working principle and operation. Adsorption : Principle and operation of equipment.	09
3	**Energy Sources:** Energy sources, their availability, energy scenario in India, Introduction to power generation: Classification: Renewable and non-renewable energy generation resources, Renewable: small hydro, biomass, wind power, solar, geothermal. Nonrenewable: Fossil fuels (Coal, oil, Natural gas) and nuclear power.	09
4	**Thermal Power Plant:** General layout of modern thermal power plant, Site selection, Presents status of power generation in India. **Boiler Instrumentation and control:** Measurements and control loops ,Drum level control, Boiler safety interlocks.	09
5	**Turbine monitoring and Control:** Turbine supervisory system for monitoring speed , vibrations, eccentricity, axial shift, shell temperature monitoring, Lube oil temperature control , Turbine trip condition. **Instrumentation and control of Condenser**	09
		45

Text Book:

1. Power Plant Engineering by Domkundwar
2. Process control, B. G. Liptak

3. Power Plant Engineering P. K. Nag McGraw Hill
4. Renewable Energy technology by Chetan Singh Solanki, PHI
5. McCabe, W. L. Smith, J.C. and Harriot, P. "Unit operations in chemical engineering", McGraw Hill
6. Heat and mass transfer by DR. D.S.Kumar

Reference Books:

1. Manoj Kumar Gupta, ―Power Plant Engineering, PHI Learning Private Limited, 1st ed.,2012.
2. Power plant engineering by S. L.Uppal.
3. G.S. Sawhney, ―Non-Conventional Energy Resources, PHI Learning Private Limited, 1st Ed., 2012
4. Power Plant engineering by N. R.Nagpal.
5. Generation of Electrical Energy by B. R.Gupta
6. Nonconventional Energy resources by B. H. Khan, McGrawHill
7. Nonconventional Energy sources, G. D. Rai, KhannaPublication.

V Semester B.E. Instrumentation Engineering

Course Code : IN501M

Title of the Course : Industrial Data Communication (PE-I-2)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Units	Contents	Hours
1	**Introduction to Networks & Fieldbus:** Proprietary & open networks. Hardware selection for Fieldbus systems .Sorting the protocols. Fieldbus trends, Advantages & Disadvantages, Design, installation, economics & documentation	09
2	**Hart Networks:** Hart protocol, field Devices, calibration, Hart applications, installing Hart Networks, Device Descriptions and Applications. Wireless transmitters & their architecture, Wireless Hart.	09
3	**Foundation Fieldbus Networks:** Standards, field bus Architecture and user Layer, H1 & HSE specifications, Segment design	09
4	**Profibus Networks:** Basics, Block Model, Applications, Network Design, system configuration and Developments. Profibus PA & DP specifications. Segment design.	09
5	**Fiber-Optic Networks:** Principles, Types of Cables, Network Design, installation finishing, Inspection and Testing. Modulation/Demodulation techniques. **Network Installation & Security:**Network components, Configuring routers & switches.Physical security, security policies, Login and password security, protection from viruses, preventive measures, internet access, Digital certificates, Network security with Firewalls.	09
		45

Text Book:

1. Instrument Engineers Handbook 'Process software and Digital Networks': BelaLiptak, CRC process.
2. Practical industrial data networks 'Design, installation & trouble shooting, by Steve Mackay, Edvin Wright, Deol and John Park, Elsevier Publication.
3. Networking A beginner's Guide: Bruce Hallberg, TMH.

Reference Books:

1. Understanding Distributed Process system for control samnel Herb, ISA.
2. Introduction to Networking Richard McMahon, TMH.

V Semester B.E. Instrumentation Engineering

Course Code : IN501M

Title of the Course : Mechatronics (PE-I-3)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Units	Contents	Hours
1	**Introduction:** Elements of Mechatronics, Mechatronics design process, measurement system, control system (prerequisite), microprocessor based controller, real-time Mechatronics system, various application of Mechatronics.	09
2	**Pneumatic and hydraulic actuating system:** Components of pneumatic and hydraulic systems, pumps, compressors, filter, control valves, pressure regulation, relief valves, accumulator. **Mechanical actuating systems:** Types of motion, degrees of freedom, constrains, kinematic chains, cams, gear and gear trains, ratchet and pawl, belt drive, chain drive, bearings, preload. **Electrical actuating systems:** Basic principles of electrical switching,solenoids, electrical relay, representation of output device, dc motor, AC motor, stepper motor, Induction motor speed control.	09
3	**System interfacing and data acquisition:** DAQs, data loggers, interfacing requirement, buffers, handshaking, polling and interrupt, digital communication, parallel communication, serial communication interface, interfacing sensors and motor drives with microcomputer system, Lab VIEW Applications.	09
4	**Introduction to CNC machines and robotics:** NC, CNC, DNC machines, machine structure, guideways, slide drives, spindle. Robotics: component of robots, classification of robots, Robot applications. **Applications of programmable logic controller in automation.**	09
5	**Design of Mechatronics system:** Introduction, Mechatronics approach to design **Mechatronics case study:** Automatic car park system, autonomous mobile system,engine management system,future trends-Smart homes.	09
		45

Text Book:

1. Mechatronics: "Electronic control system in Mechanical and Electrical Engineering," W. Boltan, Pearson Education Asia
2. D. G. Alciatore and M.B. Histand "Introduction to Mechatronics andMeasurement System,"TataMcGraw Hill

Reference Books:

1. K. P. Ramchandran, G. K. Vijayaraghavan, M. S. Balasundaram, Mechatronics: Integrated Mechanical electronic systems, Willey publication,2008
2. Bishop(Editor), Mechatronics-An Introduction, CRC Press, 2006
3. C. D. Johnsons, Process control Instrumentation technology, prentice Hall, New Delhi

V Semester B.E. Instrumentation Engineering

Course Code : IN502M

Title of the Course : Professional Management & Entrepreneurship skills

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	03	10	10	80	100

Units	Contents	Hours
1	**Organization:** Definition of Organisation& its necessity, Essential elements of good organization and advantages of good organisation, The process of organisation, Organization structure and its types. **Management:** Management: Introduction & its definitions and characteristics, difference between administration, Management and Organisation.	09
2	**Functions of Management:** Introduction, Planning, Forecasting, Organising, Staffing, directing,Motivating,Controlling,Co-ordinating,Communicating,decision making **Personnel Management:** Manpower planning, sources of recruitment, need for training and its benefits, Job Evaluation, merit rating, wages and Incentives, motivations.	09
3	**Marketing management**: Concepts of selling, marketing, market research, distribution of product, advertising sales promotion and pricing **Material management and Purchasing**: Material Management: Its Introduction, definitions, objectives, functions, importance, scope, Organisation of material management. Purchasing: Duties, functions and responsibilities of purchasing department, tendering, Purchasing procedure, methods of purchasing and purchasing organisation.	09
4	**Storekeeping and Inventory control**: Objectives of storekeeping, duties of storekeeper, types of stores, organisation of stores, location and layout of stores, functions of stores, accounts of stores, stores control, Methods of pricing the materials issued. Inventory control: Classification of Inventories, Inventory control, Inventory functions, advantages of Inventory control.	09
5	**Entrepreneurship skills:** Concept of entrepreneur and entrepreneurship, Factors influencing entrepreneurship, Entrepreneurial characteristics, Need for promotion of entrepreneurship and small business, Risk taking, developing creative ideas, Market survey, project report writing guidelines and project report format	09
		45

Text Book:

1. Industrial Engineering and Production Management by M.Mahajan, DhanpatRai Publication
2. Business Organization and Management by G.R. Basu, Tata Mc-Graw Hill

3. Business of Industrial Management by O.P. Khanna, DhanpatRai Publication

Reference Books:

1. Management for Business and Industry by C.S. George Jr., Prentice-Hall Publication
2. Principles of Management by P. C. Tripathi and P. N. Reddy, Tata Mc-Graw Hill
3. Business Organization and Management by M.C. Shulka, S. Chand

V Semester B.E. Instrumentation Engineering

Course Code : IN503M

Title of the Course : Industrial Drives & Control

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	03	10	10	80	100

Course Outcomes: After completion of the course, students will able to:

1. Understand the construction, operation and characteristics of different power semiconductor devices.
2. Design & evaluate the performance parameters of the controlled rectifiers & inverters.
3. Describe the operation of voltage regulators &cycloconverters circuits.
4. Excel in design & utilization of the choppers & speed control circuits
5. Utilize the power electronic circuits in different societal applications.

Units	Contents	Hours
1	**Introduction to Power devices** Construction, Working, Characteristics, Specifications and applications of SCR,TRIAC, DIAC, Power MOSFET, IGBT and UJT. SCR gate triggering and commutation circuits. Series and Parallel connection of SCR and its triggering arrangement, Industrial Applications.	10
2	**Converters, Choppers and Inverters** **Converters:** Single Phase and Three Phases Controlled rectifiers (Half wave, full wave and bridge Configuration) with R and R-L. **Choppers:** Principle, Working, Classification, Thyristorised Choppers- Jones Chopper, Morgan Chopper **Inverters:** Classification, Single Phase half bridge and full bridge Inverters, PWM Inverters	8
3	**DC and AC Motors:** **DC Motors:** Principle, Construction, Working, Characteristics and Applications of DC Motors, Stepper motors, Permanent-Magnet DC Motors (PMDC), Position Servo, Miniature DC Motors, Printed Circuit DC Motors, Brushless DC Motor. **AC Motors:** Principle, Construction, Working, Characteristics and Applications of Single Phase Motors, Types of single phase motors (Split Phase Motor, Capacitor start, Capacitor Start-Capacitor Run, Permanent Split-Capacitor Motor), AC Synchronous Motors(PM), Shaded Pole Motor, Universal motors.	8
4	**Controllers for DC motors**	9

	H-Bridge Drive, Stepper motor sequencer and drive, Half step and Full step method of stepper motor drive, Chopper drive, Speed and direction control, Brushless DC Motor control drive	
5	**Controllers for AC motors** Solid state relays, Firing angle control, Closed loop control of induction motor, Speed and direction control, AC Synchronous motor drive, Closed loop control of synchronous motor, Variable frequency drive.	10
		45

Text Book:

1. Power Electronics by M. D. Singh and K. B. Khanchandani, second edition, Tata McGraw Hill.
2. B. L. Theraja and A. K. Theraja, S. Chand & Suns, "A textbook of Electrical Technology", Volume-II, AC & DC Machines.

Reference Books:

1. An Introduction to thyristors and Their Applications by M. Ramamoorthy, East-West Press.
2. Power Electronics by P. C. Sen, Tata McGraw Hill, 2008.
3. Power Electronics: Circuits, Devices & Applications, by Muhammad H. Rashid, 4th Edition, Pearson Publication.
4. Electric Motor Drives–Modelling, Analysis and Control,-R.Krishnan, Pearson Education, 2003
5. G. K. Dubey, Power semiconductor controlled drives, Prentice Hall- 1989
6. Bhag S. Guru, Huseyin P. Hiziroglu,"Electric Machinery And Transformers", Third Edition, Oxford University Press.

V Semester B.E. Instrumentation Engineering

Course Code : IN504M

Title of the Course : Microcontroller and Interfacing

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	03	10	10	80	100

Units	Contents	Hours
1	Introduction to 8051 Microcontroller: Difference between microprocessor and microcontroller, Architecture of 8051, memory organization and interface, different registers (SFR's) and addressing modes, instruction syntax, data types, subroutines, addressing modes, instruction timings,8051 instructions..	08
2	8051 Programming :Assembly language programs (ALP), Developing, Building, and Debugging ALP's, Concept of assembler directives, editor, linker, debugger, simulator, and emulator. Instruction set, time delay calculations, Introduction to embedded-C, software development tools for 8051, integrated development environment, assembler, simulator and compiler.	08
3	8051 Interrupts, Timers/Counters and Serial Communication 8051 Interrupts, interrupt execution sequence, programming with software and hardware interrupts. Onchip Timers, Counters and their operating modes, programming 8051 timers and counters. Basics of serial data communication, 8051 serial communication modes, serial communication programming, Interfacing 8255A with 8051.	08
4	8051 Parallel I/O Ports :Basic I/O concepts and I/O programming, port structure and operation, interfacing push buttons, matrix keyboard, seven-segment and LCD displays, interfacing D/A and A/D converter using parallel ports, interfacing serial A/D converter,	08
5	**Introduction to Arduino**: The Arduino Platform, Block diagram, Architecture, Pin functions, overview of main features such as I/O Ports, Timers, interrupts serial port, PWM, ADC, etc. Introduction to Arduino IDE, writing, saving, compiling and uploading sketches. Interfacing discrete LEDs, Binary counter, Seven Segment LEDs. Interfacing LCD, switch Interface. Interfacing with different type of sensors and communication modules.	13
		45

Text Book:

1. 8051 Microcontroller and Embedded Systems using Assembly and C by Muhammad Ali Mazidi, Janice GillispieMazidi and RolinD.MacKinlay, Pearson Education, Second Edition
2. Arduino for beginners : Essential Skills Every Maker Needs, John Baichtal, Person Education, Inc., 1st edition.

Reference Books:

1. Microprocessor and Microcontroller by R. Theagarajan, Sci Tech Publication, Chennai.

2. Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education.
3. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J.Ayala, Penram International.
4. Beginning C for Arduino by Jack Purdum (ebook)

V Semester B.E. Instrumentation Engineering

Course Code : IN505M

Title of the Course : Control System Design

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	Nil	3	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Design lead compensators, lag compensators and lag lead compensators for feedback control systems given the performance specifications such as the damping ratio, natural undamped frequency and the static velocity error constant using root locus.
2. Design lead compensators, lag compensators and lag lead compensators for feedback control systems given the performance specifications such as the phase margin, gain margin and the static velocity error constant using Bode diagrams.
3. Design PID controllers for practical processes.
4. Represent the given Continuous Time Systems in State Space.
5. Design the state feedback controllers and observers.

Units	Contents	Hours
1	**Compensator design (root locus approach):** Need of compensators, types of compensators (series, feedback and feed-forward), Types of series compensators (lead, lag, lag-lead) ,their transfer functions, bode plots and polar plots, Implementation of lead, lag, lead-lag compensators (Electrical/ Electronic/Mechanical type),Design of compensators using **root locus approach.** Bode plot.	9
2	**Compensator design (Frequency response approach):** Frequency response of lag, lead and lag-lead compensator, Compensator design using Bode plot approach: Lead, lag and lag-lead compensator.	9
3	**Controller Design:** Design of PI/PD/PID controller for getting required performance specifications (damping factor, natural frequency, steady state error, phase margin, static error constants) using root locus and Bode plot approaches, Direct synthesis of controller, controller design for systems with and without dead time through controller synthesis formula.	9
4	**State Space Representation of Continuous Time Systems:** Terminology of state space representation, Advantages of state space representation, Physical variable form, Phase variable forms, State transition matrix, solution of state equation, concept of controllability, concept of	9

	observability	
5	**Design of Control System in State Space for Continuous Time Systems :** Pole placement, Design of servo systems, State observers, Design of regulator systems with observers, Design of control systems with observers, concept of performance indices: ISE, IAE, ITAE, ITSE	9
		45

Text Book:

1. "Modern Control Engineering", K. Ogata, Prentice Hall of India Pvt. Ltd.
2. "Process Control, Modeling, Design and Simulation", B. W. Bequette, Prentice Hall of India Pvt. Ltd
3. "Control System Design", B. S. Mandke, IstEd^{n}.,Khanna Publishers, New Delhi, 2007.

Reference Books:

1. "Modern Control Systems", Richard C. Dorf, Robert H. Bishop, XIthEd^{n}, Pearson.
2. "Control System Design", Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado,
3. "Advanced Practical Process Control", Brian Roffel, Ben H. Betlem, Springer.

V Semester B.E. Instrumentation Engineering

Course Code : IN506M

Title of the Course : Control System Design Laboratory

Course Scheme				Evaluation Scheme(Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to -

1. Use MATLAB control tool box for control system design
2. Demonstrate the performance of compensated systems based on root locus approach.
3. Demonstrate the performance of compensated systems based on root locus approach.
4. Investigate controllability and observability of given systems
5. Design Calculate control system using pole placement..

Term Work (TW) & POE:

Term work shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested List of Experiments:

1. Introduction to MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.
2. Design of lead compensation for given TF and compare the unit step responses of compensated and uncompensated system using MATLAB. Use design based on root locus method.
3. Design of lag compensation for given TF and compare theunit step responses of compensated and uncompensated system using MATLAB. Use design based on root locus method.
4. Design of lead compensation for given TF and compare the unit step responses of compensated and uncompensated system using MATLAB. Use design based on frequency domain approach.
5. Design of lag compensation for given TF and compare the unit steps responses of compensated and uncompensated system using MATLAB. Use design based on frequency domain approach.
6. To obtain state model of a given transfer function and vice-versa using MATLAB.
7. To obtain state transition matrix of a given continuous time system using MATLAB.
8. To investigate controllability and observability of a given system using MATLAB.

9. Develop a MATLAB program for pole placement design for inverted pendulum.

Text Book:

1. "Modern Control Engineering", K. Ogata, Prentice Hall of India Pvt. Ltd.
2. "Process Control, Modeling, Design and Simulation", B. W. Bequette, Prentice Hall of India Pvt. Ltd
3. "Control System Design", B. S. Mandke, IstEd^{n}., Khanna Publishers, New Delhi, 2007.

Reference Books:

1. "Modern Control Systems", Richard C. Dorf, Robert H. Bishop, XIthEd^{n}, Pearson.
2. "Control System Design", Graham C. Goodwin, Stefan F. Graebe, Mario E. Salgado,
3. "Advanced Practical Process Control", Brian Roffel, Ben H. Betlem, Springer.

V Semester B.E. Instrumentation Engineering

Course Code : IN507M

Title of the Course : Industrial Drives &Control Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to -

1. To design & verify the characteristics of power semiconductor devices.
2. To understand the various techniques of turning ON & OFF of the thyristor.
3. To evaluate the operation of different controlled rectifiers, inverters, and choppers.
4. To recognize the importance of thyristor protection circuits.
5. To design and implement the applications of SCRs for Industrial Drives.

Term Work (TW) & POE:

Term work shall consist of at least eight experiments based on suggested list and above course (5BEIE03) syllabus.

Suggested List of Experiments:

1. To Design & Verify the characteristics of SCR.
2. To Design &Verify the characteristics of Triac.
3. To Evaluate the Operation of SCR Firing Circuits.
4. To Evaluate the Operation of SCR Commutation Circuits.
5. To Calculate the Performance Parameters of Half Wave Controlled Rectifiers.
6. To Evaluate the Operation of SCR Series / Parallel Inverter.
7. To Evaluate the Operation of Step up/down Chopper.
8. Design & Implement SCR controlled Dimmer Circuit.
9. Design & Implement AC/DC universal motor speed control using SCR.
10. Speed control of stepper motor with full step and half step sequence.

Text Book:

1. Power Electronics by M. D. Singh and K. B. Khanchandani, second edition, Tata McGraw Hill.
2. B. L. Theraja and A. K. Theraja, S. Chand & Suns, "A textbook of Electrical Technology", Volume-II, AC & DC Machines.

Reference Books:

1. An Introduction to thyristors and Their Applications by M. Ramamoorthy, East-West Press.
2. Power Electronics by P. C. Sen, Tata McGraw Hill, 2008.
3. Power Electronics: Circuits, Devices & Applications, by Muhammad H. Rashid, 4th Edition, Pearson Publication.
4. Electric Motor Drives–Modelling, Analysis and Control,-R.Krishnan, Pearson Education, 2003
5. G. K. Dubey, Power semiconductor controlled drives, Prentice Hall- 1989

6. Bhag S. Guru, Huseyin P. Hiziroglu,"Electric Machinery And Transformers", Third Edition, Oxford University Press.

V Semester B.E. Instrumentation Engineering

Course Code : IN508M

Title of the Course : Microcontroller and Interfacing Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Term Work (TW) & POE:

Term work shall consist of at least eight experiments based on suggested list

Suggested list of experiments: (Minimum 8 experiments including 3 experiments on Ardiuno)

1. Programs illustrating Data Transfer Operations
2. Programs illustrating Arithmetic Operations
3. Programs illustrating Boolean & Logical Operations
4. Programs illustrating Conditional CALL & RETURN instructions
5. Programs illustrating different code conversions
6. Programs using Timers, Counter, Serial Ports and Interrupts
7. Keyboard interface to 8051
8. Traffic light interface to 8051
9. External ADC and Temperature control interface to 8051
10. Logic controller Interface to 8051
11. Elevator interface to 8051
12. At least 3 experiments on Ardiuno.

Text Book:

1. 8051 Microcontroller and Embedded Systems using Assembly and C by Muhammad Ali Mazidi, Janice GillispieMazidi and RolinD.MacKinlay, Pearson Education, Second Edition
2. PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18 by Muhammad Ali Mazidi, RolinMcKinlay, Danny Causey.
3. Arduino for beginners : Essential Skills Every Maker Needs, John Baichtal, Person Education, Inc., 1st edition.

Reference Books:

1. Microprocessor and Microcontroller by R. Theagarajan, Sci Tech Publication, Chennai.
2. Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education.
3. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J.Ayala, Penram International.
4. Beginning C for Arduino by Jack Purdum (ebook)

V Semester B.E. Instrumentation Engineering

Course Code : IN509M

Title of the Course : Seminar and Mini-Project

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	4	2	50	0	50

Course Objectives:

- To undertake & execute a Mini Project through a group of students.
- To understand the "Product Development Cycle", through Mini Project.
- To plan for various activities of the project and distribute the work amongst team members.
- To learn budget planning for the project.
- To inculcate electronic hardware implementation skills by –
  - **a.** Learning PCB artwork design using an appropriate EDA tool.
  - **b.** Imbibing good soldering and effective trouble-shooting practices.
  - **c.** Following correct grounding and shielding practices.
  - **d.** Knowing the significance of aesthetics & ergonomics while designing electronic product.
- To develop students abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
- To understand the importance of document design by compiling Technical Report on the MiniProject work carried out.

Course Outcomes:

The student will be able to

- Planning and implementation of hardware/ software project .
- Prepare the budget for hardware requirement .
- Demonstrate the project .
- Work as a team member.

Maximum Group Size:

Minimum 2 and maximum 3 students can form a group for the mini project.

Project Type:

The selected mini project must be based on development of a prototype electronic system/product mandatorily having a hardware component with supporting software.

The Assessment Scheme will be:

a.Continuous Assessment 25 marks (based on regular interaction, circuit development)
T. E. Instrumentation Syllabus 2015 Course (Credit Base)
b.End Semester 25 marks (based on implementation, testing, results, poster presentation, and demonstration)

Execution steps for Mini Projects:

1. Complete Paper work Design using datasheets specifying:
    a. Selection criteria of the components to be used.
    b. Specifications of system i/p and desired o/p.
    c. Module based hardware design.
    d. Test points at various stages in various modules
2. The circuit should be simulated using any of the standard simulation software available (eithercomplete circuit to be simulated, if possible or an appropriate part of the circuit can besimulated).
3. Algorithm and the flow chart of the software part must be defined.
4. Result verification for hardware and testing the algorithms.
5. Comparison with the paper design to identify the discrepancies, if any. Justification of the samemust be given.
6. Verified circuit should be assembled and tested on breadboard or general purpose board.
7. Simulation results and/or the snapshots indicating the current and voltage readings or Detailingthe test point results at various stages must be preserved and included in the project report.
8. Art work / layout of the circuit using standard layout tools.
9. Assembling and testing of circuit on final PCB.
10. Design and fabrication of suitable enclosure and outside fittings such as switches, Buttons, knobs,meters, indicators, displays etc.
11. Final testing of the circuit using the earlier defined test points.
12. Preparing Bill of components and materials.
13. Drawing entire circuit diagram (component level), outlining various blocks indicating test points,inputs and outputs at various stages on A3 graph sheet.

Domains for projects may be from the following, but not limited to:

- Instrumentation and Control Systems
- Electronic Systems
- Biomedical Electronics
- Power Electronics
- Embedded Systems
- Mechatronic Systems
- Agriculture Instrumentation.

A project report with following contents shall be prepared:

- Title
- Specifications
- Block diagram

T. E. Instrumentation Syllabus 2015 Course (Credit Base)

- Circuit diagram
- Selection of components
- Simulation results
- PCB artwork
- Layout versus schematic verification report
- Testing procedures
- Enclosure design
- Test results
- Conclusion

Model Curriculum

AY: 2021-22

Semester: VI

Instrumentation Engineering

VI Semester B.E. Instrumentation Engineering

Course Code : IN601M

Title of the Course : Introduction to Robotics (PE-II-1)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Understand* the role of robotics in automation industry
2. *Acquire*mechanical design aspects of robotic system
3. *Exemplify* the usage of electrical and electronics design aspects of robotic system
4. *Derive* the kinematic model of robotic manipulators.
5. *Apply* the concepts of robotics in industrial automations.

Units	Contents	Hours
1	**Introduction:** Fundamentals of Robot and Robotic system, Definition of robot, Functions of robot, Difference between robot and automated machines, Laws of Robotics, Fundamental unit structure of a robot, Advantages and disadvantages of a robot, Various models of a robotic system.	08
2	**Mechanical Aspects of Robotic system** Robotic system, Various coordinate systems, Joints and types of joints: Linear, Orthogonal, Rotational, Revolving, The terminologies : Work envelope, Degree of freedom, Workspaces, Stabilityand accuracy, Gears, pulleys, chain drives and belt drives, End effectors, Grippers and Actuators : Grippers and its types, Mechanical Actuator,Electrical Actuator, Hydraulic Actuator, Pneumatic Actuator.	08
3	**Electrical and Electronics Aspects of robotic system** Applications of Switches and relays, Diodes, LEDs and Transistors in Robotics system. Applications of sensors/transducers and Application circuits. Usage of Electrical Motors:Introduction and working principle, DC Motors, Stepper Motors,Servo Motors, Speed torque relation, Requirement of driving circuits. Usage of Microcontroller, Microprocessors and its Programming for communication with external world,Arduino boards: Introduction, Architecture, Programming, Peripheral Devices and their Interfacing.	08
4	**Kinematics, dynamics and control** Object location, three dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian matrix, manipulator dynamics, dynamic stabilization, position control and force control.	08
5	**Application of Robots in Automation Industry:** Robots in Automatic Processing Operations, Assembly & Inspection (Case Study)	08

Text Book:

1. B.L.Theraja, A.K. Theraja, A Textbook of Electrical Technology, Vol-II, S.Chand& Co., New Delhi,2005.
2. Mechatronics: "Electronic control system in Mechanical and Electrical Engineering," W. Bolton, Pearson Education Asia.
3. Sudhir Gupta, "Elements of Control system," Prentice Hall
4. Muhammad Ali Mazidi and Janice Gillispe, The 8051 Microcontroller and embedded Systems, Pearson Education Asia, Indian reprint 2002.

Reference Books:

1. Rattan, S.S.: "Theory of Machines", 2nd Edition, Tata McGraw-Hill, Publishing Co. Ltd., New Delhi, 2006.
2. V.B.Bhandari, "Design of Machine Element," Tata McGraw Hill Publications, 4th Edition, 1997
3. J. E. Shigley, J. J. Uicker, "Theory of Machines & Mechanism," McGraw Hill Publication– New Delhi, 2nd Edition
4. KastuhikoOgatta, "Modern Control Engineering" [Phi]
5. A.K. Sawhney: "A course in Electrical and Electronic measurements and Instrumentation", DhanpatRai and Company.
6. R. S. Gaonkar "Microprocessor Architecture, Programming and application with 8085/8085A", Fourth Edition, Willey Eastern Ltd.

VI Semester B.E. Instrumentation Engineering

Course Code : IN601M

Title of the Course : Automotive Instrumentation (PE-II-2)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Acquire* knowledge of various automotive standards and Protocols
2. *Understand* the basic knowledge of sensor and measuring system.
3. *Analyze* and understand the overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry
4. *Select* the basic modeling and control scheme for automotive systems
5. *Design* aspects of measurement and control strategies in automotive application.

Units	Contents	Hours
1	**Introduction of automobile system** Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.	08
2	**Engine management systems** Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.	08
3	**Vehicle power train and motion control** Electronic transmission control, adaptive power steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.	08
4	**Active and passive safety system** Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags.	08
5	**Automotive standards and protocols** Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. automotive standards like MISRA, functional safety standards (ISO 26262).	08

Text Book:

1. William B. Ribbens, “Understanding Automotive Electronics”, Sixth Edition, 2003.

Reference Books:

1. Young A.P., Griffiths, “Automotive Electrical Equipment”, ELBS & New Press, 1999.
2. Tom Weather Jr. &Cland c. Ilunter, “Automotive computers and control system”, Prentice Hall Inc., New Jersey.
3. Crouse W.H., “Automobile Electrical Equipment”, McGraw Hill Co. Inc., New York, 1995.
4. Bechhold,”Understanding Automotive Electronic”, SAE, 1998.
5. Robert Boshe, “Automotive Hand Book”, Bentely Publishers, Fifth Edition, Germany, 2005.

VI Semester B.E. Instrumentation Engineering

Course Code : IN601M

Title of the Course : Smart Sensors (PE-II-3)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Units	Contents	Hours
1	Smart Sensors for Electrical and Non-Electrical, Physical and Chemical Variables: Tendencies and Perspectives Temperature IC and Smart Sensors, Pressure IC and Smart Sensors and Accelerometers, Rotation Speed Sensors, Intelligent Opto Sensors, Humidity Frequency Output Sensors , Chemical and Gas Smart Sensors	9
2	Data acquisition methods(classification),Method with time-dividing Channeling,Method with space-division channeling,Smart sensors architectures, Main errors of DAQ systems, Data transmitting and error Protection, Classical frequency-to-digital conversion methods: direct, indirect, interpolation combined, Advantages and disadvantages Weight functions use to increase an accuracy Phase-shift – to – digital conversion methods	9
3	Advanced and self-adapted methods: ratiometric, M/T, reciprocal, CET, SB (DB), DMA Method of dependent count (MDC),Metrological performances Method with non-redundant reference frequency Advanced Phase-shift – to – digital conversion methods,Digital output smart sensors and program-oriented conversion method (PCM), Definition, realization, optimal design; examples Adaptive PCM with increased speed PCM errors analyze and reduction Systematic errors correction.	9
4	Smart sensor systems: onechannel sensor interfacing Multichannel sensor Interfacing ABS example: sensor, encoder, self-adaptive method, sensor interfacing Multiparameter sensors systems Virtual instrument definition Industrial DAQ boards for frequency-time parameters Virtual instruments examples: thermometer, data logger for pressure sensors,	9

	tachometer,videographic paperless recorder	
5	Smart sensor systems and digital sensors design Technologies and design Methodology Sensors systems examples for optical parameters, temperature, acceleration, rotation speed, humidity, pressure, magnetic Multisensors systems Direct sensor-to-microcontroller interface Advantages and disadvantages, Errors reduction measures, Universal Frequency-to-Digital Converter (UFDC-2) Universal Sensors and Transducers Interface (USTI)	9
		45

Text Book:

1. Smart Sensors and MEMS, ed. By S.Y. Yurish and M.T. Gomes, *Springer Verlag*, 2005

2.Data Acquisition and Signal Processing for Smart Sensors, Kirianaki N.V., Yurish S.Y., Shpak N.O., DeynegaV.P.,*John Wiley & Sons*, Chichester, UK, 2002

Reference Book -

1.Understanding Smart Sensors, Randy Frank, 3rd Edn.,ArtechHousse Integrated Microsystems Library.

VI Semester B.E. Instrumentation Engineering

Course Code : IN602M

Title of the Course : Biomedical Instrumentation

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	03	10	10	80	100

Units	Contents	Hours
1	**Introduction of Bio-medical Instrumentation**: Introduction to man-instrument systems, Component of man-instrument system, Man-Instrument system block diagram, Static and dynamic characteristics of medical instruments, Problem encountered in biomedical measurements.	7
2	**Sources of Bioelectric Potentials and Electrodes:** Resting and action potentials, Prapogation of action potentials, Biopotentials electrode-Microelectrode, skin surface electrode, Needle electrode. Bioelectric Potentials (ECG, EMG, EEG, ERG, EOG), Biochemical Transducers.	8
3	**Cardiac Instrumentation and Measurements:** Mechanical Function-Electrical conduction of heart, Cardiac cycle, Relation between electrical and mechanical activities of heart, Blood pressure and its measurements, Characteristics and measurements of blood flow meter,Phethysmography, Heart sound and its measurements,Pacemaker,Difibrillators.	10
4	**Neuro-Muscular Instrumentation:** SpecificationofEEG and EMG Machine. Electrode placement for EEG and EMG recording, Somatic Nervous system, Physiology of respiratory system, Test and instrument for the mechanics of breathing, Nerve conduction velocity measurement, Respiratory Parameter-Spirometer,Pneumograph.	11
5	**Measurement and Recording of Noninvasive Diagnostic Instrumentation, Patient care and electrical Safety:**Principal of ultrasonic measurement, Elements of intensive care monitoring,X-ray,CTscan and MRI,Dialysis,Diathermy,Physiological effect of electric current, Shock hazards from electrical equipments, Method of accident prevention	09
		45

Text Book:

1. Hand book of Biomedical Instrumentation- by R.S.Khandpur
2. Medical Instrumentation, Application and Design-by John G.Webster,John Willey

Reference Books:

1. ChromwellL.andWeibwell Biomedical Instrumenttion and Measurment-Dorling kingsley(2006) 2 eddition.
2. Carr J.J.and Brown-Introduction to biomedical Equipment Technology, Prantice Hall (2000) 4 eddition.

VI Semester B.E. Instrumentation Engineering

Course Code : IN603M

Title of the Course : Process Automation

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	03	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to –

1. *Illustrate* the parameters associated with process dynamics.
2. *Distinguish* the different control actions used in process industry.
3. *Compare* the principles of advance control systems.
4. *Estimate* the PID tuning parameters using standard methods.
5. *Develop* control action programs using PLC/DCS/SCADA.

Units	Contents	Hours
1	**Process Dynamics:** Introduction to Automation in process industry, Evolution of Automation in industries, Benefits of automation. **P**rocess variables and their selection criterion, types of processes, (single and multi capacity, self and non self regulating process etc) dead time, process time constant and method for finding time constant, input-output Model, Degrees of freedom, mathematical modeling and its applications,	7
2	**Control Action and Controllers:** Basic control action, two position, floating control modes, Continuous controller modes: Proportional, Integral, Derivative, Composite controller modes: P-I, P-D, P-I-D and its applications, Integral wind-up and prevention, Auto/Manual transfer, Bump less transfer, Introduction to controller tuning and methods like Cohen-Coon, Ziegler-Nichols, Pneumatic and electronic controllers.	8
3	**Advanced control systems:** Feedback and Feed-forward control, Cascade control ,ratio control, split range control, auto selective control, multivariable process control, adaptive and inferential control, interaction and decoupling , robust control.	10
4	**Programmable Logic Controller (PLC):** Introduction, Architecture, PLC specifications, input/output modules, power supplies and isolators, PLC programming procedures: programming on-off inputs/outputs, auxiliary commands and functions; PLC Basic Functions, register basics, timer functions, counter functions; PLC intermediate functions: Arithmetic functions, comparison functions, Design of interlocks and alarms using PLC, development of ladder diagram for various processes, Introduction to SCADA and HMI.	11
5	**Distributed Control Systems (DCS):** Definition, Local Control Unit (LCU) architecture, configuration and programming, communication facilities, redundancy concept, Evolution of signal standards, Definition of Protocol, HART communication protocol, HART networks. General field bus architecture – basic requirements of field bus standard.	09
		45

Text Book:

1. G. Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice Hall of India, New Delhi, 2001.
2. Process Control and Instrumentation technology by C. D. Jonson.
3. Distributed Computer Control for Industrial Automation by PoppovikBhatkar, Dekkar Publications.
4. John W. Webb Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, 4th Edition, Prentice Hall Inc., New Jersey, 1998.

Reference Books:

1. Process Control , application , designing and tuning by F.G.Shinsky
2. Krishna Kant, “*Computer-based Industrial Control*”, Prentice Hall, New Delhi, 1997.
3. Garry Dunning , “Programmable Logic Controllers “ PHI Pub, 3/e
4. Handbook of Process Control by BelaG.Liptak

VI Semester B.E. Instrumentation Engineering

Course Code : IN604M

Title of the Course : Control System Components

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Categorize* the industrial control devices for control system applications.
2. *Acquire* the principles of AC, DC servo and stepper motors.
3. *Demonstrate* the use of auxiliary components in control system.
4. *Summarize* the pneumatic and hydraulic components.
5. *Develop* sequential logic circuit using suitable control system components.

Units	Contents	Hours
1	**Industrial Control Devices -** **Switches:** Toggle switch, Slide switch, DIP switch, Rotary switch, Thumbwheel switch, Selector switch, Push button, Drum switch, Limit switch, Emergency switch, Micro-switches, Review of process switches, Switch specifications. **Relays & Contactors:** Electro-mechanical relay, Reed relay, hermetically sealed relay, Solid-state relays, contactors, Comparison between relay and contactor. Development of wiring diagram for given application using above components.	09
2	**DC and AC Servo Motors, Stepper Motors:** DC servo motor: field controlled DC servomotor, armature controlled DC servomotor, AC servomotor: introduction, construction, characteristics, theory of operation, transfer function, Stepper Motor: introduction, permanent magnet stepper motor, variable reluctance type stepper motor, application of stepper motor.	09
3	**Auxiliary Components and Control valves** Synchros, Feeders, Dampers, Alarm annunciator, High/low selectors, P to I and I to P converter. Circuit Breaker: Need of Circuit Breaker, Operating Principle, and Types. Control Valves: Introduction, Types based on design and characteristics, components of control valve, Valve sizing, Typical applications.	09
4	**Pneumatic Components** Pneumatic power supply and its components: Pneumatic relay (Bleed and Non bleed, Reverse and direct), single acting and double acting cylinder, special cylinders: cushion, double rod, tandem, multiple position, rotary Filter Regulator Lubricator (FRL), pneumatic valves (direction controlled valves, flow control etc), special types of valves like relief valve, pressure reducing etc. Development of Pneumatic circuits using Standard Symbols including Reciprocating, Sequencing, Anti-cycle repetition, Block transfer, Speed regulation etc	09
5	**Hydraulic Components** Hydraulic supply, hydraulic pumps, actuator (cylinder and motor),	09

	hydraulic valves. Introduction, basic types of hydraulic transmission lines, servo motors, power supply, hydraulic circuits and transmission, applications like motor speed control, reciprocating, loading, unloading, sequencing of cylinders and direction control. Symbols used in hydraulic circuits.	
		45

Text Book:

1. B. L. Theraja, "A text book of Electrical Technology", S. Chand & Company Ltd., Vol II First Edition 1959.
2. Industrial Hydraulics, Pippenger, Tyler Gregory Hicks, Mcgraw Hill.
3. Pneumatic Systems: Principles and Maintenance, S.R. Majumdar, TMH Publication

Reference Books:

1. C. T. Kilian, Modern Control Technology: Components and Systems", Thompson Learning Publication.
2. Industrial Electronics, F.D. Petruzella, McGraw-Hill, International First Edition, 1996.
3. W. G. Andrew & H. B. William, Applied Instrumentation In The Process Industries, Gulf Professional Publishing, 1982.
4. M. D. Desai, Control System Components, PHI Publication.
5. B. G. Liptak, Instrument Engineers' Handbook, CRC Press, Washington, 2003.
6. Les Driskell, "Control – Valves Selection and Sizing", ISA 1983.
7. C. D. Johnson, "Process Control Instrumentation Technology", Fourth Edition,Prentice.

VI Semester B.E. Instrumentation Engineering

Course Code : IN605M

Title of the Course : Digital Signal Processing

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	3	4	3	10	10	80	100

Units	Contents	Hours
1	**Introduction:** Types of signals, Types of systems, Properties of Linear Time Invariant Systems Basic elements of DSP, Analog to Digital Conversion (ADC), Comparison between Analog signal processing and Digital signal processing. Discrete time signals, Representation discrete time signals	9
2	**Frequency analysis of discrete time signals:** Fourier Series representation and Fourier transform for periodic signals,Discrete Fourier Transform (DFT), Properties of DFT, Efficient computation of DFT-Fast Fourier Transform (FFT), radix-2 decimation-in time (DIT) and decimation-in-frequency (DIF) algorithms, Frequency Transformation	9
3	**Design of Digital IIR Filters :** Introduction toZ-transform,Introduction to IIR filters, Butterworth approximation, Chebyshev approximation, Design of IIR filter: Impulse Invariance transformation, Bilinear transformation, Derivative approximation method, Frequency transformations in analog and digital domain	9
4	**Design of FIR Filters :** Introduction to FIR filters, Linear phase filters, FIR filter design using window method, Frequency sampling method, Comparison between FIR and IIR filters	9
5	**Digital filter structures:** Implementation of discrete-time systems, Basic components of implementation of structures, realization of IIR systems-Direct form-I, Direct form-II, cascade and parallel, realization of FIR systems- Direct form, cascade form, lattice structure	9
		45

Text Books:

1. John G. Proakis,Dimitris G. Manolakies “Digital signal processing Principals, Algorithms, and Applications” Pearson Education
2. Ashok Ambardar, “Digital Signal Processing A modern approach”, Cengage learning
3. Digital Signal Processing by S Salivahanan, C Gnanapriya, TMH,2e

Reference Books:

1. S. K. Mitra, “Digital Signal Processing: A Computer based Approach”, TMH.
2. Oppenheim A. V and R. W. Schafer, “Discrete Time Signal Processing”, Person Education,India
3. Rabnier, Gold, “Theory and Applications of Digital Signal Processing”, TMH

VI Semester B.E. Instrumentation Engineering

Course Code : VI Semester B.E. Instrumentation Engineering

Course Code : IN606M

Title of the Course : Biomedical Instrumentation Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	0	25

Course Outcomes: After completion of the course, the student will be able to:

1. Study of different electrical control system components like relays, switches etc.
2. Study of working principles of AC, DC Servo and Stepper motors.
3. Study of construction, working and application of various pneumatic components
4. Study of different components used in hydraulic systems
5. Study of auxiliary components and its usage in industrial applications.

Term work (TW) & POE:

Term work and practical/Oral examination shall consist of at least **eight** experiments based on contents of syllabi given in the course code 6BEIE02 in the form of a journal and necessary documentation.

Suggested list of experiments:

1. Identify the different organs of the body with the help of charts and models.
2. Operation of advance instruments and biosensor like electrode, simulator and skin sensor.
3. To study the PQRS of ECG waveform of normal patient.
4. To measure the blood pressure of normal patient using automatic and semiautomatic blood pressure measuring unit.
5. To measure the heart sound using PCG.
6. Design the external pacemaker as an artificial heart
7. To study the defibrillator for heart diagnosis
8. Distinguish the biosignals acquired by different diathermy equipment.
9. Test the mechanism of breathing using spirometer.
10. To study the dialysis machine.

Text Book:

1. Hand book of Biomedical Instrumentation- by R.S.Khandpur
2. Medical Instrumentation, Application and Design-by John G.Webster,John Willey

Reference Books:

1. ChromwellL.andWeibwell Biomedical Instrumenttion and Measurment-Dorling kingsley(2006) 2 eddition.
2. Carr J.J.and Brown-Introduction to biomedical Equipment Technology, Prantice Hall (2000) 4 eddition.

VI Semester B.E. Instrumentation Engineering

Course Code : IN607M

Title of the Course : Process Automation Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. *Illustrate* the parameters associated with process dynamics.
2. *Distinguish* the different control actions used in process industry.
3. *Compare* the principles of advance control systems.
4. *Estimate* the PID tuning parameters using standard methods.
5. *Develop* control action programs using PLC/DCS/SCADA.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested list of experiments: Students are expected to perform minimum 08 experiments.

1. Design of an electronic ON-OFF controller and plot the characteristics of neutral zone of controller
2. Configuration of PID controller and study its response.
3. Study of Cascade Control trainer (Flow & Level control)
4. Study of flow control trainer.
5. Study of basic logic operations, timer, counter, arithmetic operations in PLC.
6. Study of analog operations in Controllogix PLC.
7. Design control logic programme PLC programming for bottle filling., logic relays etc.
8. Design control logic programme for Siemens PLC.
9. Interfacing of pneumatic system with PLC
10. Study of DCS and design control logic programme using FBD
11. Interfacing of smart transmitter to PID controller.
12. Study of HART protocol

Text Book:

1. G. Stephanopoulos, “Chemical Process Control: An Introduction to Theory and Practice”, Prentice Hall of India, New Delhi, 2001.
2. Process Control and Instrumentation technology by C. D. Jonson.
3. Distributed Computer Control for Industrial Automation by PoppovikBhatkar, Dekkar Publications.

4. John W. Webb Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, 4th Edition, Prentice Hall Inc., New Jersey, 1998.

Reference Books:

1. Process Control , application , designing and tuning by F.G.Shinsky
2. Krishna Kant, “*Computer-based Industrial Control*”, Prentice Hall, New Delhi, 1997.
3. Garry Dunning , “Programmable Logic Controllers “ PHI Pub, 3/e
4. Handbook of Process Control by BelaG.Liptak

VI Semester B.E. Instrumentation Engineering

Course Code : IN608M

Title of the Course : Industrial Training/Internship/Case Study / (2 to 4 weeks)

Course				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	4	2	50		50

Course Outcomes: After completion of the course, the student will be able to:

1. Ability to work effectively in a various team (may be multidisciplinary teams).
2. Identify, formulate and solve a problem of Instrumentation and Control Engineering.
3. Understand the impact of Instrumentation and Control solutions in a global, economic, environmental and societal context.

Course contents:

Two to four weeks of training in an Industry/Institute/Research organization/NGO/Environmental studies. The internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a certified report.

Industrial Training /Internship/Case Studies:- It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code 6BEIE09 on submission of the certified relevant report at the end of sixth semester.